Agenda

Metro
600 NE Grand Ave.
Portland, OR 97232-2736

Meeting:	**RTP Safety work group meeting #5**
Date:	Thursday, July 27, 2017
Time:	9-11 a.m.
Place:	Metro Regional Center, Room 401
Purpose:	Review Regional Transportation Safety Action Plan Draft Strategies and Actions
Outcome(s):	Input on Strategies and Actions

9 a.m. **Welcome, introductions & announcements**
- *Meeting purpose and desired outcome*
- *Name and organization*
- *Work Group member updates or announcements*

9:10 a.m. **Project update**
- *April 4 meeting summary*
- *Update on MPAC and JPACT direction on Vision Zero target and framework*

9:20 a.m. **Strategies and actions discussion**
- *2018 RTP Moving from Vision to Action Framework*
- *Crash data analysis findings*
- *Strategies and Actions Table and Vision Zero Design Toolbox*

10:45 a.m. **Next steps**
- *Provide input on draft plan at September 14 meeting*
- *TPAC and MTAC review of draft plan in November*
- *Updated draft plan available for public review in 2018*

11 a.m. **Adjourn**

Meeting Packet	Next Meeting
1. Agenda	**Last meeting of the work group** **Thursday, September 14, 2017** 9 to 11 a.m. Metro, room 401 Input on draft plan
2. Memorandum	
3. April 4 meeting summary	
4. Moving from Vision to Action Framework	
5. Draft Strategies and Actions Table	
6. Draft Vision Zero Design Toolbox	
7. Crash Factor Overlaps Matrix	
8. Draft 2017 Metro State of Safety Report (not printed)	
9. "A Vision for Transportation Safety: Framework for Identifying Best Practice Strategies to Advance vision Zero"	

Directions, travel options and parking information
Covered bike racks are located on the north plaza and inside the Irving Street visitor garage. Metro Regional Center is on TriMet bus line 6 and the streetcar, and just a few blocks from the Rose Quarter Transit Center, two MAX stations and several other bus lines. Visit our website for more information: http://www.oregonmetro.gov/metro-regional-center

Memo

Metro
600 NE Grand Ave.
Portland, OR 97232-2736

Date: July 19, 2017
To: 2018 RTP Safety Work Group
From: Lake McTighe, Transportation Safety Project Manager
Subject: 2018 RTP Safety Work group Meeting #6: Strategies and Actions

Purpose
Work group provides input on the draft strategies and actions for the Regional Transportation Safety Action Plan.

Desired outcomes
The work group provides input to refine the draft Strategies and Actions. Refinements can include recommending:

- New actions
- Removing actions
- Changing the focus or wording of an action
- Action specific performance measures
- Whether to group actions into near and long-term actions

To guide the discussion work group members are asked to keep the following principles in mind:

1. Better understand the racial equity and health impacts (positive or negative) of the strategies and actions. While successful Vision Zero strategies include enforcement strategies, there are significant concerns about how increased use of enforcement would have an outsized impact on low-income communities and communities of color. For each strategy and action we want to ask "How can Vision Zero promote appropriate and equitable strategies without causing additional problems or exacerbating issues of biased enforcement?"

2. Better understand whether the strategies and actions affect systems or individual behavior change (similar to the public health understanding of upstream and downstream public health actions). A defining principle of the Vision Zero Framework is to emphasize an upstream "safe systems" approach, focused on policies and street designs that most affect people's behavioral choices, versus an approach aimed at influencing individual behavior.

Project update
The Safety Work Group last met on April 4, 2017. At that meeting the work group provided input on the draft outline for the Regional Transportation Safety Action Plan (RTSAP). Comments from the meeting are captured in the attached meeting summary.

At the April 12 and April 20, 2017 meetings, both MPAC and JPACT recommended moving forward with the Vision Zero framework, target and performance measures in the 2018 update of the

Regional Transportation Plan. The Metro Council provided unanimous support at the February 28, 2017 work session.

September 14 will be the last meeting of the Safety Work Group. After that meeting, TPAC and MTAC will provide technical input on the draft RTSAP.

Materials to support discussion
The following materials are included in the meeting packet. The discussion will focus on the Draft Strategies and Actions. Other materials are included to support the discussion.

Framework for Strategies and Actions
As the RTSAP is drafted it will utilize the "Moving from Vision to Action Framework" which will also be used in the 2018 Regional Transportation Plan and each of the modal and topical plans. It will also use the Vision Zero Framework which has been developed and used in many cities in the US and internationally.

Traditional Approach		Vision Zero Framework
Traffic deaths are inevitable	→	Traffic deaths are preventable
Perfect human behavior	→	Integrate human failing into the approach
Individual responsibility/change	→	Systems Approach
Saving lives is expensive	→	Saving lives is cheap

And finally, the RTSAP will consider the racial equity and health impacts the plan, consistent with Metro's adopted Strategic Plan to Advance Racial Equity, Diversity and Inclusion (2016). Consistent with the Vision Zero Framework, the RTSAP will focus less on enforcement and more on changes to the transportation system and policies.

DRAFT Moving from Vision to Action Framework
This draft handout describes the vision, goals, objectives, measures, targets and actions framework that the Regional Transportation Plan and supporting modal and topical plans (including the Regional Transportation Safety Action Plan) will utilize.

DRAFT Strategies and Actions
This document will be the primary focus of the work group discussion. Actions are organized into six strategic areas that were identified based on the main findings of crash data analysis and input at the April 4 work group meeting. What to consider

DRAFT Vision Zero Design Toolbox
- This document is referred to in the Strategies and Actions table and provides a selected list of safety countermeasures.
- Countermeasures that have been shown to have a significant crash reduction factors were prioritized for inclusion.
- The Toolbox will be further developed through the Designing Livable Streets project.

Crash Factor Overlaps Matrix
- This matrix shows the overlap of various crash factors from the 2011-15 data.
- The matrix is read as follows: X percent of (factors listed in the first column, e.g. Ped Involved) crashes are (factors listed across the top of the subsequent columns).
    - For example, 75 percent of serious Ped Involved crashes are Arterial.

- Or, 5 percent of serious Bike Involved crashes are Truck Involved.

DRAFT 2017 Metro State of Safety Report

- Analysis of 2011-2015 crash data.
- Highlighted sections have not yet been updated.
- High Injury Corridor and Intersection analysis has not yet been added.
- State and/or national crash data for race, ethnicity and income has not yet been added.

A Vision for Transportation Safety: Framework for Identifying Best Practice Strategies to Advance vision Zero

- Academic research paper provided as reference resource.
- The paper identifies best practice strategies to advance vision zero, and indicates whether those strategies are Proven, Recommended,

Next Steps

- September 14 – Final meeting of the work group – review first draft of the RTSAP
- November 15 and 17 - TPAC and MTAC kick-off review of draft RTSAP
- November – Draft findings and recommendations of the 2018 RTP project list system evaluation
- Spring 2018 – 45-day public review and comment on the draft RTSAP as part of the 2018 RTP public comment period

Meeting Materials

1. Agenda
2. Memorandum
3. April 4 meeting summary
4. Moving from Vision to Action Framework
5. Draft Strategies and Actions Table
6. Draft Vision Zero Design Toolbox
7. Crash Factor Overlaps Matrix
8. Draft 2017 Metro State of Safety Report
9. "A Vision for Transportation Safety: Framework for Identifying Best Practice Strategies to Advance vision Zero"

Meeting minutes

Metro
600 NE Grand Ave.
Portland, OR 97232-2736

Meeting:	**RTP Safety work group meeting #5**
Date/time:	Tuesday, April 4, 2017 | 9-11 a.m.
Place:	Metro Regional Center, room 401
Purpose:	Review Draft Annotated Table of Contents for the 2018 Regional Transportation Safety Action Plan
Outcome:	Input on Draft Annotated Table of Contents

Work Group Attendees	**Affiliate**
Anthony Buczek	Metro
Katherine Burns	Oregon Department of Transportation
Tegan Enloe	City of Hillsboro
Nick Fortey	Federal Highway Administration
Brendon Haggerty	Multnomah County
Jay Higgins	City of Gresham
Tom Kloster	Metro
Aszita Mansor	Multnomah County
Lake McTighe, Work Group Lead	Metro
Amanda Owings	City of Lake Oswego
Luke Pelz	City of Beaverton
Kari Schlosshauer	Safe Routes to Schools
Dyami Valentine	Washington County
Clay Veka	City of Portland

Interested Parties
Lidwien Rahman, Oregon Department of Transportation

Staff Attendees
Marie Miller, Metro

Welcome & introductions

The meeting was called to order at 9 a.m. by Tom Kloster. The committee was welcomed and a round of introductions was made.

Updates and Announcements

Lake McTighe provided a review of the work group's last meeting, January 24, 2017, with summary provided. The purpose from that meeting was to review safety performance targets, measures and high injury corridors. She reported that the performance measures are still being tested, and she reported out on how the measures were being used in the MTIP. The work group will have an opportunity to review the evaluation measures and continue to provide feedback. She stated that the next step for the plan was to start working on strategies and actions for the updated plan.

The Metro Council met in February 2017 where Lake presented on the Vision Zero target and framework, the safety measures being tested, and the high injury corridors. Support was given to move forward, and the Council expressed unanimous intent to incorporate Vision Zero into the 2018 RTP.

There is a video produced in Metro regarding Vision Zero that is being shown at upcoming MPAC (April 13, 2017) and JPACT (April 20, 2017) meetings. Lake will send the work group this video, but it has yet to be available for more public viewing.

Lake handed out the DRAFT Building the RTP Investment Strategy and Call for Projects. She noted that safety projects will be identified in the Call for Projects, and there is a Transportation Safety evaluation criteria for the project evaluation (which will only be applied to some projects). She also handed out the definition of a regional safety project, which had been updated based on feedback from the work group, TPAC and MTAC. *"Safety projects in the RTP are capital infrastructure projects with the primary purpose of reducing the occurrence of traffic related fatalities and serious injuries, allocating a majority of the project cost to a documented safety countermeasure to address a specific documented safety problem, or addresses systemic safety for vulnerable users, including people walking of bicycling, people with disabilities, older adults and youth."*

The handout "DRAFT Transportation Equity Assessment – 2018-2021 MTIP Draft Results" was provided. Lake reviewed the results of testing safety performance measures through MTIP equity analysis, which included exposure to VMT (vehicle miles traveled) and Crash Risk, and the share of safety projects.

The exposure to VMT and Crash Risk findings in the MTIP Equity analysis includes:

- Region: Slight increase in VMT projected with 2018-2021 MTIP investments
- Historically Marginalized (HMC) and Focused Historically Marginalized Communities (FHMC): Slight decrease in VMT exposure projected with 2018-2021 MTIP investments

Dyami Valentine, Wash Co, asked if facility types were included in the evaluation. There would be fewer conflicts with facilities with access management; thus fewer crashes. Lake stated that individual facilities were not assessed, that VMT generated from all roads per TAZ was recorded. Lidwien Rahman with ODOT pointed out that Maps could be more useful for local jurisdictions. Lake said they would likely be producing maps.

Tables shown in the Assessment handout included the Share of Safety Project findings:

- Region: About 13%, represented by 60 projects (out of 163), 2018-2021 MTIP investments are transportation safety projects. Per capita spending is approximately $98.
- HMC: The proportional number of transportation safety projects and per capita spending is higher than the region in areas with historically marginalized communities.
- FHMC: Half of the transportation safety projects are in areas with focused historically marginalized communities. Per capita spending is higher.

Of the total MTIP projects (163), 13% was the investment total with safety projects, equaling $98 cost per person, compared to $753 cost per person for all projects. Lidwien said we should note that 38% of the projects were safety projects. She also noted that there is only a certain amount of HSIP safety funding available, and while safety investments can be low dollar amount, they can have a big impact on safety.

Work Group Member Updates or Announcements

- Washington County is finalizing its Transportation Safety Plan. It may be an informational report and not adopted by the Commission.
- ODOT has a new funding of TGM grants coming out soon.
- ODOT also announced the nest round of All Roads Transportation Safety (ARTS) funding will be in the fall.
- The City Hillsboro's public comment found that 94% of respondents supported Vision Zero. Adoption of the Hillsboro TSAP is on the City Council's consent agenda for April 18. A news article about was in the Hillsboro Tribune http://www.pamplinmediagroup.com/ht/117-hillsboro-tribune-news/349431-228141-a-hillsboro-without-traffic-crashes-engineers-say-its-possible
- The City of Portland's has created a Task Force to oversee implementation of Portland's Vision Zero plan. The plan has 32 actions, and reducing speed is a big focus. Portland is seeking a new law to provide more local control to setting speeds on local streets. Portland is installing more speed cameras.
- The City of Portland is also studying a redesign with transportation to address speed for safe streets. Their goal is to lower speed for better safety. Several City of Portland staff are attending the Vision zero Conference in New York in May, 2017.
- Tegan Enloe, City of Hillsboro, mentioned the high crash relation to speed. Part of the challenge is finding what will work to reduce these crashes with multi-modes of transportation matched with correct speeds. Educating the public could be part of the answer. Working with other parts of the region to make a more cohesive plan could also help. Enloe suggested a Lunch & Learn session about enforcement of speed, with the legal aspects and effectiveness to this issue.
- Tom Kloster mentioned that with the recent poll Metro conducted, safety was ranked second of concern with transportation, behind maintenance of roads.

2018 Regional Transportation Safety Action Plan (RTSAP) Draft Table of Contents

Lake McTighe provided an overview of the DRAFT Table of Contents for the 2018 RTSAP. The work group was asked for input to the following:

- Organization and sequence?
- Sections/topics missing?
- Regional Emphasis Areas?
- Focus on Metro/regional actions?
- Update RTP Goals and Objectives?
- Specific to RTP safety policies and section dedicated to safety?

Lake stated that the crash data for 2011-2015 is still being analyzed. Analysis will be brought to the next meeting of the work group in July. Work group members provided input on the draft TOC.

Foreword Section

- Benefit of having "brand consistency" with different Vision Zero plans
- Change letter from the Metro Council or Planning Director to actual Resolution showing plan is adopted. Adoption carries more weight. In addition, the letter from Council but not staff.
- Add Implementation chapter

Introduction Section

- Add information on safety funding, how projects are funded (matrix, table)
- Add definition of safety projects
- Add information on criteria to fund safety projects
- Describe how RTSAP is part of other plans – it does not sit alone, how safety helps achieve 2040 vision
- Amend Regional Transportation Functional Plan to include safety also (currently not there).
- Add language on how data drives decisions

Section 1: Regional Safety Goals, Targets and Objectives

- Goal 5 – spate out safety and security, possibly combine safety with public health Goal
- Do not need to list all of the other Goals, only the safety Goal
- Where does the Design element with RTP fit in with this?
- Add section on other plans, design guidelines
- The Design work group is set to begin August 2017. What to include? Case studies? Safety audits? Land use? Best practices/evaluations? What can we learn from this?

Section 2: Summary of Regional Transportation Safety Trends

- List crash types an contributing factors first thing – most data analysis should be about the crash type and contributing factors
- It was confusing to have the data analysis in the State of Safety Report separate. It should be attached as an appendix or integrated.
- Use word injury where it can be substituted for crash.
- Elevate speed in list of contributing factors
- Would be good to include race/income if possible (only state and national numbers available right now): death rates which OHA has data; Portland has trauma data crash data that can be used (Portland did find that African Americans are disproportionately affected.
- Need to be clear and careful about the cause of crashes.
- Reference 2016 data – getting substantially worse
- Call out that there has been a sharp increase in crashes – more reason to act
- There should be additional equity analysis under Section 2, Data and Methods.
- Make sure there is a tight link/connection between Section 2 – data, and Section 3 – the Emphasis Areas.
- In Lake Oswego, run off road, fixed object crashes, texting could be involved

Section 3: Regional Emphasis Areas

- Number and order of the Emphasis Areas is important, Make a more compelling case with the relation of increase in speed/all crashes.
- Not sure why “Increase Travel Choices” should be an Emphasis Area
- Data driven needs to be shown
- Bullet for speed needed for emphasis
- Texting/distracted drivers. Do we have data for this included in preventive dangerous driving?
- Take out alcohol and drugs from dangerous driving – have stand alone

- What can Metro do to prevent dangerous driving - enforcement? Include information on best practices, how local jurisdictions can be most successful.
- Contributing factors should be structured more as contributing issues. Too much overlap now.
- Get to the root cause of dangerous behaviors.
- Combine increase travel choices with protect vulnerable users?
- Do not like Reduce VMT as its own emphasis area. Focus on making it safe to walk and bicycle.
- Make sure to address motorcycle crashes.
- Engage and educate: partner with schools; self enforcement – numbers to call, help each other; taxis, ride services
- Suggest combining Sections 3 & 4 as one Section

Section 4: Regional Strategies and Actions (this section will be combined with Section 3)

- Stress that actions come out of analysis of crash data
- Recommend updating Transportation Planning Rule to add safety
- Recognizing dangerous behaviors for part of strategies
- There is no enforcement for this; how does Metro work with different jurisdictions on enforcement of strategies and actions?
- Really like the six E's of Safety; emphasize these more
- Increase more travel options with marketing more possible options
- Engage and educate the public; partner with schools. Early education programs that Metro takes the lead on for all Portland school districts.
- School buys in with their timelines included.

Next steps

Lake McTighe provided a list of next steps following this meeting:

- April 12 or 26 – MPAC provides policy direction on transportation safety policy area
- April 20 – JPACT provides policy direction on transportation safety policy area
- July 27 – Transportation Safety work group provides input on strategies and actions
- September 14 – Transportation Safety work group provides input on draft plan
- October – November 2017 – TPAC and MTAC provide input on Draft 2018 Regional Transportation Safety Action Plan

Adjourn

There being no further business, meeting was adjourned by Tom Kloster at 11 a.m.

Meeting minutes respectfully submitted by
Marie Miller, Administrative Specialist

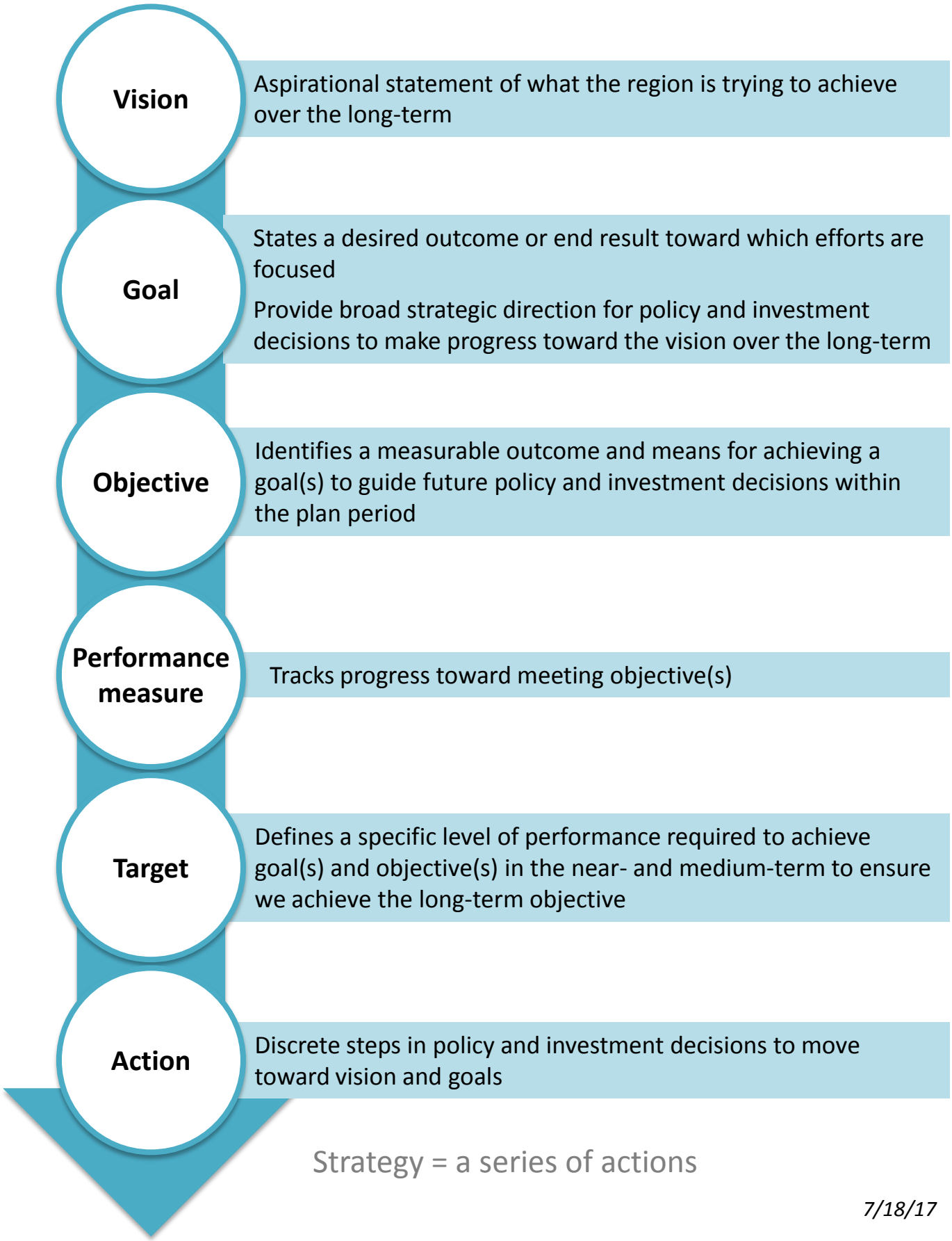
Next meeting of RTP Safety work group

Thursday, July 27, 2017 | 9-11 a.m.
Metro Regional Center, Room 401

Attachments to the Record:

Item	Topic	Document Date	Description
1	Agenda	4/4/2017	April 4, 2017 Meeting Agenda
2	Meeting Minutes	1/24/2017	RTP Safety Work Group Minutes, Jan. 24, 2017
3	Presentation	4/4/2017	RTP PowerPoint Presentation, April 4, 2017
4	Handout	3/23/2017	DRAFT Building the RTP Investment Strategy
5	Handout	4/3/2017	RTP Transportation Safety Projects definition
6	Handout	4/3/2017	DRAFT Transportation Equity Assessment – 2018-2021 MTIP Draft Results
7	Handout	3/28/2017	Memo: Regional Transportation Safety Action Plan, Annotated Table of Contents

Moving from Vision to Action



Strategy = a series of actions

2018 RTP Vision Zero ~ *DRAFT*

Vision

In 2040, everyone in the Portland metropolitan region will share in a prosperous, equitable economy and exceptional quality of life sustained by a safe, reliable, healthy, and affordable transportation system with travel options.

Goal

RTP Goal 7: Enhance Human Health

Multimodal transportation infrastructure and services provide safe, comfortable and convenient options that support active living and physical activity, and minimize transportation-related pollution and eliminate serious injuries.

Objective

(New) Objective 7.3 – Fatal and severe injuries – reduce the number of fatal and severe injury traffic crashes each year by at least 5%.

Performance measures

1) Average number of people killed and seriously injured annually in traffic crashes, by mode, per 100 million vehicle miles traveled and per 100 thousand people.
2) Number, cost and percent of safety capital projects in the RTP.
3) Increase or decrease in vehicle miles traveled.

Target

By 2035 eliminate transportation related fatalities and serious injuries for all users of the region's transportation system, with a 16% reduction by 2020 (as compared to the 2015 five year rolling average), and a 50% reduction by 2025.

Actions

1) Reduce speeds and speeding.
2) Protect vulnerable users.
3) Focus safety countermeasures on high injury and high risk intersections and corridors.
4) Address and minimize impact of dangerous behaviors.
5) Address impairment.
6) Ongoing engagement, education and planning

Strategy = a series of actions

7/18/17

7/19/17 DRAFT Strategies and Actions – Regional Transportation Safety Action Plan

Action Item #	Actions	Lead	Partners	Effectiveness
	❶ Reduce speeds and speeding Speed is the fundamental factor in crash severity – as speed increases so does risk of death in a crash, especially for people walking. Reducing speeds in the urban area must be prioritized to eliminate fatal crashes. Along with alcohol, drugs, and aggressive behavior, speed is the most common contributing factor in fatal crashes. • Speed is a factor in 7.5% of all crashes, but in 33% of fatal crashes • 55% of serious speed related crashes occurred on an arterial, and 71% occurred at a non-intersection • 25% of serious motorcycle crashes, 25% of serious freeway crashes, and 22% of serious truck crashes involved speed • 51% of serious speed related crashes involved a fixed object • 97% of serious speed related crashes involved aggressive behavior, and 38% involved alcohol • **Add data on race and ethnicity and age from state level analysis			
1.1	Implement/ prioritize design and engineering solutions indentified in the 'Vision Zero Design Toolbox' the Highway Safety Manuel and other resources that have been shown to slow speeds and reduce crashes – including, traffic/pedestrian signals, signal timing, medians and roundabouts	Cities, counties, ODOT, TriMet, SMART	Metro, public health, advocates	Proven and/or recommended
1.2	Increase the number of streets in the region eligible for fixed speed camera installation, especially at high injury locations	Cities, counties	ODOT, Metro, public health, advocates	Proven
1.3	Utilize authority provided through HB 2409 to issue speeding tickets through red light cameras	Cities, police	Public, health, advocates	Proven
1.4	Lower speed limits in urban areas to less than 35 mph	Cities, counties	ODOT, Metro, public health, advocates	Proven

Action Item #	Actions	Lead	Partners	Effectiveness
1.5	Design streets for desired speed, using design elements such as those identified in the Vision Zero Design Toolbox	ODOT, cities, counties	ODOT, Metro, public health, advocates	Proven
1.6	Fund and install intelligent speed adaptation technologies that alert the vehicle traveling over the speed limit, prioritizing high risk and high injury corridors	ODOT, cities, counties	Metro	Proven
1.7	Increase the density of protected crossings and signalized intersections, especially on high injury corridors, to lower operating speeds	ODOT, cities, counties	ODOT, Metro, public health, advocates	

❷ Protect Vulnerable Users

Vulnerable users are groups of people that are killed or seriously injured more often in crashes than other groups. Vulnerable users are pedestrians, bicyclists, motorcyclists, children, older adults, people of color and people with lower incomes.

- 56% of Regional High Injury Corridors are in areas with higher concentrations of people of color, people with low incomes and people with low English proficiency (Add analysis for high injury intersections)
- 36% of all fatal crashes involve a pedestrian (the most common fatal crash type), and 18% involve a motorcyclist
- While 1.4% of auto-only crashes are serious, crashes involving motorcycles (18%), pedestrians (16%), and bicycles (7%) have a higher serous crash rate
- 5% of serious bicycle crashes involved a truck, and 10% of serious truck crashes involved a bicycle
- In Oregon, 15% of the population is over 65, and account for 20% of pedestrian deaths
- In Oregon, American Indians/Alaska Natives have the highest average rate of deaths (5.9 per 100,000) 1.8 times the rate among whites (3.3 per 100,000) (2008-2014 crashes)
- In Oregon, American Indians/Alaska Natives and Black or African American had the highest hospitalization rate - 52.2 and 46.2 per 100,000, compared to 45.5 for whites and 20.8 Asian Pacific Islander (2012-2014)
- In Oregon, motor vehicle crashes are a leading cause of death for children
- **Add additional data on race, ethnicity, age and income as available

Action Item #	Actions	Lead	Partners	Effectiveness
2.1	Implement design and engineering solutions indentified in the 'Vision Zero Design Toolbox' the Highway Safety Manuel and other resources that have been shown to slow speeds and make it safer for people walking and bicycling – including protected crosswalks, crosswalk lighting, protected bike lanes, medians, road diets and roundabouts	Cities, counties, ODOT, TriMet, SMART	Metro, public health, advocates	Proven and/or recommended
2.2	Review standards for auto travel lane widths and explore making 10' travel lanes standard for arterials (if not already standard), slowing traffic and allowing more right-of-way for wider sidewalks, protected bikeways	Cities, counties, ODOT	Metro, public health, advocates	
2.3	Develop policies and standards for spacing of marked and protected crossings in urban areas and explore standardizing marked crossings every 550' (if not already standard)	Cities, counties, ODOT	Metro, public health, advocates	
2.4	Develop policy to make protected bike lanes the standard for streets with posted speed of 25 miles per hour or higher and/or average daily traffic above 6,000 autos a day, and/or heavy truck volumes	Cities, counties, ODOT	Metro, NACTO, public health, advocates	
2.5	Fund Safe Routes to School Programs, prioritizing schools in areas with higher concentration populations of people with lower incomes, minorities, and low English proficiency	ODOT, Metro, cities and counties	Schools, public health, advocates	Recommended
2.6	Identify funding for and provide trainings for senior citizens on walking and bicycling	ODOT, Metro, cities and counties, Senior advocates, public health	Advocates	Recommended

Action Item #	Actions	Lead	Partners	Effectiveness
2.7	Increase opportunities to provide education and products to increase visibility of people walking and bicycling (e.g. lights)	ODOT, cities and counties, schools	Public health, advocates	Recommended
2.8	Support and develop regional program to coordinate and collect bicycle and pedestrian count data	Metro	ODOT, cities and counties, PSU	Recommended
2.9	Support ODOT to make crash data on race and ethnicity of victims available	ODOT	Metro, cities and counties, PSU	
2.10	Research effectiveness of street lights relative to reducing pedestrian and bicycle crashes in urban areas	TBD		Unknown
2.11	Define process to develop policy to outfit large vehicles with front and side mirrors to improve visibility	TBD		Proven
2.12	Define process to develop policy to outfit large vehicles with rear wheel and side guards	TBD		Proven
2.13	Evaluate pedestrian and bicycle crash locations and risk factors though analysis of existing data and development of new data sources	ODOT, Metro	Cities, counties	

Action Item #	Actions	Lead	Partners	Effectiveness
	❸ Focus safety countermeasures on high injury and high risk intersections and corridors Not all streets in the region are the same. A majority of fatal and severe crashes occur on a small sub-set of streets, primarily arterials, and intersections. These corridors and intersections also have high crash risk characteristics. • 60% of serious crashes occur on 6% of the region's roadways • 49% of serious crashes occurred at an intersection, while 73% of serious bicycle crashes occurred at an intersection • 69% of all serious crashes occurred on an arterial • 75% of serious pedestrian crashes occurred on an arterial • 85% of serious failure to yield crashes are at an intersection • 81% of serious bicycle involved, and 50% of serious pedestrian involved crashes are fail to yield crashes • 63% of serious bicycle involved crashes are turning involved (while only 1% of serious pedestrian involved crashes are turning involved) and 20% of serious turning crashes are bicycle involved			
3.1	Implement context sensitive design and engineering solutions indentified in the 'Vision Zero Design Toolbox' the Highway Safety Manuel and other resources to reduce serious crashes– including medians, protected left turn signals, bicycle boxes, pedestrian lead intervals, road diets and roundabouts	Cities, counties, ODOT, TriMet, SMART		
3.2	Develop and adopt Complete Streets policies and a complete streets checklist	ODOT, Metro, cities and counties		Unknown
3.3	Conduct routine evaluation of effectiveness of traffic safety interventions	ODOT, cities and counties, academic institutions	Metro, advocates, public health	Recommended
3.4	Identify resources to develop a regional crash prediction modeling tool that utilizes and links social and environmental factors with injury data	Metro	FHWA, ODOT, public health, academic inst.	Proven

Action Item #	Actions	Lead	Partners	Effectiveness
3.5	Perform engineering reviews at all traffic fatality and high collision locations, and at scenes of fatal and severe crashes	Cities, counties, ODOT		Recommended
3.6	Investigate crashes that result in fatalities as well as crashes that result in severe injuries	Police, cities, counties, ODOT		Recommended
3.7	Targeted outreach/education to communities near high injury arterials and intersections, focusing on historically marginalized communities	Cities, counties, ODOT, Metro		Recommended
3.8	Prohibit right turn on red at high risk and high injury locations	Cities, counties		Recommended
3.9	Prioritize funding for safety projects that: • Increase safety for people walking, bicycling and accessing transit • Are on a high risk or injury location • are within 1 mile of schools, prioritizing Title 1 schools, and transit • are in areas with high concentrations of people of color, people with low-incomes and people with low English proficiency	Metro, ODOT, counties and cities	Public health, advocates	
3.10	Require regionally funded transportation projects to conduct and provide before and after case studies to understand impact	Metro		
3.11	Prioritize safety projects in regional funding opportunities. Further prioritize safety projects near Title 1 schools and near transit stops in areas with historically marginalized communities	Metro, ODOT, cities and counties		

Action Item #	Actions	Lead	Partners	Effectiveness
3.12	Track level of investment in safety projects in the Regional Transportation Plan and local Transportation System Plans	Metro, cities and counties		
3.13	Track level of investment of safety projects on high injury corridors and intersections in the Regional Transportation Plan and local Transportation System Plans	Metro, cities and counties		
3.14	Use Highway Safety Manuel crash prediction project analysis to guide project development	ODOT, cities and counties		
3.15	Provide best practices for Vision Zero street design in the Designing Livable Streets regional street design guidelines and tools	Metro	ODOT, cities and counties, public health, advocates	
3.16	Pursue congestion pricing to reduce traffic volumes	ODOT, Metro, cities and counties		Recommended
3.17	Support Transportation Demand Management programs to reduce car dependence, improve transit and promote walking and bicycling	ODOT, Metro, cities and counties		Unknown
3.18	Identify funding to update and maintain regional Crash Map tool	Metro		
3.19	Support implementation of the Oregon 2017 Commercial Vehicle Safety Plan	ODOT, cities, counties, Metro		

Action Item #	Actions	Lead	Partners	Effectiveness
	❹ Address and minimize impact of dangerous behaviors Dangerous behaviors include aggressive behavior, distracted driving, following too close, failing to yield the right of way, hit and run, and excessive speed (see actions to reduce speed). Actions can address individual behavior change and make systems changes that reduce the impacts of dangerous behaviors. • 41% of auto-only serious crashes involved aggressive behavior (compared to 9% of pedestrian involved crashes and 8% of bicycle involved crashes) • 36% of fatal crashes involve aggressive behavior • 40% of serious crashes are fail to yield ROW involved • 100% of serious following too closely crashes involved aggressive behavior • 64% of serious freeway crashes involved aggressive behavior • Drivers use their cell phones 88 out of 100 trips (analysis of 570 million trips in US) • 75% of drivers drive distracted when alone, and 44% when driving with passengers			
4.1	Focus enforcements on dangerous behaviors (speeding, failing to yield to pedestrians, signal violations, improper turns/illegal turns, texting while driving) and high injury corridors	Police, cities, counties		Recommended
4.2	Research updating fine structure(s) to promote equitable traffic enforcement strategies that do not have disproportionate economic impact on people with low incomes			
4.3	Increase penalties for driving with a suspended license, identifying actions to reduce the disproportionate impacts from fines on people of color and people with low incomes			Recommended
4.4	Update DMV point penalty structure so that dangerous offenses are punished with the most severe point values, identifying actions to reduce the disproportionate impacts on people of color and people with low incomes			

Action Item #	Actions	Lead	Partners	Effectiveness
4.5	Convene regular meetings of transportation leaders and police to review traffic safety performance and determine strategies for improvement	Cities, counties, ODOT		Recommended
4.6	Conduct high visibility enforcement of distracted driving/ texting while driving, identifying actions to reduce the disproportionate impacts from fines on people of color and people with low incomes	ODOT, cities and counties, police		Proven
4.7	Support implementation of recommendations identified in Reducing Distracted Driving in Oregon report, including implementing an education and media campaign, developing a distracted driving toolkit, and engaging in distracted driving research	ODOT, cities and counties		
4.8	Support auto insurance companies to provide reduced auto insurance to drivers that install technologies to turn off phone			
4.9	Compile a comprehensive list and contacts of private sector companies that operate large numbers of vehicles in the region. Identify a process that supports state and local partners to engage in outreach regarding safe driving behaviors to members, workforces and customers – companies such as ride hailing services and trucking companies	Metro	ODOT, cities and counties, commercial vehicle companies	
4.10	Support legislation to increase funding for and access to driver education, frequency of testing, and inclusion of urban transportation safety in test materials	Metro, ODOT, cities and counties		

Action Item #	Actions	Lead	Partners	Effectiveness
	❺ Address impairment Crashes involving alcohol and drugs have a much higher likelihood of being fatal than other crashes. • 57% of fatal crashes involved alcohol or drugs • 20% of serious auto-only crashes and 38% of serious pedestrian crashes are alcohol and/or drug involved • 27% of serious alcohol involved, and 29% of serious drug involved crashes are pedestrian involved • 56% of serious alcohol involved, and 57% of serious drug involved crashes are auto-only crashes • 77% of serious alcohol involved, and 56% of serious drug involved crashes occurred at night • 36% of serious alcohol and drug involved crashes are speed involved • 51% of serious drug involved crashes are also alcohol involved • **ADD data on race and ethnicity			
5.1	Convene and/or coordinate targeted workgroup of safety professionals (police, fire, emergency services, etc.) to continue to review and develop targeted strategies to reduce the prevalence of driving under the influence of alcohol and/or drugs	ODOT, cities, counties	Metro	
5.2	Provide training and education in impairment detection for law enforcement	Police, cities, counties, ODOT		
5.3	Adopt National Transportation Safety Board recommendation to reduce Blood Alcohol Concentration limit to 0.05	State		Proven
5.4	Explore usefulness of pre-paid morning parking programs	Cities, counties		Recommended
5.5	Promote use of apps such as SaferRide developed by NHSTA, which provide people easy ways to find a safe ride home	Cities, counties, ODOT		

Action Item #	Actions	Lead	Partners	Effectiveness
5.6	Partner with industry groups and vehicle manufacturers to further the use of technology to reduce impaired driving			Recommended
	❻ Ongoing Engagement, Education and Planning			
6.1	Convene a regional Vision Zero Work Group, made up of state and local transportation and public health professionals, equity representatives, police and fire, and community and advocacy organizations, to meet quarterly to review progress and collaborate on specific topics, such as reducing drunk driving.	Metro/ODOT	Cities and counties, ODOT, public health, advocates, TriMet, SMART	Recommended
6.2	Provide an annual Vision Zero report back to JPACT and Metro Council, reporting on safety targets and RTSAP implementation	Metro	Cities and counties, ODOT, TriMet, SMART, public health, advocates	Recommended
6.3	Identify opportunities to engage and partner with community based organizations and advocates	Metro, ODOT, cities and counties	Public health, advocates	
6.4	Continual and proactive monitoring and feedback gathering from the community on their safety issues and concerns	ODOT, cities and counties		Recommended
6.5	Maintain Metro webpage on transportation safety	Metro		
6.6	Update Metro webpage annually with MAP-21 transportation safety performance measure data; include data on race and ethnicity as available	Metro		

Action Item #	Actions	Lead	Partners	Effectiveness
6.7	Support development of city and county Transportation Safety Action Plans and Vision Zero targets Participate in local and state safety task forces	Metro, ODOT, TriMet		
6.8	Develop and participate in state, regional, county and city safety summits	Metro, cities and counties, ODOT, TriMet, SMART	Public health, advocates	
6.9	Identify opportunities to advance Vision Zero policies, practices and projects in federal programs with US DOT and Congress	ODOT, Metro, FHWA, cities and counties		
6.10	Identify funding and opportunities to host safety workshops, including a focus on racial equity and public health	Metro, ODOT	FHWA	
6.11	Develop training programs for state, regional, county and city staff on Vision Zero framework and priorities, , including racial equity and public health	ODOT, Metro, TriMet, cities and counties		
6.12	Review and update trainings for state, county and city police officers to reflect new traffic safety priorities and regularly conduct trainings, including racial equity and public health	Cities, counties		Recommended
6.13	Identify funding for and develop at least one coordinated culturally appropriate mass media safety campaign in the region	Metro, cities, counties, ODOT		

Action Item #	Actions	Lead	Partners	Effectiveness
6.14	Utilize campaign materials developed by NHSTA to promote safety awareness	Metro, cities, counties, ODOT		
6.15	Update Section 0020 of the Oregon Transportation Planning Rule requiring Transportation System Plans to include a transportation safety action plan, with data analysis that addresses all modes and is based on both an analysis of crash rates and an analysis of crash risks. Update Section 0060 (c) of the Oregon Transportation Planning Rule (plan amendments) clarifying that making a known safety problem worse constitutes a "significant effect".			
6.16	Support safety legislation and regulations at the state and federal level that implement Vision Zero and do not increase racial disparities	Metro, ODOT, cities, counties, advocates		
6.17	Support and implement land use and transportation policies that reduce driving and encourage transit, walking and bicycling	Metro, state agencies, cities and counties	Advocates, public health	

Partners

Government alone cannot achieve the broader changes needed to end traffic fatalities. In addition to national, state, regional and local agencies, multiple organizations, private entities and the public play a role in achieving Vision Zero.

National agencies
U.S. Department of Transportation
Federal Highway Administration
National Highway Traffic Safety Administration

State agencies
Oregon Department of Transportation
Oregon Health Authority
Department of Motor Vehicles

Regional agencies and Districts
Metro
TriMet
SMART
Portland of Portland

Local agencies – transportation/ public health professionals
City and county transportation and public health agencies

Schools
Public and private

Elected and appointed officials
US Representatives and Senators
State Representatives and Senators
Governor
Oregon Transportation Commission
Oregon Transportation Safety Committee
Oregon Bicycle and Pedestrian Advisory Committee
Oregon Freight Advisory Committee
Oregon Transit Advisory Committee
Metro Council
Metro Joint Policy Advisory Committee on Transportation
City Mayors and Councils
County Commissioners

Emergency Service Providers

State, County and Local Police
Oregon State Police
Clackamas, Multnomah and Washington County Sheriff's Offices
City Police

County and City Fire & Rescue
Portland Fire and Rescue
Tualatin Valley Fire and Rescue
Clackamas Fire District #1
Multnomah County Fire District #14
Washington County Fires District #2
Gresham Fire
Hillsboro Fire
Cornelius Fire
Forest Grove Fire and Rescue
Gladstone Fire
Lake Oswego Fire

Advocacy and Community Organizations
Oregon Walks
Oregon and SW Washington Families for Safer Streets
Vision Zero Network
Toward Zero Deaths
AARP
Street Trust
Community Cycling Center

Commercial Vehicle Companies
Companies located and/or operating in the region

Industry Groups
Auto insurance companies
Auto manufacturers
AAA

Technology Leaders
Volpe Institute

Research and Academic Institutions
Portland State University
ODOT Research
Transportation Research Board (TRB)

DRAFT Vision Zero Design Toolbox		
#	***Design Treatment***	***Effectiveness/Crash Reduction Factor***
	Traffic Calming/ Speed Reduction	A crash reduction factor (CRF) is the percentage crash reduction that might be expected after implementing a given countermeasure.
1	Road reorganization - reduce and/or narrow vehicle lanes to slow speeds and make room for pedestrian and bicycle safety features	Proven/ tried, 19%-47% crash reduction (1)
2	Vehicle lane width of 10 or 10.5 feet to reduce speeding	19%-47% crash reduction (1)
3	Street trees, curb extensions, median islands, buffered bike lanes, on-street parking	
4	Speed humps, chicanes, diagnol parking	
5	Transit only lanes	
	Access Management	
6	Driveway consolidation	25-31% reduction all injury crashes (2)
7	Median barrier (any type)	30% reduction all injury crashes; 43% reduction fatal crashes in rural settings (1)
8	Raised median	0-22% reduction all injury crashes (2)
	Pedestrian Safety	
9	ADA accessibility: design sidewalks to meet full ADA compliance and enable pedestrian access by people of all ages and abilities	
10	Sidewalks (to avoid walkig on roadway)	Proven, 88% reduction in pedestrian crashes (4)
11	Bulb outs, curb ramps and extensions with marked crosswalk and pedestrian warning signs	37% reduction in pedestrian crashes (3)
12	“No Ped” phase feature with flashing yellow arrow	43% reduction for all ped crashes
	Crossing Safety	

#	*Design Treatment*	*Effectiveness/Crash Reduction Factor*
13	Add traffic signal	55% crash reduction for pedestrian and bicycle crashes (3); 74% reduction in right-angle crashes
14	HAWK signals	
15	Grade Separated Crossing	Proven, 80-90% reduction in fatal and severe injury pedestrian and bicycle crashes
16	Leading Pedestrian Intervals (or signal protected pedestrian crossings) to give pedestrians and bicycles exclusive crossing time to reduce turning conflicts	37% crash reduction for all bike/ped crashes (1)
17	High visibility crosswalk	Proven, crash reduction factor varies
18	Pedestrian/ bicycle refuge islands at least 5 ft. on two-way multi-lane streets, with marked crosswalk	Proven, 46% redcution in pedestrian crashes and 39% reduction in motor vehicle crashes (1)
19	Pedestrian hybrid beacons	Tried, 69% reduction in pedestrian crashes (5), 29% reduction for all modes, all severities (1)
20	Rectangular rapid flashing beacon with median	56% reduction in pedestrian crashes(10% CRF without median) (3)
21	Minimize crosswalk spacing (minimize dsitance between marked/signalized crosswalks)	
22	Crosswalk lighting	Proven (rural roads), 28-38% reduction in night injury crashes; 42% reduction in all injury bike/ped crashes
	Bicycle Safety	
23	Protected bicycle lanes	59-74% reduction in bicycle injury crashes
24	Buffered bike lanes	47% reduction for bike injury crashes (3)
25	Bicycle Boulevards	Tried, 60% reduction in bicycle crashes (5)
26	Bicycle lanes	36% reduction for bike injury crashes
27	High visibility bicycle lane markings through intersections	
28	Bicycle signals, leadng bicycle signal	45% crash redcution factor
29	Bicycle Boxes	Experimental, no crash reduction factor defined (5)
30	Add buffer to existing bike lanes	11% reduction for bike injury crashes

#	*Design Treatment*	*Effectiveness/Crash Reduction Factor*
	Intersection Safety	
31	Roundabouts	78-82% crash reduction (82% reduction in serious crashes)(1)
32	Dedicated left turn lane(s) at unsignalized intersections	33-47% crash reduction
33	Pedestrian countdown signal heads	25% redcution in pedestrian crashes (4)
34	Protected left turns (with signal)	99% reduction all left turning crashes (2)
35	Increase sight triangles at intersections by installing curb extensions and daylighting corners	48% all injury crashes
36	Tighten turning radii with freight-friendly corners to slow turning vehicles	
37	Improved and coordinated signal timing for 25 mph or best suited speed (*ITE Determining Vehicle Change Intervals: A proposed Recommneded Practice 1985)*	55-75% reduction for serious head-on and left-turn crashes; 37% crash reduction for serious pedestrian crashes (2)
38	Advance stop or yield lines	
39	Countdown pedestrian signals	70% reduction for all pedestrian/vehicle crashes (1)
40	Longer red clearance cycle	30% reduction in right angle crashes, 15% reduction in all crash types
	Signals and Signs	
41	Dynamic curve speed warning system	40% reduction for all curve crashes
42	Dynamic message signs with safety messaging	
43	Advisory cautionary signes	
	Roadway Departure	
44	Centerline rumble strips	12% reduction all injury crashes
45	Bicycle friendly edgeline/ shoulder rumble strips	Proven, 30-35% road departure crashes (5); 23-41% reduction for auto crashes in rural settings (1)
	Crash Redcution Factor Resources:	
	(1)Crash Modification Factors Clearinghouse/	
	(2) Highway Safety Manuel	

#	Design Treatment	Effectiveness/Crash Reduction Factor
	(3)ODOT Crash Reduction Factor Appendix	
	(4) FHWA Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes	
	(5) Minnesota's Best Practices for Pedestiran/Bicycle Safety 2013	

METRO Regional Transportation Safety Action Plan - Crash Factor Overlaps, 2011-2015

X% of…..crashes **are……**

Serious crashes	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	Innatention	Reckless/ Careless	Aggressive	Failed to stop	Alcohol Involved	Drug Involved	Hit & Run
All crashes	100.0%	0.3%	2.1%	1.8%	11.3%	40%	50%	2%	2%	91%	2%	3%	16%	62%	16%	7%	47%	53%	10%	1%	45%	22%	7%	71%	18%	4%	7%	8%	33%	30%	19%	5%	2%	41%	9%	4%	1%	6%
Fatal	0.3%		100.0%	12.2%	13.8%	15%		36%	4%	38%	18%	8%	7%	69%	21%	3%	37%	63%	7%	8%	7%	10%	26%	38%	39%	15%	7%	33%	2%	31%	27%	5%	9%	36%	2%	46%	20%	8%
Serious	2.1%	12.6%		88.9%	15.3%	22%		16%	7%	60%	15%	4%	10%	66%	18%	6%	49%	51%	11%	4%	21%	24%	17%	59%	26%	8%	7%	16%	14%	40%	19%	6%	7%	33%	4%	17%	5%	4%
A	1.8%	1.7%	100.0%		15.5%	23%		13%	8%	63%	14%	3%	10%	66%	18%	6%	50%	50%	12%	3%	23%	25%	16%	61%	24%	7%	7%	14%	15%	41%	18%	6%	7%	32%	4%	14%	3%	3%
B	11.3%	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%	11%	19%	48%	15%	6%	4%	32%	4%	8%	1%	4%
C	40.0%	0.1%	1.1%	1.1%	7.3%			2%	2%	93%	1%	2%	17%	66%	13%	4%	48%	52%	10%	1%	57%	20%	4%	72%	17%	3%	7%	6%	42%	29%	12%	6%	2%	47%	11%	3%	1%	5%
PDO	50.3%							0%	0%	96%	1%	4%	16%	59%	16%	8%	45%	55%	9%	0%	42%	23%	9%	71%	17%	4%	7%	7%	31%	28%	25%	4%	2%	39%	8%	4%	1%	7%
Ped Involved	2.0%	4.7%	16.4%	12.0%	48.1%	38%	1%				2%	2%	2%	75%	16%	7%	53%	47%	1%	0%	1%	1%	2%	36%	40%	13%	11%	7%	1%	50%	6%	4%	4%	9%	0%	29%	9%	7%
Bike Involved	2.2%	0.4%	6.8%	6.4%	59.4%	32%	3%				1%	5%	1%	64%	25%	9%	73%	27%	27%	1%	3%	63%	0%	70%	18%	5%	8%	2%	1%	81%	11%	2%	3%	8%	1%	7%	2%	3%
Auto-only	91.1%	0.1%	1.4%	1.3%	8.7%	41%	53%				0%	0%	11%	66%	17%	5%	46%	54%	13%	5%	29%	23%	24%	61%	25%	8%	5%	18%	19%	34%	21%	8%	8%	41%	5%	16%	4%	3%
Motorcycle Involved	1.7%	2.8%	18.0%	15.3%	45.1%	28%	15%	2%	0%	0%		1%	12%	58%	24%	6%	47%	53%	11%	3%	15%	33%	16%	66%	18%	8%	7%	25%	11%	37%	27%	3%	7%	37%	2%	15%	3%	1%
Truck Involved	3.1%	0.7%	2.5%	1.8%	9.7%	29%	62%	8%	10%	0%	6%		25%	64%	8%	3%	43%	57%	8%	10%	28%	22%	9%	64%	24%	8%	5%	22%	17%	31%	28%	6%	2%	39%	5%	18%	3%	2%
Freeway	15.8%	0.1%	1.3%	1.2%	8.3%	43%	51%	3%	1%	70%	18%	9%					4%	96%	1%	1%	54%	1%	24%	57%	30%	9%	4%	25%	34%	2%	22%	8%	11%	64%	8%	16%	4%	3%
Arterial	62.1%	0.3%	2.2%	1.9%	11.5%	42%	48%	18%	7%	60%	13%	4%					55%	45%	12%	4%	20%	28%	13%	58%	27%	7%	7%	13%	13%	45%	17%	6%	6%	29%	4%	16%	5%	4%
Collector	15.5%	0.3%	2.5%	2.2%	13.6%	35%	53%	13%	10%	56%	19%	2%					51%	49%	14%	5%	11%	23%	25%	59%	21%	13%	7%	21%	7%	40%	22%	4%	7%	31%	2%	21%	5%	4%
Local	6.5%	0.1%	1.8%	1.7%	11.0%	24%	65%	19%	12%	52%	15%	2%					53%	47%	20%	4%	5%	16%	22%	67%	20%	9%	4%	17%	2%	39%	27%	5%	10%	27%	1%	19%	7%	4%
Intersection	47.5%	0.2%	2.1%	1.9%	13.0%	41%	48%	17%	11%	56%	14%	3%	1%	74%	19%	6%			22%	1%	14%	37%	8%	63%	26%	4%	7%	10%	9%	67%	12%	3%	5%	21%	2%	13%	3%	3%
non-Intersection	52.5%	0.3%	2.0%	1.7%	9.7%	39%	52%	15%	4%	63%	15%	4%	19%	59%	18%	5%			2%	7%	28%	11%	26%	55%	27%	12%	7%	22%	18%	14%	26%	8%	8%	44%	5%	21%	7%	4%
Angle	9.9%	0.2%	2.4%	2.2%	17.4%	41%	46%	2%	17%	66%	13%	3%	1%	67%	22%	10%	92%	8%						71%	23%	2%	4%	7%	0%	94%	3%	3%	5%	9%	0%	10%	2%	1%
Head-on	0.6%	3.3%	12.1%	9.8%	26.9%	41%	36%	0%	1%	79%	11%	10%	2%	69%	23%	5%	11%	89%						55%	19%	15%	11%	30%	1%	2%	90%	9%	9%	34%	0%	29%	12%	3%
Rear-end	45.4%	0.0%	0.9%	0.9%	6.4%	50%	46%	1%	1%	83%	11%	5%	26%	63%	10%	1%	32%	68%						70%	20%	3%	6%	10%	63%	1%	6%	12%	5%	73%	17%	7%	2%	6%
Turning	22.1%	0.1%	2.2%	2.1%	15.2%	36%	51%	1%	20%	58%	20%	3%	1%	78%	18%	4%	76%	24%						71%	18%	4%	6%	5%	1%	86%	14%	2%	2%	8%	0%	6%	1%	1%
Fixed object	7.4%	0.9%	4.8%	4.0%	17.1%	21%	59%	2%	0%	83%	14%	2%	14%	52%	27%	7%	24%	76%						39%	40%	17%	5%	48%	0%	3%	34%	9%	17%	56%	0%	37%	10%	2%
Daylight	70.9%	0.1%	1.7%	1.6%	10.6%	41%	50%	10%	9%	62%	17%	4%	9%	66%	19%	6%	52%	48%	14%	4%	25%	29%	11%					12%	17%	44%	18%	6%	3%	30%	4%	5%	3%	2%
Darkness- lit	17.8%	0.6%	3.0%	2.5%	13.4%	39%	49%	25%	5%	58%	10%	3%	11%	69%	15%	4%	48%	52%	10%	3%	16%	17%	26%					23%	8%	37%	18%	6%	14%	38%	2%	39%	6%	7%
Darkness- no lights	3.8%	1.1%	4.5%	3.6%	14.6%	31%	54%	24%	4%	55%	15%	4%	11%	54%	29%	6%	26%	75%	3%	7%	7%	11%	35%					30%	4%	20%	29%	6%	11%	40%	1%	41%	12%	6%
Dawn/ dusk	7.1%	0.2%	2.0%	1.7%	10.4%	41%	50%	26%	9%	48%	16%	2%	6%	72%	19%	3%	50%	50%	7%	6%	20%	23%	12%					14%	13%	42%	21%	6%	4%	26%	4%	15%	4%	4%
Speed Involved	7.5%	1.1%	4.4%	3.5%	17.0%	34%	50%	7%	1%	66%	23%	5%	15%	55%	24%	6%	29%	71%	5%	7%	13%	7%	51%	42%	36%	16%	6%		4%	11%	19%	3%	17%	97%	1%	38%	11%	5%
Followed too closely	33.4%	0.0%	0.8%	0.8%	6.3%	50%	46%	1%	0%	83%	12%	5%	24%	65%	10%	1%	33%	67%	0%	0%	96%	2%	0%	75%	16%	2%	6%	5%		1%	1%	9%	1%	100%	0%	3%	1%	5%
Fail to yield ROW	30.1%	0.3%	2.7%	2.5%	17.8%	38%	46%	20%	15%	51%	13%	3%	1%	75%	19%	5%	82%	18%	27%	0%	0%	51%	1%	65%	24%	4%	7%	4%	0%		5%	2%	3%	6%	0%	10%	2%	2%
Improper maneuver	19.2%	0.4%	2.1%	1.8%	8.9%	26%	65%	5%	4%	66%	21%	5%	11%	60%	21%	8%	31%	69%	2%	18%	6%	17%	30%	55%	25%	13%	8%	16%	1%	11%		3%	7%	20%	1%	23%	6%	4%
Innatention	5.1%	0.3%	2.4%	2.2%	13.1%	47%	43%	10%	3%	77%	7%	4%	14%	68%	13%	5%	27%	73%	6%	6%	41%	7%	25%	61%	25%	8%	6%	7%	21%	15%	11%		5%	30%	4%	7%	2%	1%
Reckless/ Careless	2.1%	1.1%	6.7%	5.9%	23.4%	32%	45%	9%	4%	73%	14%	1%	16%	56%	19%	9%	36%	64%	8%	5%	14%	9%	45%	29%	54%	13%	4%	41%	3%	15%	19%	4%		100%	1%	74%	19%	11%
Aggressive	41.1%	0.2%	1.6%	1.4%	8.6%	46%	47%	4%	2%	74%	17%	4%	19%	59%	17%	5%	31%	69%	3%	4%	46%	6%	29%	53%	31%	10%	5%	48%	42%	7%	12%	5%	20%		1%	29%	8%	5%
Failed to stop	8.5%	0.1%	0.9%	0.8%	4.9%	50%	47%	0%	1%	86%	8%	5%	22%	67%	9%	1%	34%	66%	0%	0%	98%	1%	0%	74%	18%	1%	7%	4%	1%	1%	4%	7%	1%	5%		6%	5%	5%
Alcohol Involved	4.2%	2.9%	8.6%	6.0%	22.2%	30%	46%	27%	3%	56%	13%	4%	9%	63%	22%	6%	38%	62%	7%	6%	8%	8%	37%	16%	58%	19%	6%	36%	3%	24%	25%	2%	28%	54%	1%		14%	8%
Drug Involved	0.7%	7.1%	13.1%	7.5%	18.2%	33%	44%	29%	3%	57%	10%	3%	8%	65%	19%	9%	29%	71%	4%	10%	11%	4%	38%	39%	35%	21%	5%	36%	3%	18%	24%	3%	27%	55%	4%	51%		11%
Hit & Run	5.9%	0.4%	1.2%	0.9%	7.7%	34%	59%	29%	7%	58%	6%	2%	7%	65%	21%	7%	41%	59%	5%	3%	33%	9%	9%	30%	50%	13%	7%	23%	19%	26%	20%	2%	20%	48%	5%	38%	14%	

Metro State of Safety Report

A compilation of information on roadway-related crashes, injuries, and fatalities in the Portland Metro region and beyond

DRAFT August 2017

(Highlighted sections have not yet been updated)

Executive Summary

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. For young people below the age of 35, 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 2017 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 bike crashes, while accounting for 12% of road lane miles. (*Sections 2, 5, and 6)*
- Alcohol or drugs were a factor in 57% of fatal crashes. *(Section 2)*
- Speed is a contributing factor in 33% of fatal crashes, and aggressive driving is a factor in 36% 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 reitgonal 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)*
- Additional findings to be added

Table of Contents

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.

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 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.

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.

"**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, 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 2005 and 2009 were considered for this analysis.

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 decades of increases or stagnation, but have increased significantly since 2010. In Oregon, these trends are consistent with national patterns. Figures 1-1 and 1-2 show the national and state trends of population, VMT, and crash-related fatalities.

Figure 1-1

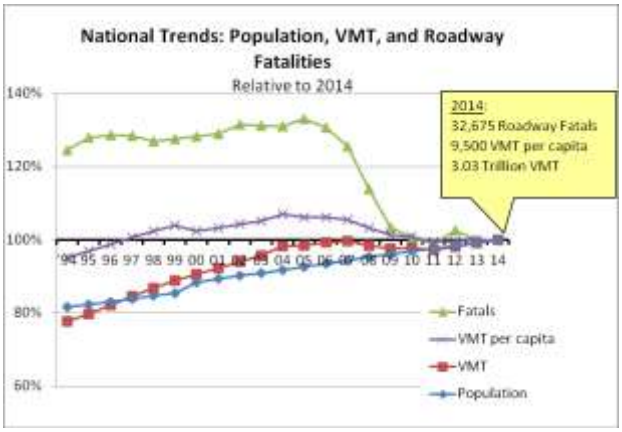
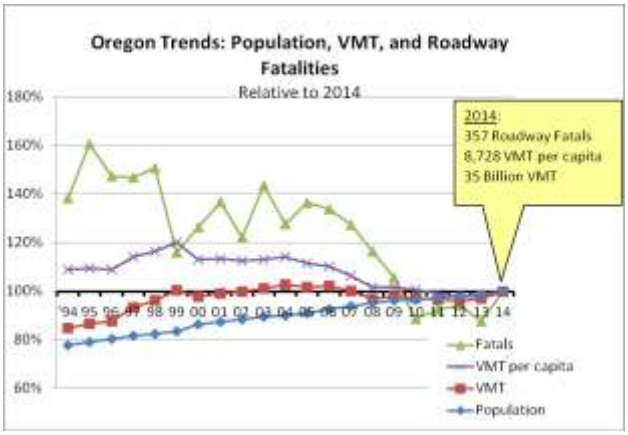


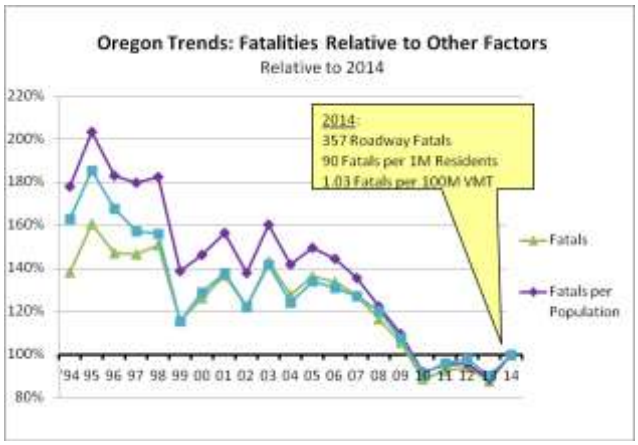
Figure 1-2



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.

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

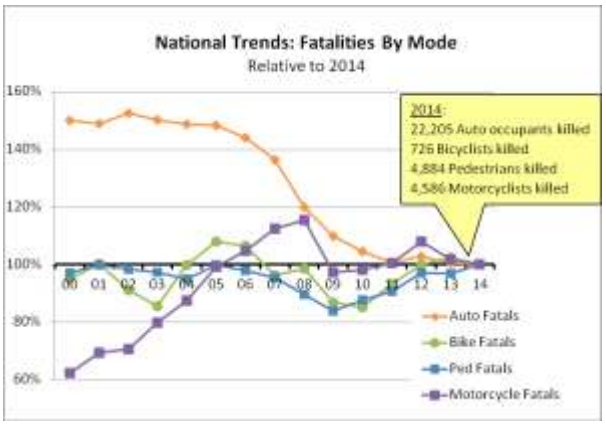
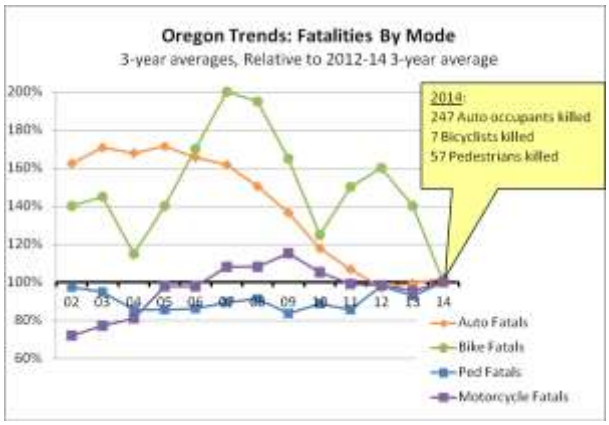


Figure 1-6



Fatalities have recently stabilized for automobile occupants and motorcyclists, while fatalities have been increasing for pedestrians and bicyclists.

Annual Vehicle-Miles Traveled (VMT)

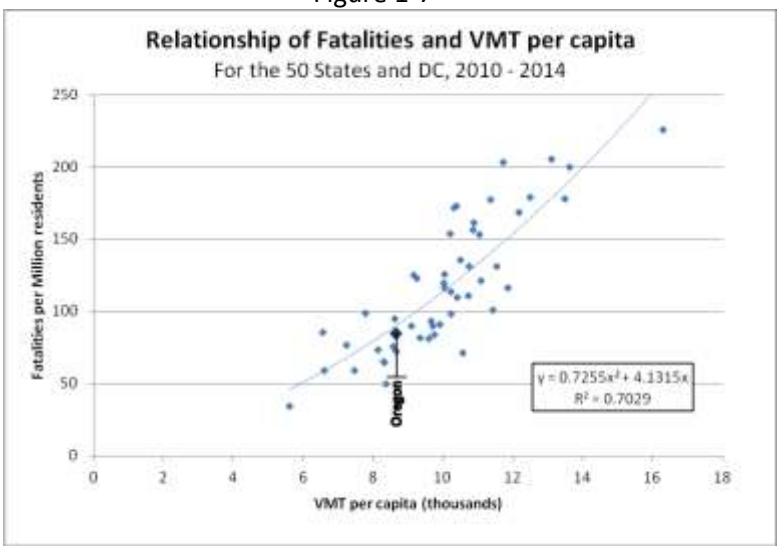
One of the clearest trends in crash data is the correlation between fatality rates and annual per capita VMT. Figure 1-7 shows the relationship by US state for all fatalities, and Figure 1-8 shows the relationship for pedestrian or bicyclist fatalities.

States with higher 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 estimate the change in roadway fatalities that would occur by changing per capita VMT, and is shown in Figure 1-7.

All Fatalities

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 5,610, and exhibits one of the lowest annual fatality rates of 65 per million residents – less than one-third of the national average. Wyoming, with the highest per capita VMT of 17,900, also has the highest annual fatality rate at 310 per million residents – 235% of the national average.

Figure 1-7



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 2010 – 2014 data is shown in Figure 1-7.

The national average is 9,500 VMT per capita and 109 fatalities per million residents.

Oregon statistics are 8,650 VMT per capita (91% of the national average) and 85 fatalities per million residents (81% of the national average).

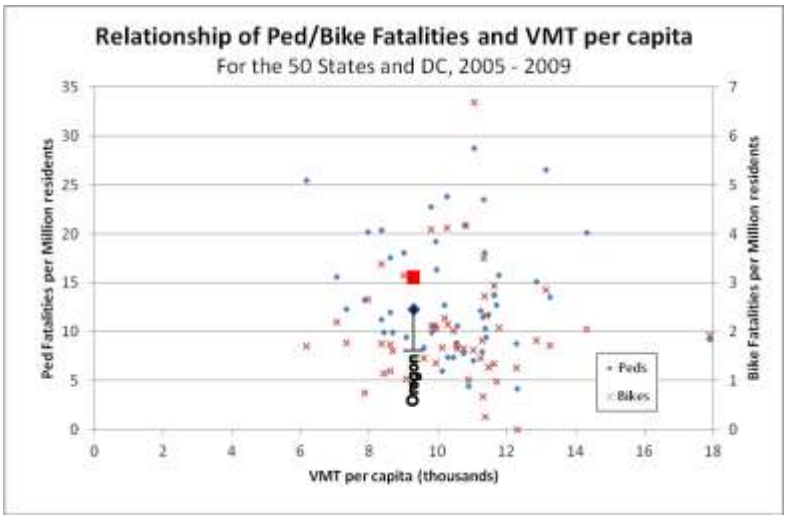
Ped/Bike Fatalities

The relationship between statewide VMT per capita and ped/bike 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 make ped/bike travel more dangerous, but discourage travel by these modes thereby reducing ped/bike exposure.

The national average (2010 – 2014) is 14.7 pedestrians killed in crashes per million residents and 2.2 cyclists killed in crashes per million residents.

Oregon crash statistics (2010 – 2014) are 13.4 pedestrians killed per million residents (91% of the national average) and 2.2 cyclists killed per million residents (97% of the national average).

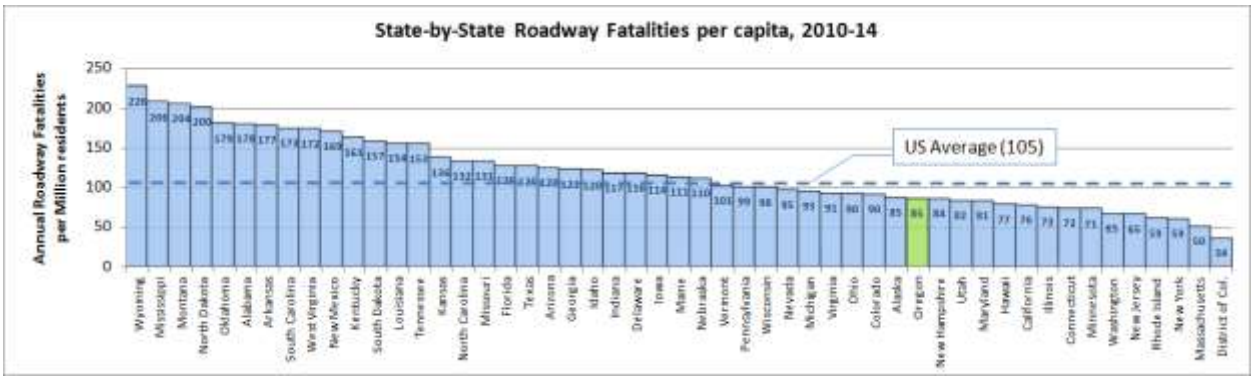
Figure 1-8



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

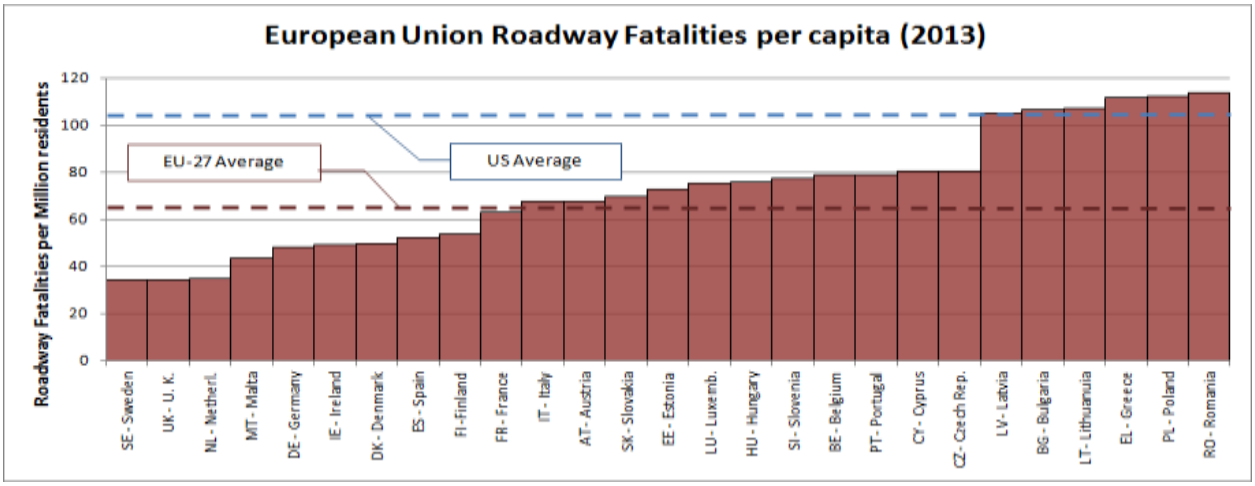
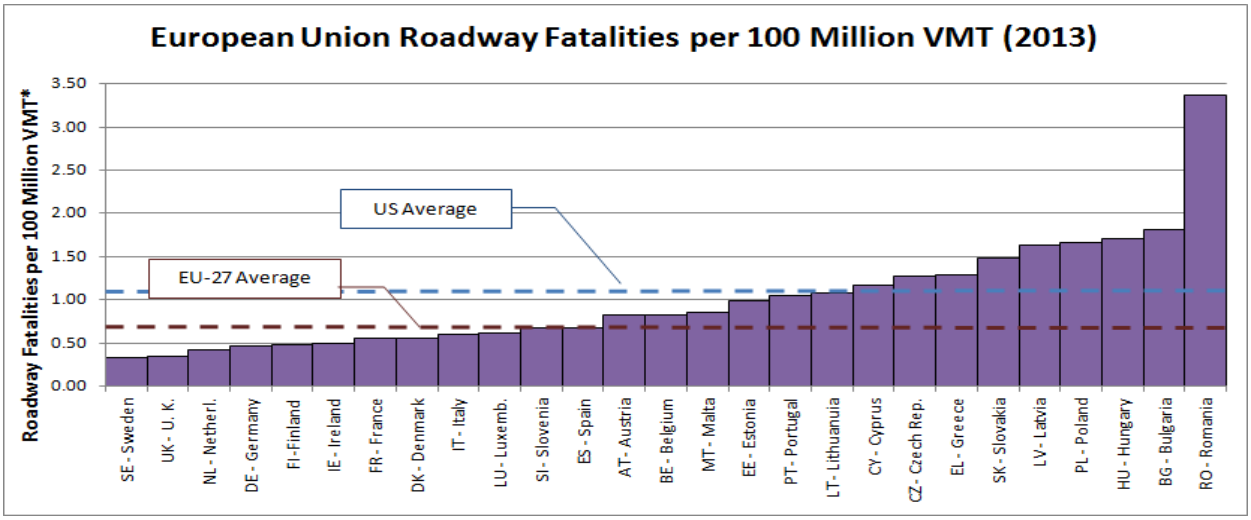


Figure 1-11

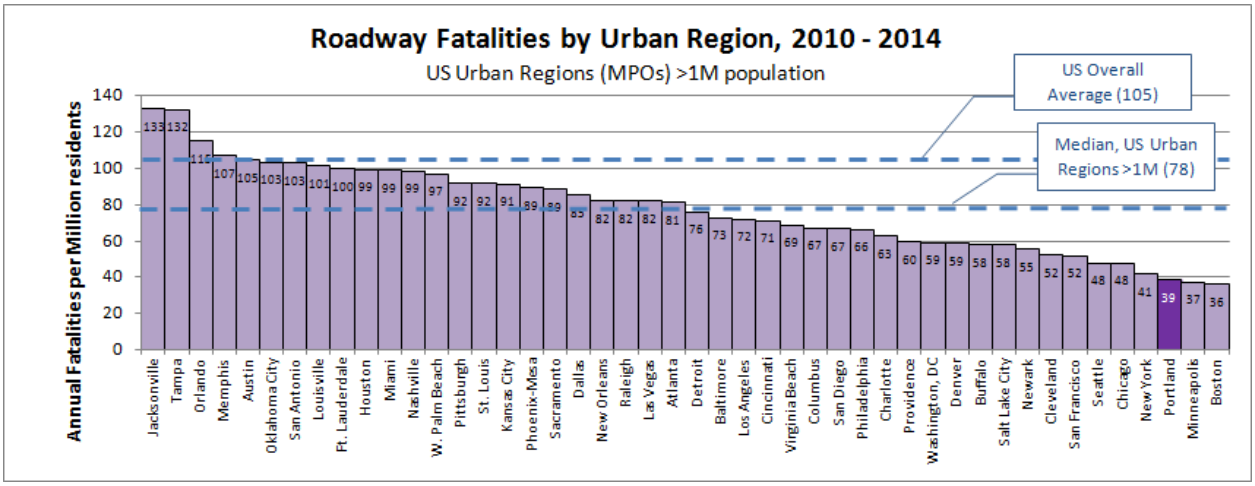


European countries appear to be limiting roadway fatalities both by managing safer roadways and developing transportation systems and development patterns which require less driving.

Urban Region Fatality Trends

Crash and population data was reviewed for the large urban regions in the US, those with populations of over 1 million people. Figure 1-12 shows the per capita fatality rate by urbanized region. Oregon is slightly better than the US average, while roadway fatalities per capita in the Portland Metro region are nearly a third the US average and more than half 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 concern for this report given the Portland Metro region's existing level of urbanization, 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 (2010 – 2014). Brightly colored bars (red or green) 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.

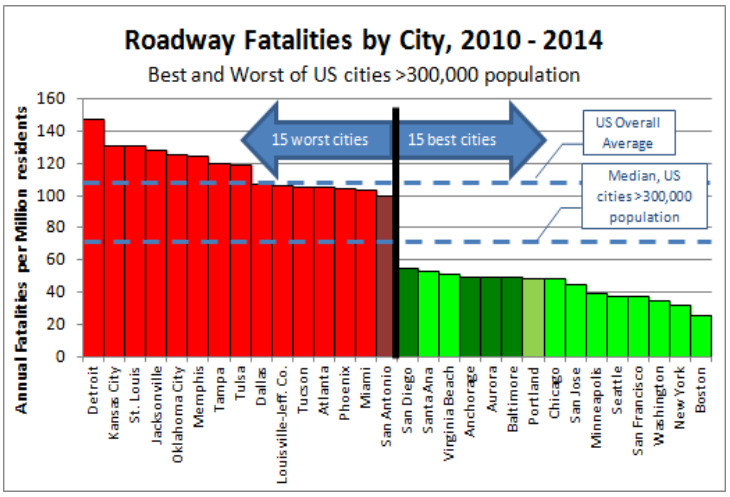
Overall fatality rates

The worst cities in the nation for overall fatality rates are Detroit, Kansas City MO, St. Louis, Jacksonville, and Oklahoma City. In general, the worst cities are in states which have invested primarily in roads, such as Michigan, Missouri, Florida, Texas, Oklahoma, and Arizona.

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

The city of Portland ranks well in this list, at 9th best out of the 64 cities of population 300,000 or more. In the prior State of Safety report, Portland ranked 8th best.

Figure 1-17

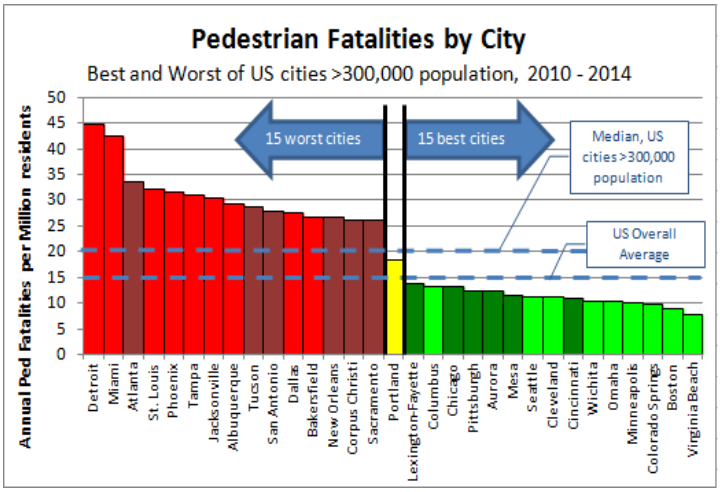


Pedestrian fatality rates

The worst cities in the nation for pedestrian crash fatality rates are Detroit, Miami, Atlanta, St. Louis, and Phoenix. Many of the most dangerous cities for pedestrians are in states which have invested primarily in roads.

The safest cities in the nation for pedestrians per capita in terms of crash fatalities are Virginia Beach, Boston, Colorado Springs, Minneapolis and Omaha. The city of Portland ranks in the middle of the pack, at 39th of the 64 cities of population 300,000 or more.

Figure 1-18



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 49 fatalities per million residents is much less than the national average of 105 and the Oregon statewide average of 85. Twelve of the 64 cities exhibited crash fatality rates above the overall national average, with 52 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 invested in a variety of modes of transportation show substantially lower overall crash fatality rates. Those which have invested disproportionately in auto infrastructure 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.

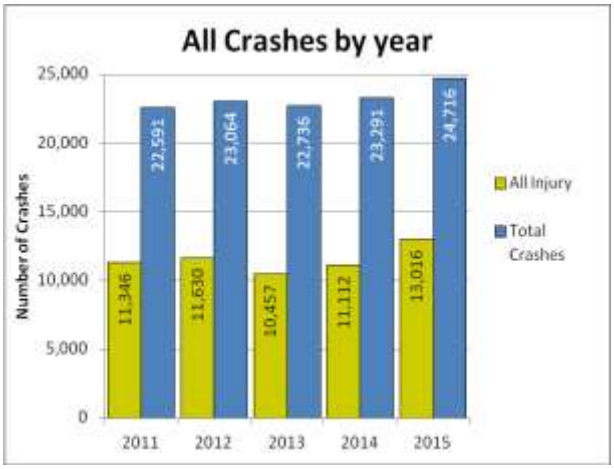
Section 2 – All Crashes

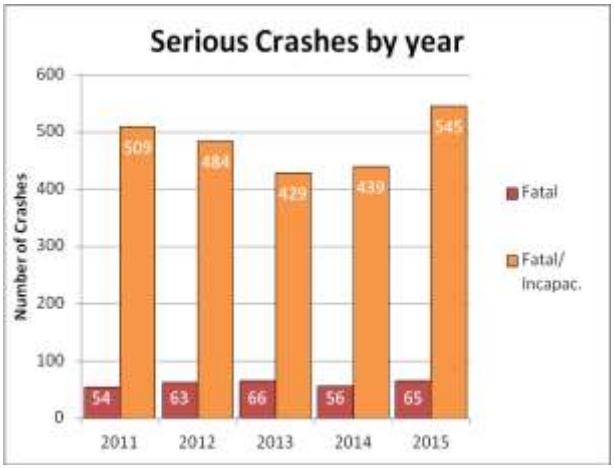
This section summarizes all crashes occurring in the Portland Metro region. The term "serious crashes" refers to all fatal or incapacitating injury (injury A) crashes.

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	11,346	509
2012	23,064	63 (66)	421	2,654	8,555	11,630	484
2013	22,736	66 (68)	363	2,428	7,666	10,457	429
2014	23,291	56 (57)	383	2,512	8,217	11,112	439
2015	24,716	65 (66)	480	2,655	9,881	13,016	545
METRO	116,398	304 (311)	2102	12,736	42,723	57,561 (81,718)	2,406

Figures 2-1 and 2-2





Total reported crashes and injury crashes increased over the 5-year period (Figure 2-1). Fatal and serious crashes fluctuated over the 5-year period (Figure 2-2).

Metro crash rates compared to other places

2011-2015	Population (2015)	Annual VMT (2015)	Annual injury crashes		Annual serious crashes	
			per million residents	per 100M VMT	per million residents	per 100M VMT
Metro	1,603,229	10,437,000,000	7,181	110.3	300	4.6

2011 - 2015	Avg. Annual Fatalities	Estimated Population (2015)	Annual VMT (2015)	Annual Fatality rate per million residents	Fatality rate per 100M VMT
Metro	62.2	1,603,229	10,437,000,000	39	0.60
City of Portland	31.8	620,540	4,303,000,000	51	0.74
Oregon	356.4	4,028,977	36,000,000,000	88	0.99
Median, cities >300,000 pop.	-	-	n/a	72	n/a
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

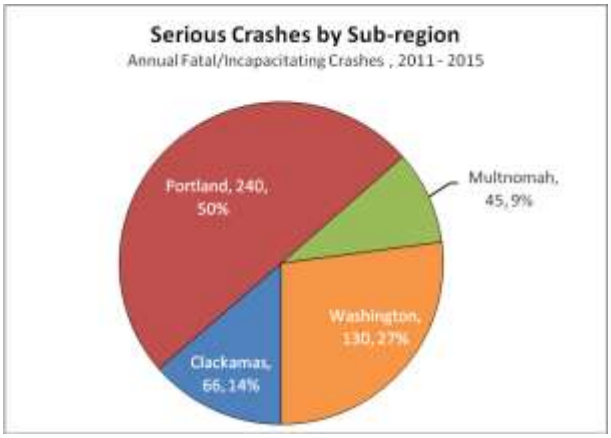
* All data for UK and EU is for year 2013

The City of Portland, the Portland Metro region, and the State of Oregon all have fatality rates below the national average. The 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	Injury A	Injury B	Injury C	All Injury	Serious
Clackamas	3,482	10 (10)	55	395	1,362	1,812	66
Portland	11,475	31 (32)	209	1,216	4,078	5,503	240
Multnomah (excl. Portland)	1,870	6 (6)	39	245	727	1,011	45
Washington	6,452	13 (14)	117	692	2,378	3,187	130
METRO	23,280	61 (62)	481	1,907	5,174	7,562	532

Figures 2-3 and 2-4



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	2,101,852,699	6,234	86	226	3.1
Portland	620,540	4,303,322,834	8,867	128	387	5.6
Multnomah (excl. Portland)	152,611	744,473,489	6,623	136	296	6.1
Washington	539,448	3,287,341,693	4,030	75.4	210	3.9
METRO	1,603,229	10,436,990,715	7,181	110	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. Washington County has the lowest rate of serious crashes per capita while Clackamas County has the lower rate of serious crashes per VMT.

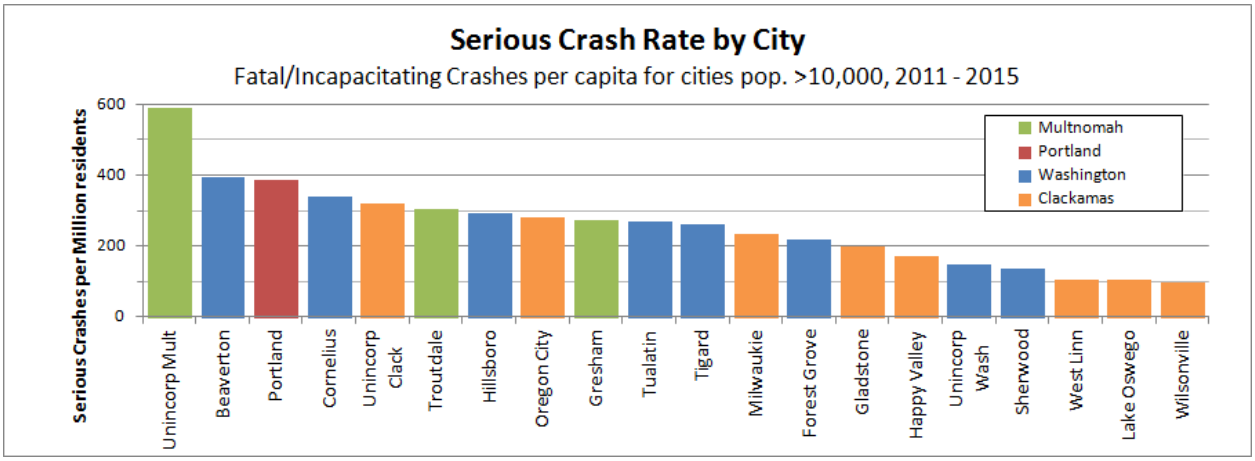
By City

City	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Beaverton	1,987	3.0	35	179	729	943	38.0
Cornelius	101	0.0	4	11	37	52	4.2
Durham	13	0.0	0	1	6	7	0.0
Fairview	88	0.2	1	13	35	48	1.4
Forest Grove	137	0.6	5	19	45	68	5.2
Gladstone	136	0.4	2	16	51	69	2.4
Gresham	1,356	3.4	27	170	546	743	30.4
Happy Valley	221	1.0	3	28	91	122	3.6
Hillsboro	1,413	3.6	26	177	545	748	29.2
Johnson City	0	0.0	0	0	0	0	0.0
King City	9	0.0	0	1	1	2	0.2
Lake Oswego	282	0.0	4	29	96	130	4.0
Maywood Park	27	0.0	1	2	12	15	1.0
Milwaukie	210	0.4	5	28	77	109	5.0
Oregon City	588	1.8	8	62	232	302	9.8
Portland	11,479	31.2	209	1,216	4,079	5505	240.4
Rivergrove	1	0.0	0	0	0	0	0.0
Sherwood	160	0.2	2	18	58	78	2.6
Tigard	935	1.6	12	91	353	455	13.4
Troutdale	167	0.8	4	22	63	88	5.0
Tualatin	486	0.4	7	50	199	256	7.2
West Linn	213	0.6	2	23	78	104	2.8
Wilsonville	218	0.0	2	23	76	102	2.2
Wood Village	67	0.2	1	7	24	32	1.0
Unincorp Clack	1,651	6.0	30	187	670	887	36.2
Unincorp Mult	155	1.6	4	29	45	79	6.0
Unincorp Wash	1,180	3.8	26	144	397	567	30.0
METRO	23,280	60.8	420	2,547	8,545	11,512	481.2

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	2011-2015 Annual crashes	
		All injury per capita	Serious per capita
Beaverton	96,704	9,751	393
Cornelius	12,389	4,230	339
Durham	1,430	4,895	0
Fairview	9,357	5,173	150
Forest Grove	23,630	2,878	220
Gladstone	11,990	5,771	200
Gresham	111,716	6,653	272
Happy Valley	20,835	5,846	173
Hillsboro	100,109	7,470	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	5,102	234
Oregon City	35,004	8,622	280
Portland	620,540	8,871	387
Rivergrove	321	623	0
Sherwood	19,012	4,124	137
Tigard	51,642	8,818	259
Troutdale	16,486	5,362	303
Tualatin	26,617	9,610	271
West Linn	26,267	3,944	107
Wilsonville	22,932	4,448	96
Wood Village	4,056	7,939	247
Unincorp Clack	113,172	7,836	320
Unincorp Mult	10,187	7,775	589
Unincorp Wash	204,098	2,777	147
METRO	1,603,229	7,181	300

Figure 2-5



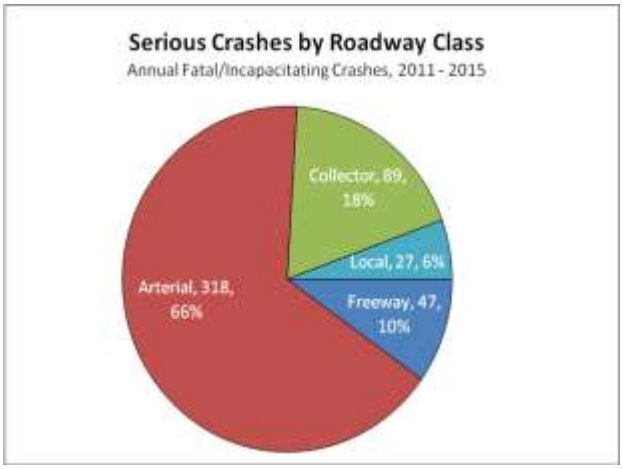
By Roadway Classification

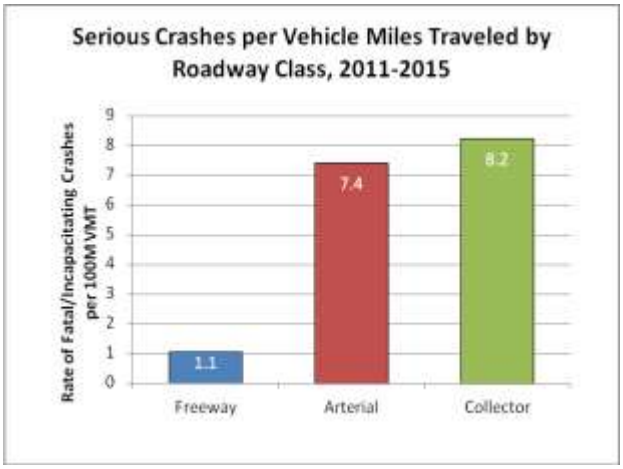
Roadway Classification	2011-2015 Annual Crashes							Percent Serious
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious	
Freeway	2,800	6.3	55	262	854	1,171	61	2.2%
Arterial	9,845	30.7	285	1,038	3,003	4,326	315	3.2%
Collector	3,398	10.0	94	426	870	1,391	104	3.1%
Local	1,346	3.3	35	128	277	440	38	2.8%
Unknown	874	0.0	13	53	170	235	13	1.4%
METRO	18,263	50.3	481	1,907	5,174	7,562	532	2.9%

Roadway Classification	Annual VMT (2015)	Crashes per VMT	
		All injury	Serious
Freeway	4,454,992,641	40.4	1.1
Arterial	4,281,001,727	174.9	7.4
Collector	1,081,114,496	156.6	8.2
Local	619,881,851*	86.2	4.3

* VMT for local streets is a low-confidence estimate

Figures 2-8 and 2-9

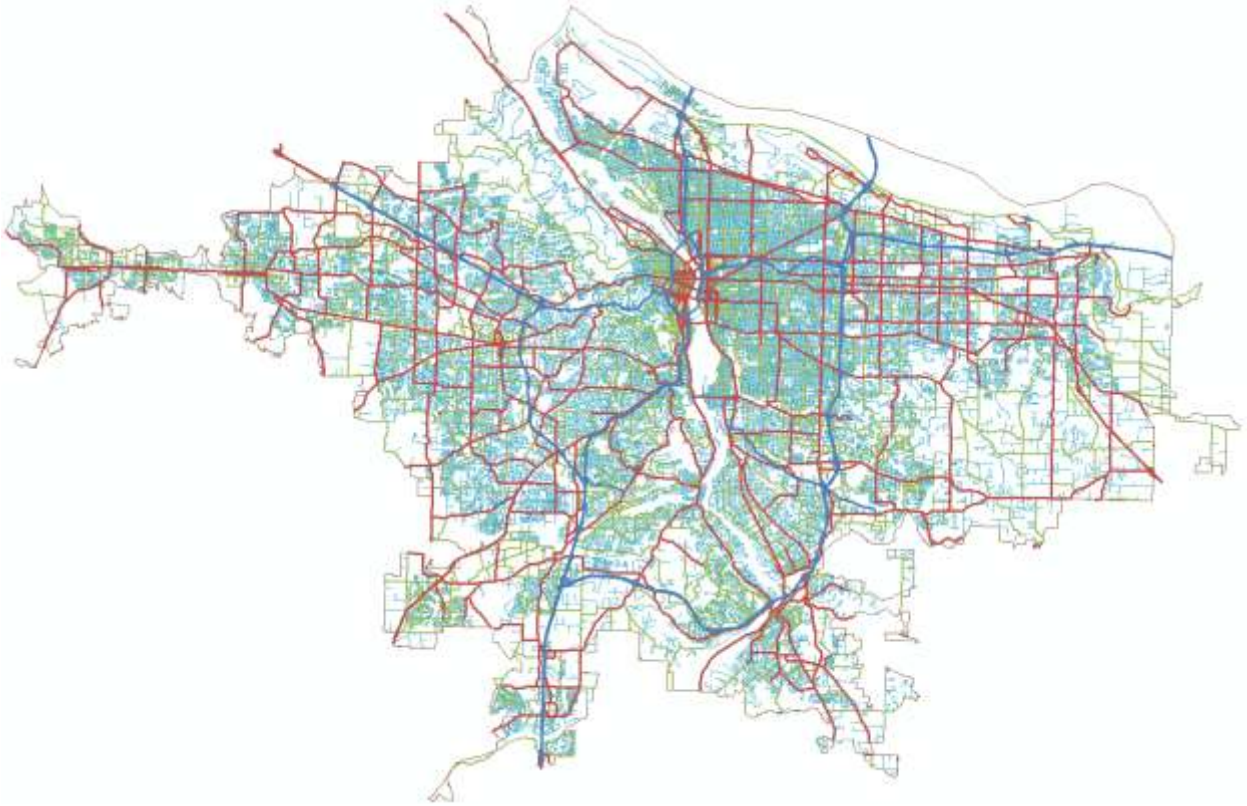




A review of the distribution of the region's serious crashes by roadway classification reveals one of the most conclusive relationships in this study. Arterial roadways are the location of the majority of the serious crashes in the region (Figure 2-8). A similar relationship is evident for pedestrians 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.

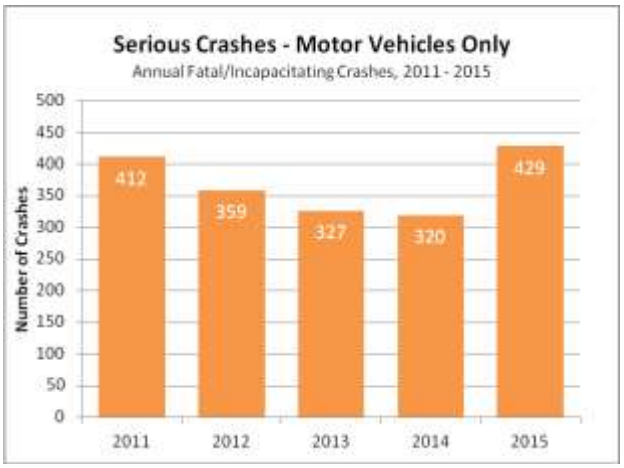
Figure 2-10



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	403	65	477	32	10,467	412	301	72	243	20
2012	485	88	558	37	10,588	359	345	63	273	16
2013	408	67	488	35	9,562	327	346	76	235	11
2014	457	81	508	38	10,147	320	289	55	280	22
2015	448	81	476	35	12,092	429	327	86	310	19
TOTAL	2,201	382	2,507	177	52,856	1,847	1,608	352	1,341	88

Figures 2-11 and 2-12



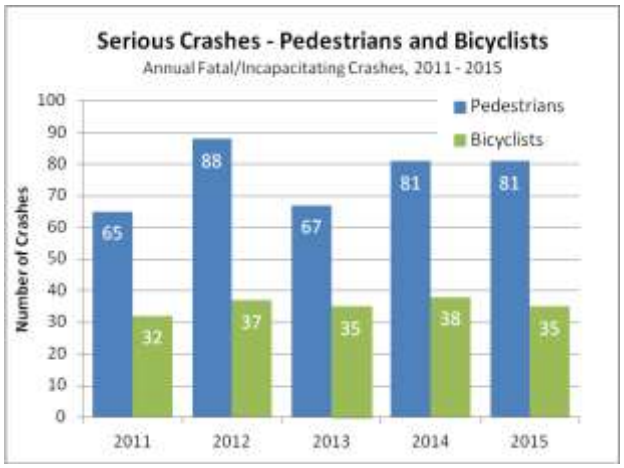


Figure 2-13

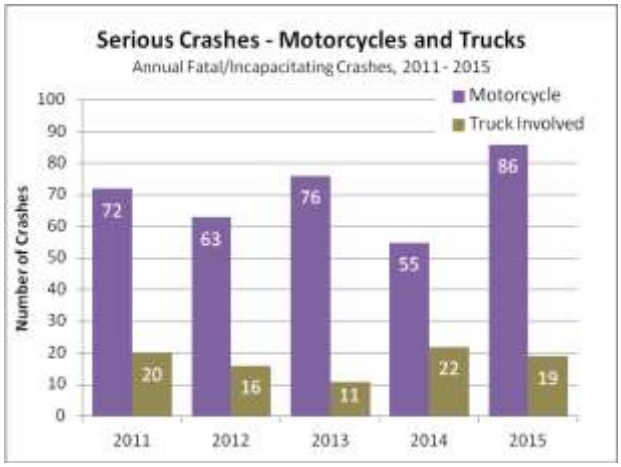


Figure 2-11 presents the annual number of serious crashes involving only motor vehicles (no pedestrians or cyclists). Figure 2-12 presents the annual number of serious crashes involving pedestrians and cyclists. Figure 2-13 presents the annual number of serious crashes involving motorcycles and large trucks.

By Month

Month	2011-2015 Annual Crashes		
	All	All injury	Serious
January	1,787	868	39.4
February	1,679	807	35.8
March	1,788	894	35.6
April	1,859	932	33.0
May	1,881	954	37.8
June	1,922	951	43.2
July	1,922	961	43.8
August	1,971	979	46.6
September	1,995	1,012	44.8
October	2,200	1,115	39.4
November	2,102	1,012	40.8
December	2,173	1,025	41.0

Figure 2-14

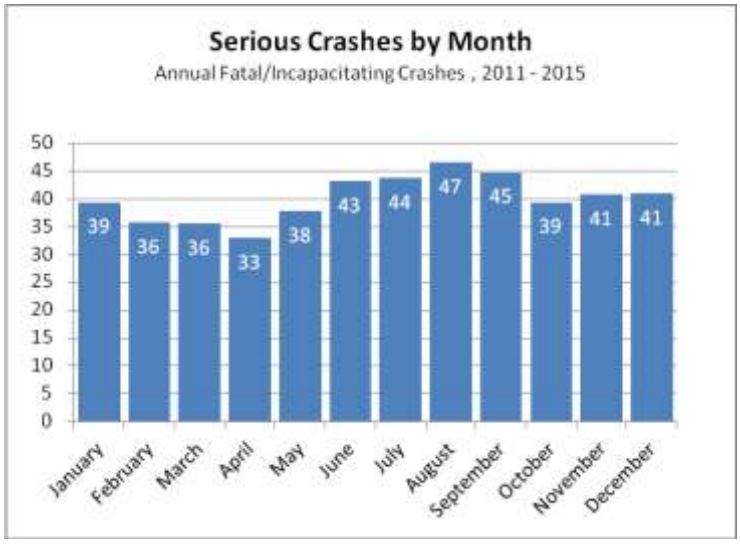


Figure 2-14 presents the annual average number of serious crashes by month. No clear trend is evident.

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	Hour	Avg Wkday	Avg Wkend
12 AM	2.2	1.8	0.8	0.6	1.8	1.8	3.0	12 AM	1.4	2.6
1 AM	2.6	2.0	0.8	1.6	0.6	1.6	2.0	1 AM	1.3	2.3
2 AM	4.8	0.6	1.0	1.8	1.2	2.8	3.6	2 AM	1.5	4.2
3 AM	1.2	0.6	0.4	0.8	0.6	1.2	2.0	3 AM	0.7	1.6
4 AM	1.4	0.2	1.2	0.6	0.2	0.2	0.6	4 AM	0.5	1.0
5 AM	0.6	1.2	1.2	1.0	1.4	1.8	0.8	5 AM	1.3	0.7
6 AM	0.8	1.8	1.4	3.0	1.8	2.8	0.6	6 AM	2.2	0.7
7 AM	2.8	2.6	3.0	4.2	2.8	2.6	1.8	7 AM	3.0	2.3
8 AM	0.6	3.2	2.4	4.2	3.4	3.0	1.0	8 AM	3.2	0.8
9 AM	1.6	1.6	2.8	2.2	2.8	2.4	1.2	9 AM	2.4	1.4
10 AM	2.0	2.0	2.6	2.4	3.2	2.0	3.4	10 AM	2.4	2.7
11 AM	2.2	2.6	2.6	3.0	3.0	5.0	3.0	11 AM	3.2	2.6
12 PM	3.0	2.0	1.8	3.4	4.8	4.8	3.6	12 PM	3.4	3.3
1 PM	3.0	3.2	4.2	3.4	3.0	4.2	4.2	1 PM	3.6	3.6
2 PM	3.6	5.6	4.6	3.0	4.2	3.0	2.8	2 PM	4.1	3.2
3 PM	4.2	4.8	5.6	4.6	4.4	5.4	5.4	3 PM	5.0	4.8
4 PM	2.8	6.2	5.8	6.6	5.8	5.2	2.8	4 PM	5.9	2.8
5 PM	4.6	5.0	7.8	7.4	6.4	6.6	5.0	5 PM	6.6	4.8
6 PM	3.4	4.8	5.0	5.0	5.2	5.8	5.2	6 PM	5.2	4.3
7 PM	3.0	3.2	4.2	3.8	5.0	4.6	4.8	7 PM	4.2	3.9
8 PM	3.4	1.4	2.8	2.0	2.2	2.2	2.6	8 PM	2.1	3.0
9 PM	2.6	3.2	2.4	3.6	3.8	3.6	1.8	9 PM	3.3	2.2
10 PM	1.8	2.0	1.8	2.8	2.6	3.0	3.4	10 PM	2.4	2.6
11 PM	1.4	1.2	1.4	2.0	1.6	2.8	1.8	11 PM	1.8	1.6

	Sun	Mon	Tue	Wed	Thu	Fri	Sat		Avg Wkday	Avg Wkend
All Day	59.6	62.8	67.6	73.0	71.8	78.4	66.4	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	All injury	Serious
Cloudy/Clear	17,658	8,941	384
Rain/Fog	4,462	2,211	84
Sleet/Snow	189	70	3
Unknown	970	290	10
Total	20,947	11,507	481

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

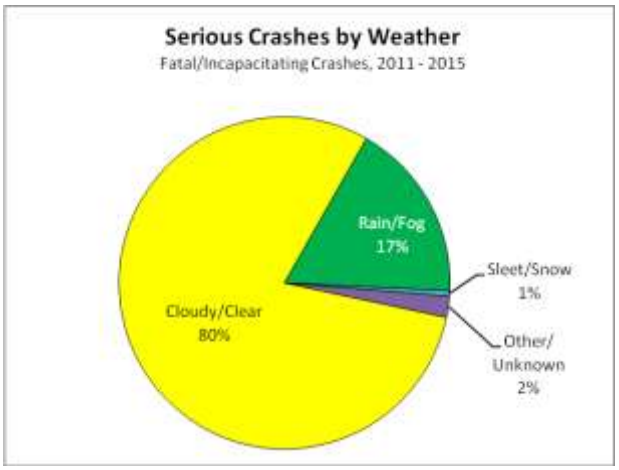


Figure 2-16

By Road Surface Condition

Road Surface	2011-2015 Annual Crashes		
	All	All injury	Serious
Dry	16,378	8,327	349
Ice/Snow	342	126	6
Wet	5,715	2,827	120
Unknown	844	233	6
Total	20,947	11,507	481

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

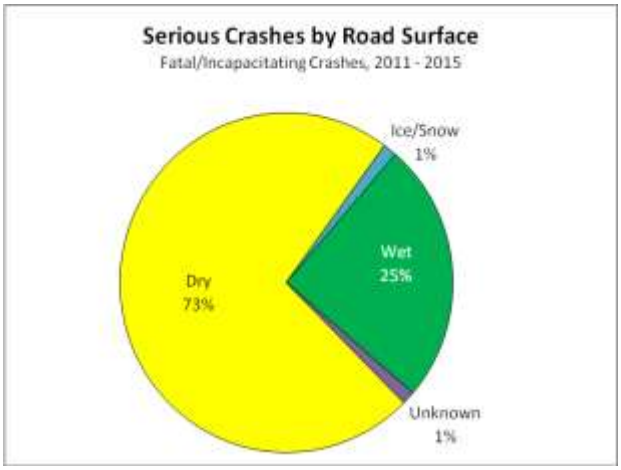


Figure 2-17

By Lighting

Lighting	2011-2015 Annual Crashes		
	All	All injury	Serious
Daylight	16,508	8,162	282
Dawn/Dusk	1,657	828	33
Night - Dark	892	399	40
Night - Lit	4,153	2,101	125
Unknown	70	22	1
Total	20947	11507	481

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

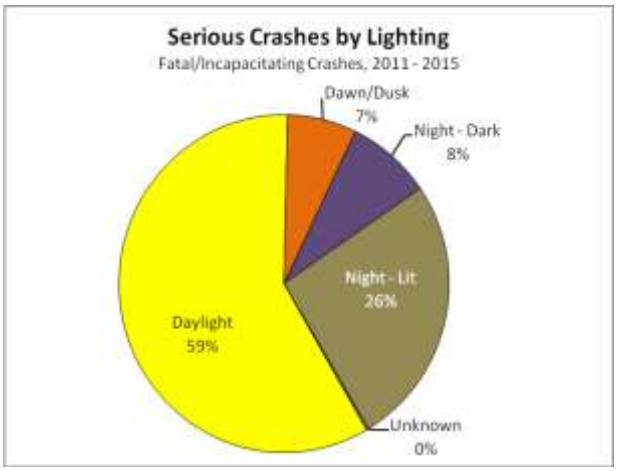
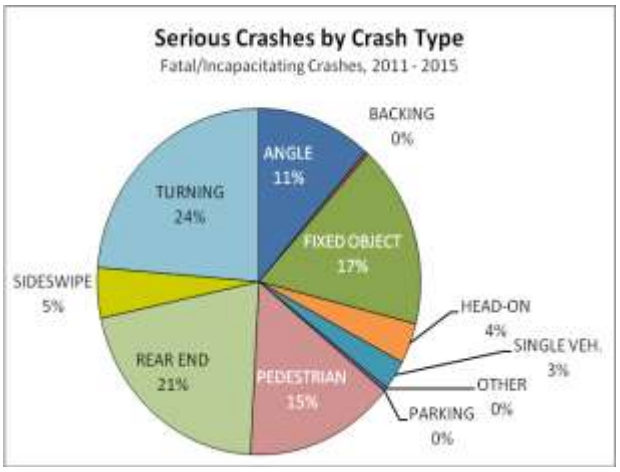


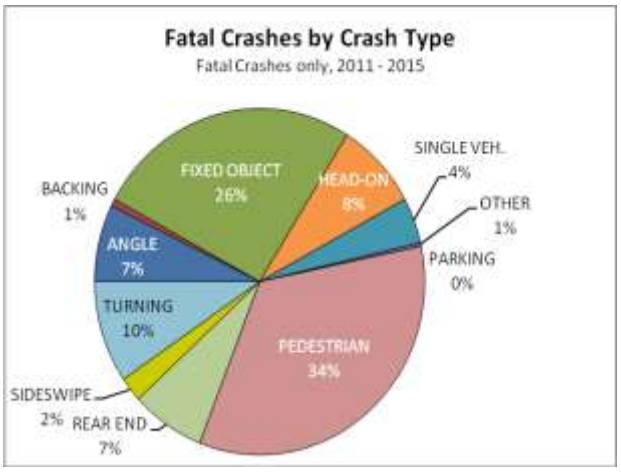
Figure 2-18

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	1,242	55
Backing	336	0	1	6	71	79	2
Fixed Object	1,734	16	67	289	341	696	82
Head-on	151	5	13	34	44	91	18
Single Vehicle	101	3	11	43	23	76	13
Other	78	0	1	10	10	21	2
Parking	201	0	0	8	30	38	0
Pedestrian	450	21	51	214	160	426	72
Rear End	10,573	4	96	661	4,948	5,705	100
Sideswipe	2,198	1	21	136	476	633	23
Turning	5,154	6	108	758	1,638	2,505	114
METRO	23,280	61	420	2,547	8,545	11,512	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.

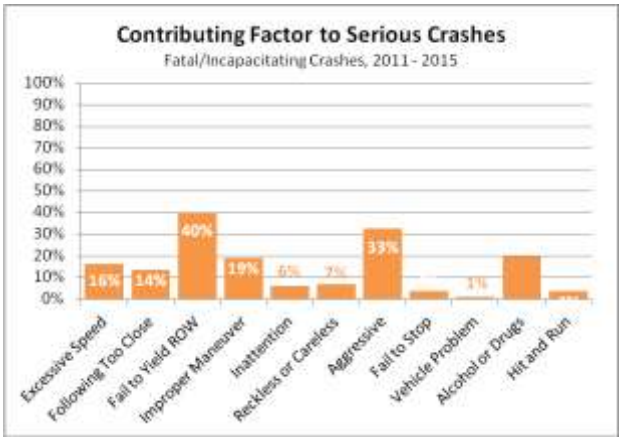
The most common serious crash types were Turning and Rear End.

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

By Contributing Factor

Collision Type	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	1,755	20.0	57	284	523	865	77
Following Too Close	7,772	1.4	64	482	3,646	4,193	66
Fail to Yield ROW	6,999	18.6	173	1,210	2,344	3,727	191
Improper Maneuver	4,469	16.2	76	383	1,068	1,527	92
Inattention	1,192	3.0	25	152	498	675	28
Reckless or Careless	479	5.2	27	106	123	256	32
Aggressive	9,577	22.0	135	801	4,110	5,047	157
Fail to Stop	1,985	1.2	16	95	945	1,056	17
Vehicle Problem	144	0.8	3	21	47	71	4
Alcohol or Drugs	1,056	34.4	60	215	265	541	94
Hit and Run	1,382	5.0	12	104	452	567	17
METRO	23,280	60.8	420	2,547	8,545	11,512	481

Figures 2-21 and 2-22



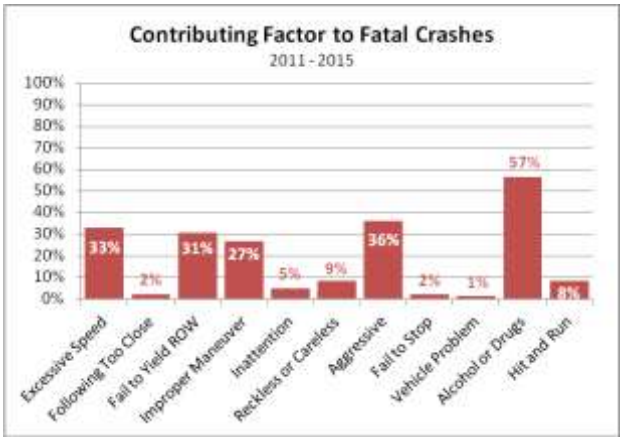


Figure 2-21 presents the the percentage of crashes of serious severity (fatal or injury A) with each contributing factor. Figure 2-22 presents the the percentage of fatal crashes with each contributing factor. Each crash may have several contributing factors.

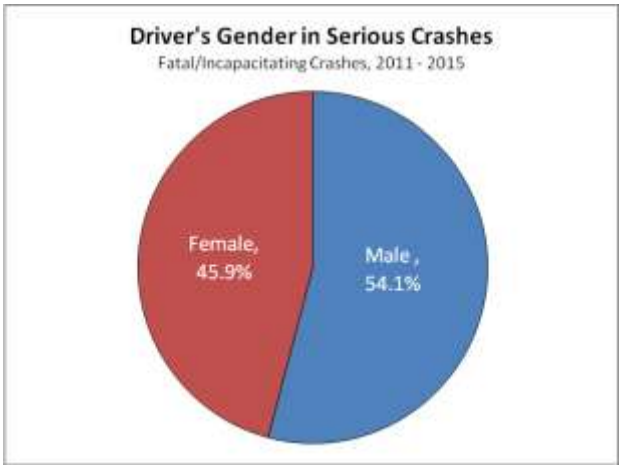
Alcohol and Drugs, Excessive Speed, Fail to Yield ROW, and Aggressive Driving are particularly common factors. Crashes involving Alcohol and Drugs have a much higher likelihood of being fatal than other crashes.

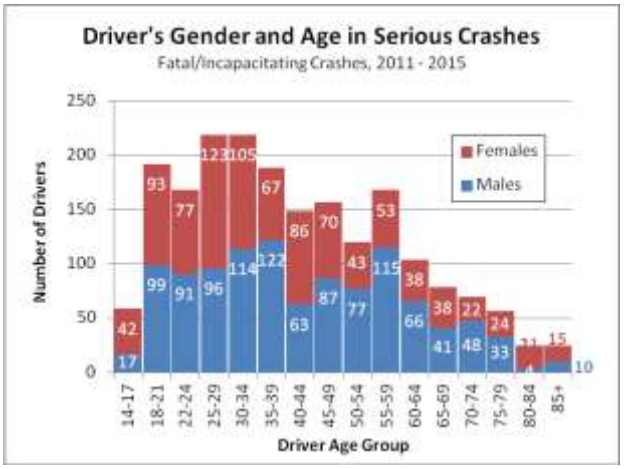
By Driver's Age and Gender

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)					
	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%
Total	162,366	1,216	87,703	99.3%	0.7%

Seat Belt Use (Serious crashes, 2011-2015)					
	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	-	-
Total	1,390	130	264	91.4%	8.6%

Seat Belt Use (Injury B, C, and PDO crashes, 2011-2015)					
	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%
Total	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.

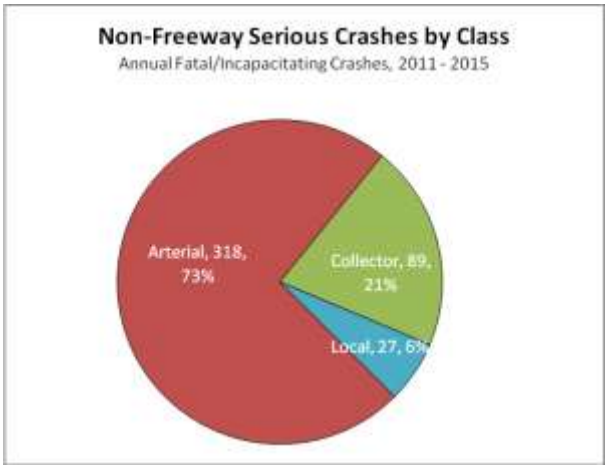
Section 3 – Roadway Characteristics of Non-Freeway Crashes

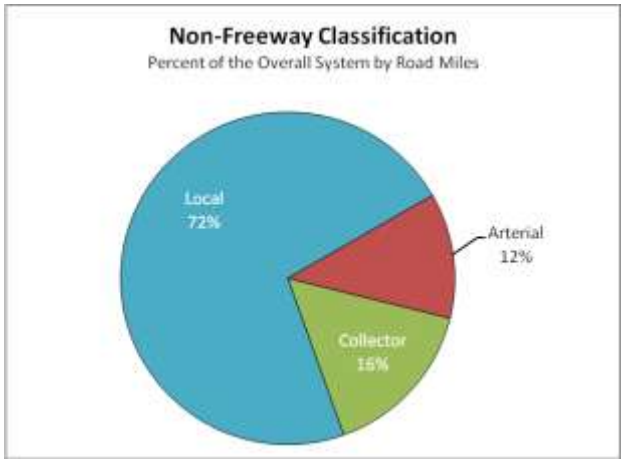
By Roadway Classification

Roadway Classification	Total Length (mi.)	Annual VMT	2011-2015 Annual Crashes		
			All	All Injury	Serious
Arterial	772	4,281,001,727	14,463	7,487	318
Collector	994	1,081,114,496	3,609	1,693	89
Local	4,565	619,881,851*	1,519	534	27
METRO	6,331	5,981,998,074	19,591	9,714	434

* VMT for local streets is a low-confidence estimate

Figures 3-1 and 3-2





Roadway Classification	% crashes resulting in		Annual Crashes per mile		Annual Crashes per VMT	
	All Injury	Serious	All Injury	Serious	All Injury	Serious
Arterial	52%	2.2%	9.70	0.412	174.9	7.4
Collector	47%	2.5%	1.70	0.090	156.6	8.2
Local	35%	1.8%	0.12	0.006	--	--
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. This is likely due to high traffic volumes, high travel speeds, and the challenges to people crossing arterials throughout the region.

Collector streets have the highest crash rate per traffic volume (Figure 3-3). Figure 3-4 presents the functional classification of the region's roadways.

Figure 3-3

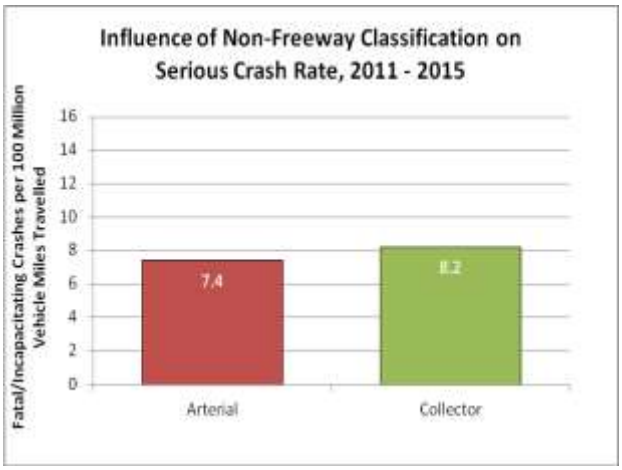


Figure 3-4

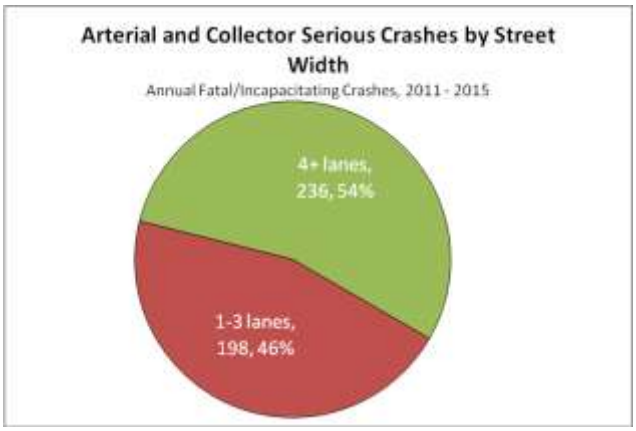
By Number of Lanes

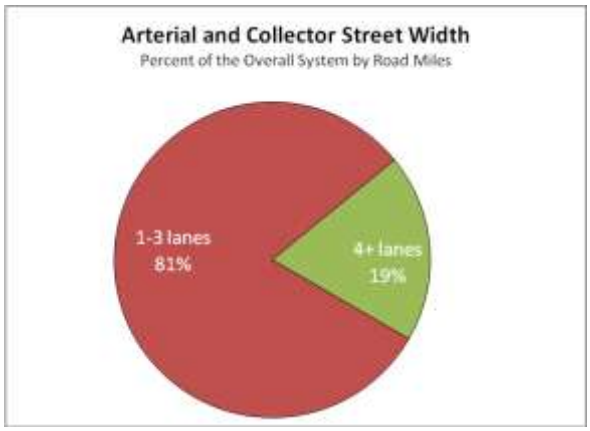
The following tables and Figures 3-5 and 3-6 summarize crashes by number of lanes for arterial and collector roadways.

Number of Lanes*	Total Length	Annual VMT	2011-2015 Annual Crashes		
			All	All injury	Serious
1 – 3 Lanes	1,427	2,971,881,073	8,932	4,191	198
4+ Lanes	340	2,738,469,044	10,597	5,502	236

* Arterial and Collector roadways only

Figures 3-5 and 3-6





Number of lanes*	% crashes resulting in		Annual Crashes per mile		Annual Crashes per VMT	
	All Injury	Serious	All Injury	All Injury	Serious	All Injury
1-3 lanes	47%	2.2%	2.94	0.14	141.0	6.6
4+ lanes	52%	2.2%	16.20	0.69	200.9	8.6

*Arterial and Collector roadways only

Figure 3-7

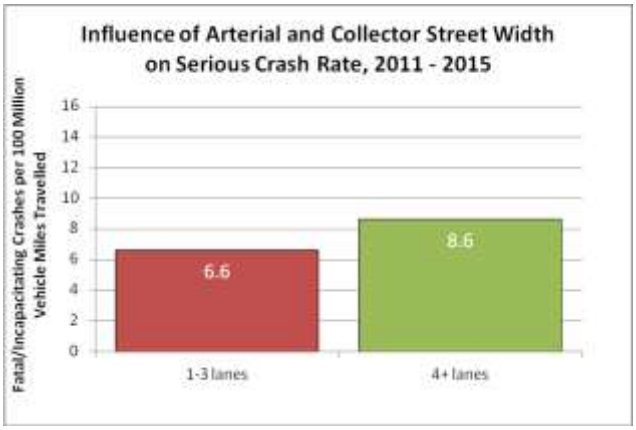
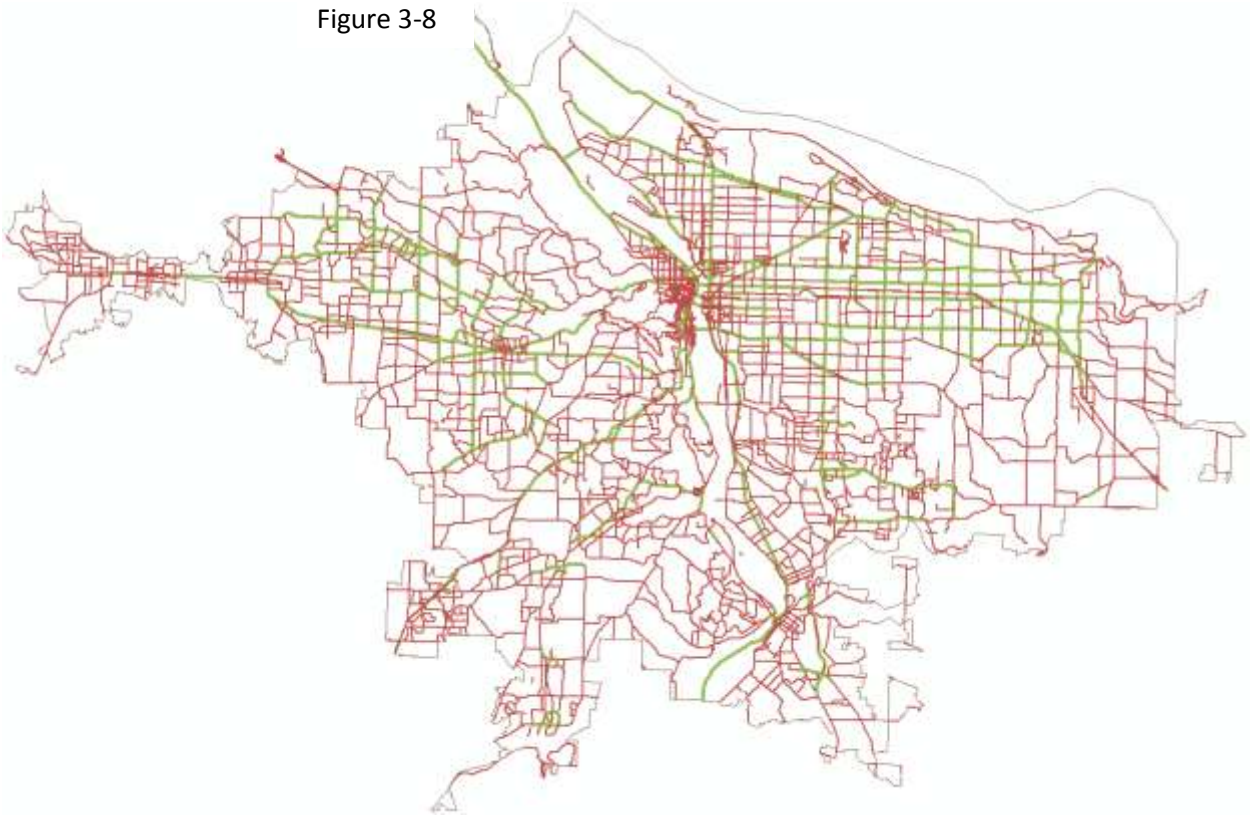


Figure 3-7 presents the crash rate per traffic volume, and Figure 3-8 presents the number of lanes for arterials and collectors in the region.

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.

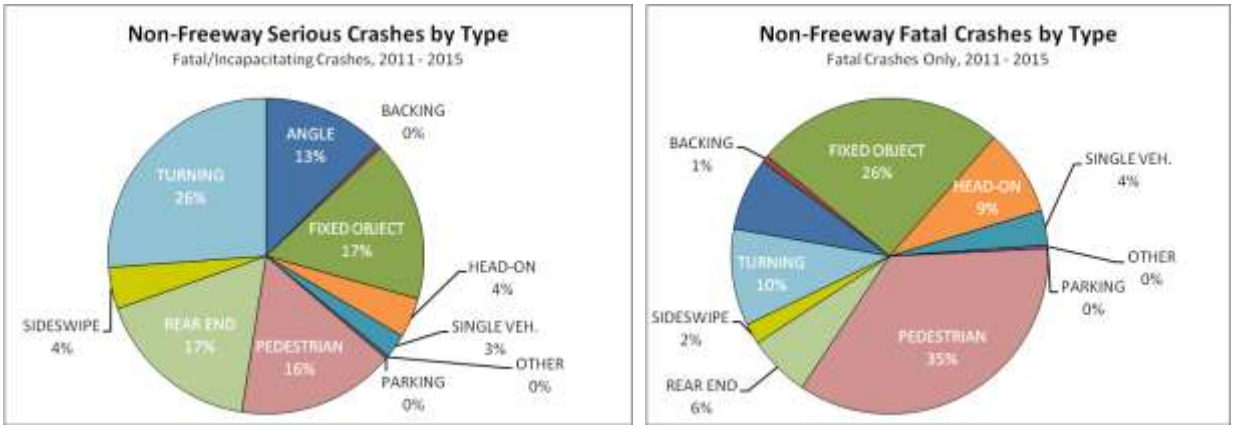
Figure 3-8



By Crash Type

Collision Type	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Angle	2,296	4	50	386	801	1,237	55
Backing	329	0	1	6	70	77	2
Fixed Object	1,416	14	57	241	263	561	71
Head-on	145	5	13	33	41	88	18
Single Vehicle	79	2	9	35	18	62	11
Other	51	0	1	7	7	14	1
Parking	200	0	0	8	30	38	0
Pedestrian	446	20	51	212	160	423	70
Rear End	7,912	4	71	467	3,753	4,290	74
Sideswipe	1,608	1	17	100	324	441	19
Turning	5,108	6	108	754	1,623	2,484	113
METRO	19,591	56	377	2,247	7,090	9,714	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.

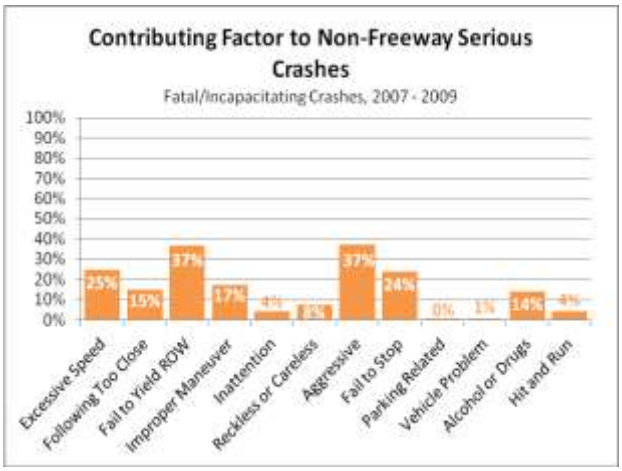
The most common serious crash types were Turning and Rear End.

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

By Contributing Factor (to be updated)

Factor	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed							
Following Too Close							
Fail to Yield ROW							
Improper Maneuver							
Inattention							
Reckless or Careless							
Aggressive							
Fail to Stop							
Parking Related							
Vehicle Problem							
Alcohol or Drugs							
Hit and Run							
METRO							

Figures 3-11 and 3-12



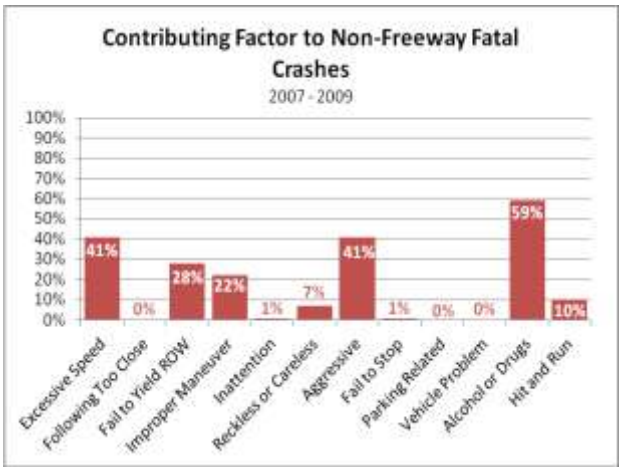


Figure 3-11 and 3-12 present the proportion of non-freeway crashes by contributing factor for serious and fatal crashes, respectively. Aggressive Driving, Speed, and Alcohol or Drugs are the most common factors.

By Volume-to-Capacity Ratio(to be updated)

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 Length (miles)	PM Peak			Per Mile		Per VMT	
		VMT	All injury	Serious	All injury	Serious	All injury	Serious
< 0.8								
0.8 - 0.89								
0.9 – 0.99								
≥ 1.0								

Figures 3-13 and 3-14

[Figure 3-13 to be added]

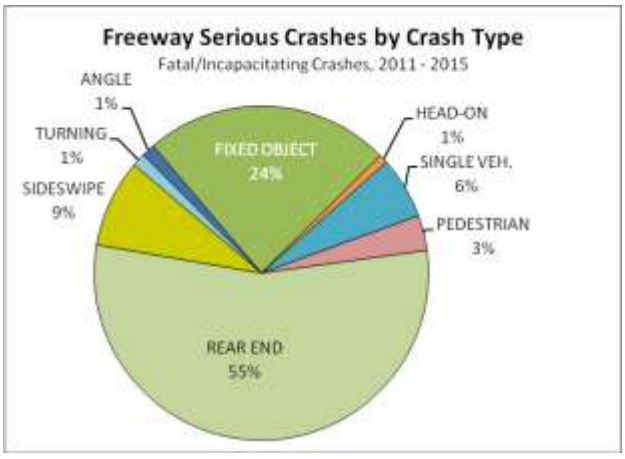
The serious crash rate per vehicle-mile travelled is … for non-freeway roadways. Non-freeway roadways with … exhibit … crash rates.

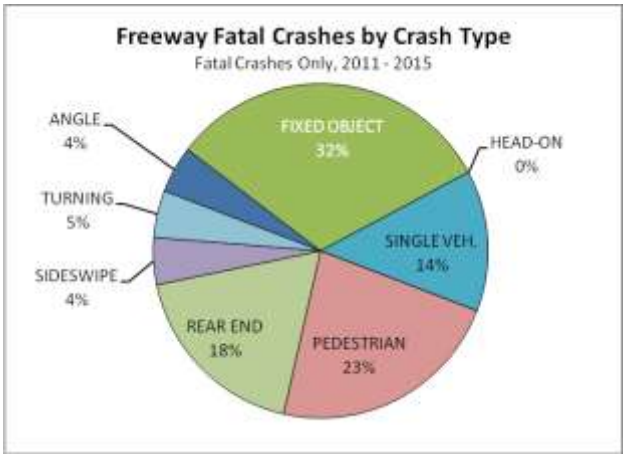
Section 4 – Roadway Characteristics of Freeway Crashes

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	5	1
Backing	7	0	0	0	1	1	0
Fixed Object	318	1.4	10	48	77	135	11
Head-on	6	0	0	1	3	4	0
Single Vehicle	21	0.6	2	8	4	15	3
Parking	1	0	0	0	0	0	0
Pedestrian	4	1.0	1	2	0	3	2
Rear End	2,661	0.8	25	195	1,195	1,415	26
Sideswipe	589	0.2	4	36	152	192	4
Turning	46	0.2	0	5	15	20	1
Other	27	0	0	3	3	7	0
METRO	3,688	4.4	43	301	1,454	1,798	47
Total – Fwy Mainline	3,117	3.8	37	252	1,230	1,519	41
Total – Fwy Ramps	572	0.6	6	48	225	279	7

Figure 4-1 and 4-2





Figures 4-1 and 4-2 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.

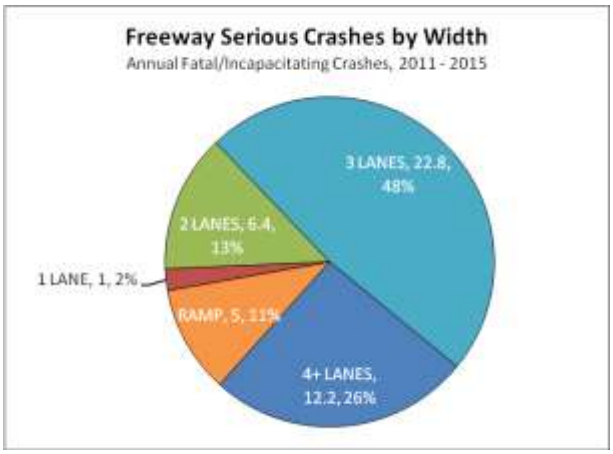
The most common fatal crash type was Fixed Object crashes.

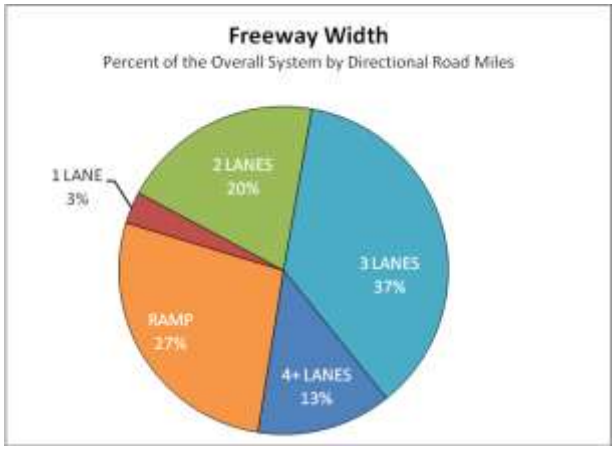
By Number of Lanes

No. lanes (in one direction)	Total Length (miles)	Annual VMT	2011-2015 Annual Crashes		
			All	All injury	Serious
Freeway ramp	83	274,628,607	300.4	150.2	5
1 Lanes	10	47,817,829	67.6	33.2	1
2 Lanes	61	757,614,942	493.4	233.4	6.4
3 Lanes	111	2,385,576,075	1906	921.6	22.8
4+ Lanes	40	979,418,170	908.8	454.6	12.2
ALL FREEWAYS	304	4,445,055,623	3,688	1,798	47

Figures 4-3 and 4-4 present the distribution of freeway crashes by number of lanes. They also present the proportion of freeway crashes that occur on ramps.

Figure 4-3 and 4-4





Number of lanes (in one direction)	% crashes resulting in		Per mile		Per VMT	
	Injury	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.	Injury crashes	Fatal/ Incapac.
Freeway ramp	50%	1.7%	1.8	0.06	54.7	1.82
1 Lanes	49%	1.5%	3.5	0.10	69.4	2.09
2 Lanes	47%	1.3%	3.9	0.11	30.8	0.84
3 Lanes	48%	1.2%	8.3	0.21	38.6	0.96
4+ Lanes	50%	1.3%	11.3	0.30	46.4	1.25
ALL FREEWAYS	49%	1.3%	5.9	0.16	40.4	1.07

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 4-5). Figure 4-6 presents the number of lanes for the region's freeways. Ramps exhibit a higher rate per mile travelled, while still representing a relatively small proportion (11%) of all serious freeway crashes (Figure 4-3).

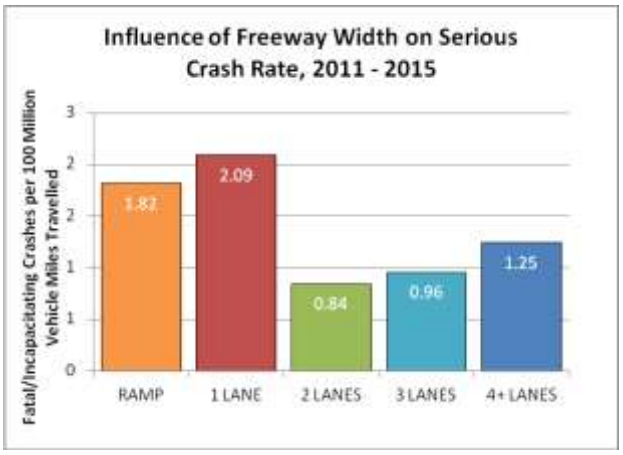


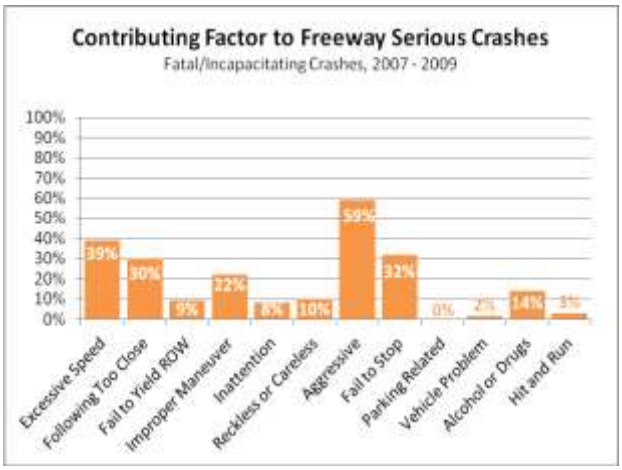
Figure 4-5

Figure 4-6

By Contributing Factor ***(to be updated)***

Factor	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed							
Following Too Close							
Fail to Yield ROW							
Improper Maneuver							
Inattention							
Reckless or Careless							
Aggressive							
Fail to Stop							
Parking Related							
Vehicle Problem							
Alcohol or Drugs							
Hit and Run							
METRO							

Figures 4-7 and 4-8



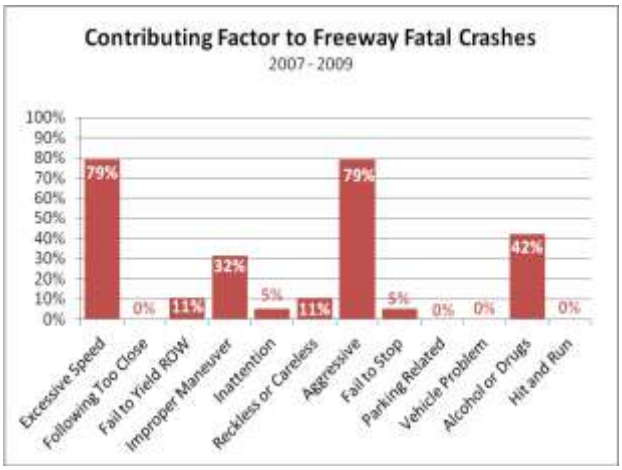


Figure 4-7 and 4-8 present the proportion of freeway crashes by contributing factor for serious and fatal crashes, respectively. Aggressive Driving and Speed are the most common factors.

By Volume-to-Capacity Ratio (to be updated)

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 Length (miles)	PM Peak			Per Mile		Per VMT	
		VMT	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.	All injury crashes	Fatal/ Incapac.
< 0.8								
0.8 - 0.9								
0.9 - 1.0								
≥ 1.0								

Figures 4-9 and 4-10

[Figure 4-9 to be added]

The serious crash rate per vehicle-mile travelled on freeways ….

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	401	64
2012	24 (24)	62	238	184	484	86
2013	19 (20)	46	227	132	405	65
2014	22 (22)	57	238	154	449	79
2015	25 (25)	55	196	190	441	80
METRO	105 (106)	269	1,090	821	2,180	374

Figure 5-1

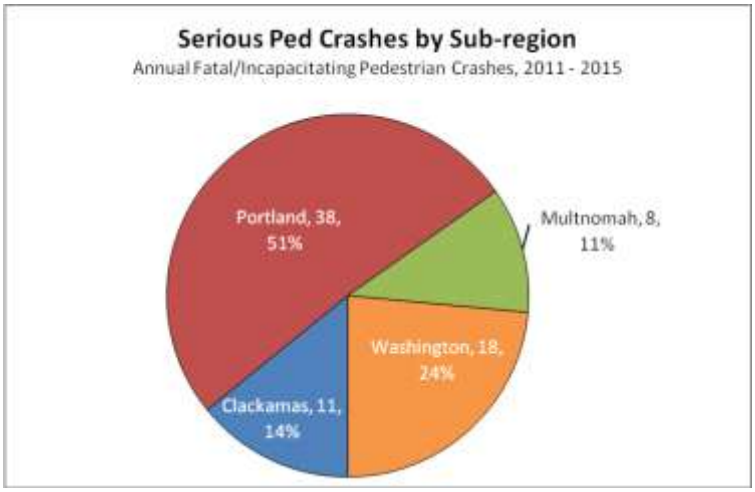
As presented in Figure 5-1, serious and fatal pedestrian crashes increased somewhat over the 5-year period.

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	51	11
Portland	10.4	28	119	86	232	38
Multnomah (excl. Portland)	1.8	7	27	18	52	8
Washington	5.8	12	47	42	101	18
METRO	21.0	54	218	164	436	75

Sub-Region	Population	Total VMT	Annual Pedestrian Injury Crashes		Annual Serious Pedestrian Crashes	
			per 1M residents	per 100M VMT	per 1M residents	per 100M VMT
Clackamas	290,630	1,047,952,697	176.2	4.89	36.5	1.01
Portland	620,540	2,095,570,120	374.5	11.09	61.6	1.82
Multnomah (excl. Portland)	152,611	548,334,475	339.4	9.45	55.0	1.53
Washington	539,448	2,030,869,086	186.5	4.95	32.6	0.87
METRO	1,614,998	5,722,726,378	270.0	7.62	46.3	1.31

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.

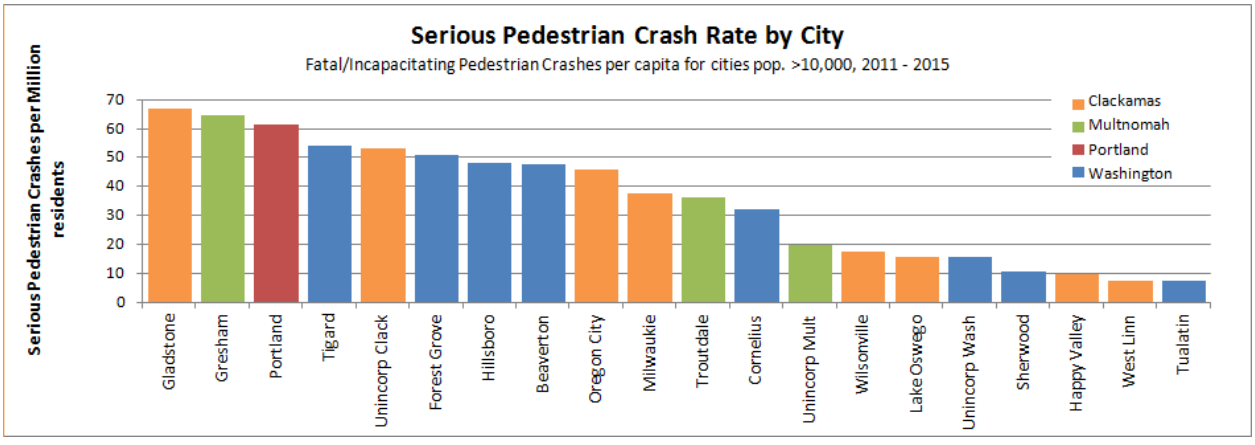
By City

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	20.2	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	4.0	1.2
Gladstone	0.2	0.6	1.0	0.0	1.6	0.8
Gresham	1.6	5.6	22.6	14.4	42.6	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	28.8	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	8.8	1.6
Portland	10.4	27.8	119.0	85.6	232.4	38.2
Rivergrove	0.0	0.0	0.0	0.0	0.0	0.0
Sherwood	0.2	0.0	2.0	0.8	2.8	0.2
Tigard	0.8	2.0	4.6	4.6	11.2	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	1.6	0.2
Uninc. Clackamas	2.0	4.0	11.0	8.2	23.2	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	22.4	3.2
METRO	21.0	53.8	218.0	164.2	436.0	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 capita	Serious per capita
Beaverton	96,704	208.9	47.6
Cornelius	12,389	145.3	32.3
Durham	1,430	0.0	0.0
Fairview	9,357	192.4	0.0
Forest Grove	23,630	169.3	50.8
Gladstone	11,990	133.4	66.7
Gresham	111,716	381.3	64.4
Happy Valley	20,835	105.6	9.6
Hillsboro	100,109	287.7	47.9
Johnson City	588	0.0	0.0
King City	3,817	157.2	52.4
Lake Oswego	38,156	120.6	15.7
Maywood Park	809	247.2	247.2
Milwaukie	21,365	262.1	37.4
Oregon City	35,004	251.4	45.7
Portland	620,540	374.5	61.6
Rivergrove	321	0.0	0.0
Sherwood	19,012	147.3	10.5
Tigard	51,642	216.9	54.2
Troutdale	16,486	291.2	36.4
Tualatin	26,617	338.1	7.5
West Linn	26,267	76.1	7.6
Wilsonville	22,932	148.3	17.4
Wood Village	4,056	394.5	49.3
Uninc. Clackamas	113,172	205.0	53.0
Uninc. Multnomah	10,187	39.3	19.6
Uninc. Washington	204,098	109.8	15.7
METRO	1,603,229	272.0	46.7

Figure 5-3



By Month

Month	2011-2015 Annual Pedestrian Crashes	
	All injury	Serious
January	48.6	11.0
February	38.6	7.2
March	33.4	5.4
April	27.0	4.2
May	30.2	4.0
June	26.2	4.6
July	29.2	3.8
August	28.0	6.0
September	31.2	5.8
October	44.0	6.6
November	47.8	8.0
December	51.8	8.2

Figure 5-4

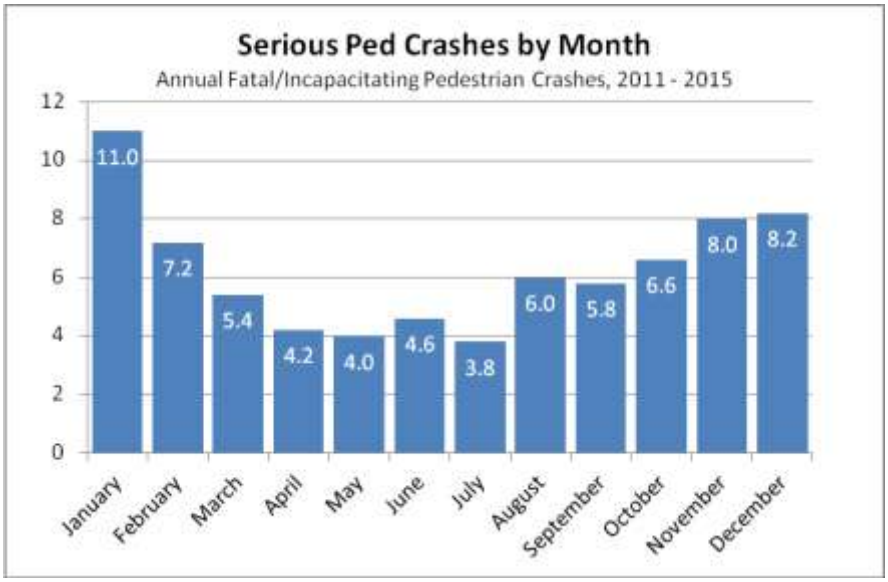


Figure 5-4 presents the annual average number of serious crashes by month. Fall and winter months generally have more serious pedestrian crashes.

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	All injury	Serious
Cloudy/Clear	310	53.6
Rain/Fog	115	19.6
Sleet/Snow	2	0.2
Unknown	9	1.4
METRO	436	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).

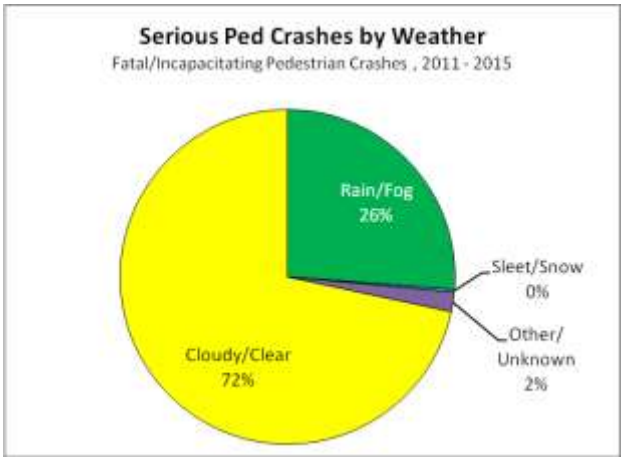


Figure 5-6

By Road Surface Condition

2011-2015 Annual Pedestrian Crashes		
Road	All injury	Serious
Dry	281	48.4
Ice/Snow	3	0.4
Wet	145	25.0
Unknown	7	1.0
METRO	436	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).

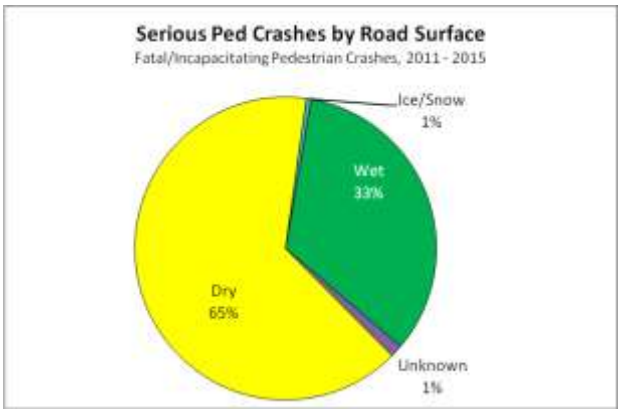


Figure 5-7

By Lighting

2011-2015 Annual Pedestrian Crashes		
Lighting	All injury	Serious
Daylight	224	27.2
Dawn/Dusk	42	8.4
Night - Dark	31	9.6
Night - Lit	138	29.6
Unknown	1	0.0
METRO	436	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.

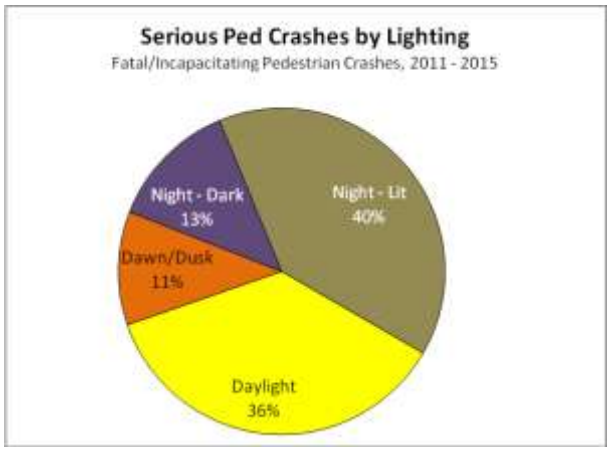
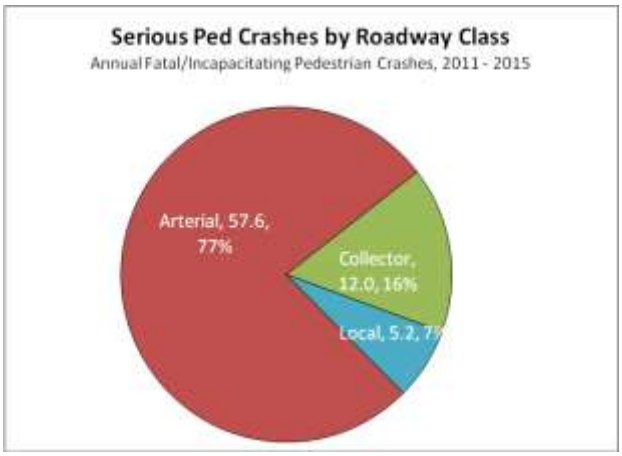


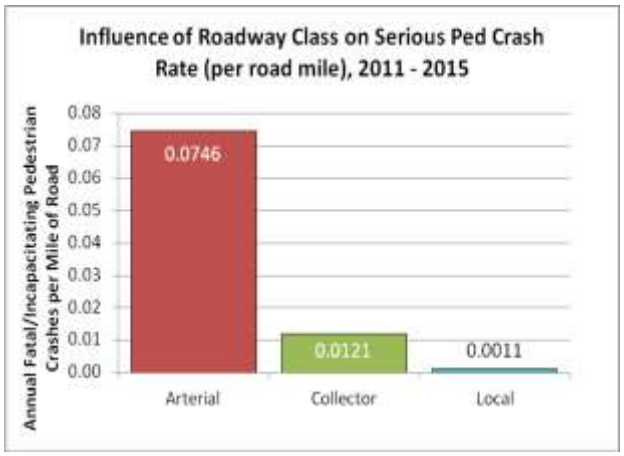
Figure 5-8

By Roadway Classification

Roadway Classification	Total Length (miles)	2011-2015 Annual Pedestrian Crashes		
		Serious	Serious per road-mile	Serious per VMT
Arterial	772	57.6	0.0746	1.35
Collector	994	12.0	0.0121	1.11
Local	4,565	5.2	0.0011	n/a
METRO	6,331	74.8	0.0118	--

Figures 5-9 and 5-10



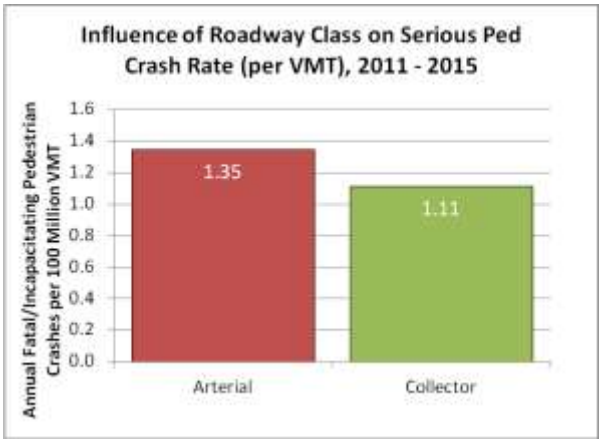


As with overall crashes, the region's serious pedestrian crashes occur primarily on the arterials, accounting for 77% of these crashes. Figure 5-9 presents the distribution of serious pedestrian crashes by roadway classification. As can be seen in Figure 5-10, which presents the rate of serious pedestrian 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.

Figure 5-11

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.

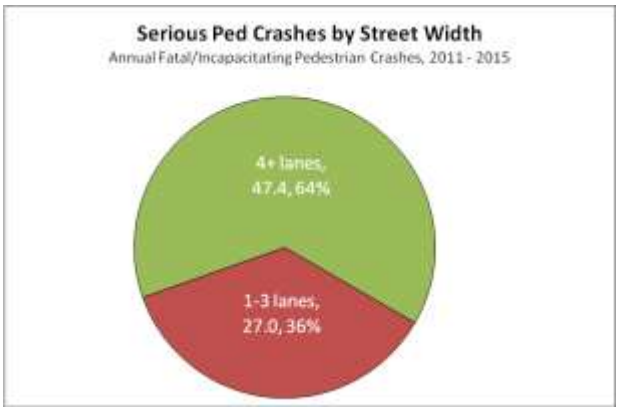


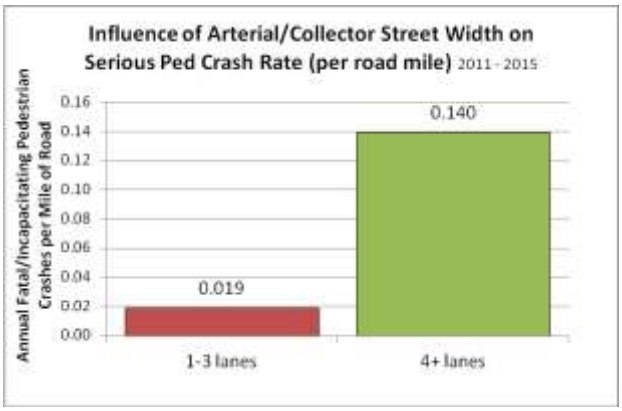
By Number of Lanes

Number of Lanes*	Total Length (miles)	2011-2015 Annual Pedestrian Crashes		
		Serious	Serious per road-mile	Serious per 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	0.88

* Arterial and Collector roadways only

Figures 5-12 and 5-13



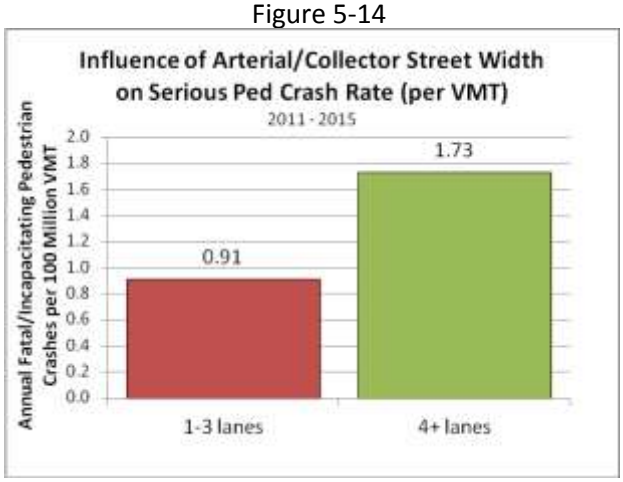


The influence of street width is consistent with the influence of roadway classification (Figure 5-12). Wider roadways are the location of a disproportionate number of serious pedestrian crashes in relation to both their share of the overall system (Figure 5-13) and the vehicle-miles travelled they serve (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						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	10	2.4	2.8	3	2	7	5.2
Following Too Close	1	0.0	0.4	1	0	1	0.4
Fail to Yield ROW	321	10.2	27.8	155	125	308	38.0
Improper Maneuver	22	1.4	3.2	11	7	21	4.6
Inattention	12	1.0	1.8	5	4	11	2.8
Reckless or Careless	7	0.8	2.2	2	1	6	3.0
Aggressive	16	2.2	4.4	5	4	13	6.6
Fail to Stop	1	0.0	0.0	0	1	1	0.0
Vehicle Problem	1	0.2	0.0	0	0	1	0.2
Alcohol or Drugs	55	11.8	13.4	20	9	43	25.2
Hit and Run	18	3.2	1.8	6	6	14	5.0
METRO	466	21.0	53.8	220	165	440	54.8

Figures 5-15 and 5-16

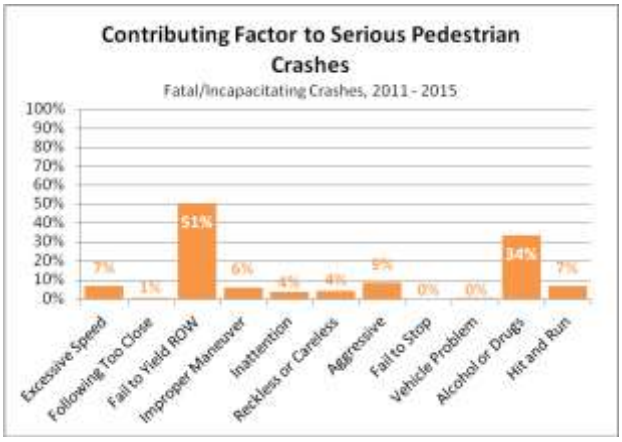


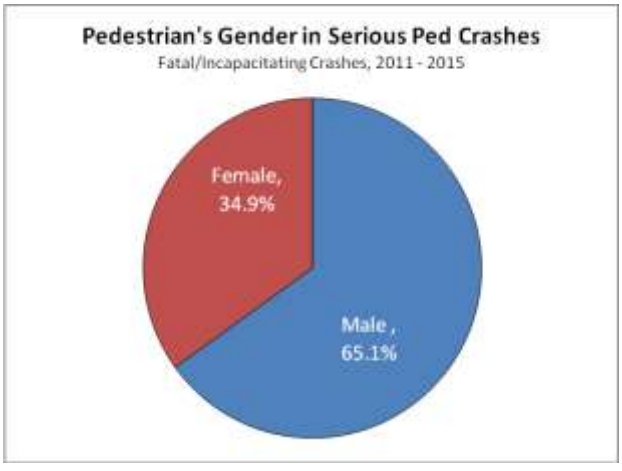
Figure 5-15 and 5-16 present the proportion of pedestrian crashes by contributing factor for serious and fatal crashes, respectively. Alcohol or Drugs, Failure to Yield, and Speed are the most common factors. The data do not specify whether the driver, the pedestrian, or both were under the influence of alcohol. Other factors, such as Failure to Yield and Speed, are for the driver.

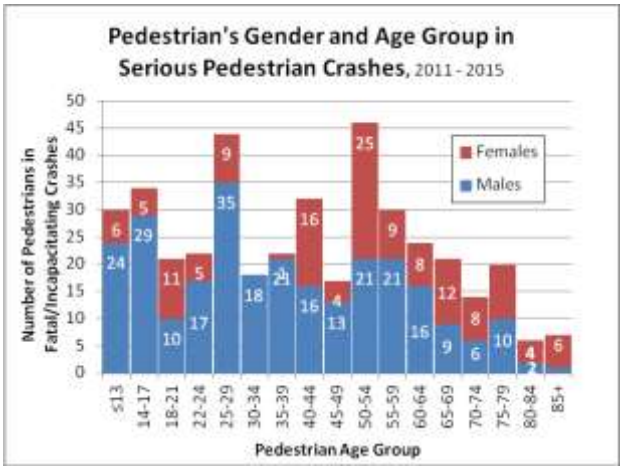
By Pedestrian's Age and Gender

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	Fatal/ Incapac.
2011	4 (4)	28	283	166	477	32
2012	3 (3)	34	357	166	557	37
2013	0 (0)	33	320	132	485	33
2014	1 (1)	37	311	160	508	38
2015	2 (2)	33	261	181	475	35
METRO	10 (10)	165	1,532	805	2,502	175

Figure 6-1

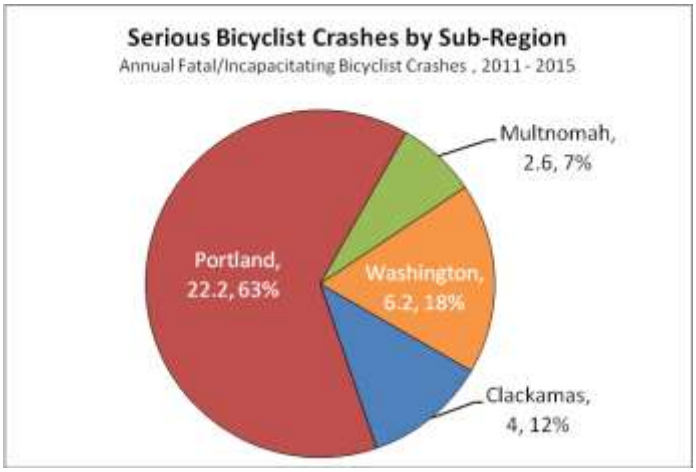
As presented in Figure 6-1, serious bicyclist crashes fluctuated over the 5-year period, while fatal bicycle crashes declined. No clear trend is evident.

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	312	22.2
Multnomah (excl. Portland)	0.0	2.6	24	15	42	2.6
Washington	0.6	5.6	63	35	103	6.2
METRO	2.0	33.0	306	161	500	35.0

Sub-region	Population (2015)	Total VMT	Annual Bicyclist Injury Crashes		Annual Serious Bicyclist Crashes	
			per 1M residents	per 100M VMT	per 1M residents	per 100M VMT
Clackamas	290,630	1,047,952,697	148.6	4.1	13.8	0.38
Portland	620,540	2,095,570,120	503.4	14.9	35.8	1.06
Multnomah (excl. Portland)	152,611	548,334,475	272.6	7.6	17.0	0.47
Washington	539,448	2,030,869,086	191.3	5.1	11.5	0.31
METRO	1,603,229	5,722,726,378	312.1	8.7	21.8	0.61

Figure 6-2



With the highest population, transit usage, VMT, and number of bicyclists, Portland has 63% of the region's serious bicycle crashes (Figure 6-2). Portland also has the highest rate of serious bicycle crashes per capita and per VMT. Multnomah (excludes Portland) has moderate rates of serious bicycle crashes per capita and per VMT. Clackamas County and Washington County have relatively low rates of serious bicycle crashes, which is likely partially due to fewer people cycling.

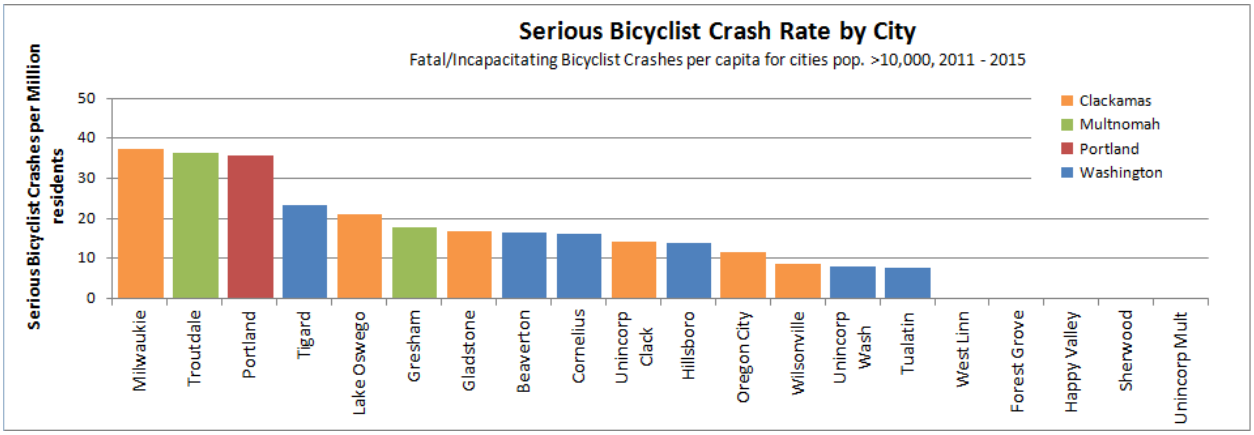
By City

City	2011-2015 Annual Bicyclist Crashes					
	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Beaverton	0.2	1.4	13.8	6.8	22.0	1.6
Cornelius	0.0	0.2	1.6	0.6	2.4	0.2
Durham	0.0	0.0	0.4	0.2	0.6	0.0
Fairview	0.0	0.0	1.2	0.2	1.4	0.0
Forest Grove	0.0	0.0	3.6	2.4	6.0	0.0
Gladstone	0.0	0.2	2.2	0.6	3.0	0.2
Gresham	0.0	2.0	18.2	11.6	31.8	2.0
Happy Valley	0.0	0.0	2.4	0.0	2.4	0.0
Hillsboro	0.2	1.2	15.4	11.0	27.6	1.4
Johnson City	0.0	0.0	0.0	0.0	0.0	0.0
King City	0.0	0.0	0.0	0.0	0.0	0.0
Lake Oswego	0.0	0.8	2.4	1.2	4.4	0.8
Maywood Park	0.0	0.0	0.4	0.0	0.4	0.0
Milwaukie	0.0	0.8	3.8	2.4	7.0	0.8
Oregon City	0.0	0.4	4.2	1.2	5.8	0.4
Portland	1.2	21.0	193.2	98.4	312.6	22.2
Rivergrove	0.0	0.0	0.0	0.0	0.0	0.0
Sherwood	0.0	0.0	1.4	0.8	2.2	0.0
Tigard	0.0	1.2	9.0	4.6	14.8	1.2
Troutdale	0.0	0.6	2.0	1.8	4.4	0.6
Tualatin	0.0	0.2	5.0	2.8	8.0	0.2
West Linn	0.0	0.0	1.4	0.4	1.8	0.0
Wilsonville	0.0	0.2	1.0	1.0	2.2	0.2
Wood Village	0.0	0.0	1.0	0.8	1.8	0.0
Uninc. Clackamas	0.2	1.4	8.6	6.2	16.2	1.6
Uninc. Multnomah	0.0	0.0	1.6	0.2	1.8	0.0
Uninc. Washington	0.2	1.4	12.6	5.8	19.8	1.6
METRO	2.0	33.0	306.4	161.0	500.4	35.0

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

City	Population (2015)	2011-2015 Annual Bicyclist Crashes	
		All Injury per capita	Serious per capita
Beaverton	96,704	227.5	16.5
Cornelius	12,389	193.7	16.1
Durham	1,430	419.6	0.0
Fairview	9,357	149.6	0.0
Forest Grove	23,630	253.9	0.0
Gladstone	11,990	250.2	16.7
Gresham	111,716	284.7	17.9
Happy Valley	20,835	115.2	0.0
Hillsboro	100,109	275.7	14.0
Johnson City	588	0.0	0.0
King City	3,817	0.0	0.0
Lake Oswego	38,156	115.3	21.0
Maywood Park	809	494.4	0.0
Milwaukie	21,365	327.6	37.4
Oregon City	35,004	165.7	11.4
Portland	620,540	503.8	35.8
Rivergrove	321	0.0	0.0
Sherwood	19,012	115.7	0.0
Tigard	51,642	286.6	23.2
Troutdale	16,486	266.9	36.4
Tualatin	26,617	300.6	7.5
West Linn	26,267	68.5	0.0
Wilsonville	22,932	95.9	8.7
Wood Village	4,056	443.8	0.0
Uninc. Clackamas	113,172	143.1	14.1
Uninc. Multnomah	10,187	176.7	0.0
Uninc. Washington	204,098	97.0	7.8
METRO	1,614,998	309.8	21.7

Figure 6-3



By Month

Month	2011-2015 Annual Bicyclist Crashes	
	All injury	Serious
January	21.4	1.4
February	27.6	2.2
March	33.2	1.6
April	37.8	1.0
May	45.8	2.6
June	47.6	3.4
July	61.2	5.0
August	56.4	4.0
September	59.8	4.8
October	48.4	2.6
November	33.8	3.0
December	27.4	3.4

Figure 6-4

Figure 6-4 presents the annual average number of serious bicycle crashes by month. May through December generally have more serious bicycle 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 Bicycle Crashes, 2007 - 2009

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 bicycle 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 bicycle 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 bicycle 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	All injury	Serious
Cloudy/Clear	427.8	30.6
Rain/Fog	59.0	3.6
Sleet/Snow	0.4	0.4
Unknown	13.2	0.4
METRO	500.4	35.0

The majority (87%) of serious bicycle crashes occurred in clear or cloudy conditions (Figure 6-6), as compared to 80% for all crashes (Figure 2-16).

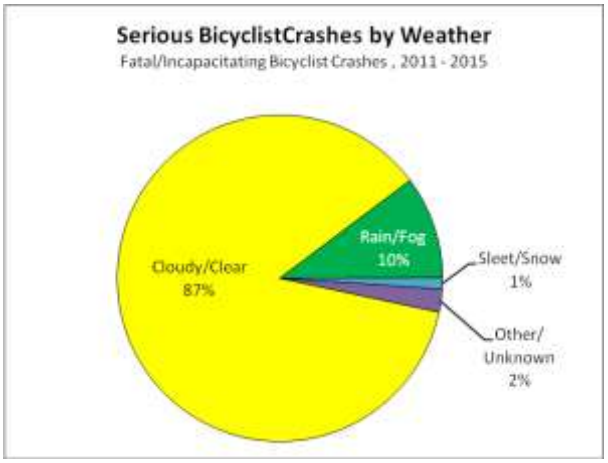


Figure 6-6

By Road Surface Condition

2011-2015 Annual Bicyclist Crashes		
Road	All injury	Serious
Dry	406.8	29.2
Ice/Snow	0.4	0.0
Wet	82.0	5.4
Unknown	11.2	0.4
METRO	500.4	35.0

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

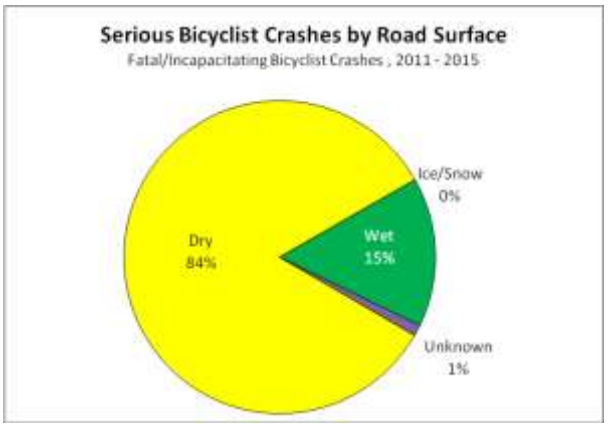


Figure 6-7

By Lighting

2011-2015 Annual Bicyclist Crashes		
Lighting	All injury	Serious
Daylight	373.6	24.4
Dawn/Dusk	40.8	2.8
Night - Dark	13.6	1.6
Night - Lit	71.4	6.2
Unknown	1.0	0.0
METRO	500.4	35.0

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

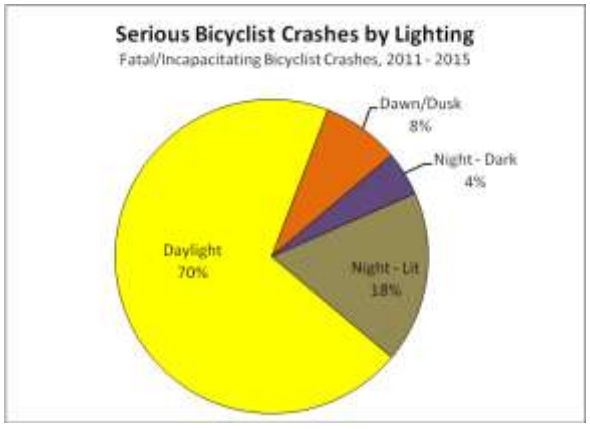
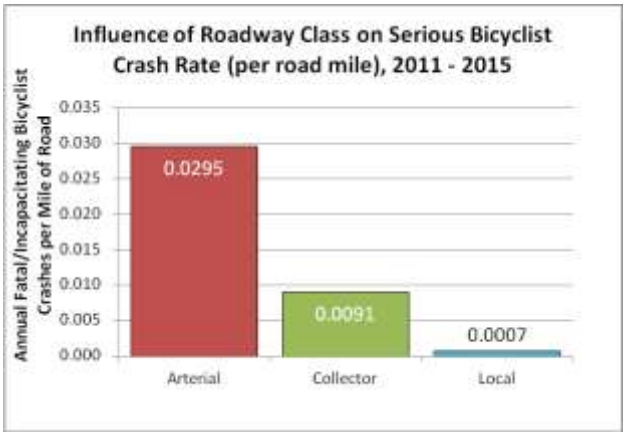


Figure 6-8

By Roadway Classification

Roadway Classification	Total Length (miles)	2011-2015 Annual Bicyclist Crashes		
		Serious	Serious per road-mile	Serious per VMT
Arterial	772	22.8	0.0295	0.533
Collector	994	9	0.0091	0.832
Local	4,565	3.2	0.0007	--
METRO	6,331	35.0	0.0055	--

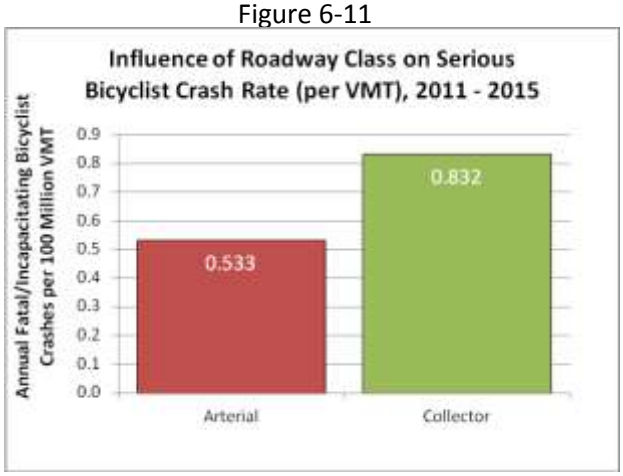
Figures 6-9 and 6-10



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

As can be seen in Figure 6-11, when normalized by motor vehicle traffic volume, the serious bike 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

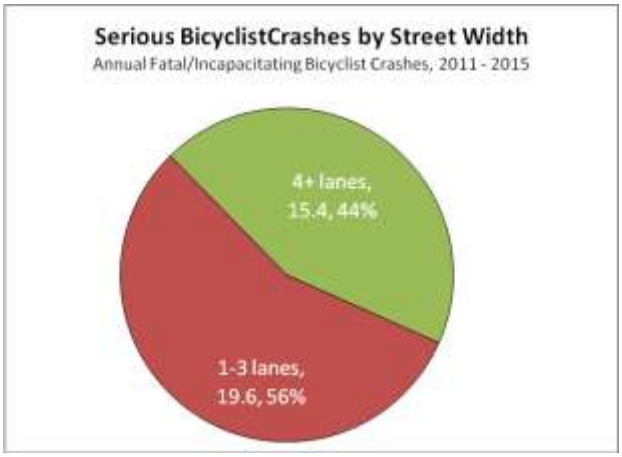


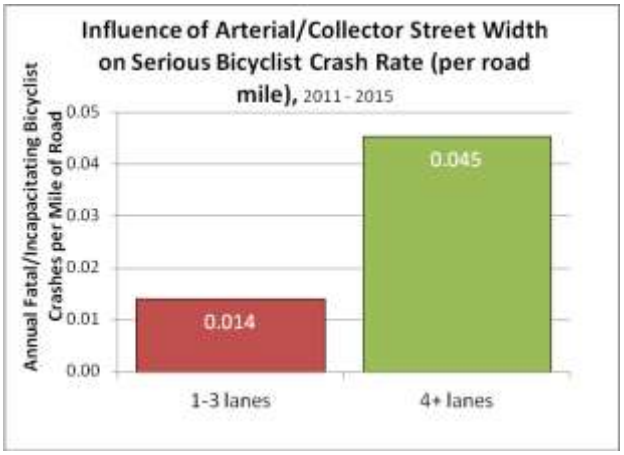
By Number of Lanes

Number of Lanes	Total Length (miles)	2011-2015 Annual Bicyclist Crashes		
		Serious	Serious per mile	Serious per VMT
1 – 3 Lanes	1,427	19.6	0.014	0.660
4+ Lanes	340	15.4	0.045	0.562
METRO	1,766	35.0	0.020	0.613

* Arterial and Collector roadways only

Figure 6-12 and 6-13

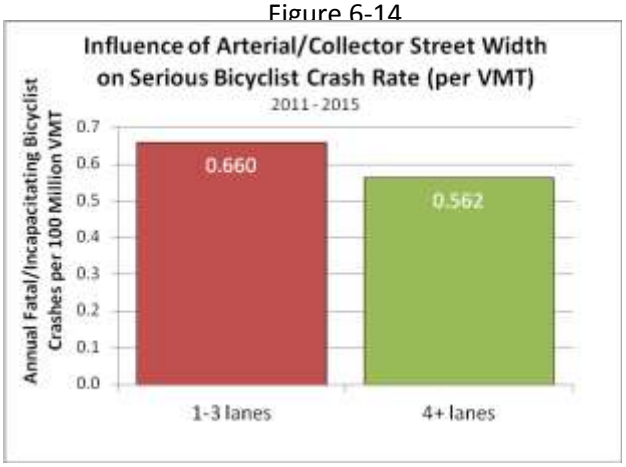




The influence of street width is consistent with the influence of roadway classification (Figure 6-12). Wider roadways are the location of a disproportionate number of serious bicycle crashes in relation to their share of the overall system (Figure 6-13), although the effect is not as pronounced as it is for serious pedestrian crashes. The serious bicycle 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.

Figure 6-14

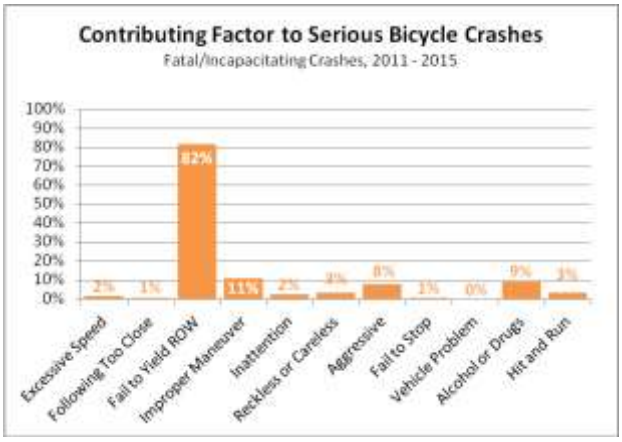
As can be seen in Figure 6-14, when normalized by motor vehicle traffic volume, the serious bike crash rate on narrower roads is higher than on wider roads. While the reason for this is not clear from the data, it may be related to a higher use of narrower roads by cyclists relative to traffic volume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



By Contributing Factor

Factor	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	3	0.2	0.4	2	0	3	0.6
Following Too Close	13	0.2	0.0	7	4	11	0.2
Fail to Yield ROW	412	1.0	27.6	246	127	400	28.6
Improper Maneuver	59	0.4	3.4	35	20	58	3.8
Inattention	6	0.0	0.8	3	2	6	0.8
Reckless or Careless	5	0.4	0.8	2	1	4	1.2
Aggressive	35	0.6	2.2	20	9	32	2.8
Fail to Stop	2	0.0	0.2	1	1	2	0.2
Vehicle Problem	2	0.0	0.0	2	0	2	0.0
Alcohol or Drugs	18	1.0	2.2	10	4	16	3.2
Hit and Run	14	0.6	0.6	8	3	12	1.2
METRO	519	2.0	33.0	307	161	501	35.0

Figures 6-15 and 6-16



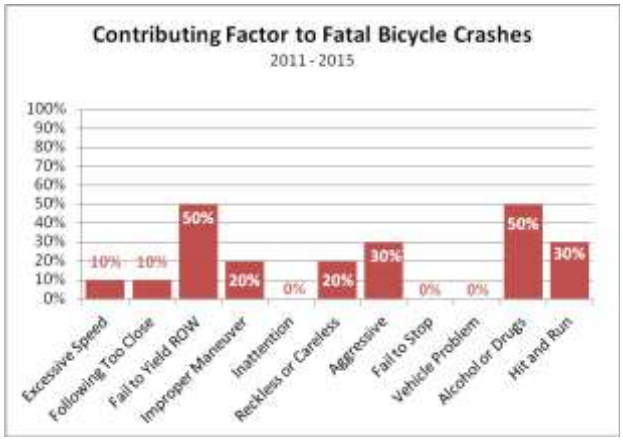


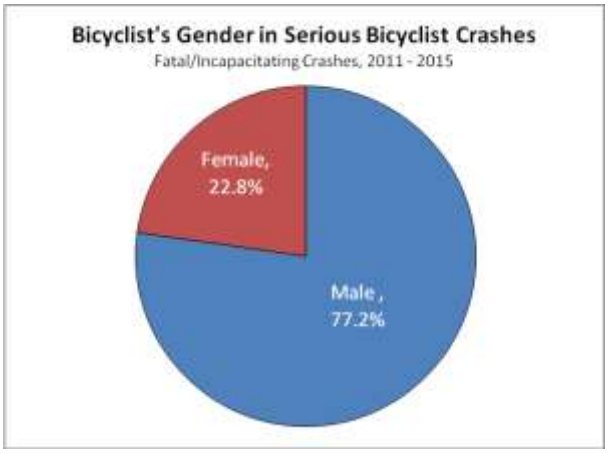
Figure 6-15 and 6-16 present the proportion of bicycle crashes by contributing factor for serious and fatal crashes, respectively. Alcohol or Drugs and Failure to Yield, and Aggressive Driving are the most common factors. The data do not specify whether the driver, the bicyclist, or both were under the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

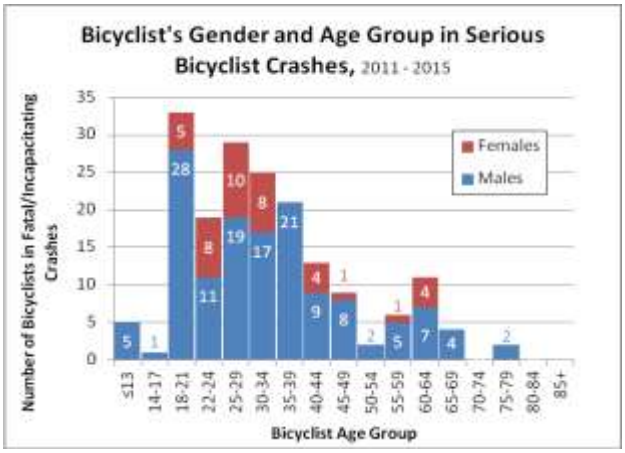
By Bicyclist's Age and Gender

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(to be updated)

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).

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 factors may apply to any single crash. Based on these causes, errors, and risk factors, crashes were evaluated for 12 contributing factors, defined for this analysis as follows:

Defined Contributing Factor	DMV codes included in factor
Excessive Speed	Speed too fast for conditions; Driving in excess of posted speed; Speed racing; Failed to decrease speed for slower moving vehicle
Following Too Close	Following too closely
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; 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
Improper Maneuver	Drove left of center on two-way road; Improper overtaking; Made improper turn; Other improper driving; Wide turn; Cut corner on turn; Left turn where prohibited; Turned from or into wrong lane; U-turned illegally; 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; Straddling or driving on wrong lanes; Improper change of lanes; Wrong way
Inattention	Driver drowsy/fatigued/sleepy; Inattention
Reckless or Careless	Reckless driving; Careless driving
Aggressive	Excessive Speed or Following too Close, as defined above
Fail to Stop	Failed to avoid stopped or parked vehicle ahead other than school bus
Parking Related	Improperly parked; Improper start leaving parked position; Improper parking; Opened door into adjacent traffic lane
Vehicle Problem	Improper or no lights; Driving unsafe vehicle (no other error apparent); Overloading or improper loading of vehicle with cargo or passengers
Alcohol or Drugs	Alcohol, Drugs
Hit and Run	Hit and Run

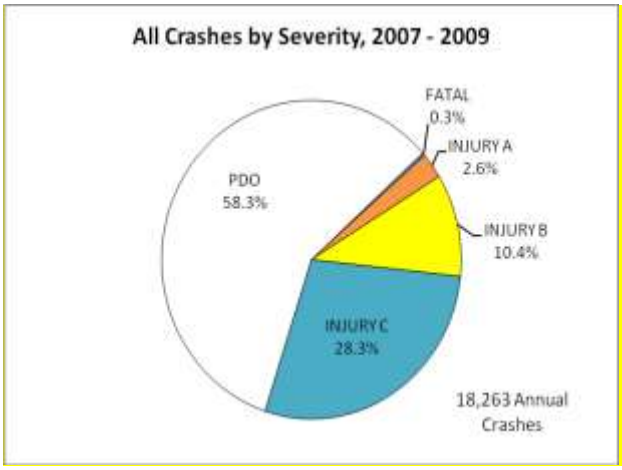
All Crash Types (to be updated)

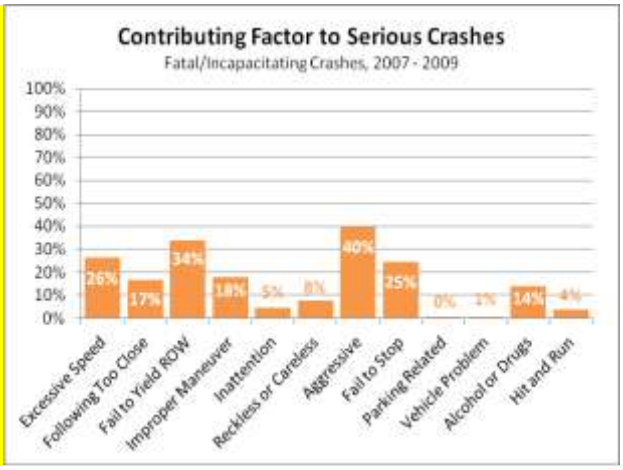
The following table summarizes all crashes in the region by severity and contributing factor, as defined on the previous page.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Crashes**
Fatal	69	0	39	35	2	11	69	2	0	0	86	13	**151**
Injury A	350	267	499	246	70	113	564	391	7	12	136	49	**1,444**
Injury B	858	1,058	2,419	903	327	378	1,763	1,279	11	26	360	223	**5,720**
Injury C	2,357	6,834	4,136	2,289	849	478	8,325	7,510	50	50	448	906	**15,523**
PDO	4,685	10,447	8,985	8,561	1,264	636	13,733	11,571	302	147	770	1,361	**31,950**

Figure 7-1 presents the crash severity distribution of all crashes. Figure 7-2 presents the percentage of crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-1 and 7-2





Aggressive driving, defined as either excessive speed or following too close, is the most common contributing factor, contributing to 40% of the serious crashes in the region. Failure to yield, excessive speed, and failure to stop are the next three most common contributing factors.

Rear End Crashes (to be updated)

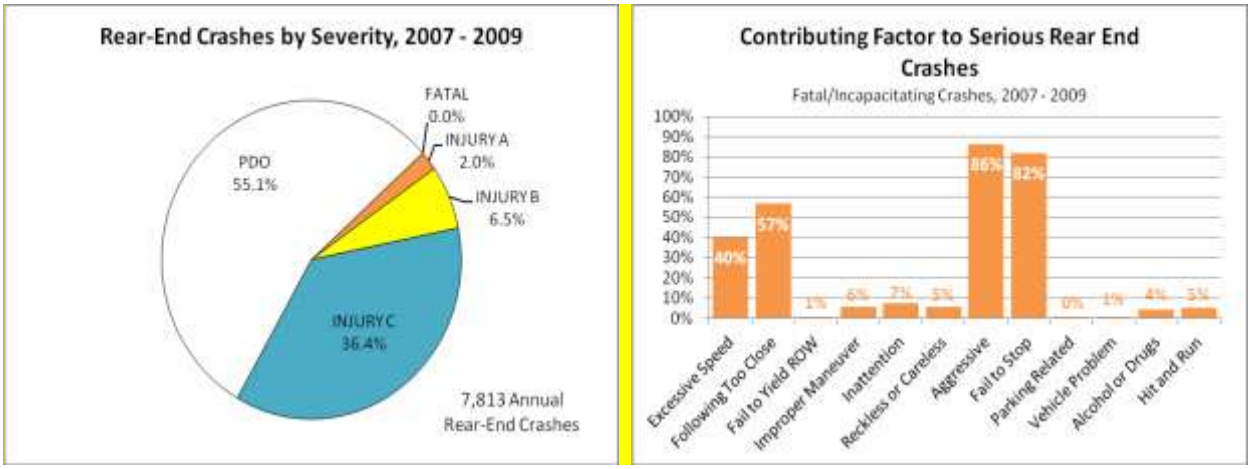
A Rear End crash results when a vehicle traveling in the same direction or parallel on the same path as another vehicle, collides with the rear end of a second vehicle. In this type, the direction of travel was parallel but continuous.

Rear End is the most common crash type in the region, as well as the most common serious crash type, although it is rarely fatal. Rear End crashes constitute 3% of fatal crashes, 29% of serious crashes, and 43% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Rear End Crashes**
Fatal	3	0	0	2	0	1	3	1	0	0	3	1	**5**
Injury A	183	263	4	24	34	24	398	379	1	4	16	22	**459**
Injury B	341	1,033	17	107	169	103	1,232	1,230	3	6	68	75	**1,521**
Injury C	1,620	6,655	37	478	677	248	7,481	7,304	6	24	168	497	**8,542**
PDO	2,490	10,095	72	837	852	175	11,341	10,855	17	21	166	369	**12,911**

Figure 7-3 presents the crash severity distribution of Rear End crashes. Figure 7-4 presents the percentage of Rear End crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-3 and 7-4



Rear End crashes are less severe than most crashes, producing a high proportion of injury C and PDO crashes. Aggressive driving is a factor in 86% of Rear End crashes. Failure to stop, following too closely, and excessive speed are all factors in a substantial proportion of Rear End crashes of serious severity.

Turning Crashes (to be updated)

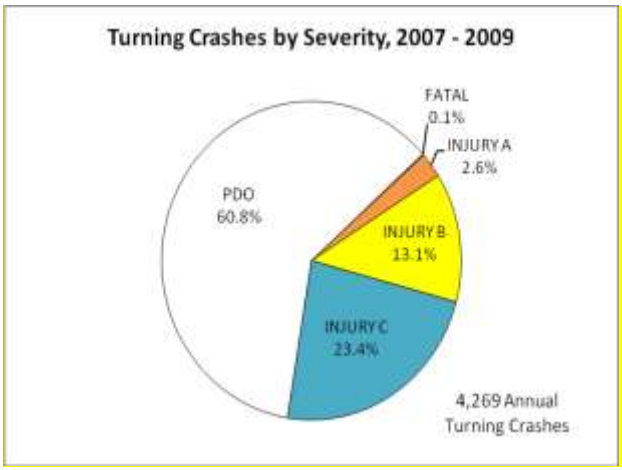
A Turning crash results when one or more vehicles in the act of a turning maneuver is involved in a collision with another vehicle. It differs from an Angle crash in that Turning crashes involve vehicles traveling on the same street, whereas Angle crashes involve vehicles traveling on intersecting streets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

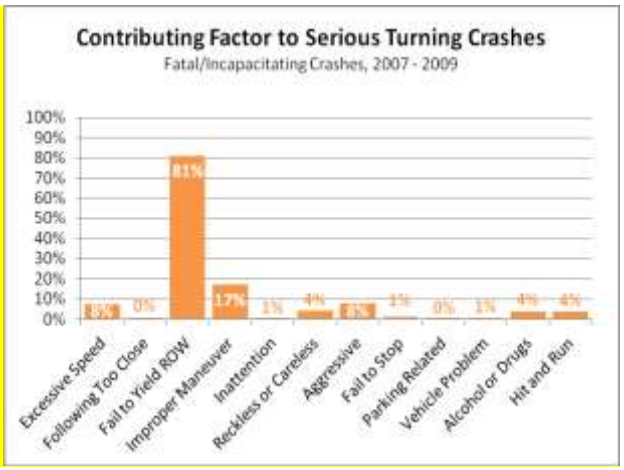
Turning is the second most common crash type in the region, as well as the second most common serious crash type. Turning crashes constitute 10% of fatal crashes, 22% of serious crashes, and 23% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Turning Crashes**
Fatal	4	0	11	3	0	1	4	0	0	0	4	2	**15**
Injury A	22	1	269	57	3	14	23	4	1	2	9	11	**331**
Injury B	52	13	1,354	246	12	54	59	17	0	2	45	41	**1,683**
Injury C	157	141	2,239	637	35	59	244	126	2	4	57	141	**2,995**
PDO	417	261	5,259	2,442	53	67	568	277	13	8	73	338	**7,781**

Figure 7-5 presents the crash severity distribution of Turning crashes. Figure 7-6 presents the percentage of Turning crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-5 and 7-6





Fixed Object Crashes (to be updated)

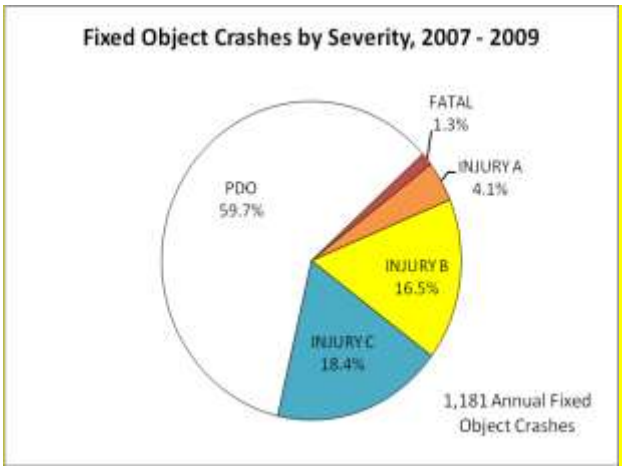
A Fixed Object crash results when one vehicle strikes a fixed or other object on or off the roadway.

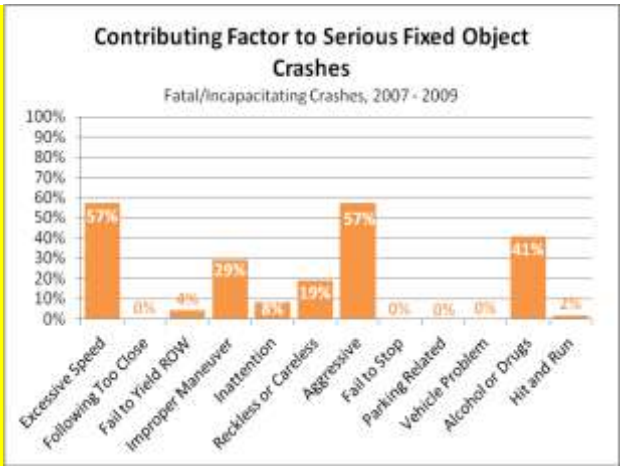
Fixed Object is the most common fatal crash type in the region. Fixed Object crashes constitute 31% of fatal crashes, 12% of serious crashes, and 6% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Fixed Object Crashes**
Fatal	36	0	4	14	1	3	36	0	0	0	33	0	**47**
Injury A	74	0	4	42	15	33	74	0	0	0	45	3	**145**
Injury B	289	4	5	187	72	93	291	7	2	8	129	21	**583**
Injury C	334	6	19	197	65	85	337	7	1	5	107	30	**653**
PDO	1,150	12	41	603	181	267	1,158	13	3	43	314	101	**2,116**

Figure 7-7 presents the crash severity distribution of Fixed Object crashes. Figure 7-8 presents the percentage of Fixed Object crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-7 and 7-8





Fixed Object crashes have a higher rate of severity including fatalities compared to other crash types. Speed, aggressive driving, and alcohol or drugs are often involved in Fixed Object crashes.

Pedestrian Crashes (to be updated)

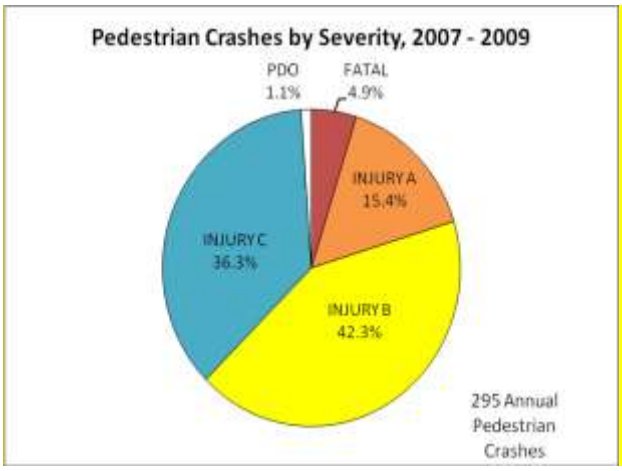
A Pedestrian crash results when the first harmful event is any impact between a motor vehicle in traffic and a pedestrian. It does not include any crash where a pedestrian is injured after the initial vehicle impact.

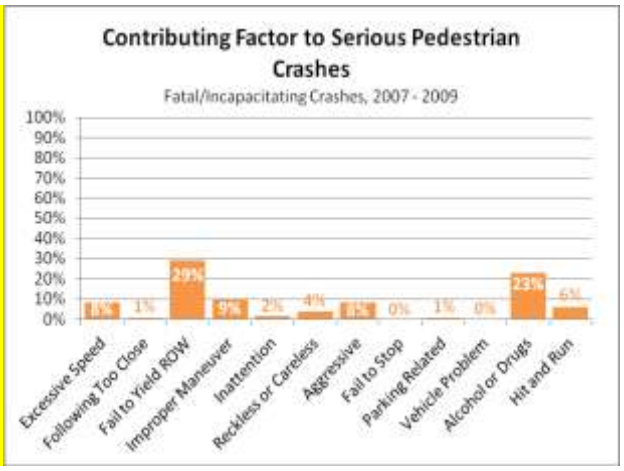
Pedestrian is the second most common fatal crash type in the region. Pedestrian crashes constitute 29% of fatal crashes, 11% of serious crashes, and 2% of all crashes in the region.

Three years of crash data, 2007 - 2009													
	Excessive Speed	Following Too Close	Fail to Yield ROW	Improper Maneuver	Inattention	Reckless or Careless	Aggressive	Fail to Stop	Parking Related	Vehicle Problem	Alcohol or Drugs	Hit and Run	**All Pedestrian Crashes**
Fatal	8	0	9	4	1	3	8	0	0	0	19	7	**43**
Injury A	7	1	43	13	2	4	7	0	1	0	22	4	**136**
Injury B	4	0	210	12	6	13	4	2	0	2	29	11	**374**
Injury C	5	0	202	13	6	4	5	1	0	0	28	11	**321**
PDO	1	0	7	1	0	0	1	0	0	0	0	0	**10**

Figure 7-9 presents the crash severity distribution of Pedestrian crashes. Figure 7-10 presents the percentage of Pedestrian crashes of serious severity (fatal or injury A) with each contributing factor. Each crash may have several contributing factors.

Figures 7-9 and 7-10





Pedestrian crashes have the highest severity of any crash type. Failure for the driver to yield right of way and alcohol or drug involvement are the two most coming contributing factors, although each is well below 50%.

A Vision for Transportation Safety

Framework for Identifying Best Practice Strategies to Advance Vision Zero

Arielle Fleisher, Megan L. Wier, and Mari Hunter

The Traffic Safety Best Practices Matrix is presented. It is a tool to help U.S. cities to identify the landscape of strategies being used domestically and internationally to advance Vision Zero, as pioneered by Sweden. Many cities across the United States have expressed an interest in Vision Zero, with a growing number passing policies calling for the elimination of traffic-related fatalities over the next decade. Despite the increase in interest, little guidance exists around what Vision Zero is and what actions can be implemented to help realize zero deaths. The matrix culls together the results of an extensive examination of the measures that cities and countries are pursuing to reduce traffic-related fatalities and improve safety. The matrix attempts to bridge the gap by presenting a framework that cities can use to identify effective strategies, benchmark their efforts relative to other jurisdictions, and reach out to cities and countries pursing Vision Zero policies for additional information. An analysis of the matrix, focuses on three categories: measures with widespread adoption, limited implementation, and minimal utilization. There is discussion of how these findings can inform the next steps for Vision Zero implementation, with a focus on implications for U.S. cities. The main recommendations are to develop mechanisms that institutionalize Vision Zero across sectors, focus education on supporting changes in organizational practices and policy reform, improve collaboration across all levels of government, explore technology that meets the unique needs of cities, and create data systems that facilitate accountability and encourage public participation.

Vision Zero is a road safety policy that aims to achieve a transportation system in which there are zero fatalities or serious injuries for all modes of transportation. Adopted by Sweden in 1997, the safety platform attempts to create a safe system by taking an ethical approach to road safety (*1*). Vision Zero is widely accepted as an innovative road safety policy and is noted for its departure from the traditional road safety paradigm with regard to its charge that the road safety problem to be addressed is the shortcomings in the design of the transportation system, assertion that transportation system designers are responsible for road safety, call for road users to demand safety, and insistence that the ultimate objective of road safety is zero deaths (*2*).

Many cities across the United States have expressed an interest in Vision Zero. As of July 2015, the following cities have passed a Vision Zero policy, calling for the elimination of traffic-related fatalities and in some cases serious injuries over the next 10 years: San Francisco, San Jose, San Mateo, and San Diego, California; Seattle, Washington; Portland, Oregon; New York City; Washington, D.C.; and Boston, Massachusetts. Despite the increase in interest, little guidance exists for local transportation planners, policy makers, public health practitioners, police, and others working as part of this effort around what Vision Zero is and what actions could be implemented to help realize zero deaths. This paper aims to bridge that gap by presenting a tool, the Traffic Safety Best Practices Matrix, to help cities identify the landscape of strategies being used domestically and internationally to advance Vision Zero. The matrix culls together the results of an extensive examination of the measures that cities and countries are pursuing to reduce traffic-related fatalities and serious injuries.

By identifying the landscape of strategies being used by cities pursuing Vision Zero, and specifying strategy efficacy as currently known, the matrix presents a framework for strategy identification and evaluation, as well as opportunity benchmarking. Analysis of the matrix focuses on three categories: measures with (*a*) widespread adoption, (*b*) limited implementation, and (*c*) minimal utilization. Also, the research offers findings that can inform next steps for Vision Zero implementation. While the potential for Vision Zero to reduce fatalities and serious injuries is significant based on Sweden's experience (*3*), there is currently a knowledge gap with respect to specific implementation measures utilized to advance the policy. It is anticipated that the matrix, in addition to the analysis presented in this paper, will help cities, especially those considering adopting the policy, to develop comprehensive strategies, benchmark their efforts, and reach out to other jurisdictions pursing Vision Zero for additional information.

CALL FOR SAFE SYSTEM APPROACH TO SAFETY: WHAT IS VISION ZERO?

Vision Zero is based on two premises: people make mistakes, and there is a critical limit beyond which survival and recovery from an injury are not possible (*4*). Vision Zero does not assume that collisions will not happen—people make mistakes no matter how well-educated and compliant in obeying traffic laws (*5*). Rather, the focus for road safety analysis and planning is on eliminating the risk of chronic health impairment or death caused by a collision (*4*). To do so, Vision Zero focuses on decreasing the likelihood that crashes will result in serious injury or death by designing the transportation system in a way that ensures that road users can tolerate the kinetic energies produced by the collision. It is kinetic energy that kills and injures the road user—not the collision. The level of physical force the human body can tolerate thus forms the basic parameter in the

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DOI: 10.3141/2582-09

design of the transportation system, the core around which all safety interventions are to be based (*4, 6*).

One of the main implications of this is that traffic speeds should be reduced to prevent injuries (*7*). If the impact of crash energy is to be kept below the critical limit, speeds must lowered and set according to the safety of the road and roadside (*4*). Vulnerable road users, including pedestrians, have a 10% chance of surviving if hit by vehicles traveling at speeds above 45 mph, but this level rises to 90% at speeds of 17 mph (*8*). Speed management underpins nearly every consideration in Vision Zero (*5*).

While Vision Zero places a strong emphasis on reducing speeds, it does so in the context of the road system in its entirety—referred to as a safe system approach to road safety (*4, 5*). The approach encourages countermeasures that address the three key elements of the road system—roads and roadsides, vehicles and speed—because the interaction of these elements determines physical force and thus trauma levels in a crash (*4*). Considering the inputs in isolation ignores the power of their interactions. To prevent collisions, the whole system must be considered and all its parts strengthened (*5*): If one part fails, the other parts must be able to offer protection. Core activities are supported by a range of countermeasures (such as education, regulation, and enforcement) that encourage alert and compliant behavior on the part of road users (*9*).

Vision Zero alters the view on responsibility for road safety. In the United States, responsibility has been placed on the individual road user: bad drivers, careless bicyclists, and distracted pedestrians are the causes of collisions; perfecting human behaviors through licensing, testing, education, training, and publicity are the appropriate solutions (*6, 7*). Under the Vision Zero framework, actions and responsibilities are attributed to the system designers who include engineers, public health professionals, policy makers, and law enforcement (*4, 10*). It remains the responsibility of individuals to abide by laws and regulations, that is, to follow the rules for using the transportation system set by the system designers. If fatalities do still occur, or if the rules are not followed, the burden is placed back on the system designers to take further measures (*1*).

Although Vision Zero is closely associated with Sweden's efforts, the safe system approach on which it is based has also provided the foundation for Netherland's Sustainable Safety policy, as well as the safety platforms of Australia, New Zealand, Denmark, Iceland, Norway, and London (*5*). Vision Zero and Sustainable Safety represent the longest and most well-established safe system approaches (*9*). In the United States, state governments are required to develop strategic highway safety plans that detail the state's approach to reducing traffic injuries. Since the early 2000s, many states have framed this work as Toward Zero Deaths (TZD), an approach that traces its roots Vision Zero (*11*). In 2014, FHWA published *Toward Zero Deaths: A National Strategy for Highway Safety,* which similarly frames safety as a systems approach (*12*).

METHODS

To provide guidance for U.S. cities as they seek to implement Vision Zero, research was conducted into the measures that cities in the United States and cities and countries abroad, are, as of May 2015, pursuing to reduce pedestrian-, bicycle-, or traffic-related injuries and fatalities. Those data are compiled into the Traffic Safety Best Practices Matrix.

The safety strategies of eight U.S. cities, one European city, and three countries were reviewed for the matrix: San Francisco; New York City; Chicago, Illinois; Portland; Seattle; Washington, D.C.; Boston; Los Angeles, California; London; Sweden; the Netherlands; and Australia. The U.S. cities included in the matrix were the early adopters or early considerers of Vision Zero, either by cities or departments of transportation. Sweden and the Netherlands are international leaders in road safety. Australia was selected because it was one of the first countries to follow Sweden in adopting the safe system approach; London was selected because it is a large city that also subscribes to a systems approach to road safety (*9, 13*). These locations were also selected because information about their safety platforms is widely available online and in English. While Norway, Finland, Iceland, and Denmark have all adopted Vision Zero or Vision Zero–like policies, these countries were not included in the review because their safety documents were not readily available (*5*).

The matrix is divided into nine categories:

1. Supportive infrastructure and planning;
2. Engineering;
3. Education;
4. Enforcement;
5. Monitoring, analysis, and evaluation;
6. Policy;
7. Large vehicles;
8. Vehicle technology; and
9. Taxi services and transportation network company.

Countries and cities received a √ (i.e., checkmark) for a measure if it was referred to in one of their safety documents, defined as their city's safety resource webpage, safety action plan, or bicycle or pedestrian strategy, as either in practice or as a priority/planned/in process. Cities and countries received an NA (not applicable) for measures if implementation was not feasible. For example, New York City received an NA for "Align state level Towards Zero Death efforts with local level Vision Zero policy" (6.9) because its state did not adopt the TZD approach. A total of 106 measures are included in the matrix. There is no hierarchy to the matrix; rather, measures are listed alphabetically within subsections. The matrix is not exhaustive but attempts to provide a full scope of the safety measures being used by cities and countries. Matrix review did not take into account prioritization of the measures, scale of implementation (e.g., one intersection versus routine strategic implementation) or funding.

The matrix also includes a category that indicates the efficacy of a measure, defined as capacity to reduce injury, both directly (i.e., collision reduction factor) or indirectly (i.e., through creation of the institutions, structures, and political will that drive or create frameworks for changes in system design). Measures were given a designation of proven (P), recommended (R), or unknown (U), as described in Table 1. This methodology was used by Washington State in its 2013 Washington State Strategic Highway Safety Plan (*14*), which is a target zero plan. This plan was chosen as the model of the current research not only because of the rigor it applied to the efficacy assessments, but also because consistency in efficacy methodology among plans related to Vision Zero was felt to be a potential strength. As in Washington State, the researchers relied on three main sources to make the designations; if an action was not found in one of these primary sources, the researchers surveyed the academic literature as well as other countermeasure reference documents. For supplemental sources, designations were given based on the outcomes, quality, and breadth of the evaluation. A list of these sources can be found in Table 2.

TABLE 1 Efficacy Definitions and Criteria (*14*, p. 168)

Strategy Effectiveness	Definition	Countermeasures That Work (CTW)	NCHRP Report 500	Crash Modification Factors (CMF) Clearinghouse
Proven (P)	Proven to be effective based on several evaluations with consistent results	***** Demonstrated to be effective by several high-quality evaluations with consistent results	Proven (P). Those strategies that have been used in one or more locations and for which properly designed evaluations have been conducted that show them to be effective.	***** = 14 quality points
Recommended (R)	Generally accepted to be effective based on evaluations or other sources	**** Demonstrated to be effective in certain situations or *** Likely to be effective based on balance of evidence from high-quality evaluations or other sources	Tried (T). Those strategies that have been implemented in many locations, and may even be accepted as standards or standard approaches, but for which there have not been found valid evaluations.	**** = 11–13 quality points *** = 7–10 quality points
Unknown (U)	Lower quality rating; limited evaluation or evidence; experimental; outcomes inconsistent and inconclusive between studies	** Effectiveness still undetermined; different methods of implementing this countermeasure produce different results or *Limited or no high-quality evaluation evidence	Experimental (E). Those strategies represent ideas that have been suggested, with at least one agency considering them sufficiently promising to try them as an experiment in at least one location.	** = 3–6 quality points

TABLE 2 Matrix Sources

Document	Link
San Francisco	
San Francisco Pedestrian Strategy	http://archives.sfmta.com/cms/rpedmast/documents/1-29-13PedestrianStrategy.pdf
SFMTA Bicycle Strategy	https://www.sfmta.com/sites/default/files/BicycleStrategyFinal_0.pdf
Vision Zero San Francisco: two-year action strategy	http://visionzerosf.org/about/two-year-action-strategy/
Walk First	http://walkfirst.sfplanning.org/
New York	
Vision Zero Action Plan	http://www.nyc.gov/html/visionzero/pdf/nyc-vision-zero-action-plan.pdf
NYC Pedestrian Safety Study and Action Plan	http://www.nyc.gov/html/dot/downloads/pdf/nyc_ped_safety_study_action_plan.pdf
Truck Side Guards	http://www.nyc.gov/html/dcas/downloads/pdf/fleet/nyc_fleet_newsletter_05_16_2014.pdf; http://www.volpe.dot.gov/news/engineers-passion-pedestrian-and-bike-safety-leads-partnership-with-nyc
Chicago	
Chicago Forward: Department of Transportation Action Agenda	http://www.cityofchicago.org/dam/city/depts/cdot/Admin/ChicagoForwardCDOTActionAgenda.pdf
Chicago Forward: Department of Transportation Action Agenda 2013 Update	http://www.cityofchicago.org/content/dam/city/depts/cdot/ChicagoForward/ChicagoForwardUpdate2013_web-lo.pdf
Chicago Pedestrian Plan	http://chicagopedestrianplan.org/pedestrian-plan/
Chicago Streets for Cycling Plan 2020	http://www.cityofchicago.org/content/dam/city/depts/cdot/bike/general/ChicagoStreetsforCycling2020.pdf
Portland	
Portland Bicycle Plan for 2030	http://www.portlandoregon.gov/transportation/article/289122
Portland Bicycle Plan for 2030: One-Year Progress Report	http://www.portlandoregon.gov/transportation/article/345419
Real Solutions to Traffic Safety Problems	https://www.portlandoregon.gov/transportation/article/299189
Traffic Safety Resources	https://www.portlandoregon.gov/transportation/55303
Vision Zero	https://www.portlandoregon.gov/transportation/article/518952
Seattle	
2012 Action Agenda: Laying the Groundwork	http://www.seattle.gov/transportation/docs/SDOTActionAgenda2812.pdf
Action Agenda: 2013 Progress Report	http://www.seattle.gov/transportation/docs/SDOTActionAgendatProgRep_2013-01.pdf
Pedestrian Master Plan: Implementation Overview	http://www.seattle.gov/transportation/pedestrian_masterplan/pmp_implementation.htm
Vision Zero: Seattle's Plan to End Traffic Deaths and Serious Injuries by 2030	http://www.seattle.gov/visionzero

(continued)

TABLE 2 *(continued)* **Matrix Sources**

Document	Link
Washington, D.C.	
District DOT: Safety Programs Overview	http://ddot.dc.gov/page/safety-programs
District of Columbia Bicycle Master Plan	http://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/bicycle_master_plan_2005_final_document_0.pdf
District of Columbia Pedestrian Master Plan	http://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/pedestrianmasterplan_2009.pdf
District of Columbia Strategic Highway Safety Plan	http://www.ddot-hso.com/ddot/hso/documents/Publications/SHSP/2014/DDOT%20SHSP%20-%20October%202014.pdf
Toward Zero Deaths website	http://www.towardzerodeathsdc.com/
Boston	
Access Boston 2000–2010: Boston's Citywide Transportation Plan	http://www.cityofboston.gov/transportation/accessboston/default.asp
Boston Bicycle Plan	http://www.cityofboston.gov/transportation/accessboston/pdfs/bicycle_plan.pdf
Boston Bike Network Plan	http://www.cityofboston.gov/images_documents/Boston%20Bike%20Network%20Plan%2C%20Fall%202013_FINAL_tcm3-40525.pdf
Boston Bikes	http://www.cityofboston.gov/bikes/
Boston Cyclist Safety Report	http://www.cityofboston.gov/images_documents/Crash%20Report%202013%20FINAL%20reduced%202_tcm3-38304.pdf
City of Boston–Transportation	http://www.cityofboston.gov/transportation/
Pedestrian Safety Guidelines For Residential Streets	http://www.cityofboston.gov/transportation/accessboston/pdfs/pedestrian_safety_guidelines.pdf
Update on Safety Efforts in Boston	http://www.bostonglobe.com/metro/2013/03/18/boston-launches-traffic-safety-initiative-along-busy-commonwealth-ave/rpIzq1bJTz8LuxvALlu0UJ/story.html
Los Angeles	
2010 Bicycle Plan	http://planning.lacity.org/cwd/gnlpln/transelt/NewBikePlan/Txt/LA%20CITY%20BICYCLE%20PLAN.pdf
Greater Streets for Los Angeles Strategic Plan	http://www.smartgrowthamerica.org/documents/cs/impl/ca-losangeles-dot-strategicplan2014.pdf
LA DOT Bicycle Services	http://bicyclela.org/
LA DOT Safety	http://www.ladot.lacity.org/WhatWeDo/Safety/index.htm
Traffic Study Policies and Procedures	http://ladot.lacity.org/stellent/groups/departments/@ladot_contributor/documents/contributor_web_content/lacityp_026875.pdf
Watch the Road	http://www.watchtheroad.org/
Sweden	
Achieving Traffic Safety Goals in the United States: Lessons from Other Nations	http://onlinepubs.trb.org/onlinepubs/sr/sr300.pdf
An Independent Review of Road Safety in Sweden	http://publikationswebbutik.vv.se/upload/4314/2008_109_an_independent_review_of_road_safety_in_sweden.pdf
International Transport Forum: Road Safety Annual Report 2014	http://www.internationaltransportforum.org/pub/pdf/14IrtadReport.pdf
Management by Objectives for Road Safety Work Stakeholder Collaboration Towards New Interim Targets 2020	http://publikationswebbutik.vv.se/upload/4253/89217_management_by_objectives_for_road_safety_work_stakeholder_collaboration_towards_new_interim_targets_2020_summary.pdf
Urban Mobility Strategy	http://international.stockholm.se/globalassets/ovriga-bilder-och-filer/urban-mobility-strategy.pdf
The Netherlands	
Advancing Sustainable Safety: National Road Safety Outlook for 2005–2020	http://www.swov.nl/rapport/dmdv/Advancing_sustainable_safety.pdf
Cycling in the Netherlands	http://www.fietsberaad.nl/library/repository/bestanden/CyclingintheNetherlands2009.pdf
International Transport Forum: Road Safety Annual Report 2014	http://www.internationaltransportforum.org/pub/pdf/14IrtadReport.pdf
Road Safety Strategic Plan: 2008–2020	http://www.fietsberaad.nl/library/repository/bestanden/5a_Philippens_ICSC2012.pdf
Signalized Intersection Safety in Europe	http://international.fhwa.dot.gov/pubs/pl03020/pl03020.pdf
Sustainable Safety	http://www.fietsberaad.nl/index.cfm?lang=en&section=kennisbank&mode=list&kennisbankPage=Categorisering+en+fietsen+in+verblijfsgebieden

(continued on next page)

TABLE 2 *(continued)* **Matrix Sources**

Document	Link
London	
Intelligent Pedestrian Technology	http://www.tfl.gov.uk/info-for/media/press-releases/2014/march/tfl-to-launch-worldleading-trials-of-intelligent-pedestrian-technology-to-make-crossing-the-road-easier-and-safer
The Mayor's Vision for Cycling in London	http://www.tfl.gov.uk/cdn/static/cms/documents/gla-mayors-cycle-vision-2013.pdf
Lorry Drivers Have No More Excuses When It Comes to Cycling Blind Spots	http://www.theguardian.com/environment/green-living-blog/2010/aug/02/hgv-lorries-cycling-campaign
Pedestrian Safety Action Plan	http://www.tfl.gov.uk/cdn/static/cms/documents/pedestrian-safety-action-plan.pdf
Plans for New Out-of-Hours Delivery Trials	http://www.tfl.gov.uk/info-for/media/news-articles/plans-for-new-outofhours-delivery-trials
Puffin Crossing Study	http://www.trl.co.uk/reports-publications/trl-reports/traffic-management/report/?reportid=6680
Safe Streets for London: The Road Safety Action Plan for London 2020	https://www.tfl.gov.uk/cdn/static/cms/documents/safe-streets-for-london.pdf
Safer Lorries Scheme	http://www.tfl.gov.uk/info-for/media/press-releases/2014/july/safer-lorries-scheme-consultation
Trial of Roadside Safety Mirrors for Cycle Visibility	https://www.tfl.gov.uk/cdn/static/cms/documents/trial-of-roadside-safety-mirrors-for-cycle-visibility-report.pdf
Supplemental Efficacy Sources	
Section 1. Supportive infrastructure and Planning	
1.1 Safety Action Plan (Vision Zero) and Strategy	
Health in All Policies: A Guide for State and Local Governments	Rudolph et al. (*22*)
Health in All Policies: Taking Stock of Emerging Practices to Incorporate Health in Decision Making in the United States	Gase, L.N., R. Pennotti, and K.D. Smith. Health in All Policies: Taking Stock of Emerging Practices to Incorporate Health in Decision Making in the United States. *Journal of Public Health Management and Practice,* Vol. 19, No. 6, 2013, pp. 529–540.
1.2 Vision Zero Policy (or Vision Zero–like policy)	
Towards Zero: Ambitious Road Safety Targets and the Safe System Approach	Organisation for Economic Co-operation and Development/International Transportation Forum. *Towards Zero: Ambitious Road Safety Targets and the Safe System Approach.* OECD Publishing, Paris, 2008.
The Vision Thing: Actors, Decision-Making, and Lock-In Effects in Swedish Road Safety Policy Since the 1990s	Andersson, F., and T. Pettersson. *The Vision Thing: Actors, Decision Making, and Lock-In Effects in Swedish Road Safety Policy Since the 1990s*. Umeå, Sweden, Umeå Universitetet, 2008.
1.3 Vision Zero Steering Committee	
Governance Tools and Framework for Heath in All Policies	St-Pierre, L. Governance Tools and Framework for Heath in All Policies. National Collaborating Centre for Healthy Public Policy. http://www.ci.richmond.ca.us/DocumentCenter/Home/View/9047.
Section 2. Engineering	
2.1a Informative signage: advisory or cautionary signs (e.g., "State law: stop for pedestrians"; "high bicycle activity zone")	
Evaluation of Pedestrian-Related Roadway Measures: A Summary of Available Research	Mead, J., C. Zegeer, and M. Bushell. *Evaluation of Pedestrian-Related Roadway Measures: A Summary of Available Research.* Pedestrian and Bicycle Information Center, Chapel Hill, N.C., April 2013.
2.1b Informative signage: dynamic message signs with safety messaging	
Effectiveness of Safety and Public Service Announcement Messages on Dynamic Message Signs	Federal Highway Administration. *Effectiveness of Safety and Public Service Announcement Messages on Dynamic Message Signs.* Publication FHWA-HOP-14-015. FHWA, U.S. Department of Transportation, 2014.
2.2 Perform engineering reviews at all traffic fatality and high collision locations and at scenes of crashes	
Highway Safety Improvement Program Manual	Federal Highway Administration. *Highway Safety Improvement Program Manual.* Publication FHWA-SA-09-029. FHWA, U.S. Department of Transportation, 2010.
Road Safety as a Shared Responsibility and a Public Problem in Swedish Road Safety Policy	McAndrews (*7*).
Presentation at Workshop on Independent and Transparent Accident Investigation Recommendations	Bergfalk, L. Presentation at Workshop on Independent and Transparent Accident Investigation Recommendations, Brussels, 2007. http://erso.swov.nl/safetynet/fixed/WP4/Workshop_3_2007/sn_wp4_Brussels_WSguest4_SwedishTrafficInspectorate_LB.pdf.
2.3b Restrictions on street access: restrict car access in the city center	
Green Light for Midtown Evaluation Report	http://www.nyc.gov/html/dot/downloads/pdf/broadway_report_final2010_web.pdf
Vehicle Restrictions: Limiting Automobile Travel at Certain Times and Places	http://www.vtpi.org/tdm/tdm33.htm.

(continued)

TABLE 2 *(continued)* **Matrix Sources**

Document	Link
2.4 Shared-space area for cars, bicyclists, and pedestrians	
Lesson 20: Traffic Calming	U.S. Department of Transportation. *Lesson 20: Traffic Calming.* July 2006. http://www.fhwa.dot.gov/publications/research/safety/pedbike/05085/pdf/lesson20lo.pdf.
2.5b Signal hardware additions: pedestrian countdown signal	
2.8h Road design and maintenance: restrict parking near intersections (aka "daylighting")	
Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes	Federal Highway Administration (*17*).
2.7b Slow zone: senior slow/safety zones	
2.7c Slow zones around schools/local streets	
Safe Streets for Seniors	http://www.nyc.gov/html/dot/html/pedestrians/safeseniors.shtml.
Neighborhood Slow Zones	http://www.nyc.gov/html/dot/html/motorist/slowzones.shtml.
Slow Zones: Their Impact on Mode Choices and Travel Behaviour	O'Fallon, C., and C. Sullivan. Slow Zones: Their Impact on Mode Choices and Travel Behaviour. *Research Report 438*, NZ Transport Agency, 2011.
2.8a Road design and maintenance: Advance stop or yield lines	
2.8c Road design and maintenance: high visibility crosswalk	
Achieving Vision Zero: A Data-Driven Investment Strategy for Eliminating Pedestrian Fatalities on a Citywide Level	Kronenberg, C., L. Woodard, B. DuBose, and D. Weissman. Achieving Vision Zero: Data-Driven Investment Strategy to Eliminate Pedestrian Fatalities on a Citywide Level. In *Transportation Research Record: Journal of the Transportation Research Board, No. 2519,* Transportation Research Board, Washington D.C., 2015, pp. 146–156.
2.8b Road design and maintenance: enhanced sharrow marking	
Evaluation of Bicycle-Related Roadway Measures: A Summary of Available Research	Mead, J., A. McGrane, C. Zegeer, and L. Thomas. *Evaluation of Bicycle-Related Roadway Measures: A Summary of Available Research.* Pedestrian and Bicycle Information Center, Chapel Hill, N.C., February 2014.
Section 3. Education	
3.2 Educate state level organizations on city actions and Vision Zero commitments to broaden understanding of Vision Zero's impact on pedestrian/bike/traffic fatalities and injuries	
Road Safety as a Shared Responsibility and a Public Problem in Swedish Road Safety Policy	McAndrews (*7*).
Health In All Policies: A Guide for State and Local Governments	Rudolph et al. (*22*).
3.3 Engage with community-based organizations and advocates	
Health in All Policies: A Guide For State and Local Governments	Rudolph et al. (*22*).
3.10 Training for senior citizens on walking and biking	
Safe Routes for Seniors: Improving Walkability for Seniors in New York City	Shin-pei, T. Safe Routes for Seniors: Improving Walkability for Seniors in New York City. http://activelivingresearch.org/safe-routes-seniors-improving-walkability-seniors-new-york-city.
Evaluation of the Walkable Neighborhoods for Seniors Project in Sacramento County	Hooker, S.P., L.A. Cirill, and A. Geraghty. Evaluation of the Walkable Neighborhoods for Seniors Project in Sacramento County. *Health Promotion Practice,* Vol. 10, No. 3, 2011, pp. 402–410.
Section 4. Enforcement	
4.1e Automated enforcement: point to point camera	
Effects of Average Speed Enforcement on Speed Compliance and Crashes: A Review of the Literature	Soole, D.W., B.C. Watson, and J.J. Fleiter. Effects of Average Speed Enforcement on Speed Compliance and Crashes: A Review of the Literature. *Accident Analysis and Prevention,* Vol. 51, 2013, pp. 46–56.
Austroads Research Report: Point to Point Speed Enforcement	Soole, D.W., J. Fleiter, and B. Watson. *Austroads Research Report: Point to Point Speed Enforcement*. Publication AP-R415-12. Centre of Accident Research and Road Safety, Sydney, New South Wales, Australia, 2012.
4.2 Convene regular meetings of transportation leaders and the police department to review traffic safety performance and determine strategies for improvement	
Road Safety in the Context of Urban Development in Sweden and California	McAndrews, C. *Road Safety in the Context of Urban Development in Sweden and California*. University of California, Berkeley, City and Regional Planning, 2010.
Country Guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms	Bliss, T., and J. Breen. *Country Guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms.* World Bank Global Road Safety Facility, Washington, D.C., 2009.
4.6 Investigate crashes that result in fatalities as well as crashes that result in critical injuries	
Independent Review of Road Safety in Sweden	Breen, J., E. Howard, and T. Bliss. *Independent Review of Road Safety in Sweden,* 2008.
Presentation at Workshop on Independent and Transparent Accident Investigation Recommendations	Bergfalk, L. Presentation at Workshop on Independent and Transparent Accident Investigation Recommendations, Brussels, 2007. http://erso.swov.nl/safetynet/fixed/WP4/Workshop_3_2007/sn_wp4_Brussels_WSguest4_SwedishTrafficInspectorate_LB.pdf.

(continued on next page)

TABLE 2 *(continued)* **Matrix Sources**

Document	Link
4.7 Random breath testing	
A National Examination of Random Breath Testing and Alcohol-Related Traffic Crash Rates	Ferris, J., L. Mazerolle, M. King, L. Bates, S. Bennett, and M. Devaney. Random Breath Testing in Queensland and Western Australia: Examination of How the Random Breath Testing Rate Influences Alcohol Related Traffic Crash Rates. *Accident Analysis and Prevention,* Vol. 60, 2013, pp. 181–188.
Random Breath Testing: A Canadian Perspective	Solomon, R., E. Chamberlain, M. Abdoullaeva, and B. Tinholt. Random Breath Testing: A Canadian Perspective. *Traffic Injury Prevention,* Vol. 12, No. 2, 2011, pp. 111–119.
4.8 Update technology that assists with capturing crash data and/or speed detection	
Data Systems: A Road Safety Manual for Decision-Makers and Practitioners	World Health Organization. *Data Systems: A Road Safety Manual for Decision-Makers and Practitioners,* 2010. http://apps.who.int/iris/bitstream/10665/44256/1/9789241598965_eng.pdf.
Section 5. Monitoring, analysis, and evaluation	
5.1 Comparative data system linking social and environment factors with injury data	
5.6 Publish citywide collision report	
Data Systems: A Road Safety Manual for Decision-Makers and Practitioners	World Health Organization. *Data Systems: A Road Safety Manual for Decision-Makers and Practitioners,* 2010. http://apps.who.int/iris/bitstream/10665/44256/1/9789241598965_eng.pdf.
5.2 Continual, proactive monitoring and feedback gathering from the community on their safety issues and concerns	
Pedestrian Safety: A Road Safety Manual for Decision Makers and Practitioners.	World Health Organization. *Pedestrian Safety: A Road Safety Manual for Decision Makers and Practitioners.* World Health Organization, Geneva, 2013.
5.3 Engage in public health surveillance on traffic-related hospitalizations and fatalities	
Data Systems: A Road Safety Manual for Decision Makers and Practitioners	World Health Organization. *Data Systems: A Road Safety Manual for Decision Makers and Practitioners,* 2010. http://apps.who.int/iris/bitstream/10665/44256/1/9789241598965_eng.pdf.
Review of Swedish Experiences Concerning Analysis of People Injured in Traffic Accidents	Howard, C., and A. Linder. *Review of Swedish Experiences Concerning Analysis of People Injured in Traffic Accidents*, 2013. https://www.vti.se/en/publications/pdf/review-of-swedish-experiences-concerning-analysis-of-people-injured-in-traffic-accidents.pdf.
5.4 Independent review/audit of safety program	
Independent Review of Road Safety in Sweden	Breen, J., E. Howard, and T. Bliss. *Independent Review of Road Safety in Sweden,* 2008.
Evaluating the Effectiveness of State Toward Zero Deaths Program	Munnich et al. (*11*).
NCHRP Synthesis of Highway Practice 336: Road Safety Audits	Wilson, E. M., and M. E. Lipinski. *NCHRP Synthesis of Highway Practice 336: Road Safety Audits.* Transportation Research Board of the National Academies, Washington, D.C., 2004.
5.5 Interagency sharing of collision and other key data	
Road Safety as a Shared Responsibility and a Public Problem in Swedish Road Safety Policy	McAndrews (*7*).
Data Systems: A Road Safety Manual for Decision Makers and Practitioners	World Health Organization. *Data Systems: A Road Safety Manual for Decision-Makers and Practitioners.* 2010. http://apps.who.int/iris/bitstream/10665/44256/1/9789241598965_eng.pdf.
5.7 Routine evaluation of effectiveness of traffic safety interventions	
Presentation at Workshop on Independent and Transparent Accident Investigation Recommendations	Bergfalk, L. Presentation at Workshop on Independent and Transparent Accident Investigation Recommendations, Brussels, 2007. http://erso.swov.nl/safetynet/fixed/WP4/Workshop_3_2007/sn_wp4_Brussels_WSguest4_SwedishTrafficInspectorate_LB.pdf.
Road Safety Inspections: Best Practice and Implementation Plan	European Road Safety Observatory. *Road Safety Inspections: Best Practice and Implementation Plan*. http://ec.europa.eu/transport/wcm/road_safety/erso/knowledge/Content/70_qrst/monitoring_targets.htm.
Policy Instruments for Managing Road Safety on EU-Roads	Laurinavicius, A., L. Juknevičiūtė-Zilinskienė, K. Ratkevičiūtė, I. Lingytė, L. Cygaitė, V. Grigonis, R. Ušpalytė-Vitkūnienė, D. Antov, T. Metsvahi, Z. Toth-Szabo, and A. Varhely. Policy Instruments for Managing Road Safety on EU-Roads. *Transport,* Vol. 27, No. 4, 2012, pp. 397–404.
5.8 Website with relevant safety data collected in a timely manner	
What Do the Best Government Websites of 2015 Have in Common?	Wood, C., S. Towns, N. Knell, and J. Mulholland. What Do the Best Government Websites of 2015 Have in Common? *Government Technology*, September 2015. http://www.govtech.com/internet/2015-Best-of-the-Web-Award-Winners-Announced.html.
Using Technology to Promote Transparency in City Government	Pulidindi, J. *Using Technology to Promote Transparency in City Government*. National League of Cities, Washington, D.C., 2010.
Section 6. Policy	
6.1 Measures to reduce traffic volumes	
Traffic Accidents and the London Congestion Charge	Green, C. P., J. S. Heywood, and M. Navarro. *Traffic Accidents and the London Congestion Charge.* Economics Working Paper Series, Lancaster University Management School, 2014.

(continued)

TABLE 2 *(continued)* **Matrix Sources**

Document	Link
6.5 Pre-pay for morning parking to discourage drinking and driving	
Overnight options	Estey, M. Overnight Options. *International Parking Institute,* November 2015. http://www.parking.org/media/320165/prepaid%20parking%20in%20seattle.pdf.
Successful Pre-Paid Parking Program Saves Lives	http://sdotblog.seattle.gov/2013/03/18/successful-pre-paid-parking-program-saves-lives/.
6.6 Restrict deliveries to off peak hours to remove trucks from the busiest streets to improve road safety and ease congestion	
Delivering a Road Freight Legacy: Working Together for Safer, Greener and More Efficient Deliveries in London	Transport for London. Delivering a Road Freight Legacy: Working Together for Safer, Greener and More Efficient Deliveries in London. 2013. http://content.tfl.gov.uk/delivering-a-road-freight-legacy.pdf.
SWOV Fact Sheet: Blind Spot Crashes	SWOV Institute for Road Safety. SWOV Fact Sheet: Blind Spot Crashes. https://www.swov.nl/rapport/Factsheets/UK/FS_Blind_spot_crashes.pdf.
6.7b Policies targeted at protecting vulnerable users: illegal to harass (threaten verbally or physically) a vulnerable user	
Good Intentions: The Enforcement of Hate Crime Penalty-Enhancement Statutes.	Franklin, K. Good Intentions: The Enforcement of Hate Crime Penalty-Enhancement Statutes. *American Behavioral Scientist,* Vol. 46, No. 1, 2002, pp. 154–172.
Improving Road Safety Through Deterrence-Based Initiatives: A Review of Research	Davey, J.D., and J.E. Freeman. Improving Road Safety Through Deterrence-Based Initiatives: A Review of Research. *Sultan Qaboos University Medical Journal,* Vol. 11, No. 1, 2011, pp. 29–37.
6.8 Target safety improvements to school areas	
Healthy Urban Environments for Children and Young People: A Systematic Review of Intervention Studies	Audrey, S., and H. Batista-Ferrer. Healthy Urban Environments for Children and Young People: A Systematic Review of Intervention Studies. *Health and Place,* Vol. 36, 2015, pp. 97–117.
Effectiveness of a Safe Routes to School Program in Preventing School-Aged Pedestrian Injury	DiMaggio, C., and L. Guohua. Effectiveness of a Safe Routes to School Program in Preventing School-Aged Pedestrian Injury. *Pediatrics,* Vol. 131, No. 2, 2013, pp. 290–296.
6.11b State level policies targeted at protecting vulnerable users: mandatory for cars to give at least three feet of clearance when passing a bicycle in the same lane (aka "three-foot rule")	
Is the Three-Foot Bicycle Passing Law Working in Baltimore, Maryland?	Love, D.C., A. Breaud, S. Burns, J. Margulies, M. Romano, and R. Lawrence. Is the Three-Foot Bicycle Passing Law Working in Baltimore, Maryland? *Accident Analysis and Prevention,* Vol. 48, 2012, pp. 451–456.
The 3-ft. Law: Lessons Learned from a National Analysis of State Policy and Expert Interviews	Brown, C. *The 3-ft. Law: Lessons Learned From a National Analysis of State Policy and Expert Interviews*. New Jersey Bicycle and Pedestrian Resource Center. http://njbikeped.org/wp-content/uploads/2013/04/3-Foot-Final-Report-Draft_V7.pdf.
6.11d State level policies targeted at protecting vulnerable users: vulnerable user law	
Is It Time to Advocate for a Vulnerable Road User Protection Law in New Zealand?	Weiss, H., and A. Ward. Is it Time to Advocate for a Vulnerable Road User Protection Law in New Zealand? *New Zealand Medical Journal,* Vol. 126, No. 1374, 2013, pp. 5–10.
The Deterrent Effect of Increasing Fixed Penalties for Traffic Offences: The Norwegian Experience	Elvik, R., and P. Christensen. The Deterrent Effect of Increasing Fixed Penalties for Traffic Offences: The Norwegian Experience. *Journal of Safety Research,* Vol. 38, No. 6, 2007, pp. 689–695.
6.14 Lower alcohol limit	
Reaching Zero: Actions to Eliminate Alcohol-Impaired Driving	National Transportation Safety Board. *Reaching Zero: Actions to Eliminate Alcohol-Impaired Driving*. Safety Report NTSB/SR-13/01. NTSB, Washington, D.C., 2013.
The Effects of Introducing or Lowering Legal per se Blood Alcohol Limits For Driving: An International Review.	Mann, R.E., S. Macdonald, G. Stoduto, S. Bondy, B. Jonah, and A. Shaikh. The Effects of Introducing or Lowering Legal per se Blood Alcohol Limits for Driving: An International Review. *Accident Analysis and Prevention,* Vol. 33, No. 5, 2001, pp. 569–583.
Section 7. Large vehicles	
7.1 Heavy goods and large vehicle task force to suggest safety improvements and monitor regulations	
Industrial HGV task Force Review of First Six Months of Operations	Transport for London. *Industrial HGV Task Force Review of First Six Months of Operations*. http://democracy.cityoflondon.gov.uk/documents/s37699/Road%20Safety-%20Casualties%20and%20Collisions-%20Appendix.pdf.
7.4 Outfit large vehicles with front and side mirrors to improve visibility	
Truck Mirrors, Fields of View, and Serious Truck Crashes	Blower, D.F. *Truck Mirrors, Fields of View, and Serious Truck Crashes*. Publication UMTRI-2007-25. University of Michigan Transportation Research Institute, Ann Arbor, 2007.
7.5 Outfit large vehicles with rear wheel and side guards	
Truck Sideguards for Vision Zero: Review and Technical Recommendations for Safe Fleet Transition Plan Pilot Deployment	Epstein, A.K., S. Peirce, A. Breck, C. Cooper, and E. Segev. Truck Sideguards for Vision Zero: Review and Technical Recommendations for Safe Fleet Transition Plan Pilot Deployment. Publication DOT-VNTSC-DCAS-14-01. U.S. Department of Transportation, Cambridge, Mass., John A. Volpe National Transportation Systems Center, 2014.
Section 8. Vehicle technology	
8.3 Intelligent speed adaption technologies that alert or slow the vehicle if traveling over the speed limit	
Is Intelligent Speed Adaptation Ready for Deployment?	Carsten, O. Is Intelligent Speed Adaptation Ready for Deployment? *Accident Analysis and Prevention,* Vol. 48, 2012, pp. 1–3.

(continued on next page)

TABLE 2 *(continued)* **Matrix Sources**

Document	Link
How Much Benefit Does Intelligent Speed Adaptation Deliver: An Analysis of Its Potential Contribution to Safety and Environment.	Lai, F., O. Carsten, and F. Tate. How Much Benefit Does Intelligent Speed Adaptation Deliver: An Analysis of its Potential Contribution to Safety and Environment. *Accident Analysis and Prevention,* Vol. 48, 2012, pp. 63–72.
8.5 Partner with industry groups and vehicle manufacturers to further the use of technology to achieve safety aims	
Vision Zero: Adopting a Target of Zero for Road Traffic Fatalities and Serious Injuries	Whitelegg and Haq (*6*).
Road Safety: Impact of New Technologies	Organisation for Economic Co-operation and Development. *Road Safety: Impact of New Technologies,* 2003. http://www.internationaltransportforum.org/Pub/pdf/03SRnewTech.pdf.
Section 9. Taxi services and transportation network company	
9.2 Black box data recorders in taxis	
Vehicle Safety Technology Pilot Program	http://www.nyc.gov/html/tlc/html/industry/veh_safety_tech_pilot_program.shtml.
Driver Characteristic Using Driving Monitoring Recorder	Ueyama, M. J. Driver Characteristic Using Driving Monitoring Recorder. *Proceedings of the 17th International Technical Conference on the Enhanced Safety of Vehicles Conference,* June 4–7, 2001, Amsterdam, Netherlands. June 2001.
9.3 Increase late-night taxi stand zones	
Overnight Options	Estey, M. Overnight Options. *International Parking Institute,* November 2015. http://www.parking.org/media/320165/prepaid%20parking%20in%20seattle.pdf.

To support accuracy, each city and country that was included in the matrix reviewed its entries. Cities designated a reviewer, typically their Vision Zero lead or safety expert. Reviews took place from May to July 2015, and 11 of 12 cities or countries initially included in the analysis participated. The representative from Australia opted to not review the Traffic Safety Best Practices Matrix because he felt there was too much variation among cities to make an assessment at the country level. As a result, Australia was removed from the final version of the matrix. Reviewers were contacted via email and were sent a copy of the matrix that included data for their jurisdiction only with a column titled review and a column titled comments as well as a letter that explained the purpose of the project. Reviewers were instructed to indicate if a measure erroneously received a checkmark (i.e., their city was not in fact pursing or considering the measure) by placing an X in the review column and to indicate if a measure was missing a checkmark (i.e., their city was in fact pursuing or considering the measure) by placing a √ in the review column; to indicate that a measure was accurate, reviewers were asked to leave the review column blank. The matrix was then revised to reflect reviewer feedback.

The majority of reviewers corrected some measures and expressed either an eagerness to use the matrix to further their efforts or were neutral toward the exercise. One region initially identified is not represented in the matrix, for the primary contact opted to not participate because of too much variation between cities to make an assessment at a regional level; the region was thus removed from the matrix.

DISCUSSION OF RESULTS

The Traffic Safety Best Practices Matrix (Figure 1) lists measures that cities in the United States and cities and countries abroad are pursuing as of May 2015 to reduce pedestrian-, bicycle-, and traffic-related injuries and fatalities. Also included for each measure are efficacy designations based on existing evidence. Table 2 provides a list of the sources used for the review.

Big cities across the United States, in adopting Vision Zero, are leading efforts to reframe the way in which traffic safety is viewed and managed. While this effort is commendable, and speaks to the role of cities as catalysts for change, cities are doing so without much guidance as to what Vision Zero is and what actions could be implemented to reach zero deaths. The Traffic Safety Best Practices Matrix attempts to bridge this gap by presenting a framework for cities to understand and identify potential strategies for Vision Zero implementation. The discussion details the ways in which the matrix can assist jurisdictions in identifying the range of tools available to them to reduce severe and fatal collisions and further the Vision Zero movement. In addition, the discussion includes an analysis of the matrix throughout which are recommendations for implementation that are supported by lessons learned from Vision Zero implementation abroad, as well as insights from other fields.

Uses of the Matrix

Strategy Identification

To move the needle on Vision Zero further and faster, cities need to understand the Vision Zero landscape and be able to share best practices in real time. The matrix can help cities understand the range of levers available to advance the safety platform. The measures listed in the matrix, organized by categories, can help cities understand the breadth of strategies available while also providing a structure for strategy organization. This aspect of the matrix can be especially useful for cities considering implementing the policy.

This is not to suggest that there is only one way to implement Vision Zero. Sweden and the Netherlands, for example, have the longest and most well-established safe system approach; yet they differ in how they articulate the safety platform. Sweden's Vision Zero has focused on issues of rural transportation safety, while the Netherlands has focused on pedestrian and bicycle safety in urban areas (*15*). Both have achieved great success in their efforts (*16*). That said, Sweden, as it is the birthplace of Vision Zero, is looked to as providing the blueprint for Vision Zero implementation. Nonetheless, it is inevitable—and appropriate as informed by analysis of safety issues and crash patterns in specific jurisdictions—that the safety measures advanced in the United States will deviate from those of Sweden (and the Netherlands, and other counties that have for some time pursued a systems approach to road safety).

Traffic Safety Best Practices	SF	NYC	Chicago	Portland	Seattle	DC	Boston	LA	Sweden	Netherlands	London	Efficacy
	Domestic								International			
1. Supportive infrastructure/ Planning												
1.1 Safety Action Plan (Vision Zero)/ Strategy	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	R, LIT
1.2 Vision Zero Policy (or VZ like policy)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, LIT
1.3 Vision Zero Steering Committee	✓	✓		✓	✓	✓	✓	✓		✓	✓	R, LIT
2. Engineering												
2.1 Informative signage												
a. Advisory/cautionary signs (e.g. "State Law: Stop for Pedestrians"; "High Bicycle Activity Zone")	✓		✓	✓	✓	✓					✓	R, LIT
b. Dynamic message signs with safety messaging	✓	✓	✓		✓	✓		✓	✓	✓	✓	R, LIT
c. Remove unnecessary and/or confusing signage		✓		✓	✓	✓				✓	✓	R, NCHRP
d. Speed indicator signs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, NCHRP
2.2 Perform engineering reviews at all traffic fatality and high collision locations and at scenes of crashes	✓	✓	✓		✓		✓		✓	✓	✓	R, LIT
2.3 Restrictions on street access												
a. Pedestrian only streets		✓		✓		✓	✓			✓	✓	R, NCHRP
b. Restrict car access in the city center	✓								✓	✓	✓	R, LIT
2.4 Shared-space area for cars, bicyclists and pedestrians	✓		✓	✓			✓		✓	✓	✓	R, LIT
2.5 Signal hardware additions												
a. Bicycle signals	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	R, NCHRP
b. Pedestrian countdown signals	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	P, LIT
c. Hawk signal	✓			✓		✓						R, CMF
d. Protected turns (turn pockets & signal phasing)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, CMF
e. Puffin Crossing											✓	R, CMF
f. Rapid flash beacons	✓		✓	✓	✓	✓		✓				R, CMF
2.6 Signal hardware uses												
a. Leading bike interval	✓	✓	✓		✓	✓			✓	✓	✓	R, NCHRP
b. Leading pedestrian interval	✓	✓	✓	✓	✓	✓	✓	✓		✓		R, CMF
c. Pedestrian scrambles (exclusive pedestrian phase)	✓	✓	✓		✓	✓		✓			✓	U, CMF
2.7 Slow Zones												
a. Arterial slow zones	✓	✓	✓	✓	✓				✓	✓	✓	U
b. Senior slow/safety zones	✓	✓			✓		✓					P, LIT
c. Slow zones around schools/ local streets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	P, LIT
2.8 Road design												
a. Advance stop or yield lines	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	R, LIT
b. Enhanced sharrow markings	✓	✓	✓	✓			✓					R, LIT
c. High visibility crosswalk (continental crosswalk)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	P, LIT
d. Increase street lighting to improve visibility in high crash locations	✓	✓	✓	✓	✓	✓		✓			✓	R, CMF
e. Lane narrowing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, NCHRP
f. Pedestrian refuge islands and medians	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	R, NCHRP
g. Separated bike lanes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, CMF
h. Restrict parking near intersections (aka "daylighting")	✓	✓	✓			✓		✓		✓	✓	P, LIT
i. Road diet	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	P, CTW
j. Roundabouts	✓			✓	✓	✓		✓	✓	✓	✓	P, NCHRP
k. Speed humps, chicanes, diagonal parking, bulb outs, raised crosswalks (general traffic calming measures)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	P, NCHRP
3. Education												
3.1 Bike and safety/crosswalk ambassadors	✓	✓	✓	✓	✓	✓		✓		✓	✓	U, CTW
3.2 Educate state level organizations on city actions and Vision Zero commitments to broaden understanding of Vision Zero's impact on pedestrian/bike/traffic fatalities and injuries	✓	✓		✓	✓	NA	✓		✓	✓	✓	R, LIT
3.3 Engage with community based organizations and advocates	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, LIT
3.4 Helmet focused education	✓	✓	✓	✓	✓		✓	✓	✓		✓	U, CTW
3.5 Mass media/communication education campaign focused on pedestrian awareness, bike safety, and/or speeding	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	R, NCHRP
3.6 Measures to increase the conspicuousness of bicyclists (e.g. promotion of reflector vests, lights, etc.)	✓	✓	✓	✓	✓	✓			✓	✓	✓	R, CTW
3.7 Outreach to schools to educate students on bike/pedestrian/traffic safety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, CTW
3.8 Targeted education/outreach to high priority areas	✓	✓	✓	✓	✓	✓		✓			✓	R, NCHRP
3.9 Train city staff on Vision Zero safety priorities	✓	✓		✓	✓		✓	✓			✓	R, NCHRP
3.10 Trainings for senior citizens on walking and biking	✓	✓	✓			✓				✓		R, LIT
3.11 Update officer trainings to reflect new safety priorities and regularly conduct trainings	✓	✓	✓	✓	✓	✓	✓	✓			✓	R, NCHRP
3.12 Website dedicated to bike/pedestrian/traffic safety issues and concerns	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, LIT
4. Enforcement												
4.1 Automated enforcement												
a. Block the box camera						✓					✓	U
b. Failure-to-yield crosswalk camera						✓				✓		U
c. Illegal turn camera												U
d. Oversize vehicle camera						✓					✓	U
e. Point to point camera											✓	P, LIT
f. Red light camera	✓	✓	✓	✓	✓	✓		✓		✓	✓	P, NCHRP
g. Speed camera	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	P, CTW
4.2 Convene regular meetings of transportation leaders and the police department to review traffic safety performance and determine strategies for improvement	✓	✓	✓		✓		✓		✓		✓	R, LIT
4.3 DUI checkpoints	✓	✓	✓			✓		✓	✓		✓	P, NCHRP
4.4 High visibility enforcement	✓	✓	✓		✓	✓	✓				✓	P, NCHRP
4.5 Increase enforcement against dangerous moving violations (speeding, failing to yield to pedestrians, signal violations, improper turns/illegal turns, phoning/texting while driving)	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	R, CTW
4.6 Investigate crashes that result in fatalities as well as crashes that result in critical injuries	✓	✓	✓		✓				✓	✓		R, LIT
4.7 Random breath testing									✓	✓		P, LIT
4.8 Update technology that assists with capturing crash data and/or speed detection	✓	✓						✓			✓	R, LIT

(a)

FIGURE 1 Traffic Safety Best Practices Matrix (SF = San Francisco; NYC = New York City; DC = Washington, D.C.; LA = Los Angeles).

(continued on next page)

Traffic Safety Best Practices	SF	NYC	Chicago	Portland	Seattle	DC	Boston	LA	Sweden	Netherlands	London	Efficacy
	Domestic								International			
5. Monitoring, Analysis, and Evaluation												
5. 1 Comparative data system linking social and environment factors with injury data	✓	✓					✓	✓			✓	P, LIT
5. 2 Continual, proactive monitoring and feedback gathering from the community on their safety issues and concerns	✓	✓	✓		✓		✓			✓	✓	R, LIT
5.3 Engage in public health surveillance on traffic-related hospitalizations and fatalities	✓	✓	✓		✓		✓		✓	✓	✓	P, LIT
5.4 Independent review/audit of safety program									✓	✓	✓	R, LIT
5.5 Interagency sharing of collision and other key data	✓	✓	✓	✓	✓		✓	✓	✓		✓	R, LIT
5.6 Publish city-wide collision report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, LIT
5.7 Routine evaluation of effectiveness of traffic safety interventions		✓		✓	✓				✓	✓	✓	R, LIT
5.8 Website with relevant safety data collected in a timely manner	✓	✓			✓				✓		✓	R, LIT
6. Policy												
Local												
6.1 Measures to reduce traffic volumes												
a. Congestion pricing									✓		✓	R, LIT
6.2 Crosscutting measures to reduce car dependence/ improve transit /promote walking and biking												
a. Implement Complete Streets policy	✓		✓	✓	✓	✓		✓		✓	✓	U
b. Transportation Demand Management Program	✓	✓	✓	✓	✓	✓	✓	✓			✓	U
6.3 Mandatory helmet law (18+)					✓							R, CTW
6.4 No right turn on red (city-wide)		✓				✓			✓	✓	✓	R, NCHRP
6.5 Pre-pay for morning parking to discourage drinking and driving					✓							R. LIT
6.6 Restrict deliveries to off peak hours to remove trucks from the busiest streets to improve road safety and ease congestion	✓	✓								✓	✓	R, LIT
6.7 Policies targeted at protecting vulnerable users												
a. Classify traffic-related incidents as collisions and not accidents	✓	✓	✓	✓			✓				✓	U
b. Illegal to harass (threaten verbally or physically) a vulnerable user								✓				U, LIT
6.8 Target safety improvements to school areas	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R, LIT
State												
6.9 Align state level Towards Zero Death policy with local level Vision Zero policy	✓	NA			✓	✓			NA	NA	NA	U
6.10 State policies targeted at collision reduction												
a. Change DMV point penalty structure so that dangerous offenses are punished with the most severe point values		✓							NA	NA	NA	U, CTW
b. Increase penalties for driving with a suspended license		✓	✓						NA	NA	NA	R, CTW
c. Increase penalties for leaving the scene of a crash		✓	✓						NA	NA	NA	R, CTW
6.11 State level policies targeted at protecting vulnerable users												
a. Increase consequences (fines, tickets, jail time) for careless driving (e.g. injuring a pedestrian/bicyclist, failing to stop and give right of way to pedestrians in crosswalks, etc.)		✓	✓			✓				✓		U, CTW
b. Mandatory for cars to give at least three feet of clearance when passing a bicycle in the same lane (aka "three-foot rule")	✓		✓			✓		✓				U, LIT
c. Ticket and fine motorists who open a door into the path of other traffic, including bicycles and pedestrians (aka "dooring")	✓	✓	✓	✓	✓	✓	✓	✓			✓	U
d. Vulnerable User law		✓	✓	✓	✓		✓			✓		U, LIT
6.12 Variable speed limits via signage		✓							✓	✓	✓	R, NCHRP
Federal												
6.13 Identify opportunities to advance Vision Zero policies, practices and projects in federal programs with US DOT and Congress	✓	✓	✓						NA	NA	NA	U
6.14 Lower alcohol limit									✓	✓		P, LIT
7. Large Vehicles												
7.1 Heavy Goods/ Large Vehicle Task Force to suggest safety improvements and monitor regulations	✓	✓				✓				✓	✓	R, LIT
7.2 Install blind spot mirrors at the most hazardous intersections to help large vehicle drivers better see bicyclists									✓	✓	✓	U
7.3 Large vehicle driver education on bike/pedestrian safety	✓	✓	✓						✓		✓	R, NCHRP
7.4 Outfit large vehicles with front and side mirrors to improve visibility	✓	✓	✓			✓				✓	✓	P, LIT
7.5 Outfit large vehicles with rear wheel and side guards	✓	✓				✓	✓			✓	✓	P, LIT
8. Vehicle Technology												
8.1 Alcohol interlocks in government and commercial fleets									✓	✓		P, NCHRP
8.2 Driver awareness systems to alert the driver to the presence of pedestrians near the vehicle cameras, sensors)		✓							✓		✓	R, CMF
8.3 Intelligent speed adaption technologies that alert or slow the vehicle if traveling over the (speed limit)									✓	✓	✓	P, LIT
8.4 Lane departure warning assistance									✓	✓		R, CMF
8.5 Partner with industry groups and vehicle manufacturers to further the use of technology to achieve safety aims	✓	✓							✓	✓	✓	R, LIT
9. Taxi Services and Transportation Network Company												
9.1 Automatic meter shut-off in taxis that speed												U
9.2 Black box data recorders in taxis	✓	✓							✓			U, LIT
9.3 Increase late-night taxi stand zones					✓						✓	R, LIT
9.4 Issue tickets to taxi drivers identified by red light cameras		✓	✓	✓					✓		✓	R, CTW
9.5 TNC regulations (training, devices, safety equipment)	✓		✓	✓	✓							U
9.6 Update taxi education to reflect safety priorities	✓	✓	✓	✓							✓	R, NCHRP
9.7 Window stickers warning passengers to not open their door into passing bicyclist	✓	✓	✓	✓		✓	✓				✓	R, CTW

KEY	✓= Planned/ A Priority/ In Process/ In Practice	NA = Not applicable	P = Proven R = Recommended U = Unknown	CTW = Countermeasures that Work NCHRP = NCHRP 500 Report CMF = Crash Modification Factors Clearinghouse LIT = Literature

(b)

FIGURE 1 *(continued)* **Traffic Safety Best Practices Matrix.**

Adaptation and implementation of Vision Zero in the United States should be mindful of the core principle of Vision Zero: to reduce severe and fatal injuries and shield the human body from excessive force, speed must be managed. This can best be achieved by lowering speeds and redesigning streets to support low speeds (*4*).

Efficacy Assessment and Future Research Needs

By identifying the known efficacy of measures, the matrix can help cities select evidence-based measures to assist them in their efforts to reach zero. However, since Vision Zero is so new to the U.S. context, many measures have yet to be evaluated (or evaluated consistently), and thus may yet prove to be effective. Several of these measures are concentrated in the policy section of the matrix. For example, the change in classification of traffic-related incidents as collisions and not accidents (6.7a, U) is a recent linguistic shift, and its impact on road safety has yet been studied. Strategies that promote walking, biking, and transit (6.2a, U; 6.2b, U) have the potential to affect safety dependent of the extent to which they include changes in system design that have proven safety benefits (i.e., to ensure increases in active transportation are not accompanied by increases in severe and fatal injury), beyond encouraging mode shift.

This does not mean these and other U measures should not be pursued per se; rather, if practitioners pursue a U, they should seek to also include an evaluation component as part of the project. Researchers should consider measures designated U as opportunities for future research. Adoption of Vision Zero by U.S. cities is in many ways a natural experiment, with notable variation in how U.S. cities are adopting and implementing the platform. It is anticipated that there should be ample opportunities for researchers to evaluate the efficacy of individual measures that currently lack sufficient evaluation—as well as evaluation opportunities for the synergistic impacts of implementing multiple safety measures, consistent with the safe system approach.

Benchmarking

The matrix can also be used as a means for cities to benchmark efforts to advance Vision Zero. Cities can examine the matrix to consider what additional measures other cities are implementing, toward setting realistic goals for improvement or identify opportunities for new partnerships to help advance the Vision Zero goal.

Discussion Among Cities

Cities can also use the matrix to facilitate peer city exchange. The matrix allows cities to become aware of the measures that their peers are implementing. Thus, cities will know whom to engage to find out more information and to determine if a measure is appropriate for their city.

Analysis of Traffic Safety Best Practices Matrix

The researchers analyzed the matrix and arranged their observations by the themes that emerged: measures with (*a*) widespread adoption, (*b*) limited implementation, and (*c*) minimal utilization. In the following analysis, there is discussion of how these findings can inform the next steps for Vision Zero implementation, with a focus on implications for U.S. cities. The discussion notes the location of the measure on the matrix as well as the efficacy designation.

Widespread Adoption

In several sections and individual lines in the matrix there is a clustering of checkmarks, which suggests widespread adoption of the measures among the cities included in this analysis, including implementation or plans for adoption. Clustering for a section or line is defined as its having more than 70% of the boxes checked.

Engineering, the second section, is an area in which one sees significant clustering of checkmarks. That suggests that this area has received considerable attention from the cities and countries included in the review and that many of the countermeasures are well-used. The engineering countermeasures focus on reducing speeds and range from reducing speeds limits on local streets and near schools and senior centers, and on arterials (2.7a, U; 2.7b, P; 2.7c, P); installing electronic signage that indicates speed (2.1d, R); and geometric changes, in particular pedestrian refuge islands (2.8f, R) (*17*); roundabouts (2.8j, P) (*17*); and speed humps (2.8k, P) (*18*). Many of these measures have an on impact road design, which is a critical way to modify speeds to make roads inherently safe (*19*). Engineering measures not well used or selectively used include puffin crossings (2.5e, R); senior slow zones (2.7b, P); in the United States, specifically, restrictions on street access (2.3a, R; 2.3b, R); and roundabouts (2.8j, P). Some of these measures are particularly innovative, some may necessitate significant construction, and some may require enhanced political or community support. These factors, among others, could explain their paucity in uptake. Cities leading on these efforts could be sought out for additional information.

Education, Section 3, is another section where most peer cities and counties have implemented multiple measures. The main exception in this section is Sweden, for it is the only location included in the review not using mass media or communication education (3.5, R). This is fitting with how Sweden conceptualized Vision Zero: education was considered capable of maintaining existing safety levels, but it was unlikely to generate the significant future improvement needed to achieve the paradigm's ambitious goals (*5*). Indeed, focusing on educating the road user is antithetical to the idea that grounds Vision Zero: Individuals make mistakes no matter how well educated (*1*). Under Sweden's Vision Zero, road users are responsible for following the rules, but this expectation runs parallel to system designers' efforts at continually making the road system safer (*10*). Sweden does not emphasize education per se, but instead creating more respect for the rules of the road, in particular with regard to speed limits, seat belt use, and intoxicated driving (*6*), a nuanced but important distinction. Education about road safety in the traditional sense was never emphasized in Sweden because its planning focus, since the 1960s, was to alter the built environment, by placing restriction on cars, to achieve safety. In essence, the road has provided the education (*7*).

It is not surprising that education is a well-used tool for Vision Zero implementation in the United States, given that education and enforcement have since the 1960s assumed a primary role in safety promotion—equally aligned with the other E: engineering. Yet these tools have been used in an environment where, unlike Sweden, the dominance of the car was never challenged so as to make streets inherently safe (*7*). Now many U.S. cities are focusing more on changes to the built environment to achieve safety. It

will be interesting to see how the emphasis on education shifts over time as Vision Zero is implemented, particularly if U.S. implementation maintains Sweden's focus on system design. U.S. cities could approach this transition as an opportunity to consider an alternative approach to education, advanced by the field of public health, which would be to take a socioecological approach to education efforts and focus not only on enhancing individual skills, but on how education can support changes in organizational practices and policy reform (*20*). This approach seems more aligned with Vision Zero principles.

Another area of widespread adoption is supportive infrastructure and planning, Section 1, which the research suggests is fundamental to successful Vision Zero implementation. Here, again, Sweden is the exception in that it does not use a Vision Zero task force or steering committee (1.3, R). In this case, that absence suggests less a fundamental difference in approach (as with education) and instead a limitation in implementation (*7*). While multisectorial thinking informed the development of Vision Zero in Sweden, this collaboration did not continue into the implementation phase. Lack of cooperation and consultation among sectors were acknowledged as reasons for which Sweden failed to reach its 2007 target of a 50% reduction in traffic-related deaths from 1997 (*21*). Since then, Sweden has set up structures for collaboration: six times a year representatives from municipalities, the police, occupational health, vehicle industry and insurance companies meet with representatives from the Swedish Transport Administration and Agency to discuss safety efforts. Stakeholders are also engaged at the annual result conferences, where analysis of road safety performance indicators (such as speed compliance and seat belt use) is presented (*3*). In addition, representatives from different sectors come together to analyze crash data. What seems to be lacking are ongoing, daily, working relationships across sectors (*7*). McAndrews (*7*) argues that public health, police, vehicle manufactures, and safety specialists have been left out of Vision Zero, and that it has concentrated responsibility in the transportation sector (*7*). U.S. cities can learn from this shortcoming and concentrate on developing mechanisms that support the institutionalize Vision Zero in existing institutions beyond the transportation sector, including public health, police, and other key implementation partners.

Vision Zero is an example of Health in All Policies (HiAP), an approach to policy making that has struggled since forming in the 1980s to engage across sectors and whose experience further demonstrates how lacking institutions can undermine even best intentions at collaboration. HiAP calls for incorporating health considerations into decision-making structures across sectors and policy areas (*22*). Like Vision Zero, HiAP has as its origins in Europe and is a nontraditional approach. It requires leadership and resources from outside public health and the formation of new structures and processes that align agency missions and identify shared agendas to advance health in nonhealth sectors (*23, 24*). Yet HiAP has struggled because it has had difficulty creating a foundation to support its intersectoral work. HiAP experts argue that the how of shared governance—infrastructures, tools, instruments, and processes that facilitate intersectoral partnerships—is not well understood, and that, until it is, there will be difficulty in overcoming the typical, siloed approach to government work (*25*). The experience of HiAP suggests the salience of investing the resources, time and personnel necessary to develop productive intersectoral collaborations. Done well, Vision Zero cities could emerge as models for HiAP efforts.

Limited Implementation

Some measures are being used by only a few U.S. cities and only a few of the international cities and countries included in the review. The definition of "select" is having, for a section or line, between 40% and 69% of the boxes checked.

As can be seen in the matrix, cities are not seeking opportunities for collaboration across all levels of government, even though positioning on traffic safety policy in U.S. at the federal, state, and local level is more aligned than not. Only a select group of cities are educating state level organizations on their city's Vision Zero commitment (3.2, R), engaging with their state level TZD policy (6.9, U), or seeking opportunities to advance their efforts at the federal level (6.13, U). All the U.S. cities included in the review, with the exception of New York City, have at their state level a TZD policy. Seattle stands out in that it drafted its Vision Zero strategy to be in line with the state's Target Zero plan (J. Curtin, e-mail correspondence, July 6, 2015). TZD is an effective strategy: a 2012 evaluation of the TZD programs in Idaho, Minnesota, Utah, and Washington found that fatality rates decreased faster in these states than in states without TZD programs (*11*). Efforts at the federal level also have as their focus the elimination of traffic fatalities, and the government's recently published national strategy on highway safety aims to provide direction for both federal and state level TZD efforts (*12*).

Federal, state, and local levels of government share the vision of eliminating traffic fatalities and are all developing strategies that trace their roots to Vision Zero and the safe system approach. While the space governed by each agency is different (highway as opposed to local roads, for example), at the very least, this alignment of goals suggests an opportunity for collaboration to advance and strengthen traffic safety efforts and address challenges that lie at the intersection of federal, state, and local jurisdictions. What can cities learn from successful TZD efforts? What do city-level Vision Zero efforts have to offer state and federal TZD efforts? Where do these efforts meet and diverge? How can these policies be aligned and strengthened? These are all questions that cities can consider and pursue as they implement Vision Zero, and the answers will help practitioners and researchers better understand if and how this collaboration is effective.

Minimal Utilization

Many measures are being implemented by less than 40% of the cities and countries included in the review. This suggests that there are many areas where U.S. cities could consider placing additional emphasis as they further efforts to implement Vision Zero.

Vehicle technology, Section 8, is the one with the fewest boxes checked by the peer cities and counties. So it represents an area of great opportunity for U.S. cities. Only New York City and San Francisco indicated that they are considering partnerships with industry groups and vehicle manufactures (8.5, R) as part of their approach to Vision Zero. The four technologies highlighted in the Matrix, alcohol interlocks (8.1, P), driver awareness systems (8.2, R), intelligent speed adaptation (8.3, P), and lane departure warning assistance (8.4, R) all have proven safety benefits (*26–28*). Vehicle safety, achieved through advances in vehicle technology, is a strong focus of Vision Zero in Sweden, but this is not surprising, given that representatives from the automobile industry and experts on motor vehicle design were involved in the conceptualization of the safety philosophy (*7*).

In the United States, vehicle safety is pursued at the federal level by NHTSA; cities have not historically been designated actors in this space (*29*). because vehicle safety is NHTSA's domain, cities may be unsure how they fit, or if they should become involved at all. Cities do have jurisdiction over their bus fleet and may consider ways to use technology to improve the safety of their buses. For example, London is piloting intelligent speed adaptation, an innovative technology that ensures that vehicles cannot exceed speed limits on their buses (*30*). Perhaps the answer for U.S. cities is to not involve themselves in vehicle safety outright, but to consider ways in which private sector partnerships or technology in general can help them eliminate fatalities and serious injuries from their roads. Such an approach is consistent with Vision Zero's emphasis on systems thinking. A good example of this is New York City's request to Google to change its directions to discourage left turns (*31*).

Automated enforcement (4.1a–d, U; 4.1e–g, P), actively pursued in the United States by Washington, D.C., is an area where checkmarks are scant. This suggests that automated enforcement is not only a key area for pursuit, but, in addition, an area apt for peer-city information sharing. Automated enforcement is a highly effective tool for speed reduction (*32*). Washington, D.C., uses five types of automated cameras, while the other U.S. cities employ only red light or transit-only cameras, if they do so at all. Many cities checked the box for speed cameras (4.1g; P), but for most cities, this is something they are planning should they be able to get jurisdiction from their state. Other reasons that could explain why some U.S. cities are pursuing efforts while others are not are timing, funding, and staffing needs.

Publishing a website with relevant safety data (5.8, R)—another area on the matrix where checkmarks are lacking—is a means through which cities could help achieve Vision Zero's core principle that road users demand safety improvements—a responsibility that implies that public participation in transportation decision making is central to achieving Vision Zero (*7*). A website that clearly articulates the number of severe and fatal injuries, project delivery status, and relevant enforcement citation data, in addition to other key indicators, can facilitate transparency and accountability. It can thus assist the public in monitoring progress toward zero and allowing cities to achieve this key aim of the safety philosophy. To ensure this outcome, it is imperative that information on the website be presented in such that it can be easily interpreted by a lay audience and that analysis be provided where needed. In addition, staff responsible for the website should be responsive to the public's needs for additions or clarifications. Public participation and accountability for Vision Zero initiatives were not adequately captured by the matrix review. Nevertheless, they are important components for consideration as Vision Zero is implemented across U.S. cities, given the political will required to change the status quo with respect to some of the identified strategies (e.g., automated speed enforcement), as well as findings that severe and fatal injuries are often concentrated in areas that are disproportionately low-income, communities of color, and home to residents including seniors and people with disabilities reliant on walking or public transit (*33*).

Additionally, routine evaluation of the effectiveness of traffic safety initiatives (5.7, R), while standard practice in the international regions reviewed, was notably absent among U.S. cities. Institutionalizing evaluation of the effectiveness of these measures will help ensure that resources are used most efficiently and can help inform the state of the practice. However, this requires prioritization of funding and staff resources to ensure that robust evaluation can be planned, implemented, and shared to inform local practice. Development of comprehensive surveillance systems (5.4, R) is strongly supportive of this effort, as well as the overall data-driven approach to Vision Zero.

LIMITATIONS

The matrix can be a useful tool for strategy identification, benchmarking, and facilitating discussion among jurisdictions implementing Vision Zero. However, the matrix is a macrolevel effort and should be approached as a screening tool. To develop targeted, efficient, evidence-based strategies, cities should consider analysis of crash types; priority locations for investments based on severe and fatal crash densities and predictive factors; funding; staffing needs; and other area-specific issues.

Two limitations are specific to the matrix. First, comparing cities with countries has the potential to obscure the analysis. However, as Vision Zero (and its iterations) in Sweden, the Netherlands, and Australia is a country-level effort, it was believed appropriate to look at the country as a whole. Further, it was believed appropriate because these countries have led on implementing systems approaches to traffic safety, and the researchers did not want to miss out on their insights and lessons. Moreover, there was great difficulty in finding sufficient city-specific information that would allow analyzing an individual city in these countries. Second, the cities and countries included in the review elected whom they wanted to review the matrix, and the researchers are unaware of the extent to which they sought corroboration from other members of their own staff. The assumption was that the checkmarks were accurate, but this is acknowledged as a limitation.

CONCLUSIONS AND RECOMMENDATIONS

The article presents the Traffic Safety Best Practices Matrix, a tool to help cities identify the landscape of strategies being used domestically and internationally to advance Vision Zero. There are fours ways in which cities implementing Vision Zero can use the tool:

1. Identify the range of levers available to advance Vision Zero,
2. Understand the currently known efficacy of the strategies and identify opportunities for future research,
3. Benchmark efforts to advance Vision Zero, and
4. Engage in peer exchange.

Through an analysis of the matrix, which was supported by lessons learned from Vision Zero implementation abroad, as well as insights from other fields, there was identification of measures with widespread adoption, limited implementation, and minimal utilization.

On the basis of matrix analysis, lessons learned from Vision Zero implementation abroad, as well as insights from other fields, the following recommendations are offered as next steps for Vision Zero implementation in cities in the United States:

1. Develop mechanisms that institutionalize Vision Zero in existing institutions needed for its implementation that extend beyond the transportation sector.
2. Consider approaching education more in line with that of Sweden, where the focus is on creating respect for the rules of the road that are being emphasized through system design, for example, slow speeds. Focus education efforts on how education can support

the changes in organizational practices and policy reform that allow for changes in system design.

3. Seek opportunities to engage with state and federal leaders on Vision Zero efforts.

4. Explore technology advances that address the unique safety needs of cities.

5. Pursue automated speed enforcement and other camera technologies that have proven safety benefits.

6. Facilitate accountability by creating web-based, publicly accessible spatial data systems that monitor, analyze, and report fatalities and severe injuries and associated factors, as well as facilitate benchmarks on policy progress, to help constituents realize the magnitude and distribution of transportation injuries and create the collective consciousness needed to achieve the policy's aims.

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The Standing Committee on Transportation Issues in Major Cities peer-reviewed this paper.

2018 REGIONAL TRANSPORTATION PLAN UPDATE

Transportation Safety Action Plan

Draft Strategies and Actions

2018 RTP safety Work Group – Meeting #6

July 27, 2017

Welcome - meeting purpose and desired outcome

Purpose:

- Work Group input on the Draft Strategies and Actions

Desired outcome:

- Refinement of the Draft Strategies and Actions

Introductions & announcements

- Name & organization
- Work group member announcements

Project update

- Recap of April 4 meeting – (draft table of contents of RTSAP)
- MPAC and JPACT recommended moving forward with Vision Zero framework, target and performance measures in the 2018 RTP
- Metro Council gave unanimous support
- Sept 14 will be last work group meeting

Vision Zero is a framework

Traditional Approach	Vision Zero
Traffic deaths are inevitable	Traffic deaths are preventable
Perfect human behavior	Integrate human failing in approach
Prevent collisions	Prevent fatal and severe crashes
Individual responsibility	Systems approach
Saving lives is expensive	Saving lives is cheap

Moving from Vision to Action

Strategy = a series of actions

2018 RTP Vision Zero ~ *DRAFT*

Vision

In 2040, everyone in the Portland metropolitan region will share in a prosperous, equitable economy and exceptional quality of life sustained by a safe, reliable, healthy, and affordable transportation system with travel options.

Goal

RTP Goal 7: Enhance Human Health

Multimodal transportation infrastructure and services provide safe, comfortable and convenient options that support active living and physical activity, and minimize transportation-related pollution and eliminate serious injuries.

Objective

(New) Objective 7.3 – Fatal and severe injuries – reduce the number of fatal and severe injury traffic crashes each year by at least 5%.

Performance measures

1) Average number of people killed and seriously injured annually in traffic crashes, by mode, per 100 million vehicle miles traveled and per 100 thousand people.
2) Number, cost and percent of safety capital projects in the RTP.
3) Increase or decrease in vehicle miles traveled.

Target

By 2035 eliminate transportation related fatalities and serious injuries for all users of the region's transportation system, with a 16% reduction by 2020 (as compared to the 2015 five year rolling average), and a 50% reduction by 2025.

Actions

1) Reduce speeds and speeding.
2) Protect vulnerable users.
3) Focus safety countermeasures on high injury and high risk intersections and corridors.
4) Address and minimize impact of dangerous behaviors.
5) Address impairment.
6) Ongoing engagement, education and planning

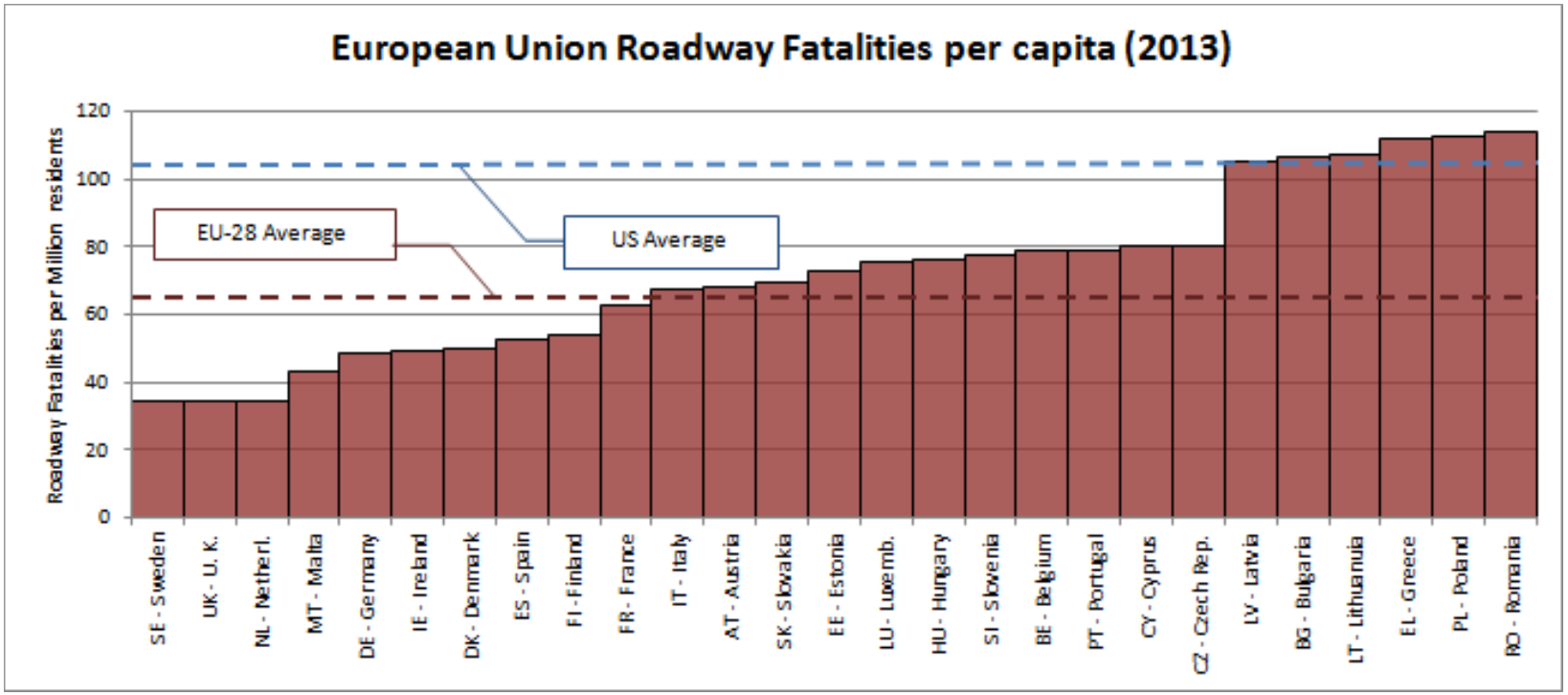
Strategy = a series of actions

Crash data key findings

Roadway Deaths in the US

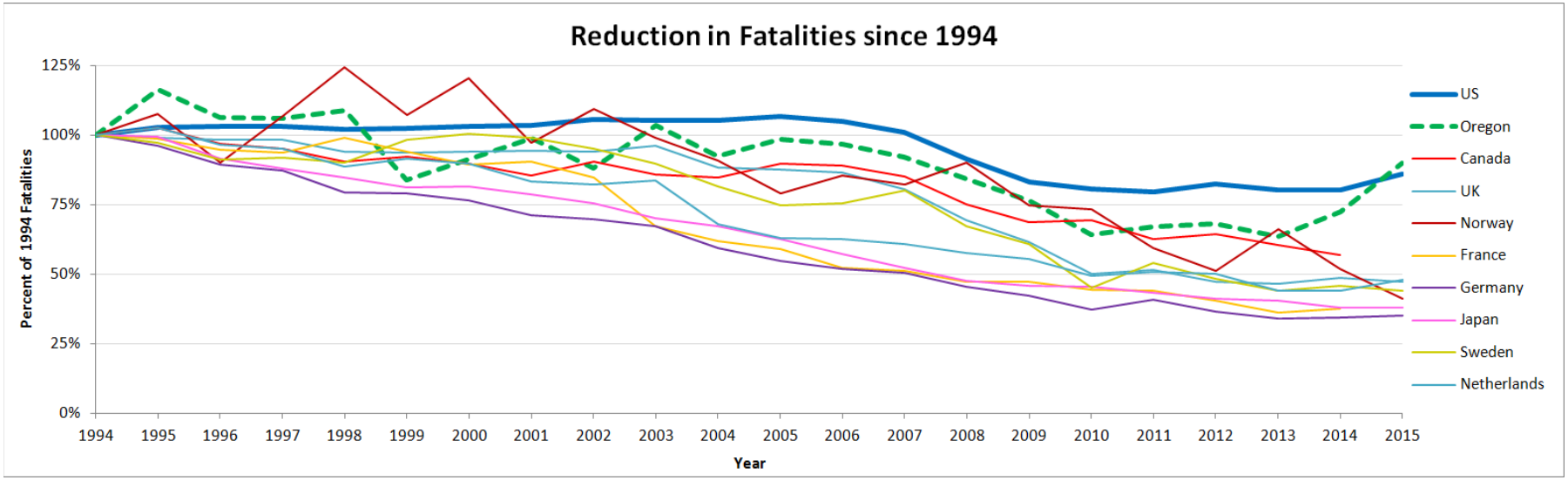
- Estimated 40,000 people killed in crashes in 2016
- Highest number in a decade
- One of the leading causes of death in all age groups
- 65 people killed in the Metro region in 2015

How do we compare? Countries



- US safety record is abysmal

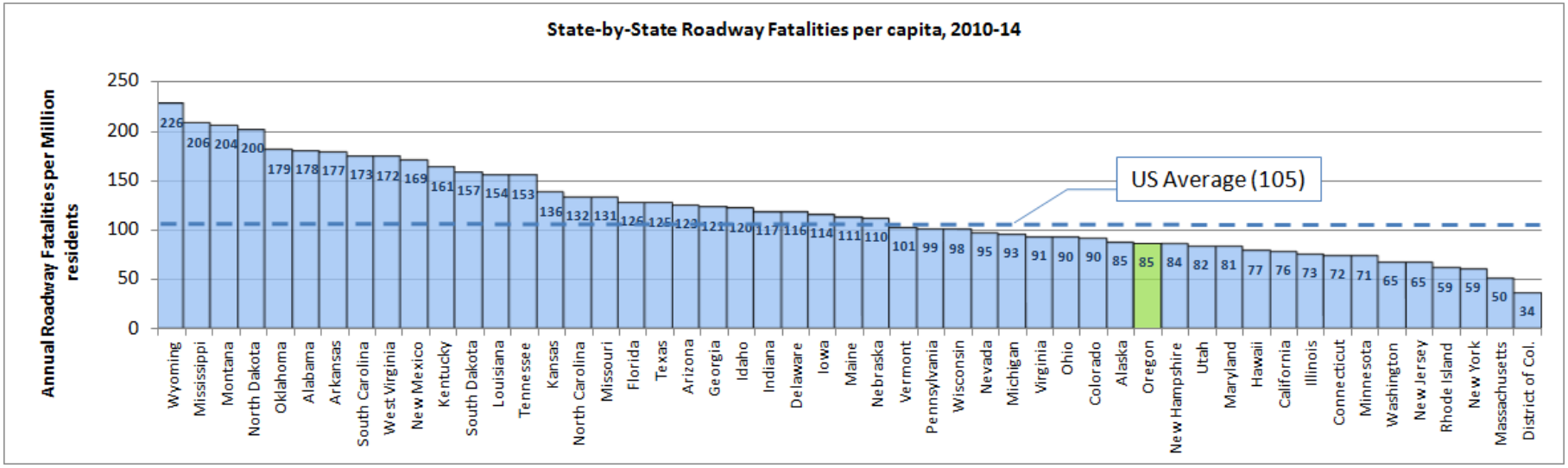
Other Countries Show Progress



- Germany -65%
- United Kingdom -53%
- Canada -43%

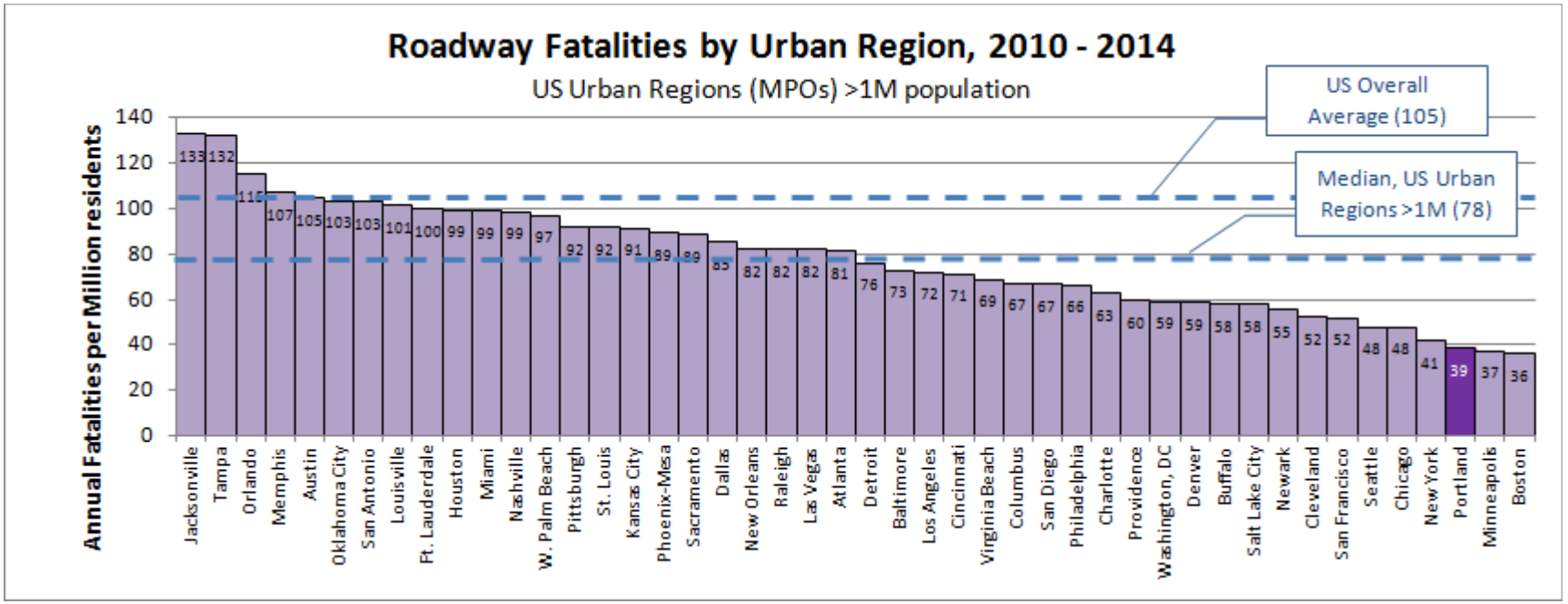
- United States -14%
- Oregon -10%

How do we compare? States



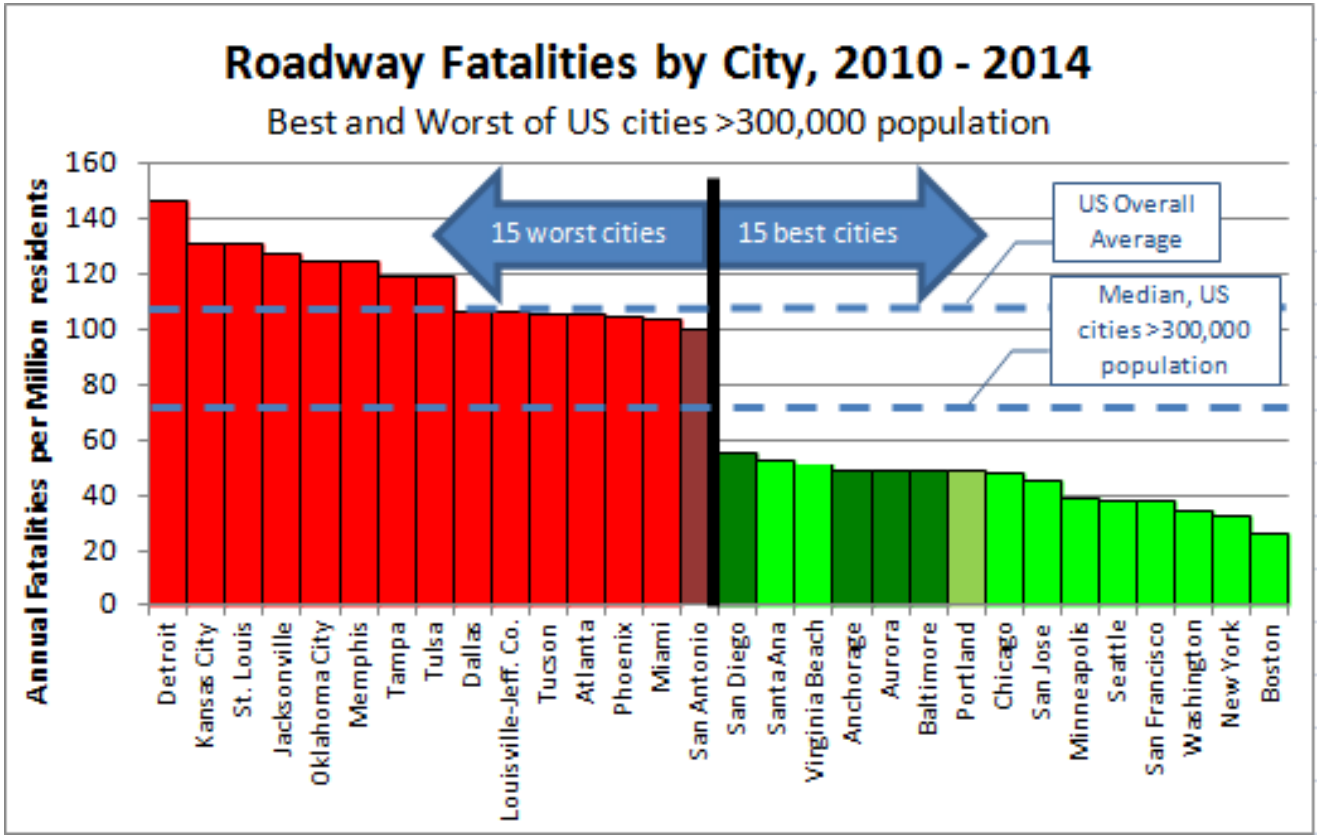
- Oregon is doing well by US standards

How do we compare? Regions



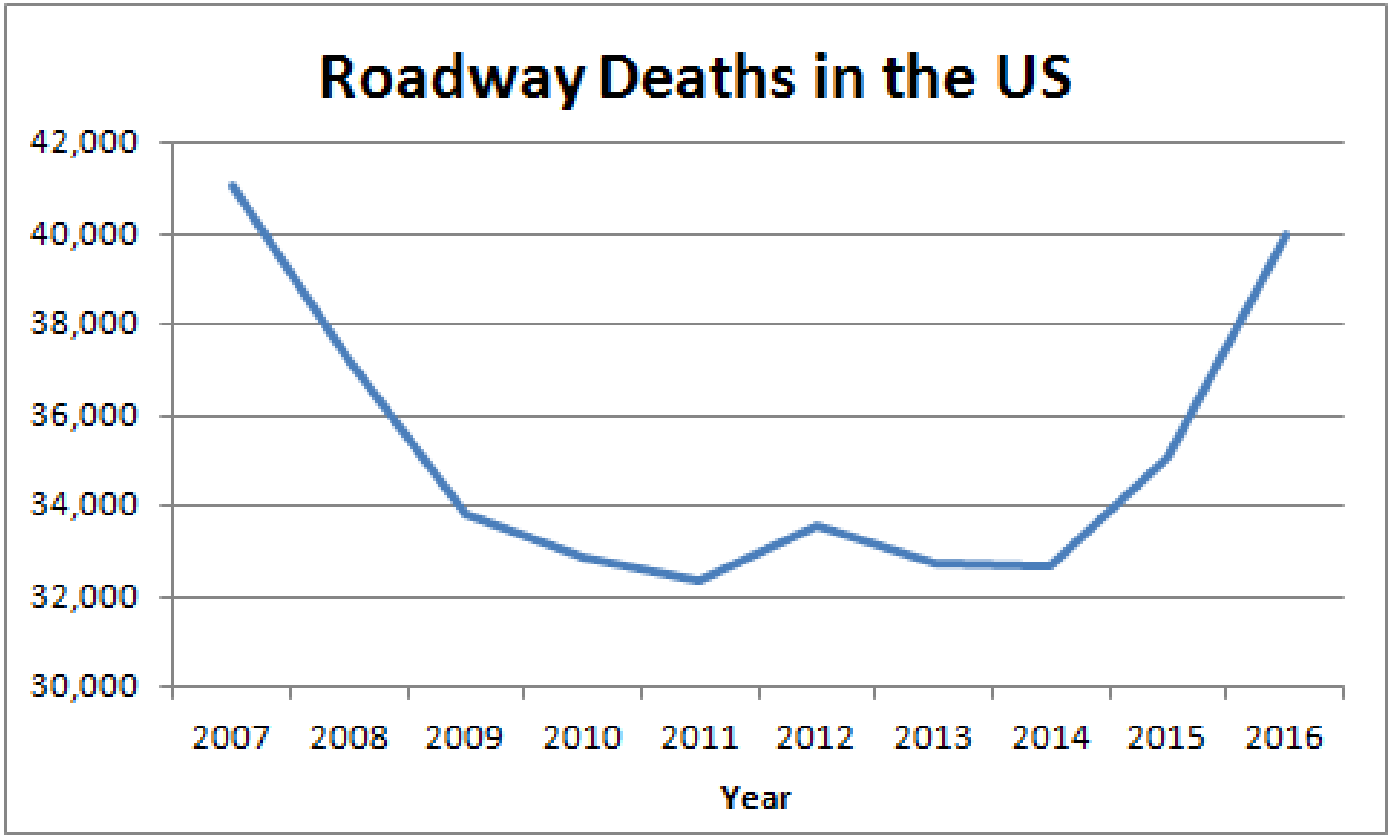
- Metro region is doing well by US standards

How do we compare? Cities



- Portland is doing well by US standards

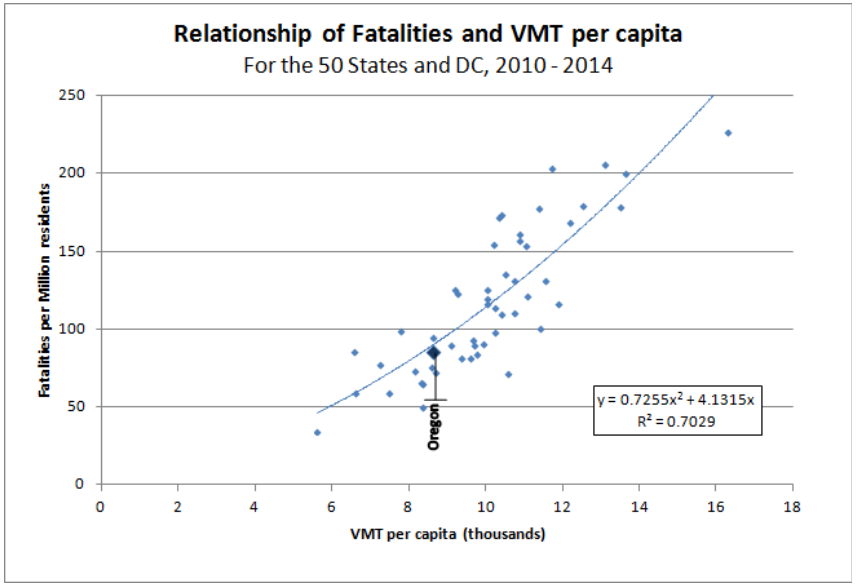
Deaths are Increasing



- Oregon: **58% increase** in deaths 2013 (313) to 2016 (495)

Increased Driving is a factor

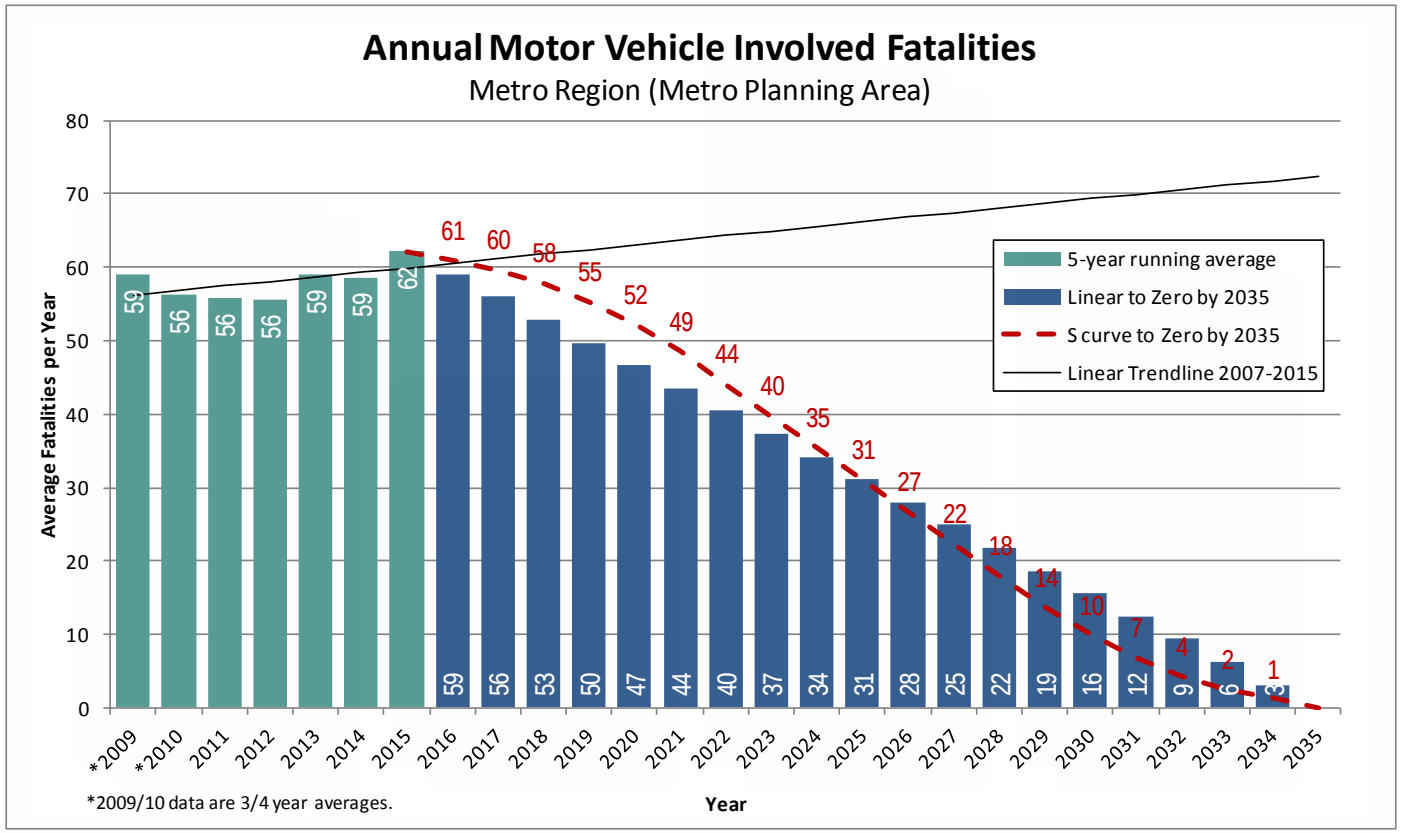
- More driving = more exposure and risk



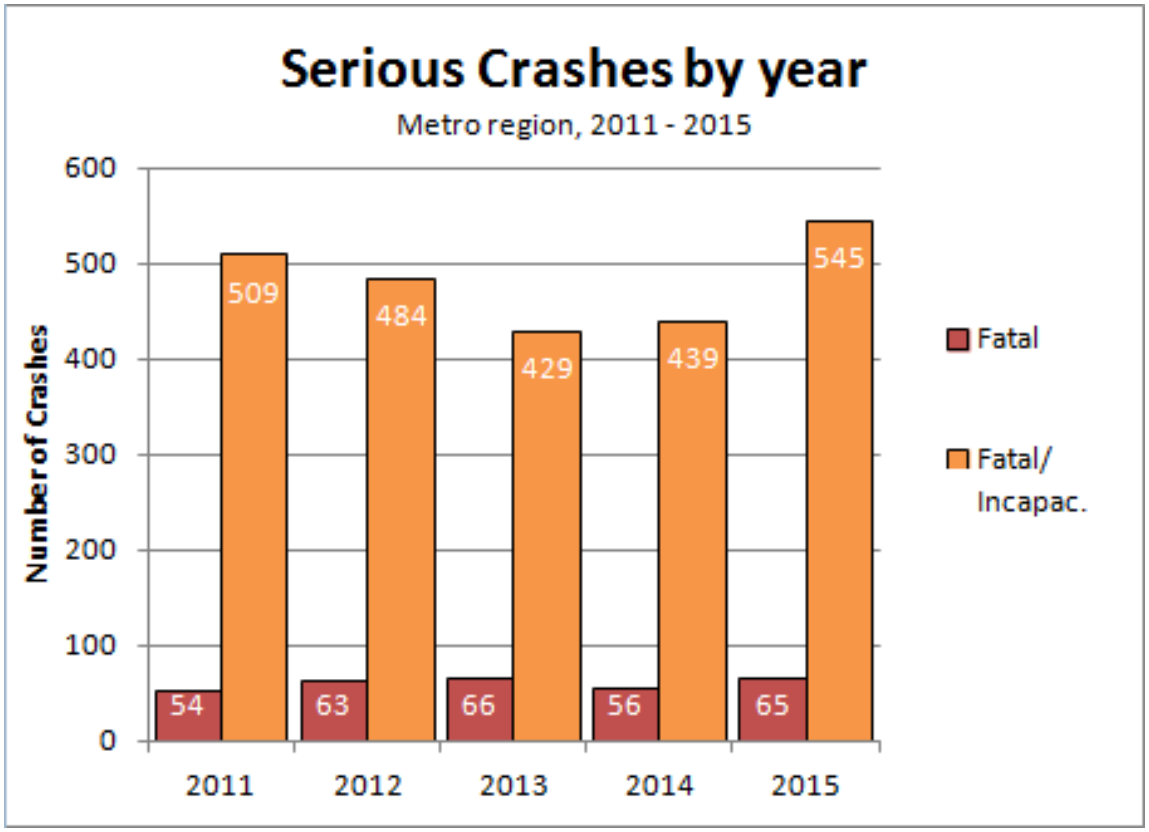
- Distracted driving
- Alcohol and Drugs
- Speed

Regional Safety Target

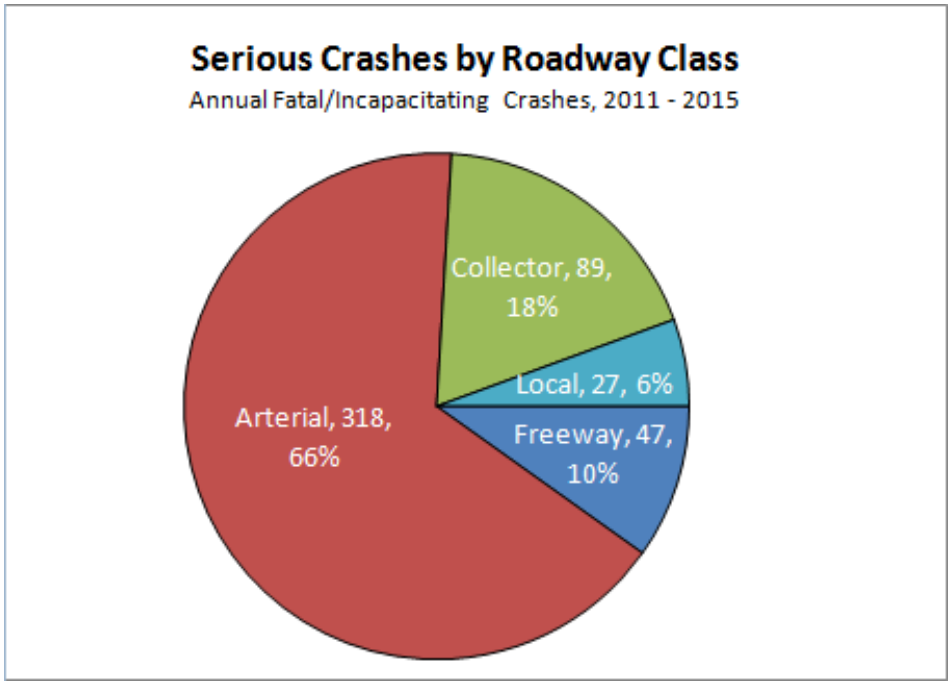
- Zero deaths and serious injuries by 2035



Serious and Fatal Crashes are Increasing in the Region

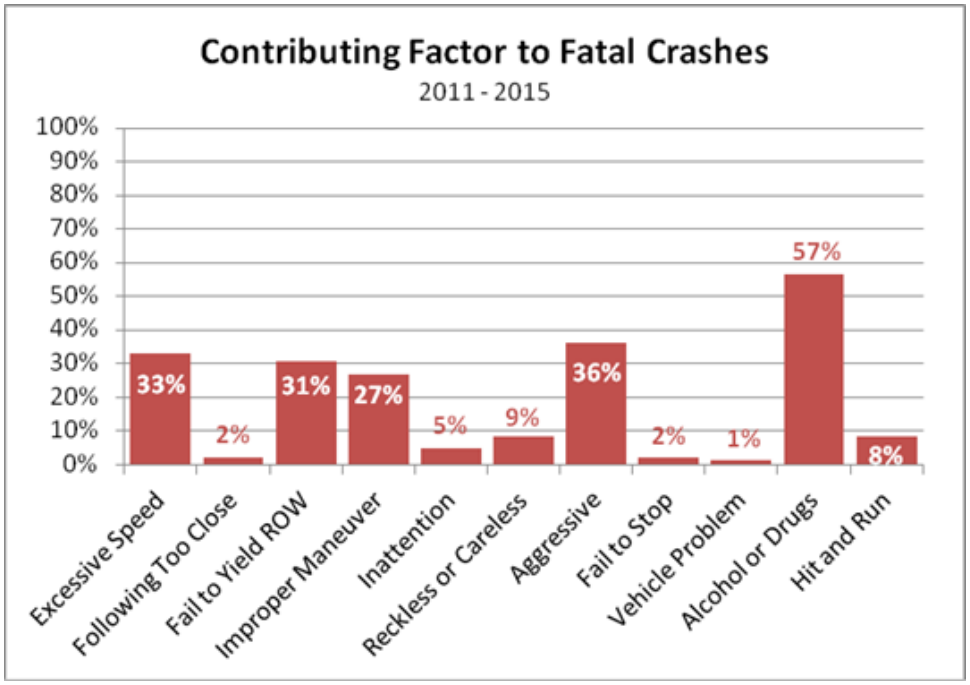


Risk Factors in the Region: Arterial Roadways



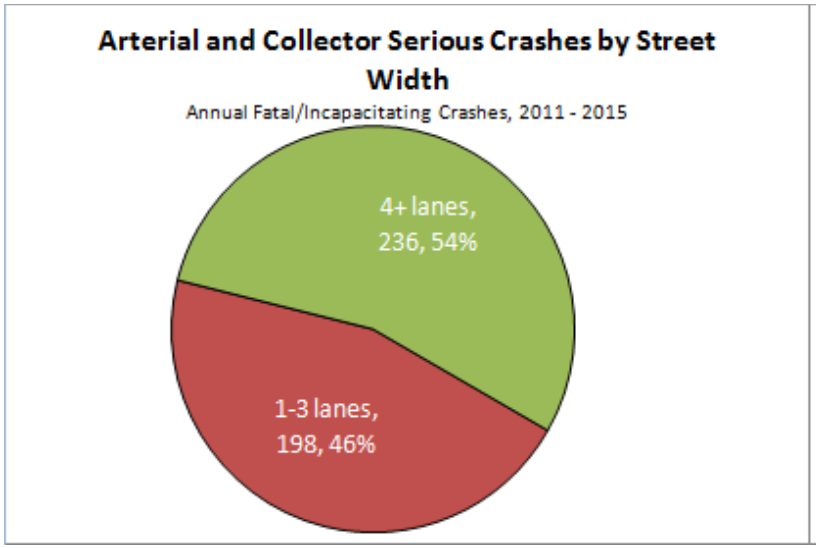
- 66% of serious crashes
- 77% of serious ped crashes, 65% of serious bicycle crashes
- 12% of road-miles, 41% of VMT

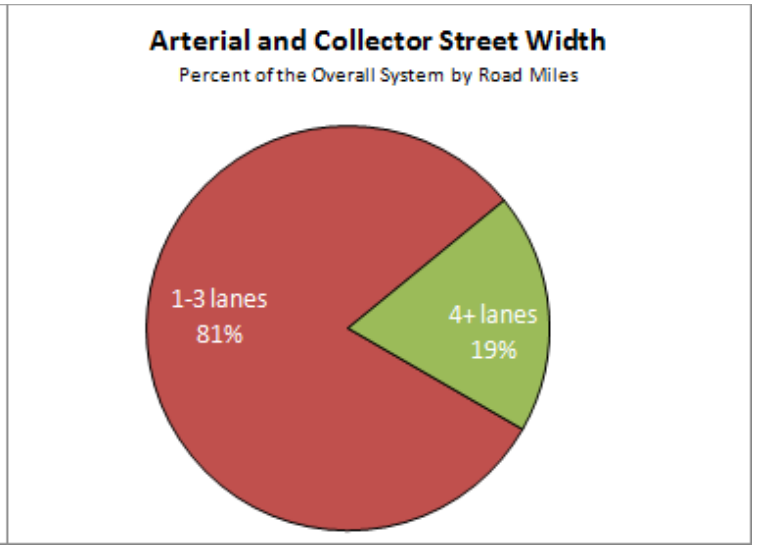
Risk Factors in the Region: Risky Behavior



- Alcohol/Drugs
- Speed
- Aggressive Driving

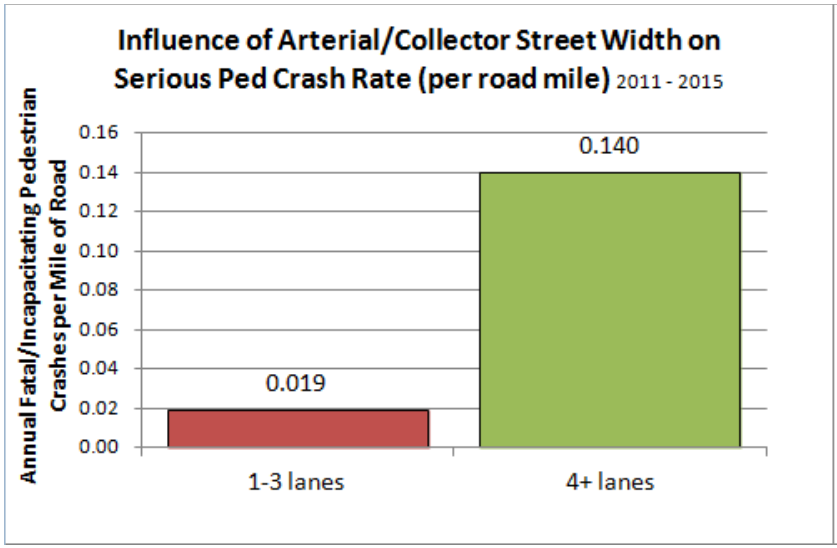
Risk Factors in the Region: Number of Lanes

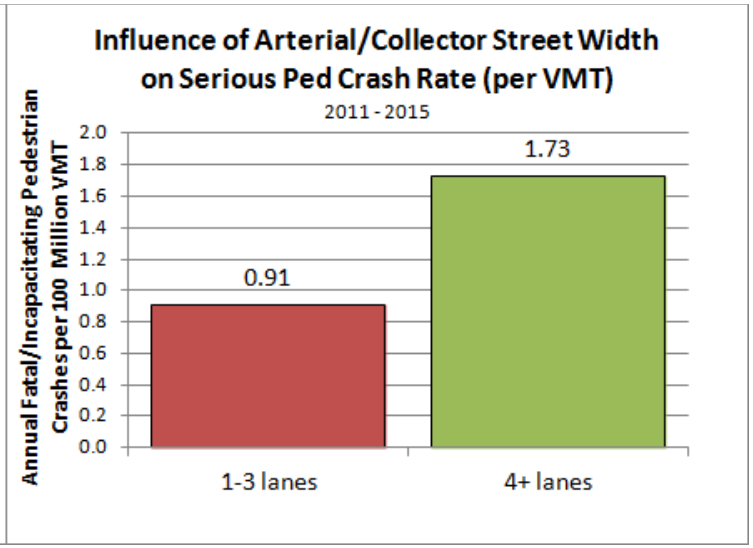




- Multilane streets generate more serious crashes

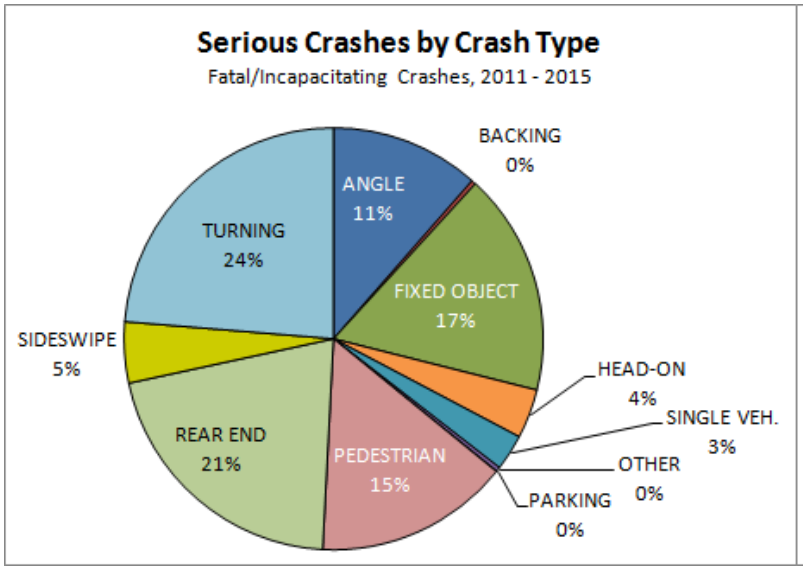
Risk Factors in the Region: Number of Lanes and Pedestrians

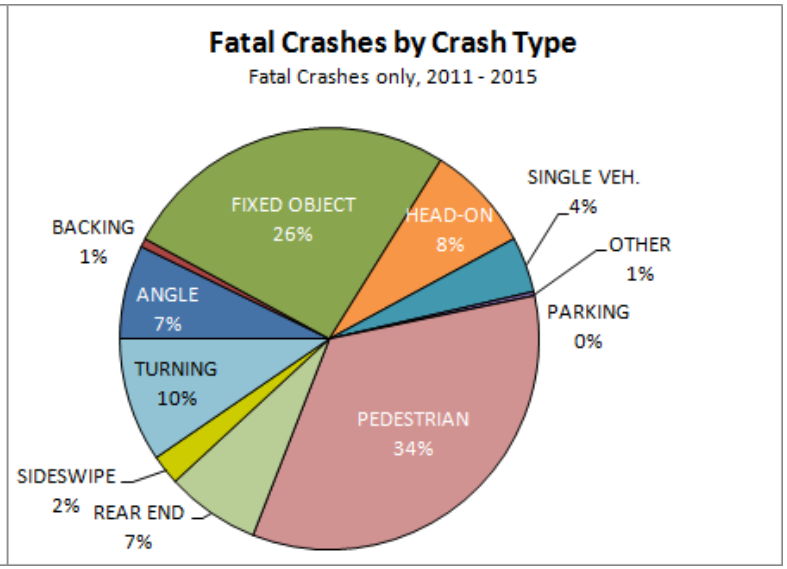




- Multilane streets are much more dangerous for pedestrians

Risk Factors in the Region: Crash Types





Serious

- Turning (24%)
- Rear End (21%)

Fatal

- Pedestrian (34%)
- Fixed Object (26%)

Dangerous by Design

- Wide
- Multi-lane
- Fast
- Few crossings
- Poorly lit

=

- Ped crashes
- Auto crashes
- Lots of deaths

Strategies and Actions

- New actions?
- Remove actions?
- Changing the focus or wording of actions?
- Action specific performance measures?
- Group actions into near and long-term timeframes?

Strategies and actions organization

- Six strategies identified from key findings in data
- Actions are grouped under strategies – actions can achieve more than one strategy
- Actions derived from current RTSP, local and state safety plans, national best practices, safety work group input
- Lead agency/group, partners and action effectiveness identified (list of partners at end)
- Focus on proven and recommended actions that reduce fatal and serious crashes

Vision Zero strategies & actions best practices to keep in mind

- Better understand the racial equity and health impacts (positive or negative) of the strategies and actions
- Better understand whether the strategies and actions affect systems or individual behavior change (similar to the public health understanding of upstream and downstream public health actions)

Strategies and actions - discussion

1. **Reduce speeds and speeding**

Design streets to lower speeds, automated speed enforcement, set lower speed limits

Strategies and actions - discussion

2. **Protect vulnerable users**

Design streets to provide maximum visibility and protection, training and education, better data on vulnerable users and crashes, truck safety improvements

Strategies and actions - discussion

3. **Focus safety countermeasures on high injury and high risk intersections and corridors**

Prioritize funding and interventions where most fatal and severe crashes are occurring/ high risk, design streets and intersections for safety, better data, evaluation and modeling, targeted outreach, reduce VMT

Strategies and actions - discussion

4. **Address and minimize the impact of dangerous behaviors**

Focus on high risk behaviors, increase penalties for dangerous behaviors without disproportionate impact people of color, support technology strategies, education and training

Strategies and actions - discussion

5. **Address impairment (drugs and alcohol)**

Detection training for officers, safe rides home, support technology strategies

Strategies and actions - discussion

6. **Ongoing engagement, education and planning**

Collaboration, research, data, comprehensive planning, legislation

Next steps

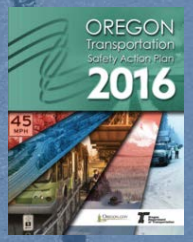
- **September 14** - Transportation Safety Work Group provides input on first draft of Regional Transportation Safety Action Plan (RTSAP)
- **November 15 and 17** – TPAC and MTAC provide input on revised draft RTSAP
- **November** – Draft findings and recommendations of the 2018 RTP project list system evaluation, including number, percentage, cost, location and timing of safety projects
- **Spring 2018** – 45-day public review and comment on the Draft RTSAP as part of the 2018 RTP public comment period

Recommended 2018 RTP Vision Zero target for 2035

By 2035 eliminate transportation related fatalities and serious injuries for all users of the region's transportation system, with a 16% reduction by 2020 (as compared to the 2015 five year rolling average), and a 50% reduction by 2025.

VISION ZERO

LET'S STOP CRASHES DRIVE to ZERO IN CLACKAMAS COUNTY



Measure how well 2018 RTP projects are addressing transportation safety and equity

1. Share of safety projects in the plan
2. Exposure to VMT – crash risk