STEP

Safe Transportation for Every Pedestrian

EDC





Proactively Addressing Crash Risk with Systemic Safety Analysis

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U.S. Department of Transportation
Federal Highway Administration

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What is “Every Day Counts”(EDC)?

State-based model to identify and rapidly deploy proven but underutilized innovations to

- shorten the project delivery process
- enhance roadway safety
- reduce congestion
- improve environmental sustainability

EDC-5 STEP: The Spectacular Seven

- Leading Pedestrian Interval
- Crosswalk Visibility Enhancements
- Raised Crosswalks
- Pedestrian Refuge Island
- Rectangular Rapid-Flashing Beacon
- Pedestrian Hybrid Beacon
- Road Diets





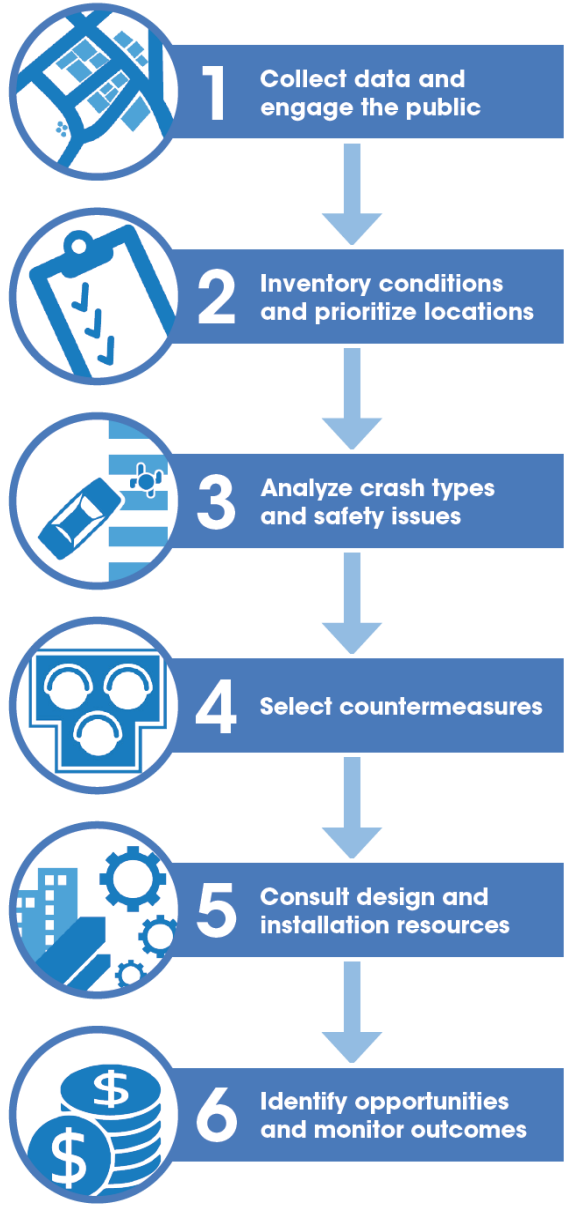


Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

Follows a 6-step process

Guides the selection of countermeasures to improve pedestrian safety

Supported by a "Field Guide for Selecting Countermeasures at Uncontrolled Pedestrian Crossing Locations"



4 Select countermeasures

July 2018 version includes RRFB

Highlights situations where a marked crosswalk *alone* is not sufficient

Presents *options* for countermeasure selection

Table 1. Application of pedestrian crash countermeasures by roadway feature.

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 ❾	① ❸ 5 6 8 9	
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ 8 ❾		

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parki… crosswalk approach, adequate nighttime lighting levels, and crossing warning sign
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

*Refer to Chapter 4, "Using Table 1 and Table 2 to Select Countermeasures," for more information about using multiple countermeasures.
**The PHB and RRFB are not both installed at the same crossing location.

What is Systemic Safety? (NCHRP 17-73)

- Approach to identify high-risk roadway features correlated with specific or severe crash types
- Data-driven
- Network-wide
- Addresses locations with
  - prior crash occurrence
  - similar roadway or environmental crash characteristics
- Considered more proactive

Why Systemic Safety for Pedestrians and Bicyclists?

- Low density of severe crashes can make prioritization difficult
- MAP-21 acknowledges that crash *potential* is important to examine (i.e., not just *history*)
- Supplementary and complementary to site analysis
- Research indicates promise, still relatively new

NCHRP 17-73 Systemic Pedestrian Safety Analysis Framework

FHWA's Systemic Safety Project Selection Tool

Identify Focus Crash Types & Risk Factors

- Identify prevalent, severe crash types
- Identify factors associated with severe crashes → risk factors, e.g.,
  - Higher AADT
  - Higher number of lanes
  - Higher number of legs
  - Transit boardings
  - Slope

Data Needs – Recommended Minimum

- System type (e.g., state, local)
- Crash type* (e.g., mv LT into bicyclist opp dir)
- Facility type (e.g., freeway, arterial)
- Crash location type (e.g., intersection v. segment)
- Location characteristics (e.g., topography)

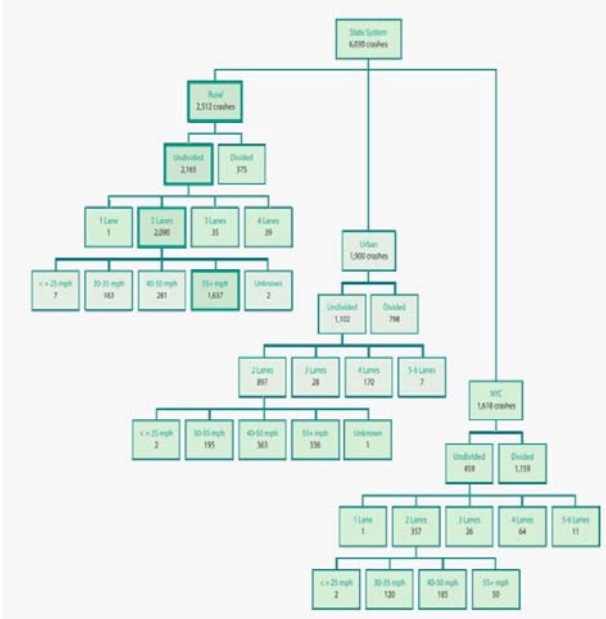
*Will need to be derived from crash data

Select Focus Crash Types

- Which crash types do the data show to be the most severe (fatal and/or serious)?
- Which crashes are disproportionately severe?
- Which are most prevalent?
- Can also look to emphasis areas in other plans (e.g., HSIP)
  - Be aware of limitations in applicability
  - Balance local v. statewide needs

Select Focus Facilities

- Use crash trees or safety performance functions to clarify problem locations, risk factors, e.g.,
  - Urban v. rural
  - Arterial v. collector v. local
  - Intersection v. segment
  - Higher-speed v. lower-speed
  - Street lighting v. absence of lighting

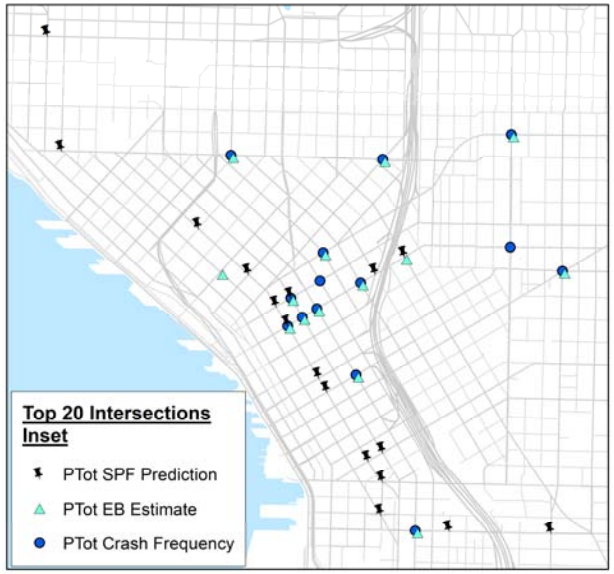


Identify and Evaluate Risk Factors

- Identify characteristics common between the select crash types and focus facilities
  - Focus on features more likely to be associated with severity
- If needed, look to research, best practice to identify known risk factors, e.g.,
  - Higher traffic volumes
  - Higher traffic speeds
  - Number of lanes
  - Slope

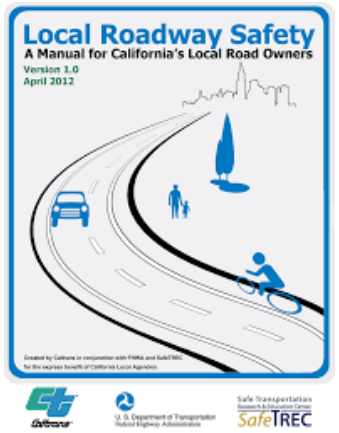
Screen and Prioritize Candidate Locations

- Screen network to identify locations with those same combinations of features
- Prioritize locations with higher expected crash numbers, based on:
  - Crash history + weighted risk factors
  - Predicted crashes
  - Empirical Bayes combination of predicted crashes + crash history



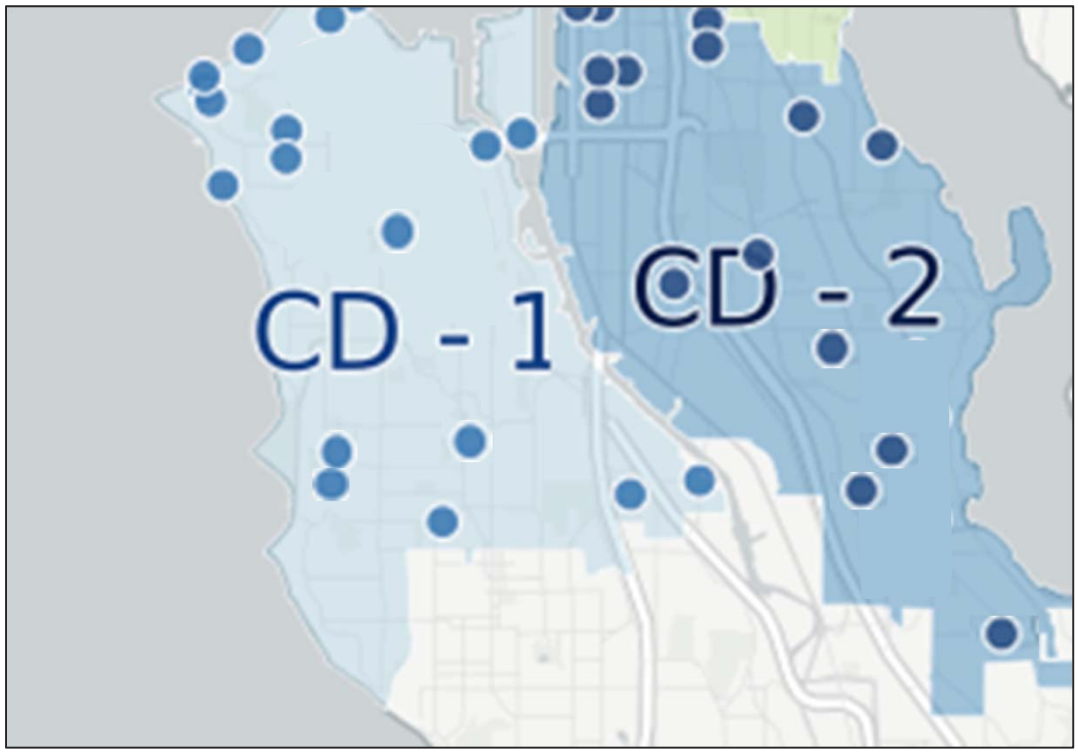
Select Countermeasures

- Aim to install low-cost countermeasures that can work at a majority of the priority locations
  - Driven by higher number of locations
  - Goal is to broadly treat risk factors and risk factor combinations



Prioritize Projects

- Results can be used within other frameworks, e.g., districts or other transportation plans



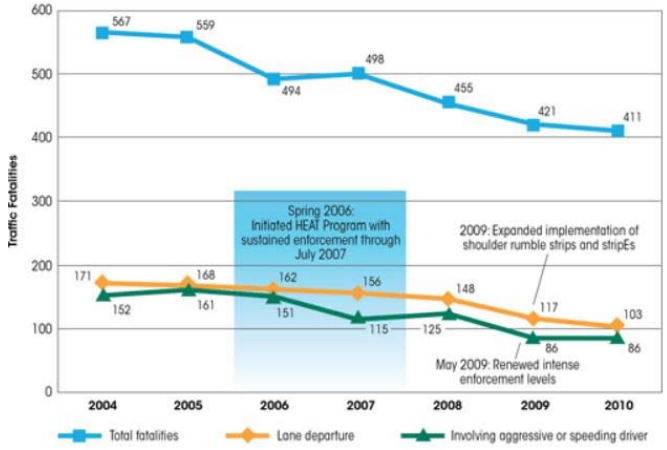
Example Rankings by Council District, Seattle, WA

Identify Funding for Program, Implement

- What are agency goals and priorities?
- Which funding sources exist?
- How can identified needs be built into existing efforts, e.g., pedestrian or bicycle plans?

Perform Systemic Program Evaluation

- Evaluation of effectiveness important for:
  - Future support
  - Broader professional knowledge
- "Roll up" the data, include at least three years of crash data
- Include changes in other key risk factors
- Can also look at metrics like CBA



Resources for Systemic Safety Analysis

- FHWA Systemic Safety Project Selection Tool
- Highway Safety Manual
- NCHRP 17-73 Systemic Pedestrian Safety Analysis Guidebook
- Highway Safety Improvement Program Manual
- 15-63 Guidebook on Pedestrian and Bicyclist Safety at Intersections (forthcoming)

EDC-5 STEP Contacts

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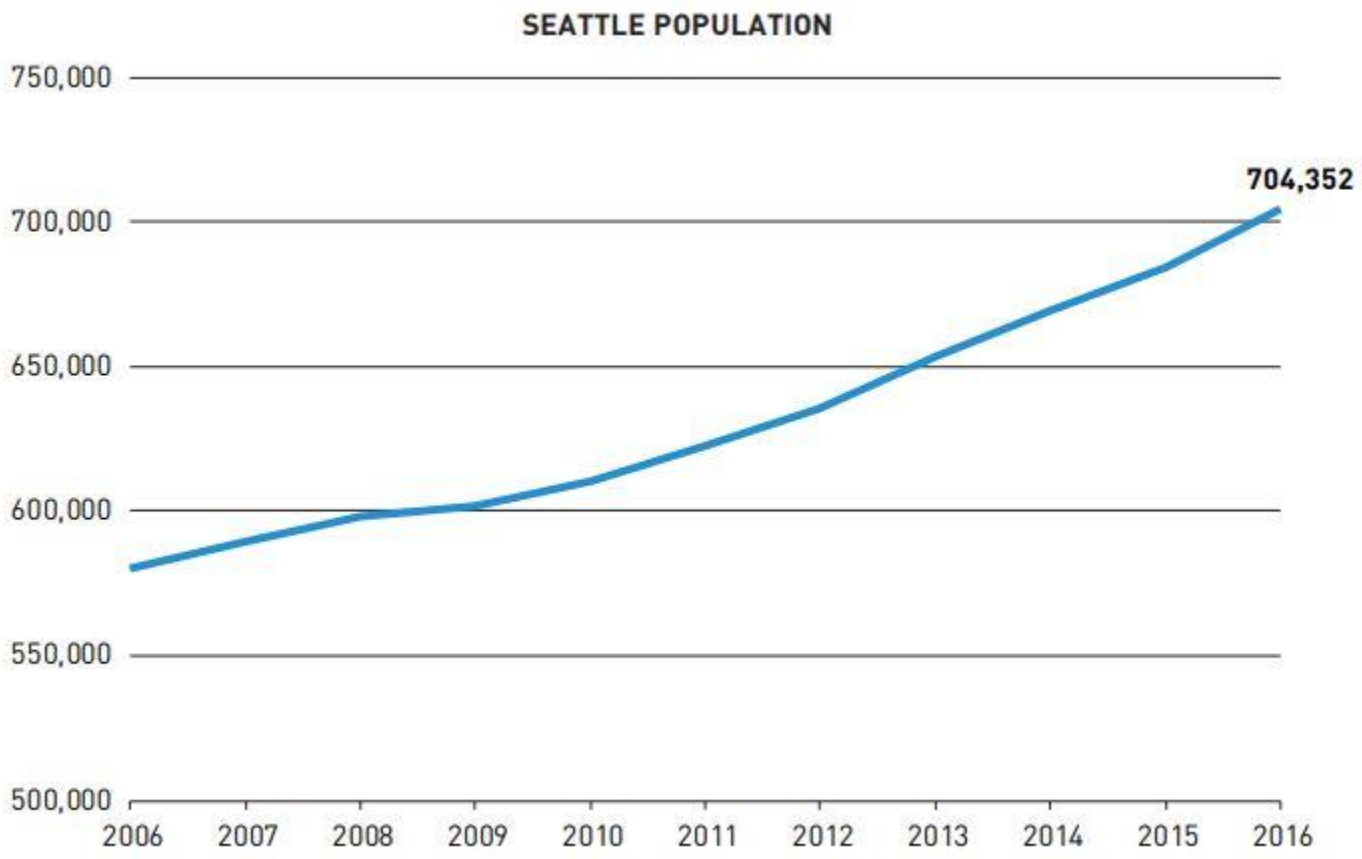
Bicycle and Pedestrian Safety Analysis

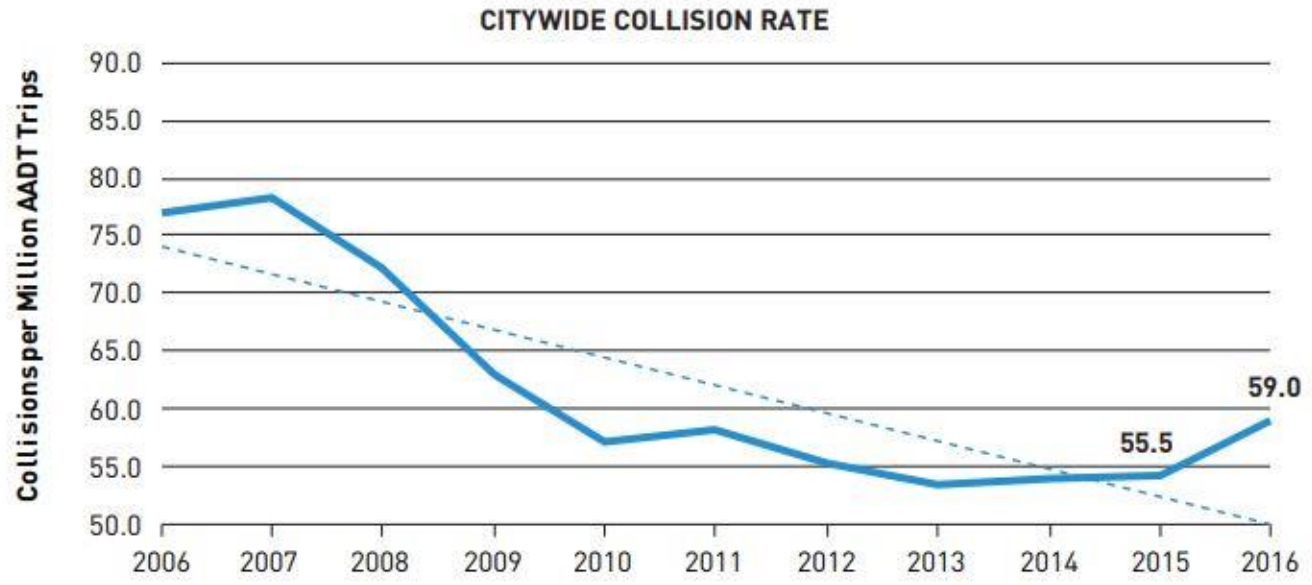
SDOT
Seattle Department of Transportation

Seattle and Vision Zero

- Targeting zero severe/fatal collisions by 2035



Data



Fatal Collisions
2013-2015

23

4

Pedestrian and bicycle collisions make up 6% of total crashes but 40% of fatalities

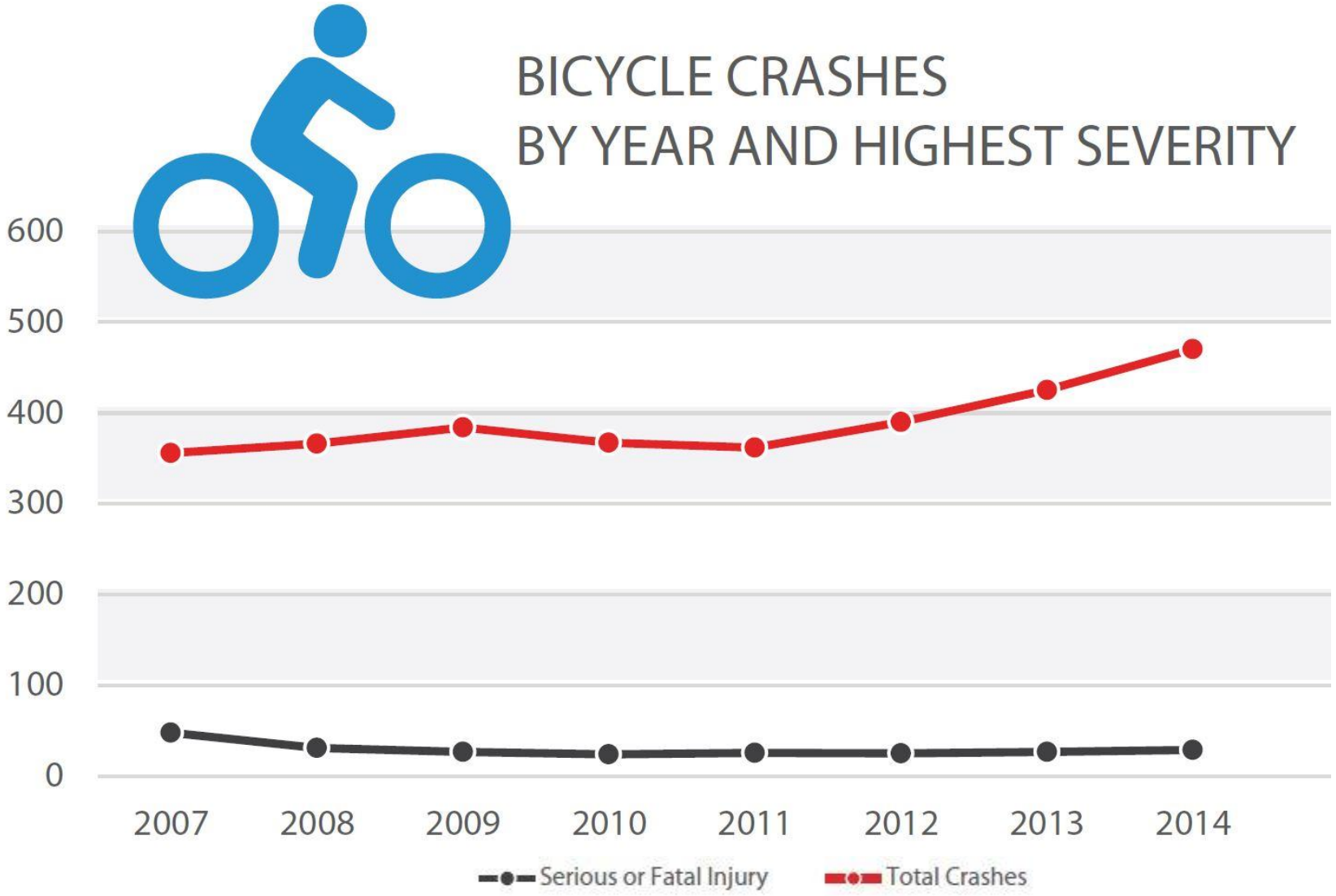
9 out of 10 reported bicycle/pedestrian collisions result in injury

Purpose of Bicycle and Pedestrian Safety Analysis

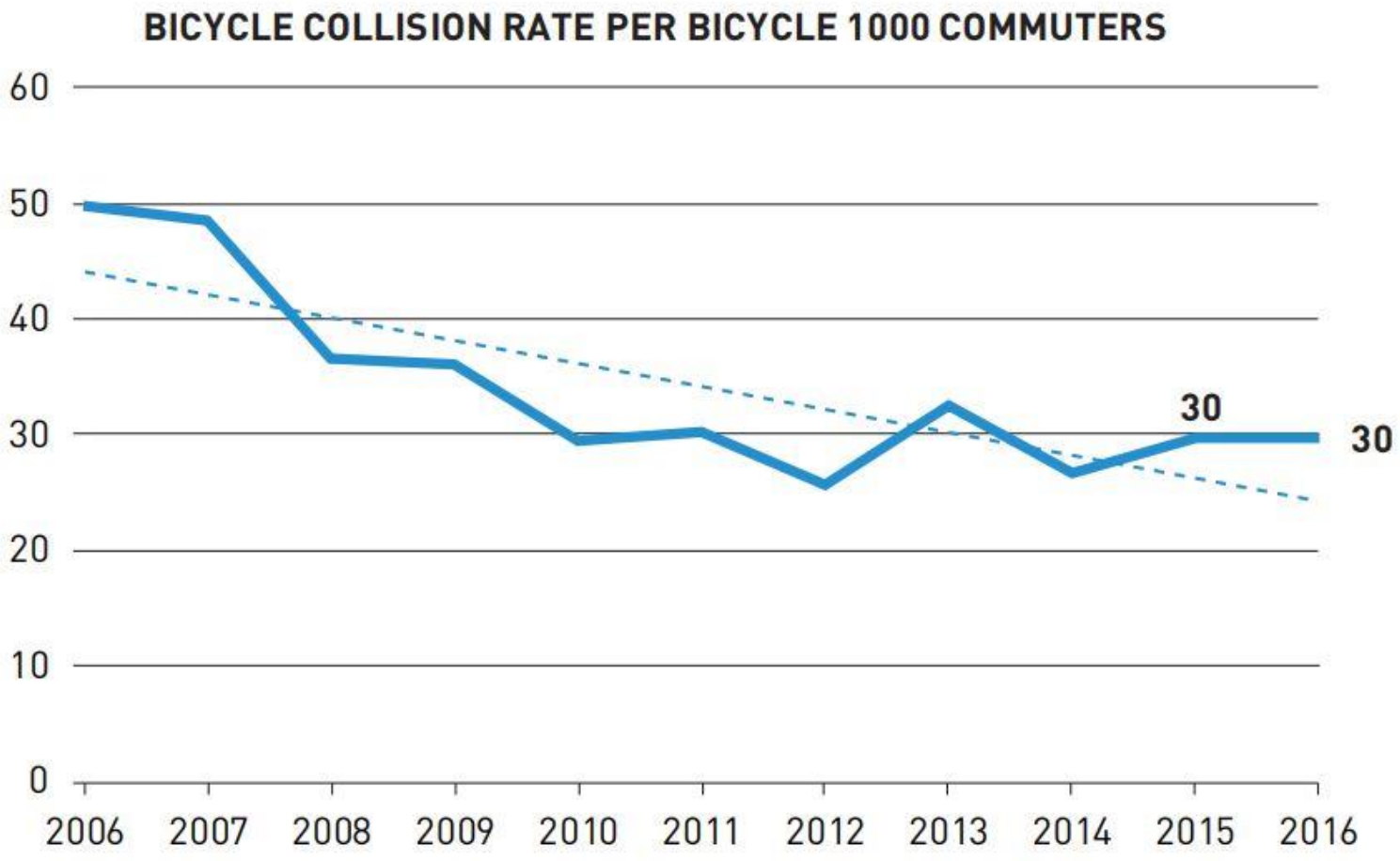
- Better understand risk factors contributing to pedestrian and bicyclist crashes
- Proactively and systemically address risk factors to mitigate potential crashes
- Advance Seattle's Vision Zero Goals

Data At a Glance – Crash Data

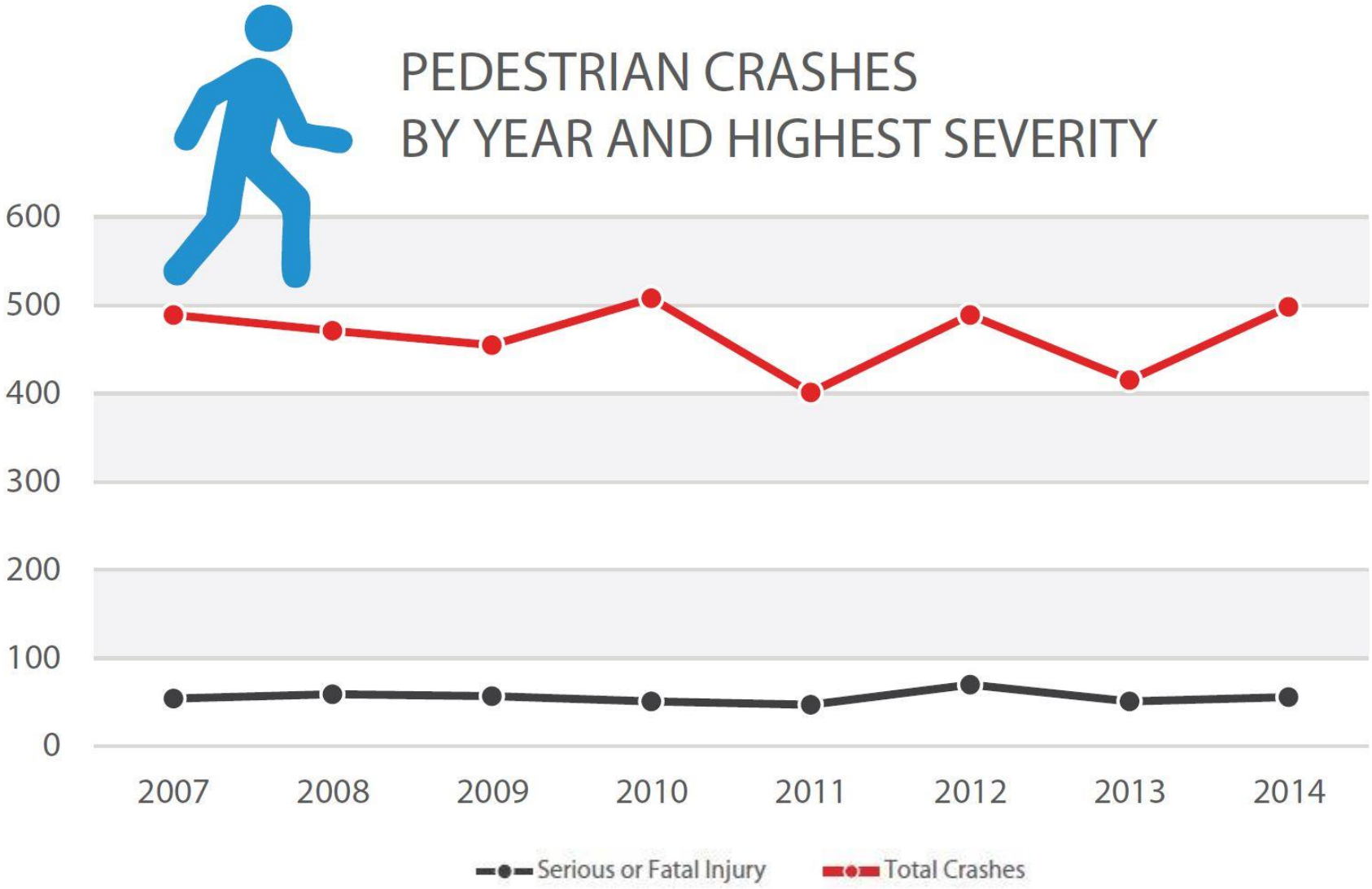
Bicycle Collision Trends



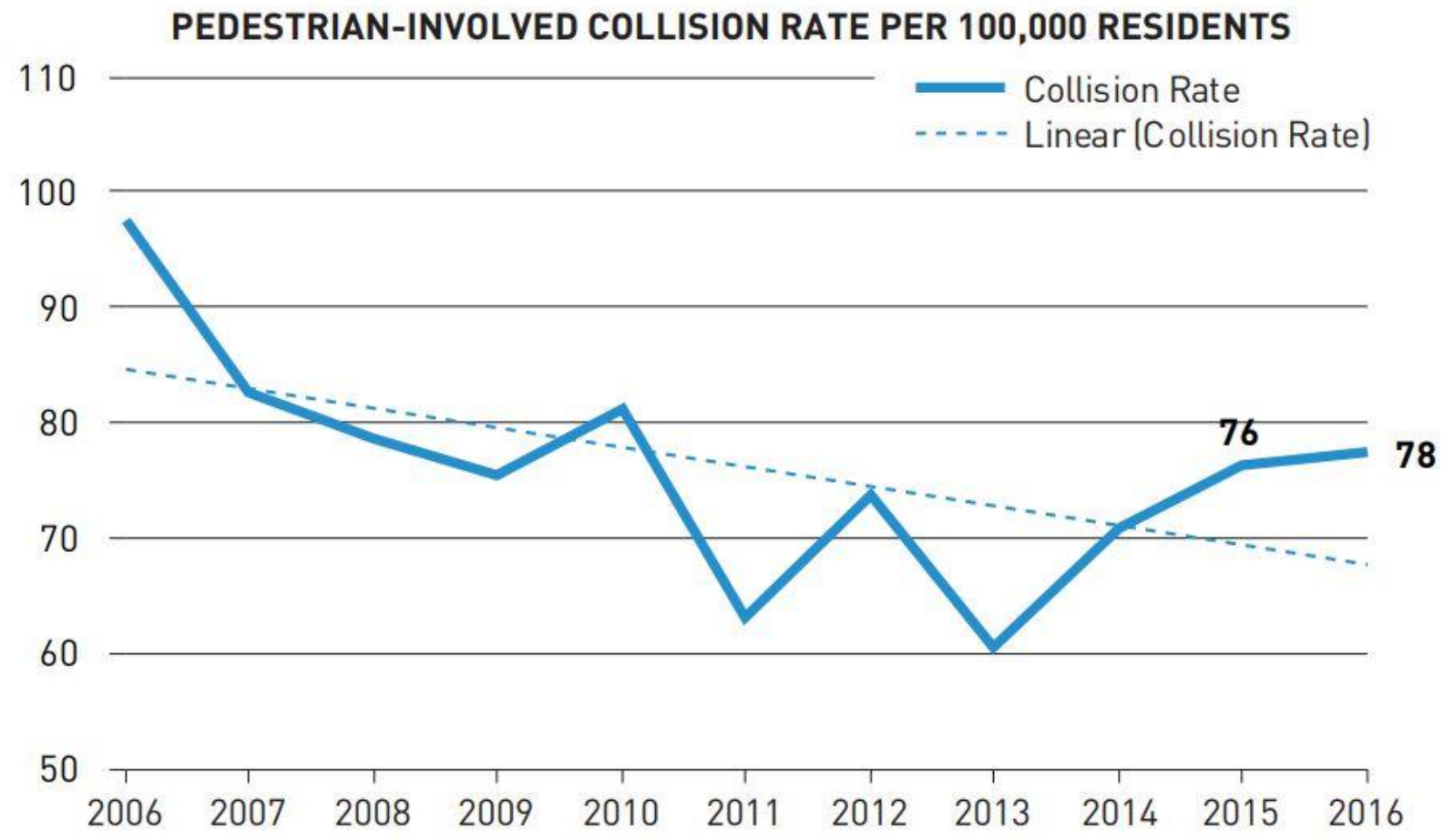
Bicycle Collision Rates



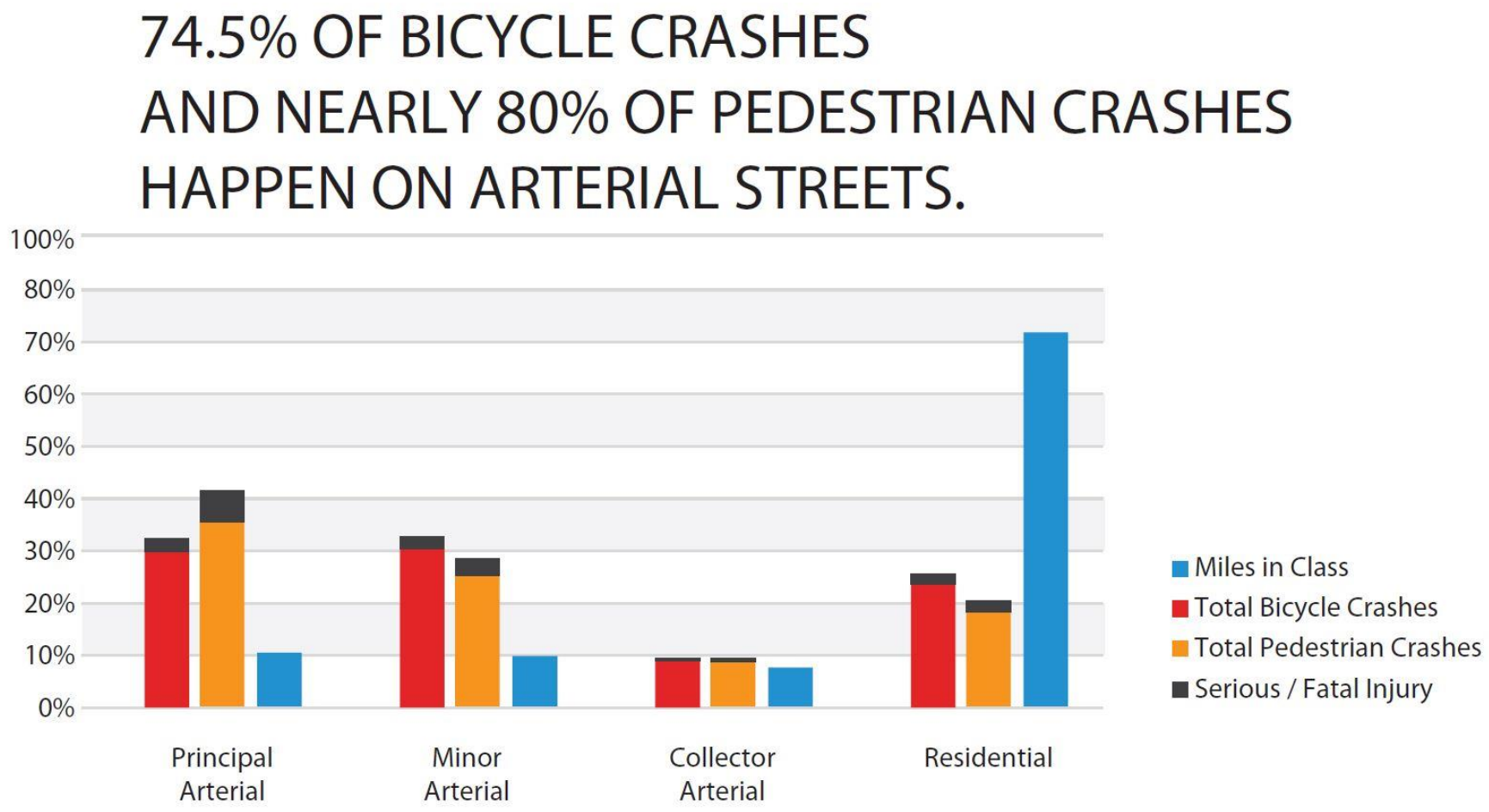
Pedestrian Collision Trends



Pedestrian Collision Rates

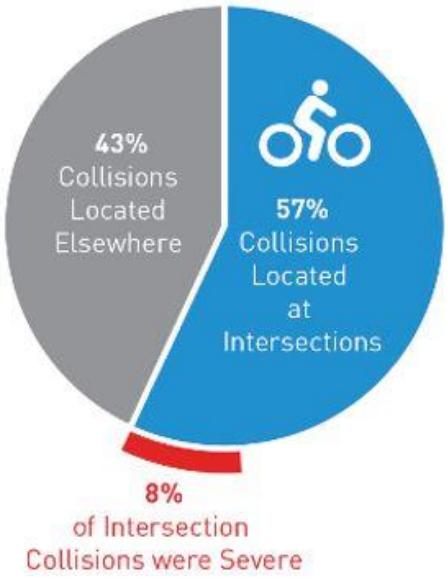


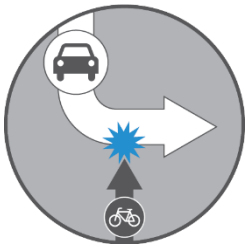
Exploratory Analysis

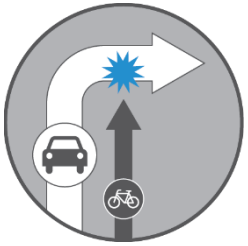


Exploratory Analysis - Bicycle

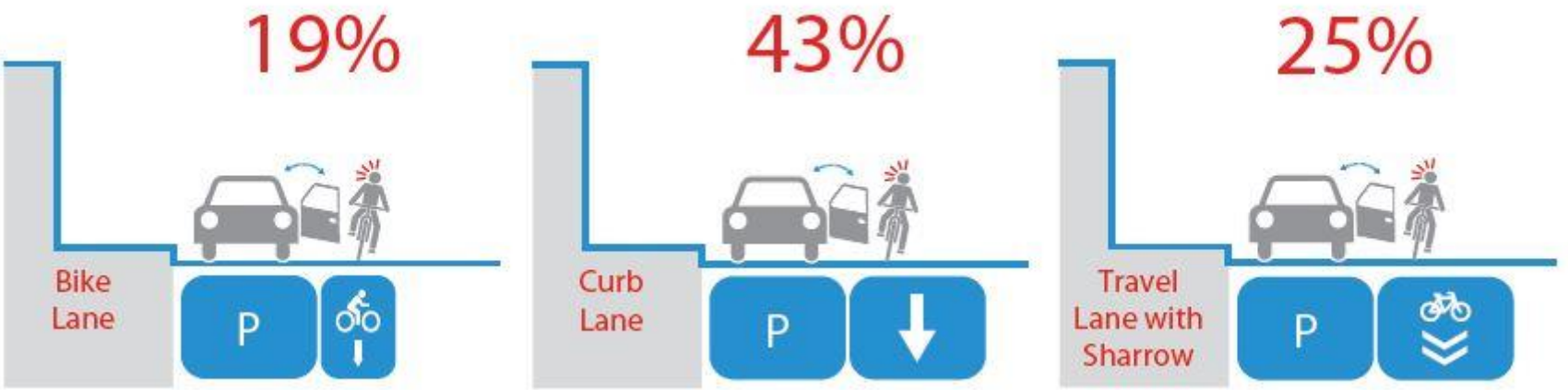
Collision Type	% of Total	% of Severe/Fatal
Left Hook	13.9	21.5
Angle	9.4	9.9
Right Hook	7.1	2.7
Dooring	5.0	6.0





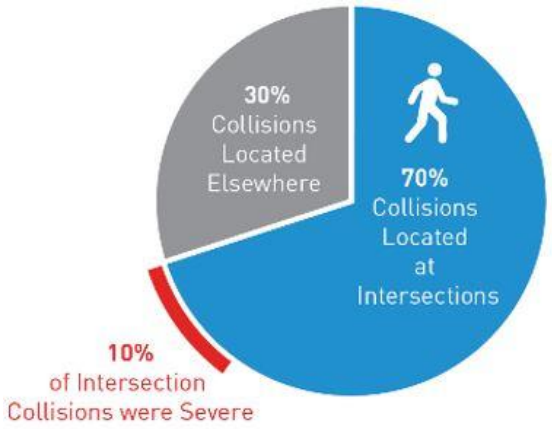


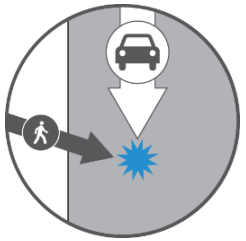
Exploratory Analysis - Bicycle



Exploratory Analysis - Pedestrian

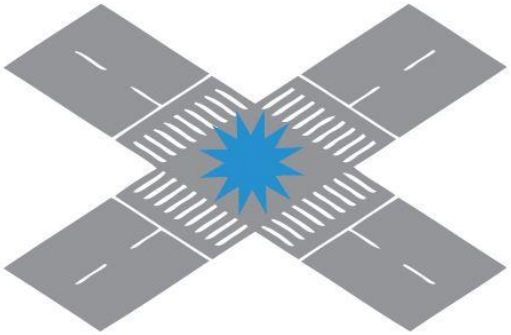
Collision Type	% of Total	% of Severe/Fatal
Left hook at crossing (controlled)	29.1	20.7
Angle at crossing (controlled)	23.0	31.0
Angle at midblock (uncontrolled)	21.7	33.8

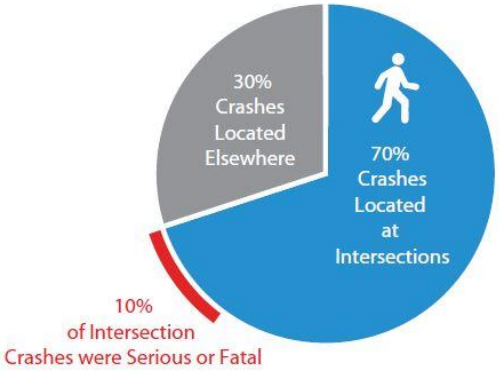


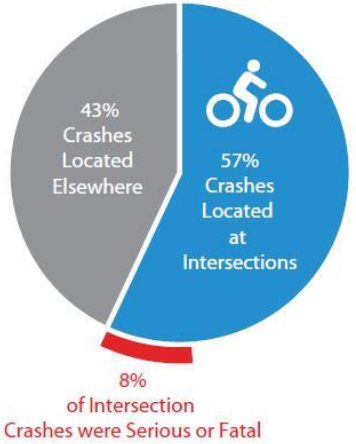


Exploratory Analysis

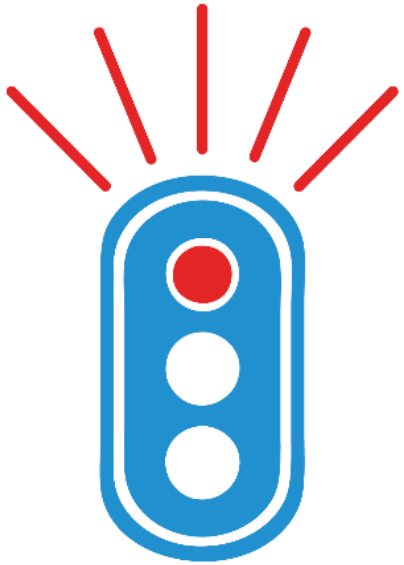
THE MAJORITY OF BICYCLE AND PEDESTRIAN CRASHES HAPPEN AT INTERSECTIONS



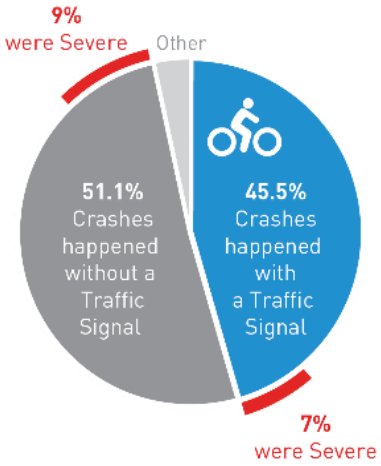


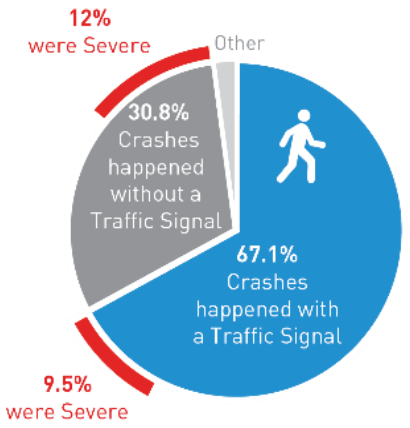


Exploratory Analysis



PEDESTRIAN INTERSECTION CRASHES MORE LIKELY TO HAPPEN AT LOCATIONS WITH TRAFFIC SIGNALS





Accounting for Exposure

Exposure = level of pedestrian/bicycling activity

Pedestrian Activity

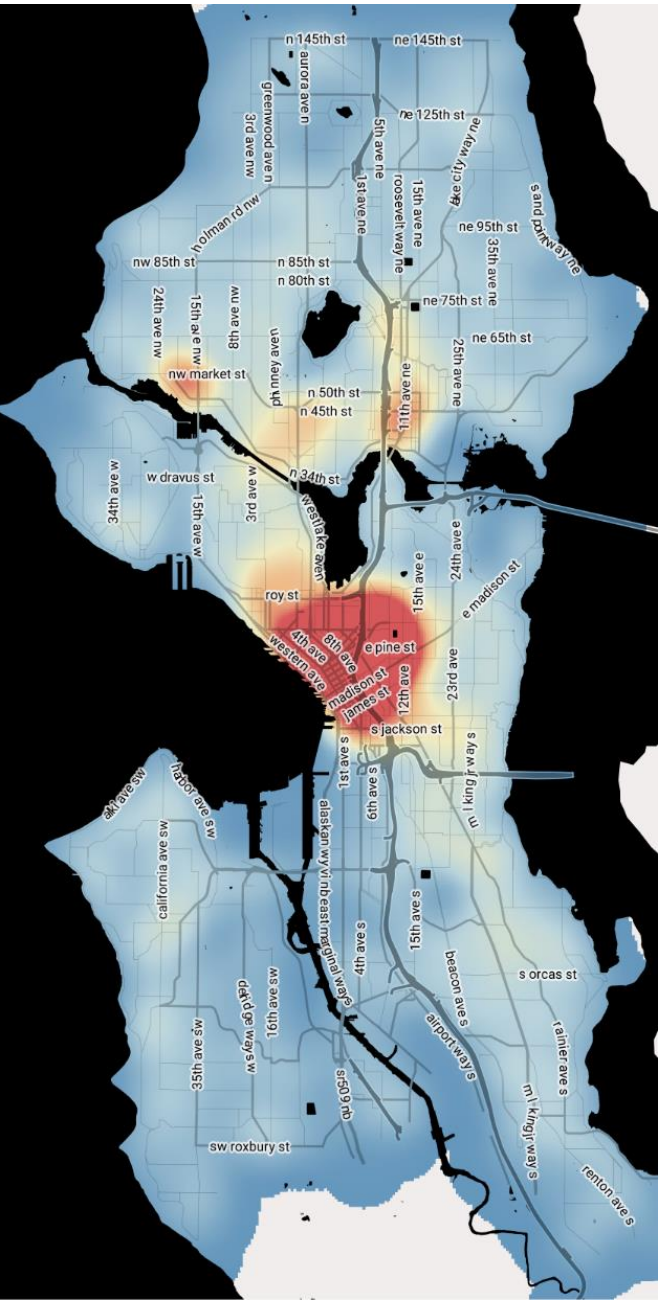
- Annualized count data
- Trip generators

Bicycle Activity

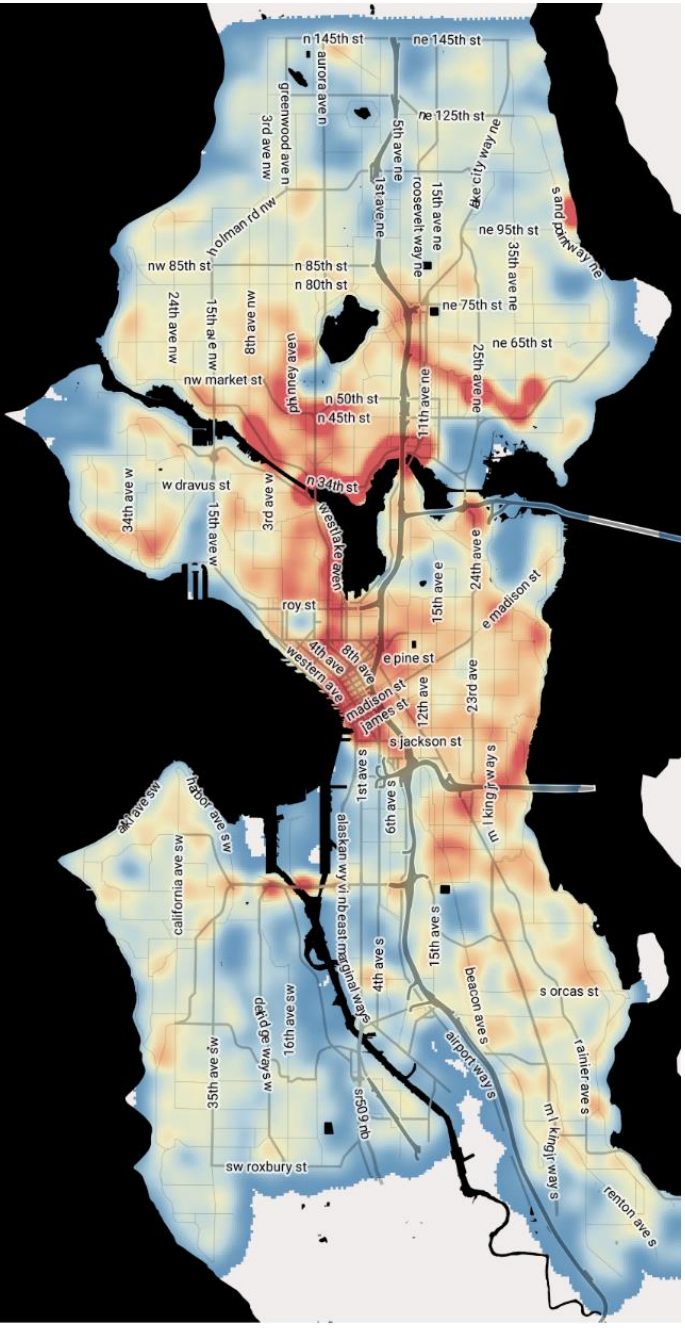
- Annualized count data
- Trip generators
- Strava data
- Bicycle Network

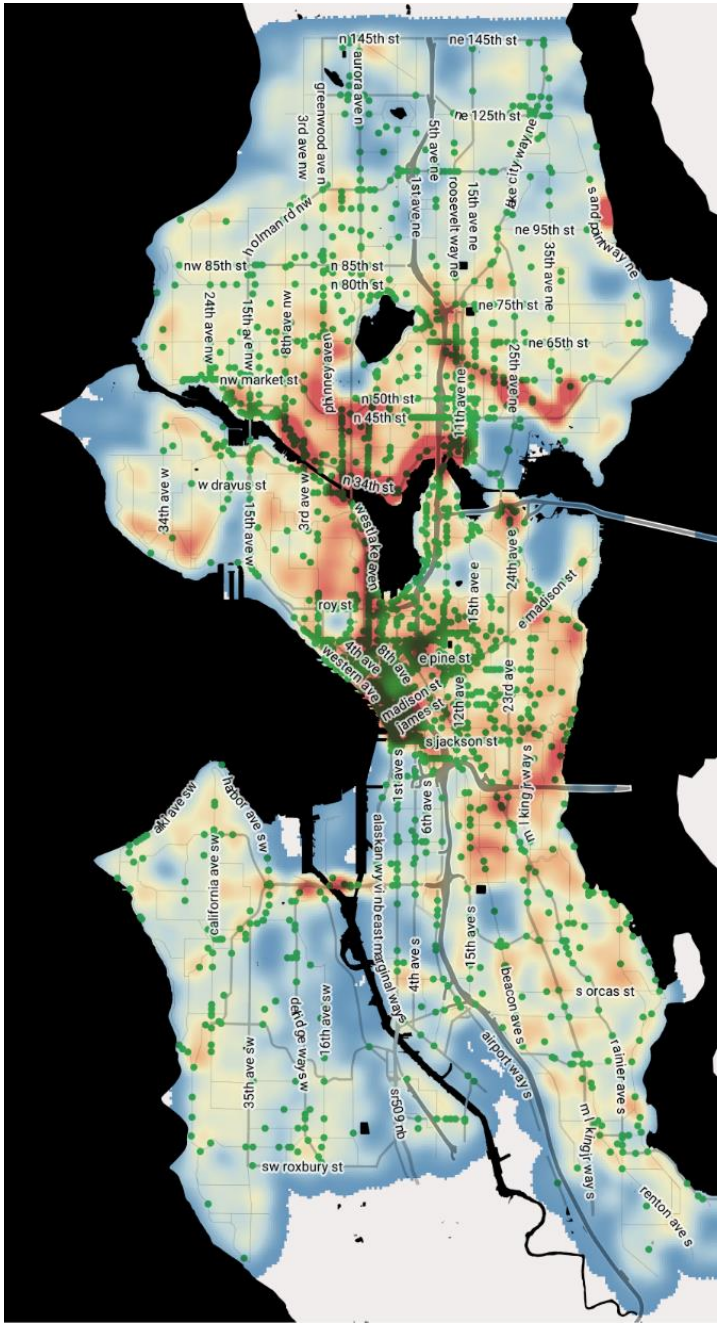
Trip generators: housing units (single family or multifamily), commercial destinations, transit locations, and universities or schools.

Pedestrian Volumes

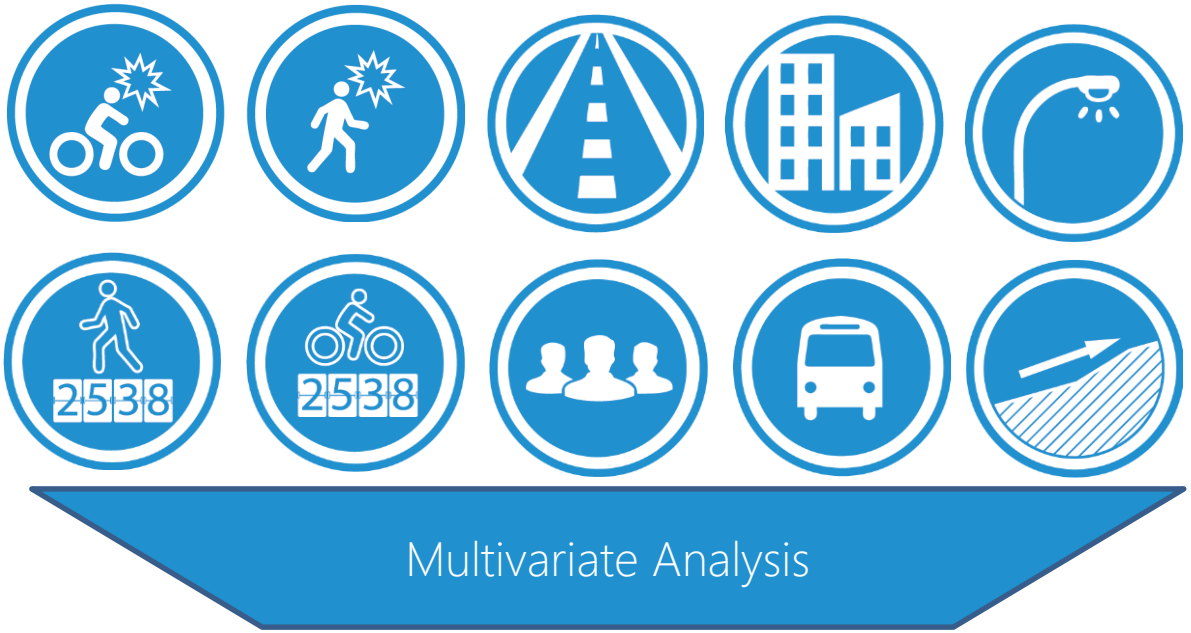


Bike Volumes





Leading Edge Analysis



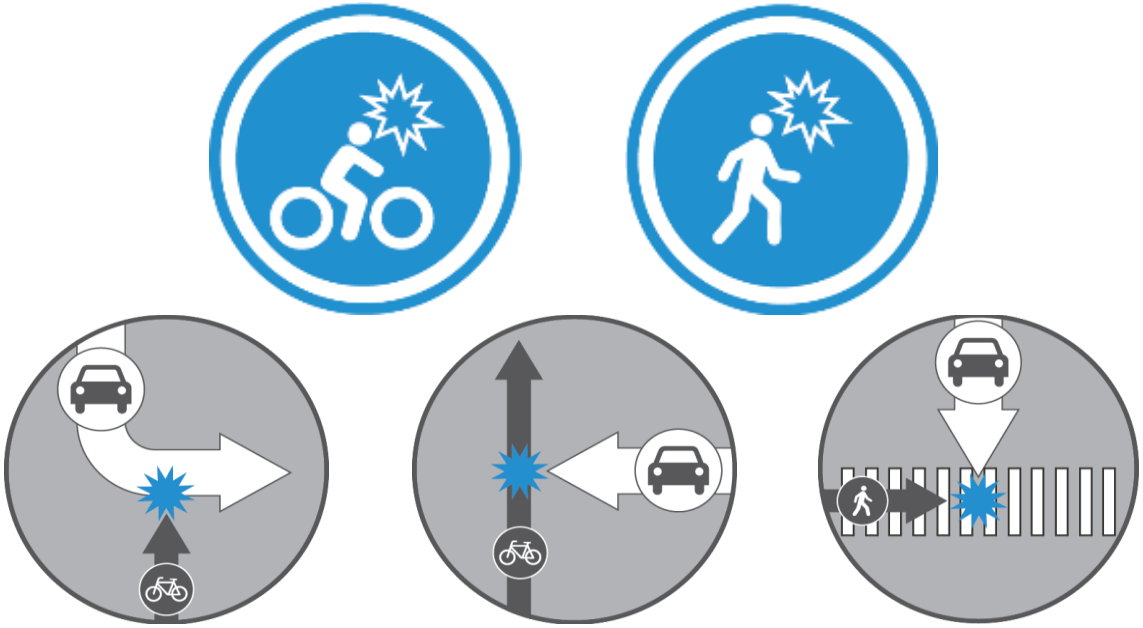
Identify Risk Factors

Ranked Lists of Locations by Safety Performance Factor

A Proactive, Systemic Approach

Focusing on modeled collision rates at **intersection locations** based on the 5 following prioritized collision types:

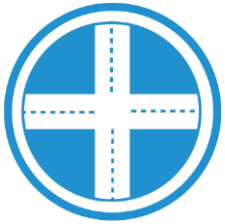
- Total bicycle collisions
- Total pedestrian collisions
- Opposite direction bicycle collisions
- Angle bicycle collisions
- Angle pedestrian collisions



How is Seattle Using These Findings?

- Identify locations where street or signal design changes may be needed
- Make informed decisions around prioritizing safety improvements
- Proactively treat locations with the intention of mitigating potential crashes




The Value of Good Data

- Quality vs quantity of collision data
- Geospatially located data's benefit to local and systemic trend analyses
- Simple statistical and spatial analysis can reveal informative patterns that may not be apparent
- Understanding exposure is key to understanding risk, prioritizing safety improvements

BPSA Phase 2

- Additional 3 years of collision data
- Evaluate additional Safety Performance Factors for new collision types
- Develop a more robust exposure model for bicycle and pedestrian activity
- Video analysis of bicycle facility interactions with vehicle movements
- Promote education and enforcement

Questions?

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http://www.seattle.gov/visionzero




SDOT
Seattle Department of Transportation

Systemic Strategies for Reducing Pedestrian Injury in California

Work presented by:

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

In partnership with:

Berkeley SafeTREC

FEHR PEERS

Presented as part of:

FHWA's STEP Program Webinar Series

Proactively Addressing Crash Risk with Systemic Safety Analysis

October 11, 2018

Presentation Outline

- Background
  - Caltrans Pedestrian Safety Improvement Monitoring Program
  - Systemic Safety
- Application of a systemic safety approach in California
  - Set up
  - Screening
  - Improvements

Sidewalk Gap Closure

Source: Napa Valley Register

Raised Medians/Refuge Islands

Source: NACTO Urban Streets Design Guide

Right-Turn-On-Red Restrictions

Source: CA MUTCD Figure 3B-27

Pedestrian Warning Signs

Source: CA MUTCD Figure 2C-11

Advanced Yield Lines & "Yield Here To Pedestrian" Signs

Source: Toole Design Group

Accessible Pedestrian Signals, Countdown Signal Heads

Source: SFMTA

Parking Restrictions for Visibility

Source: SFMTA

Rectangular Rapid Flash Beacon

Source: FHWA

Leading Pedestrian Interval

Source: SFMTA

Advanced Stop Lines

Source: FHWA-SA-09-010

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Status

Pilot (Round 1) Sent to Districts.
Fund Source: HSIP, 201.010 (Safety)
7/2016

Districts Report Progress to HQ
9/2016

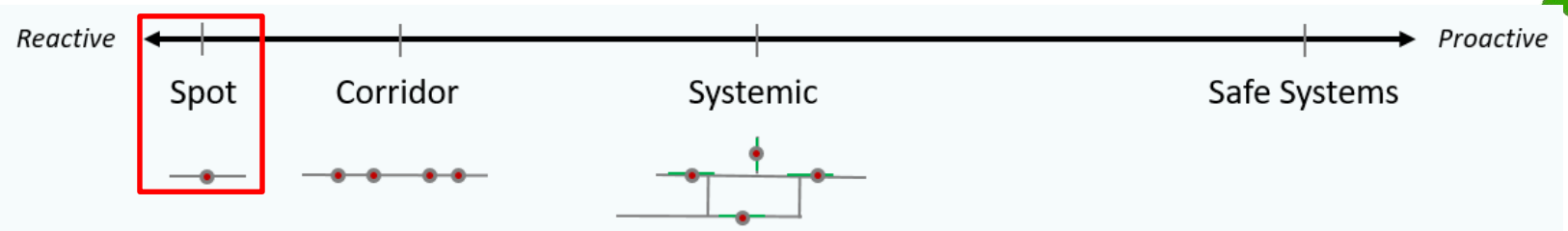
Districts Report Progress to HQ
11/2016

Districts Complete Investigations
3/2017

Jul | Aug | Sep | Oct | Nov | Dec | 2017 | Feb | Mar

2017

Pedestrian Safety Improvement Monitoring Program, Round 1



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Jul | Aug | Sep | Oct | Nov | Dec | 2017 | Feb | Mar

2017

Pedestrian Safety Training

- Who: District Traffic Safety Engineers
- Why: To learn effective solutions and best practices in design and operations for pedestrian safety

Course	When	Where	Audience
201-Advanced	1/24/2017-1/25/2017	Sacramento	Statewide, Traffic Safety Staff
101- Basic	9/6/2017-9/7/2017	Oakland	District 4 Traffic Safety, Design & Transportation Planning Staff
Pedestrian Safety Traffic Investigations and Countermeasures Training (3 sessions)	Spring 2019	Various District Offices	Statewide, Traffic Safety Staff

FUTURE

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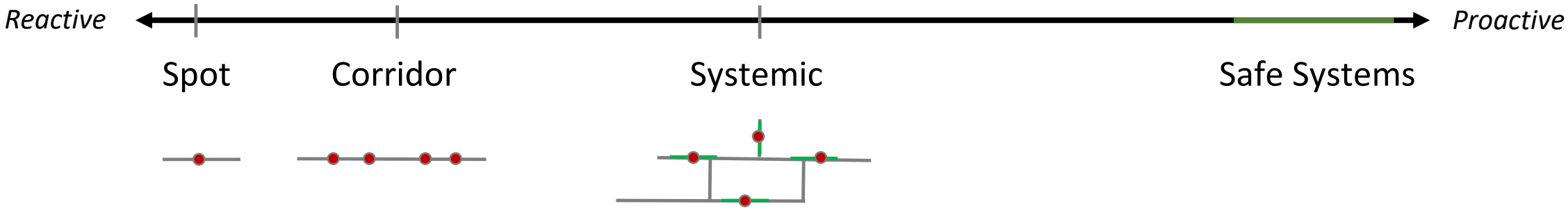
Pedestrian Safety Improvement Monitoring Program Results

District	Investigations Initiated by Pedestrian Monitoring Program	Completed Investigations (Percent Complete)	Actions Underway					No Engineering Recommendation	Total Actions
			New Recommended Improvements			Prior Improvements Planned or Recommended	Recent Improvement Implemented		
			Capital Project	MWO	Completed Safety Action				
1	8	8 (100%)		1		4	2	1	8
2	6	6 (100%)		1	4			1	6
3	6	6 (100%)	1	3				3	7
4	33	33 (100%)	7	10	1	19	3	1	41
5	8	8 (100%)	4	7					11
6	6	6 (100%)	2	1		1		3	7
7	20	20 (100%)	7	12			2	2	23
8	6	6 (100%)	4	1				1	6
9	2	2 (100%)	1				1		2
10	8	8 (100%)	1	4	1	1	2		9
11	7	7 (100%)		7					7
12	19	19 (100%)	2	7		7	2	2	20
Statewide	129	129 (100%)	29	54	6	32	12	14	147*

*Includes short term and long term improvements for select locations.

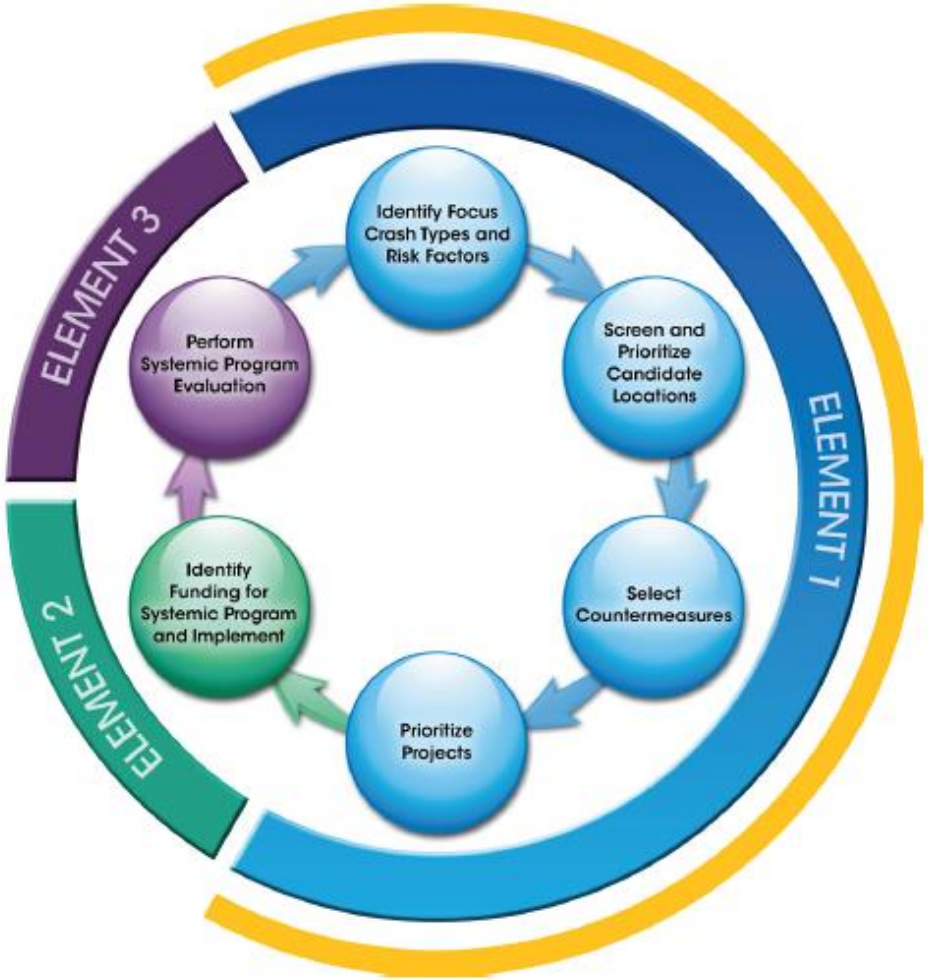
Where does Systemic Safety fit in?



Systemic approach:

- reactive - it uses historical crash data to identify priorities
- proactive - make improvements also at low or non-crash sites

FHWA's Systemic Safety Program



Two Tasks into One Matrix

Facilities

Crash Types

Intersections: Urbanized Conventional/One-way city street	Control Type	Unsignalized																Signalized														Total
	# of Lanes - Main	> 3								<= 3								> 3								<= 3							
	# of Lanes - Cross	> 3				<= 3				> 3				<= 3				> 3				<= 3				> 3				<= 3			
	AADT - Main	>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000	
ALL Districts	AADT - Cross	>=12,000	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	>=12,00	<12,000	
# of Intersections		0	3	3	28	0	284	10	3659	0	0	0	24	0	5	18	10611	55	49	186	264	14	116	69	1129	0	0	30	41	0	2	36	478	17114
Pedestrian Movements	Primary Collision Factors																															
Xing Xwalk – Intersection	Influence of Alcohol																															
	Following too close																															
	Failure to Yield																															
	Improper Turn																															
	Speeding																															
	Other Violations																															
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	Improper Turn																															
	Speeding																															
	Other Violations																															
Total																																0
Rates																																0

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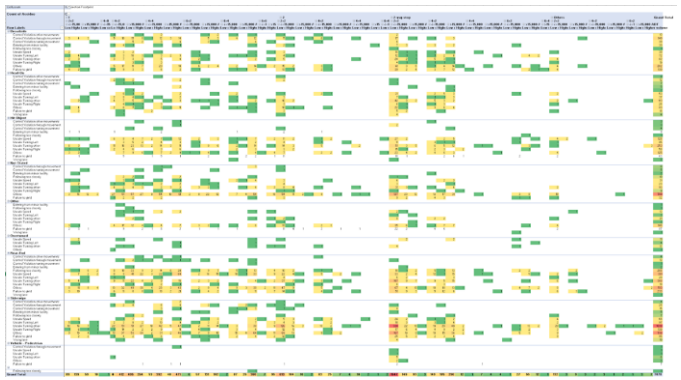
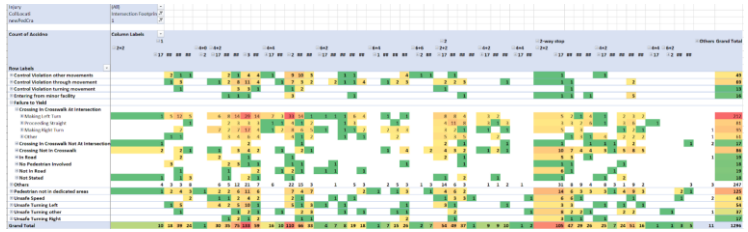
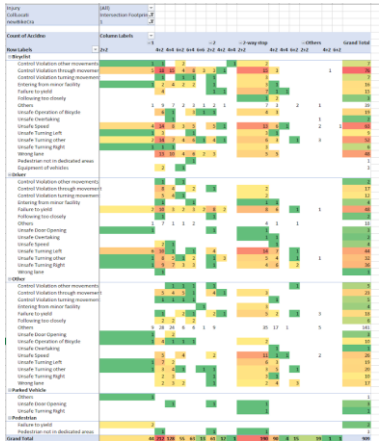
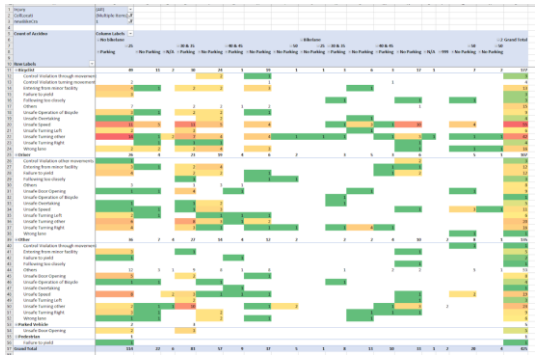
Different Matrices Reveal Different Insights

	VEHICLE	PEDESTRIAN	BICYCLE
INTERSECTION FOOTPRINT			
MIDBLOCK			

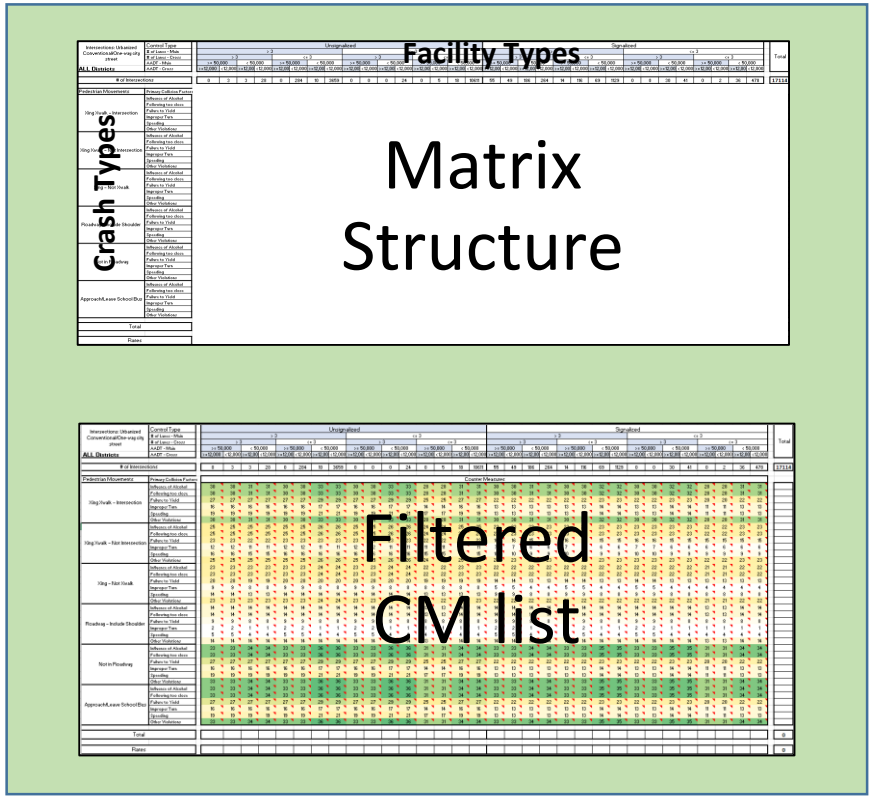
Systemic Matrix Approach: **Set-up**

1

Define the “crash types” and the “facility types” of the matrix

2

Evaluate and determine the relevant countermeasures for each matrix cell



Potential Matrices of Interest

Intersections: Urbanized Conventional/One-way city street	Control Type	Unsignalized																Signalized														Total
	# of Lanes - Main	> 3								<= 3								> 3								<= 3							
	# of Lanes - Cross	> 3				<= 3				> 3				<= 3				> 3				<= 3				> 3				<= 3			
	AADT - Main	>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000	
ALL Districts	AADT - Cross	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	
# of Intersections		0	3	3	28	0	284	10	3659	0	0	0	24	0	5	18	10611	55	49	186	264	14	116	69	1129	0	0	30	41	0	2	36	478	17114
Pedestrian Movements	Primary Collision Factors																															
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	Other Violations																															
Total																																0
Rates																																0

Potential list of factors for which a separate matrix may be developed:

- Location: intersection, highway segment, ramp
- Jurisdiction: responsible districts
- Urbanization level: urban core, urbanized, rural
- Severity: property-damage only (PDO), non-PDO
- etc.

Tailored to the needs of the agency.

Choosing the Rows and Columns

Facilities

Crash Types

Intersections: Urbanized Conventional/One-way city street	Control Type	Unsignalized																Signalized														Total
	# of Lanes - Main	> 3								<= 3								> 3								<= 3							
	# of Lanes - Cross	> 3				<= 3				> 3				<= 3				> 3				<= 3				> 3				<= 3		
	AADT - Main	>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000	
ALL Districts	AADT - Cross	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	
# of Intersections		0	3	3	28	0	284	10	3659	0	0	0	24	0	5	18	10611	55	49	186	264	14	116	69	1129	0	0	30	41	0	2	36	478	17114
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	Speeding																															
	Other Violations																															
Total																																0
Rates																																0

Iterative, data-driven process to determine:

- ROWS: **representation of the crash dynamics**
  - collision factors, violations, collision type, movements, etc.
- COLUMNS: **built-environment conditions**
  - traffic controls, volume, speed, number of lanes, median presence, parking, crosswalk, etc.

Decision-making factors: road safety expertise, share of blank cells, kurtosis, table size, etc.

The Countermeasure Matrix

Intersections. Zone:ALL, Road: Conventional/One-way city street	Control Type	Unsignalized																Signalized													
	# of Lanes - Main	> 3								<= 3								> 3								<= 3					
	# of Lanes - Cross	> 3				<= 3				> 3				<= 3				> 3				<= 3				> 3				<= 3	
	AADT - Main	>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000	
ALL Districts	AADT - Cross	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000
# of Intersections		0	3	3	28	0	284	10	3659	0	0	0	24	0	5	18	10611	55	49	186	264	14	116	69	1129	0	0	30	41	0	2	36	478

Pedestrian Movements	Primary Collision Factors
Xing Xwalk – Intersection	Influence of Alcohol
	Following too close
	Failure to Yield
	Improper Turn
	Speeding
	Other Violations
Xing Xwalk – Not Intersection	Influence of Alcohol
	Following too close
	Failure to Yield
	Improper Turn
	Speeding
	Other Violations
Xing – Not Xwalk	Influence of Alcohol
	Following too close
	Failure to Yield
	Improper Turn
	Speeding
	Other Violations
Roadway – Include Shoulder	Influence of Alcohol
	Following too close
	Failure to Yield
	Improper Turn
	Speeding
	Other Violations
Not in Roadway	Influence of Alcohol
	Following too close
	Failure to Yield
	Improper Turn
	Speeding
	Other Violations
Approach/Leave School Bus	Influence of Alcohol
	Following too close
	Failure to Yield
	Improper Turn
	Speeding
	Other Violations

Countermeasures		Locations												
ID & Countermeasures		Urban	Rural	Intersections	Midblock Crossings	Along roadways	Expressway/Freeway	Conventional/One-way city street	Signalized	Unsignalized	High design speed	Low design speed	High volume	Low volu
1	Install sidewalks and walkways	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
14	Widen sidewalks	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
59	Maintain a sidewalk level across the	Y	Y	N	N	Y	N	Y	N	N	Y	Y	Y	Y
18	install bike lanes	Y	Y	N	N	Y	N	Y	N	N	Y	Y	Y	Y
2	Curb ramps	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y
11	Curb-extensions	Y	N	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y
23	Curb radius reduction	Y	N	Y	N	N	N	Y	Y	Y	N	Y	Y	Y
3	Marked crosswalks at signalized	Y	N	Y	N	N	N	Y	Y	N	Y	Y	Y	Y
6	Marked crosswalks at unsignalized	Y	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
12	marked crosswalks at midblock crossings	Y	Y	N	Y	N	N	Y	N	N	Y	Y	Y	Y
4	Non-motorist guiding signs	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
5	warning signs for motorists([illegible] SPEED	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y
53	Adult Crossing Guards	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y
52	School zone signals	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y
54	Safe routes to school	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
7	Advanced "STOP" markings	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y
44	Advanced stop line	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y
45	Sign "Stop here for pedestrians"	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y

SUMMARY	
District # or All	ALL
Total # of crashes in district	1302
# of Null crashes (not counted)	125

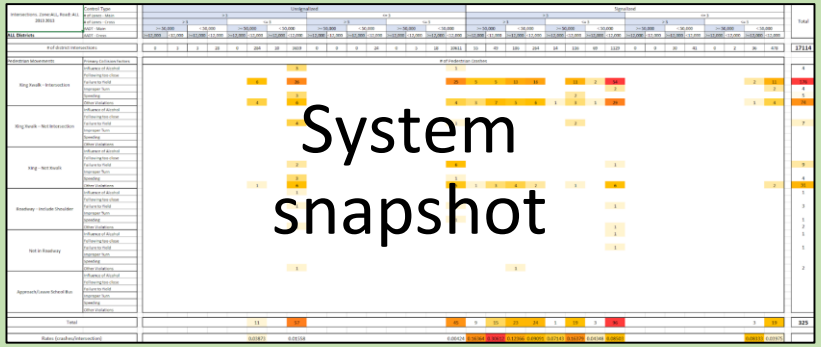
Systemic Matrix Approach: **Screening**

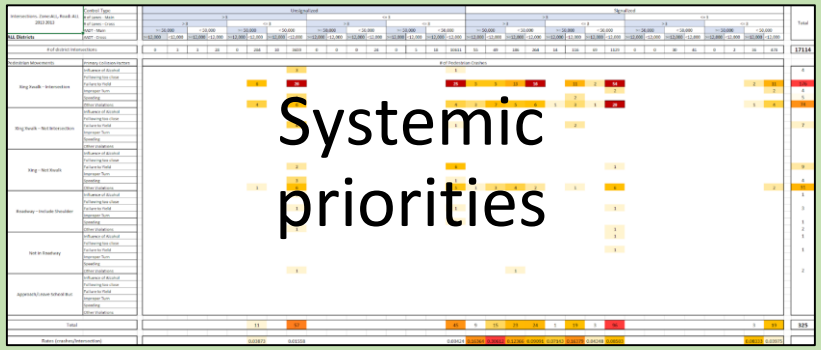
3

Determine what type of crashes are happening on what type of facilities

4

Identify the systemic concerns and priorities





Populating the Crash Matrix - Intersections

District 10

Intersections. Zone:ALL, Road: ALL 2007 2017	Control Type	Unsignalized										Signalized										Total
	# of Lanes - Main	> 3								<= 3		> 3								<= 3		
	# of Lanes - Cross	> 3				<= 3				<= 3		> 3				<= 3				> 3		<= 3
	AADT - Main	>= 50,000		< 50,000		>= 50,000		< 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000		< 50,000		< 50,000		< 50,000
District: 10	AADT - Cross	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	
# of district Intersections		0	0	0	3	0	1	1	196	2	1377	0	0	7	12	0	0	1	64	1	6	4	77	**1757**
Pedestrian Movements	Primary Collision Factors	# of Pedestrian Crashes																						
Xing Xwalk – Intersection	Influence of Alcohol																							
	Following too close																							
	Failure to Yield								22		44			4	2				9		1	3	13	98
	Improper Turn								1		1								1				2	5
	Speeding								4		4													8
	Other Violations								16		10			3	3				21				4	57
Xing Xwalk – Not Intersection	Influence of Alcohol																							
	Following too close																							
	Failure to Yield										3													3
	Improper Turn																							
	Speeding										2													2
	Other Violations										1													1
Xing – Not Xwalk	Influence of Alcohol																							
	Following too close																							
	Failure to Yield								2		5													7
	Improper Turn																						1	1
	Speeding								1		3			1										5
	Other Violations								13		10			1					3		1		2	30
Roadway – Include Shoulder	Influence of Alcohol																							
	Following too close																							
	Failure to Yield										2													2
	Improper Turn																							
	Speeding								2		2								1					5
	Other Violations			1							4								1					6
Not in Roadway	Influence of Alcohol										2													2
	Following too close																							
	Failure to Yield								1										1					2
	Improper Turn								1		1													2
	Speeding										1													1
	Other Violations										1													1
Approach/Leave School Bus	Influence of Alcohol																							
	Following too close																							
	Failure to Yield																							
	Improper Turn																							
	Speeding																							
	Other Violations																							
Total		1							63		96			9	5				37		2	3	22	**238**
Rates (crashes/intersection)		0.3333							0.3214		0.0697			1.2857	0.4167				0.5781		0.3333	0.75	0.2857	

SUMMARY

District # or All	10

Total # of crashes in district	262
# of Null crashes (not counted)	24

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Considerations for Screening

Trade-offs when setting safety screening priorities:

Inclusive approach	**Restrictive approach**
Capturing all potential systemic safety challenges	Higher cost-effectiveness
Lower cost-effectiveness	Potentially missing valuable safety-improving opportunities

Identify Systemic Concerns

Intersections. Zone:ALL, Road: Conventional/One-way city street	Control Type	Unsignalized									
	# of Lanes - Main	> 3									
	# of Lanes - Cross	> 3				<= 3				>	
	AADT - Main	>= 50,000		< 50,000		>= 50,000		< 50,000		>= 50,000	
ALL Districts	AADT - Cross	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000	>=12,000	<12,000
# of Intersections		0	3	3	28	0	284	10	3659	0	0
Pedestrian Movements	Primary Collision Factors										
Xing Xwalk – Intersection	Influence of Alcohol								3		
	Following too close										
	Failure to Yield		1				16		132		
	Improper Turn								2		
	Speeding								8		
	Other Violations						7		53		

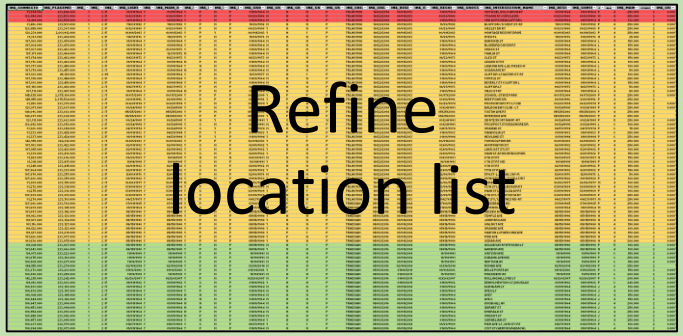
Systemic Matrix Approach: **Improvements**

5

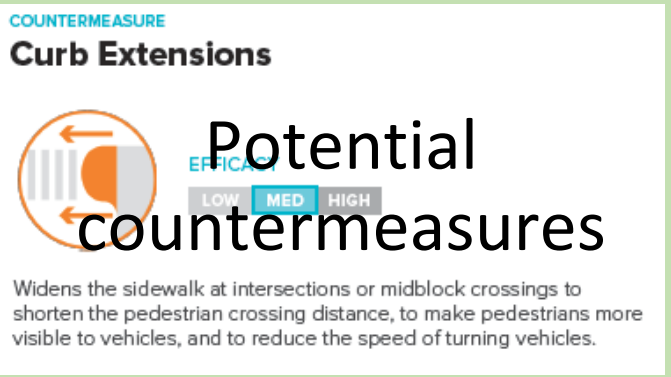
Create preliminary lists for investigations and apply data for priority factors

6

Provide the safety staff with recommendations on which countermeasures to consider first



Refine location list



Potential countermeasures

Create **Preliminary Lists**

Identify specific locations for review.

- Statewide or by district
- Identifies number of collisions by facility type
- Identifies all locations corresponding to facility type

Highways. Zone:ALL, Road: ALL- 2007-2017	AADT	<50000					
	Design Speed	<60			>=60		
	# of Lanes (Left + Right)	=<4	>4		=<4	>4	
ALL Districts	Median Presence	-	YES	NO	-	YES	NO
Total Mileage		6213.119	24.924	59.415	7439.055	214.518	95.666
Pedestrian Movements	Primary Collision Factors						
Xing Xwalk – Intersection	Influence of Alcohol	9					
	Following too close	2					
	Failure to Yield	149		9	190	10	8
	Improper Turn	1			3		
	Speeding	13		1	5	2	1
	Other Violations	72			87	2	2

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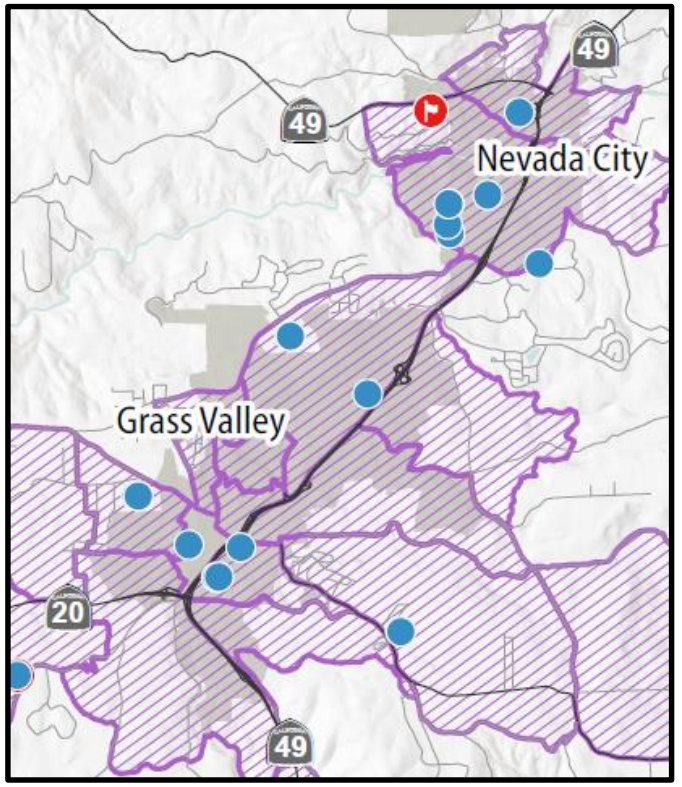
Add Data for **Priority Factors**

Develop prioritized lists of locations.

- GIS-based proximity analysis
  - Pedestrian exposure
  - Schools
  - Disadvantaged communities
  - Population density
  - Jobs density
  - Upcoming Caltrans projects
  - Others



Identify **Countermeasures**

Provide districts guidance for action.

- Use characteristics of each location to provide specific countermeasures

Area:	ALL
Type of road:	Conventional/One-way city street
Control Type	Unsignalized
# of Lanes - Main	Long crossing distance
# of Lanes - Cross	Short crossing distance
AADT - Main	Low volume
AADT - Cross	Low volume
DISTRICT	ALL
Number of Locations	3659
Number crashes	26
ID & Countermeasures	**Countermeasures**
11	Curb-extensions
23	Curb radius reduction
6	Marked crosswalks at unsignalized intersections
5	warning signs for motorists(school advance warning sign, SPEED LIMIT 25 WHEN FLASHING)
53	Adult Crossing Guards
52	School zone signals
7	Advanced "STOP" markings
44	Advanced stop line
45	Sign "Stop here for pedestrians"

COUNTERMEASURE

Curb Extensions

EFFICACY

LOW | MED | HIGH

Widens the sidewalk at intersections or midblock crossings to shorten the pedestrian crossing distance, to make pedestrians more visible to vehicles, and to reduce the speed of turning vehicles.

COUNTERMEASURE LRSM CODE: S21

Advance Stop Bar

CRF 0.15

CRASH TYPE

A stop bar placed 5 to 7 feet ahead of the crosswalk at stop signs and signals reduces instances of vehicles encroaching on the crosswalk.

COUNTERMEASURE LRSM CODE: NS6/NS17/NS18

High-Visibility Crosswalk

CRF 0.25-0.35

CRASH TYPE

A crosswalk that is designed to be more visible to approaching drivers. Crosswalks should be designed with continental markings, also known as ladder markings, and use high-visibility material such as inlay tape or thermoplastic tape instead of paint.

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Discussion

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