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CITY SAFETY PLAN

JANUARY 2024

PREPARED FOR THE CITY OF WASHOUGAL

PREPARED BY DKS ASSOCIATES

Southwest Washington Regional Transportation Council

Acknowledgements

RTC

Jennifer Campos

CITY OF WASHOUGAL

Trevor Evers
Scott Collins

KITTELSON & ASSOCIATES, INC.

Camilla Dartnell
Hermanus Steyn

DKS ASSOCIATES

Justin Sheets
Christian Galiza

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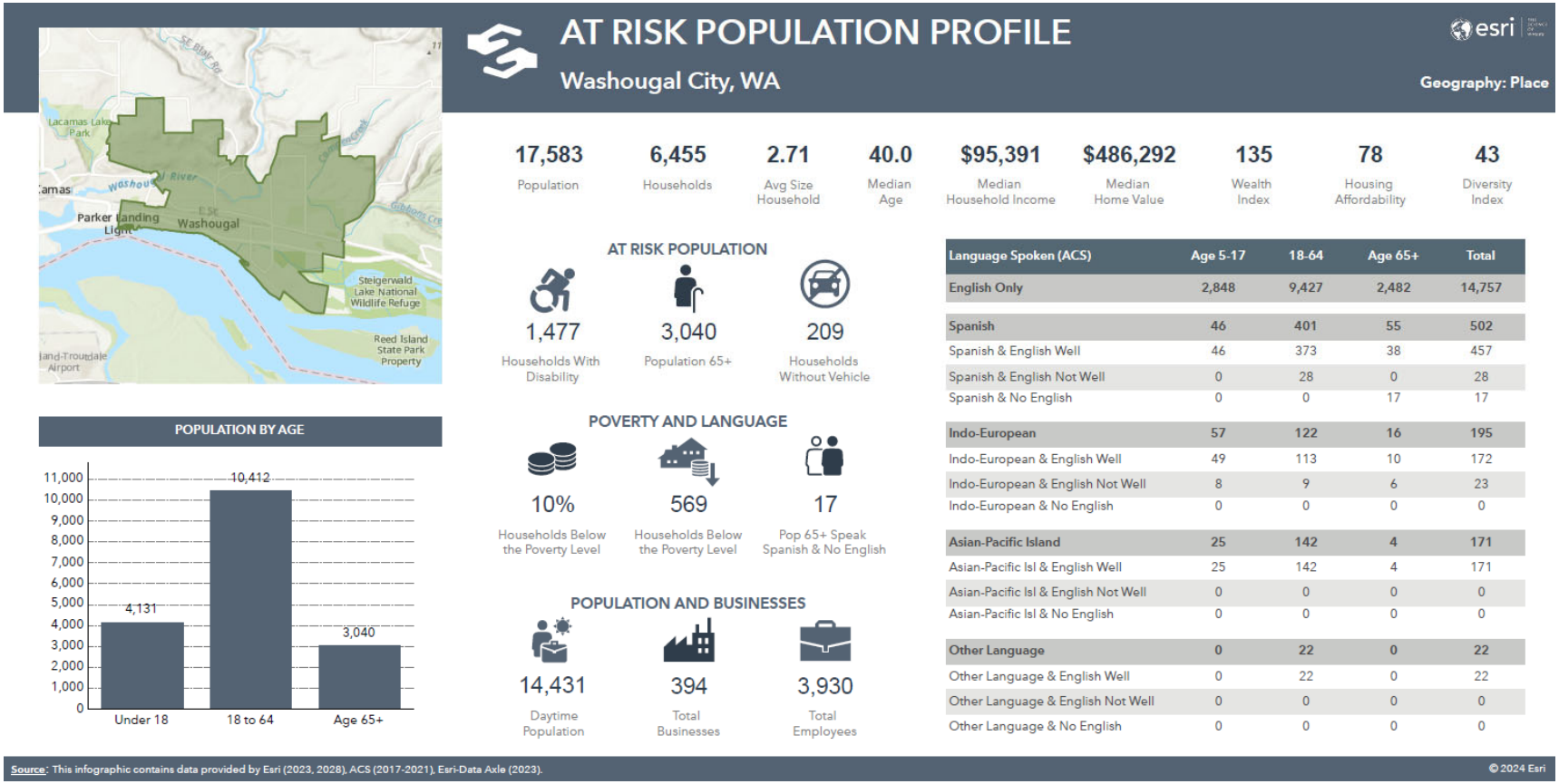
INTRODUCTION

The City of Washougal is located along the Columbia River and east of Camas, WA. Washougal is home to over 17,000 residents with around 390 businesses within the city limits. The following 'At Risk Population Profile' provides key population and equity statistics based on 2023 data.[1]



Language Spoken (ACS)	Age 5-17	18-64	Age 65+	Total
English Only	2,848	9,427	2,482	14,757
Spanish	46	401	55	502
Spanish & English Well	46	373	38	457
Spanish & English Not Well	0	28	0	28
Spanish & No English	0	0	17	17
Indo-European	57	122	16	195
Indo-European & English Well	49	113	10	172
Indo-European & English Not Well	8	9	6	23
Indo-European & No English	0	0	0	0
Asian-Pacific Island	25	142	4	171
Asian-Pacific Isl & English Well	25	142	4	171
Asian-Pacific Isl & English Not Well	0	0	0	0
Asian-Pacific Isl & No English	0	0	0	0
Other Language	0	22	0	22
Other Language & English Well	0	22	0	22
Other Language & English Not Well	0	0	0	0
Other Language & No English	0	0	0	0

[1] Source: ESRI Business Analysis Tool. https://storymaps.arcgis.com/stories/52764a9948074c4b9d527a390aefdc67

CITY SAFETY PLAN PROCESS

The purpose of the City Road Safety Plan is to analyze collision data from within the city in order to effectively identify trends, contributing circumstances, associated risk factors, and deficiencies present in the City's road network. Following this approach allows for the effective identification of appropriate, low-cost countermeasures to be implemented for the purpose of collision reduction. The following plan includes a summary of existing safety conditions in Washougal, identification of safety needs, and recommended treatments to address high-priority collision types and locations.

Figure 1 below describes the steps taken to create a prioritized list of projects, from collecting and analyzing available data to identifying safety needs, then identifying potential countermeasures before focusing on the final projects.

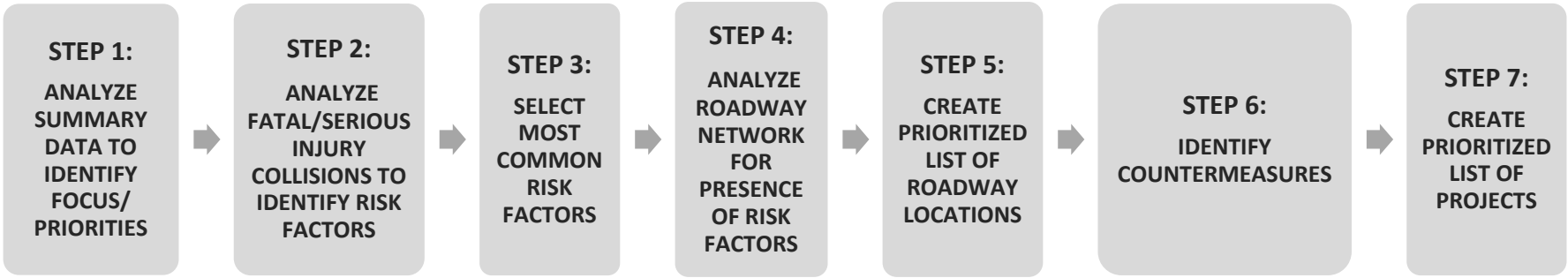


Figure 1. City Safety Plan Prioritization Process.

The data used and process followed are consistent with Washington State Department of Transportation's (WSDOT's) guidelines from the 2024 City Safety Program. The recommended safety countermeasures are limited to infrastructure-based treatments eligible for one or more of the following grant programs:[2]

[2] Additional details regarding available grant programs are available in Appendix B, Grant Programs.

- WSDOT grant programs: City Safety, Safe Routes to School, Bicycle-Pedestrian, and Railway-Highway Grade Crossings
- Transportation Improvement Board (TIB) grants, including Complete Streets
- Several Southwest Washington Regional Transportation Council (RTC) grants

Appendix A, Safety Countermeasure Toolbox, includes a description of each treatment, when it should be used, estimated costs, and collision modification factor (CMF).

The sections below describe the process of collecting and analyzing available data and identifying safety needs from that analysis.

STEP 1: ANALYZE SUMMARY DATA TO IDENTIFY FOCUS/PRIORITIES

The consultant support team worked with the City of Washougal, Southwest Washington Regional Transportation Council (RTC), and WSDOT Transportation Data to acquire the following data sets.

- WSDOT database of all collisions on City of Washougal streets, Jan 2018 - Dec 2022 (provided by WSDOT Transportation Data)

The City reviewed the quality and accuracy of the data sets, communicated with WSDOT on discrepancies, and solicited and received the desired data from the State.

DATA ANALYSIS OVERVIEW

As illustrated in Figure 2, over the past five years, there were a total of 11 fatal and serious injury collisions on City-owned roads. During the five-year study period, there were two fatal collisions that occurred in 2019. One fatality involved a train hitting a truck at the railroad crossing on SE Whitney Street/3rd Street, where the driver disregarded the crossing signal. The other fatality involved a hit-and-run on N Shepherd Road where a driver hit a person located off the roadway in an adjacent park. Alcohol impairment was listed as a contributing factor.

The number of all reported collisions (regardless of severity) has ranged between 39 and 73 per year, as shown in Figure 3. It should be noted that although 2020 has seen the lowest number of collisions within the study period, the total number of collisions have steadily increased since 2020.

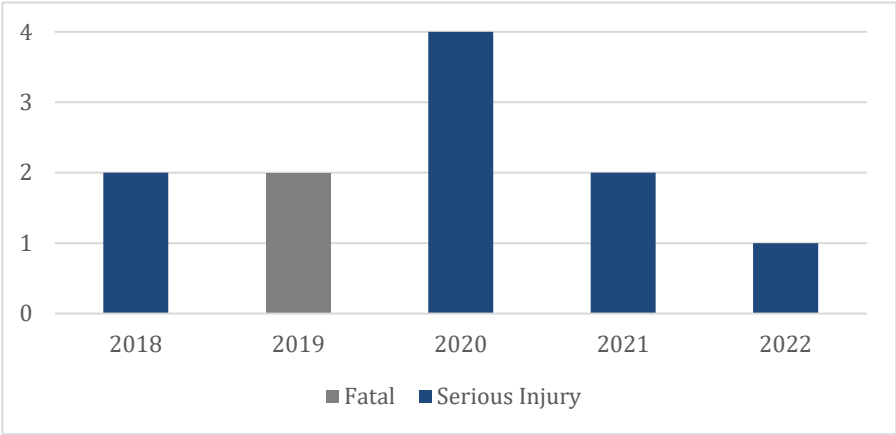


Figure 2. Fatal and Serious Injury Collisions in Washougal, 2018-2022.

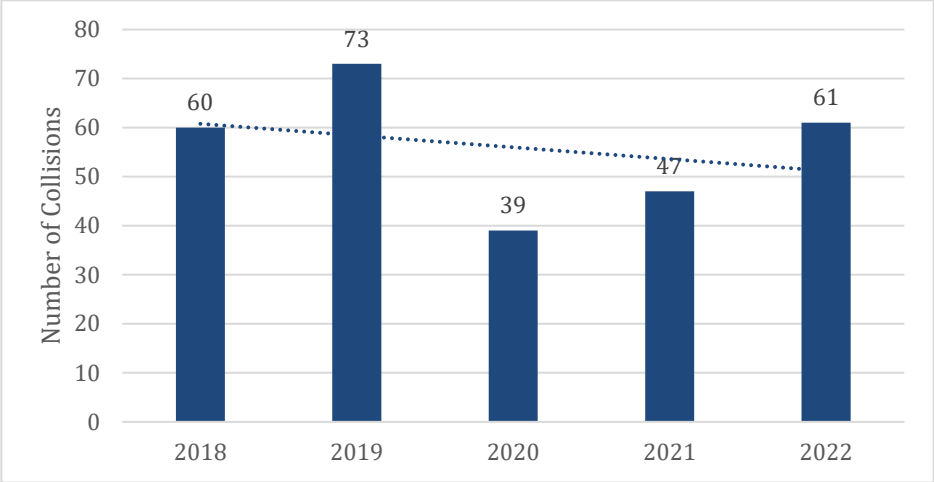


Figure 3. All Reported Collisions in Washougal, 2018-2022.

Figure 4 shows the heat map of fatal and serious injury collisions over the five-year study period.

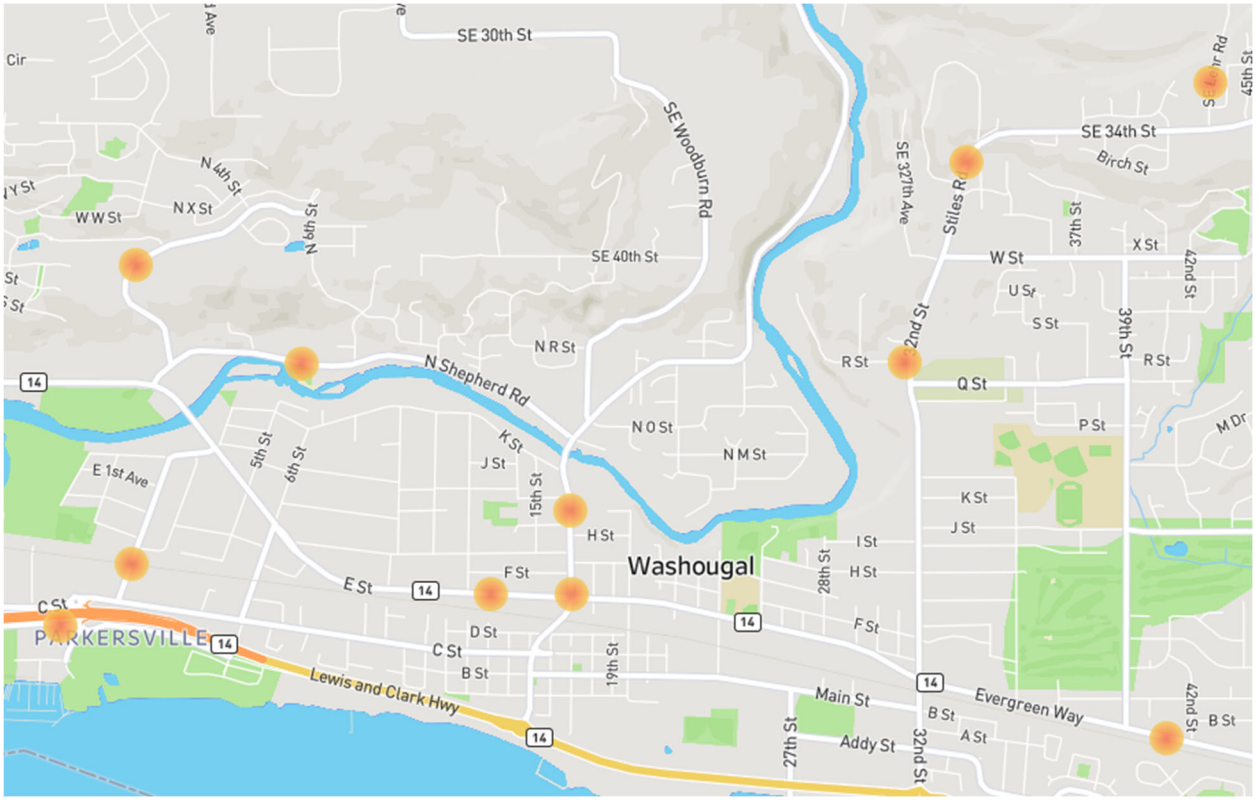


Figure 4. Heat Map of Fatal and Serious Injury Collisions in Washougal, 2018-2022.

Figure 5 provides a heat map of all reported collisions that occurred on City-owned streets in Washougal during the study period.

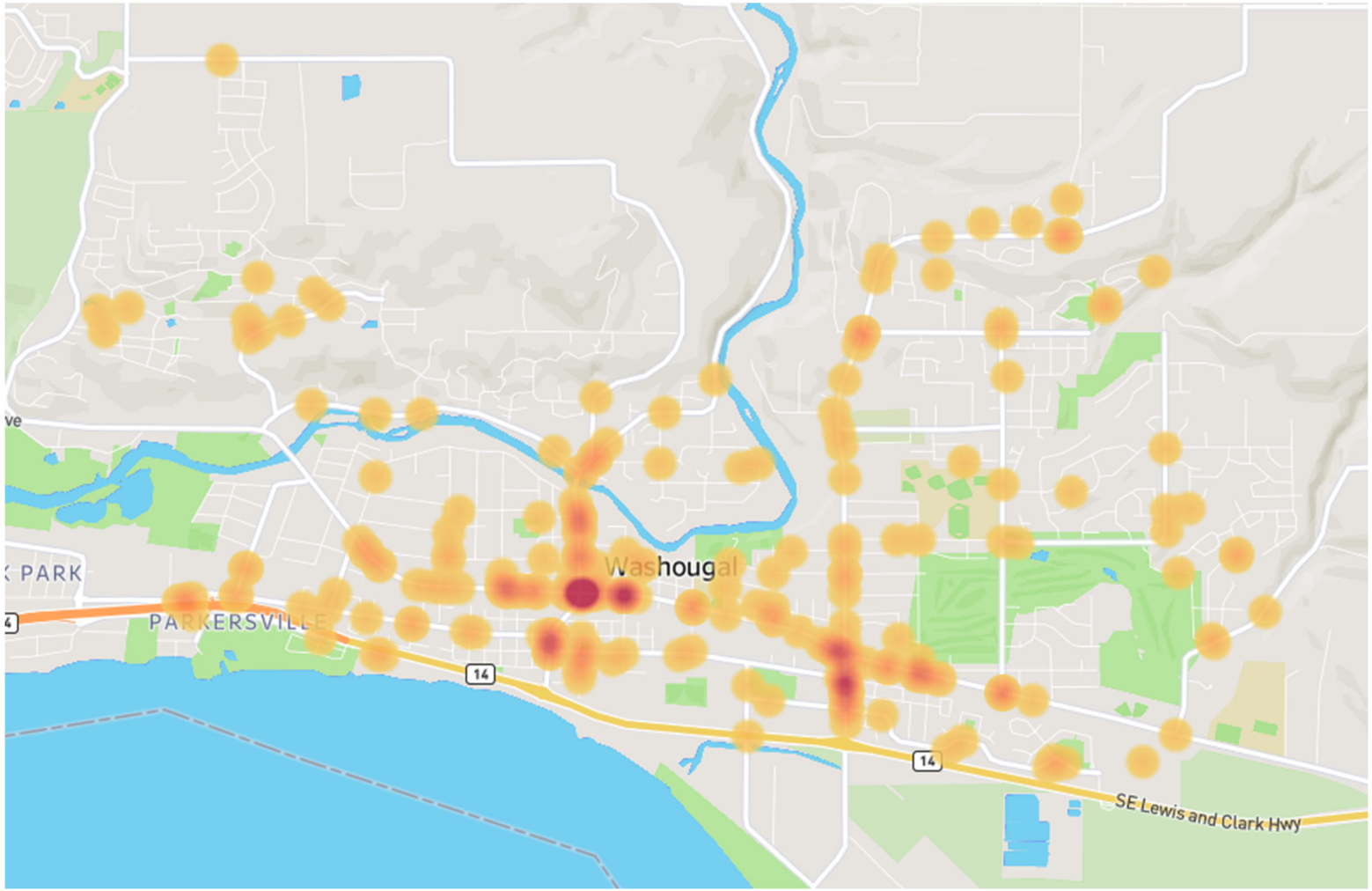


Figure 5. Heat Map of All Reported Collisions in Washougal, 2018-2022.

STEP 2: ANALYZE FATAL/SERIOUS INJURY COLLISIONS TO IDENTIFY RISK FACTORS (COLLISION ATTRIBUTES)

The City studied each risk factor (collision attribute) to determine which would be most useful for future steps. Table 1 shows some of the most common attributes present in collisions that occur on City-owned streets in Washougal.

TABLE 1. MOST COMMON COLLISION ATTRIBUTES, WASHOUGAL, 2018-2022

Data Element	Collision Attribute	Total Collisions	Fatal Collisions (F)	Serious Injury Collisions (SI)	Percent of all Washougal Collisions with this Attribute [1]	Percent of F&SI Washougal Collisions with this Attribute [2]
Citywide	*Any*	280	2	9		
Collision Type	Roadway Departure	86	1	5	30.7%	3.9%
	Head-On	2	0	1	0.71%	9.1%
	Entering at Angle	57	0	0	20.4%	0.0%
Contributing Circumstance (For at least one vehicle)	Exceeding Reasonable Safe Speed or Exceeding Stated Speed Limit	24	0	1	8.6%	9.1%
	Alcohol-Impaired [3]	40	1	3	14.3%	36.4%
	Drug-Impaired [3]	3	0	0	1.1%	0.0%
	Inattention / Distraction	89	0	4	31.8%	36.4%
Motor Type Involved	Motorcycle	5	0	1	1.8%	9.1%
	Heavy Vehicle	8	0	1	2.9%	9.1%

Data Element	Collision Attribute	Total Collisions	Fatal Collisions (F)	Serious Injury Collisions (SI)	Percent of all Washougal Collisions with this Attribute (1)	Percent of F&SI Washougal Collisions with this Attribute (2)
Lighting Condition	Dark/Dusk/Dawn	93	0	3	33.2%	27.3%
Intersection	At Intersection or Intersection Related	117	1	0	41.8%	9.1%
	Signalized Intersection	27	1	0	9.6%	9.1%
	Unsignalized Intersection	90	0	0	32.1%	0.0%
Road User	Pedestrian Involved	8	1	1	2.9%	18.2%
	Bicyclist Involved	8	0	0	2.9%	0.0%
Roadway Surface	Wet	60	0	2	21.4%	18.2%
	Ice	4	0	0	1.4%	0.0%
Age	Driver Age 16 to 25 Involved	96	0	3	34.3%	27.3%
	Driver Over Age 65 Involved	58	1	2	20.7%	27.3%
Restraint (Seat Belt) Usage	No Restraints Used	7	0	2	2.5%	18.2%

(1) For example, in Washougal 30.7% of all collisions involved roadway departure.
(2) For example, in Washougal 9.1% of all fatal and serious injury collisions were intersection-related collisions.
(3) As of this writing, WSDOT has identified an issue with 2020 impaired driving data and is looking into the details.

The City identified the following notable trends from this analysis:

- The most common collision type, roadway departure, accounted for almost one-third of all collisions.
- Although about 3% of all collisions involved a pedestrian, almost one-fifth of fatal and serious injury collisions were pedestrian-involved. A similar trend occurs with collisions related to non-restrained vehicle occupants.
- About 42% of all collisions took place in an intersection or were intersection-related. Almost one-third of all collisions took place at unsignalized intersections.

STEP 3: SELECT MOST COMMON RISK FACTORS (COLLISION ATTRIBUTES)

Based on the findings of Step 1 and Step 2, the City identified the following collision attributes correlated with the highest frequency or severity of collisions. These collision attributes are the focus of the network analysis in Step 4:

1. Roadway Departure
2. Inattention/Distraction
3. Entering at an Angle
4. At Intersection or Intersection-Related
5. Dark/Dusk/Dawn conditions
6. Driver Age 16-25

STEP 4: ANALYZE ROADWAY NETWORK FOR PRESENCE OF RISK FACTORS

Following WSDOT's recommended procedure[3], the City applied the most common risk factors in fatal/serious injury collisions to the entire network using frequency of collisions based on the most common collision attributes. In later steps, these collision attributes will be referred to as risk factors.

The City mapped collision frequency based on the most common risk factors in fatal and serious injury collisions. The heat maps in Appendix C illustrate the locations of collisions with these risk factors.

[3] WSDOT Local Road Safety Plans Guidance, https://wsdot.wa.gov/sites/default/files/2021-10/LP-Local-Road-Safety-Plan.pdf

STEP 5: CREATE PRIORITIZED LIST OF ROADWAY LOCATIONS

Tables 2 and 3 below include intersections and corridors ranked by the number of risk factors identified. A location received a "point" for a risk factor if it experienced a relatively high frequency of collisions with that attribute compared to the rest of the city roadway network.

Note that these are not the recommended intersections for treatment, but rather the first step in the process toward the final prioritization of safety projects in Step 7.

TABLE 2. PRIORITIZED INTERSECTION SAFETY NEEDS BY NUMBER OF IDENTIFIED 6 RISK FACTORS

Intersection	Number of Collisions	Roadway Departure	Inattention/ Distraction	Entering at an Angle	Inter-section Related	Dark/Dusk/ Dawn	Driver Age 16-25	At Least 1 Fatal or Serious Injury Collision	Tota l
E St and Washougal River Rd	17	-	✓	✓	✓	✓	✓	-	**5**
20th Street and E Street	8	-	✓	✓	✓	✓	✓	-	**5**
39th Street and Evergreen Way	4	-	✓	✓	✓	✓	✓	-	**5**
Washougal River Rd and C St	7	-	✓	✓	✓	✓	✓	-	**5**
32nd St and Main St	5	-	✓	✓	✓	-	✓	-	**4**

TABLE 3. PRIORITIZED CORRIDOR SAFETY NEEDS BY NUMBER OF IDENTIFIED 6 RISK FACTORS

Segment	Number of Collisions	Roadway Departure	Inattention/ Distraction	Entering at an Angle	Inter-section Related	Dark/Dusk/ Dawn	Driver Age 16-25	At Least 1 Fatal or Serious Injury Collision	Total
E Street from SE Lechner Street to E 39th Street	81	✓	✓	✓	✓	✓	✓	✓	**7**
32nd Street from W Street to Addy Street	32	✓	✓	✓	✓	✓	✓	✓	**7**
N Washougal River Roud from N 18th Street to E Street	20	✓	✓	✓	✓	✓	✓	✓	**7**
Main Street from Washougal River Road to 32nd Street	16	✓	✓	✓	✓	✓	✓	-	**6**
N Shepherd Road from N Lebrun Drive to Washougal River Road	4	✓	✓	✓	✓	✓	✓	-	**6**

STEP 6: IDENTIFY COUNTERMEASURES TO ADDRESS PRIORITIZED LOCATIONS

In Step 6, potential countermeasures were identified using the list in Appendix A, which describes treatments that may be applied at intersections or along roadway segments to address specific crash patterns.

The City compared the list of prioritized intersections and corridors identified in Step 5 to recent and already-funded projects to identify the most pressing safety current needs, and then analyzed collision data and existing conditions at the following locations shown in Table 4.

TABLE 4. PRIORITIZED SAFETY STUDY LOCATIONS

Location	Number of Collisions	Roadway Departure	Inattention/ Distraction	Entering at an Angle	Inter-section Related	Dark/Dusk /Dawn	Driver Age 16-25	At Least 1 Fatal or Serious Injury Collision	Total
1. Segment: E Street from SE Lechner Street to E 39th Street	81	✓	✓	✓	✓	✓	✓	✓	**7**
2. Segment: N Washougal River Road from N 18th St to E Street	20	✓	✓	✓	✓	✓	✓	✓	**7**
3. Segment: N Shepherd Road from N Lebrun Drive to Washougal River Road	4	✓	✓	✓	✓	✓	✓	-	**6**

STEP 7: DEVELOP A PRIORITIZED LIST OF PROJECTS

Upon completion of that analysis and identification of potential countermeasures, the City selected the priority spot location and systemic safety projects shown below in Table 5 as well as next steps, including potential funding opportunities. Appendix B lists state and local grant funding opportunities that may be appropriate for these projects.

TABLE 5. SAFETY PROJECTS TO PURSUE

Location	Safety Project Including Proven Countermeasures	Next Step
1. E Street from SE Lechner Street to E 39th Street/Evergreen Way	Access management, pedestrian crossing, median islands, speed feedback signs	Consider other funding opportunities in Appendix B
2. Systemic Stop-Controlled Intersection Treatments	Signing, pavement marking	Apply for 2024 WSDOT City Safety Program grant
3. N Shepherd Road from N Lebrun Boulevard to N Washougal River Road	Curb extensions, raised crosswalks, rectangular rapid-flashing beacons (RRFBs), speed feedback signs	Consider other funding opportunities in Appendix B
4. N Washougal River Road from N 18th Street to E Street	Lighting, bridge rail protection, profiled edge line striping, curb extensions	Consider other funding opportunities in Appendix B
5. Systemic Roadway Departure Treatments	Citywide horizontal curve safety treatments, enhanced signing, pavement marking, rumble strips	Consider other funding opportunities in Appendix B
6. 39th Street from Evergreen Way to J Street	Sidewalk infill and crossing enhancements	Apply for Safe Routes to School or other funding opportunities in Appendix B
7. S 27th Street from SR-14 to Index Street terminus	Shared use path for pedestrians and bicyclists	Project funded from RTC Transportation Alternative grants
8. S 32nd Street from Addy Street to Stiles Road	Profiled edgeline pavement markings, shoulder widening, lighting, guardrail	Project funded from 2022 WSDOT City Safety Program

The following sections detail existing conditions, countermeasures, and estimated project costs, monetary value of estimated safety benefits, and the estimated benefit/cost ratio of each recommended safety project. The projects are organized by City priority, with the highest-priority projects first.

PRIORITY 1: E STREET FROM SE LECHNER STREET TO E 39TH STREET/EVERGREEN WAY

Identified Safety Needs. E Street is a primary east-west corridor in Washougal that provides access to transit, commercial, residential, and recreational opportunities. As shown in Figure 6, E Street has a three-lane cross-section with a two-way left-turn lane, no on-street parking, and a high density of driveways. This segment of E Street is the most frequent location for a collision to occur within the last five years.

Figure 6. Facing westbound on E Street near the intersection of 12th Street.

Based on the past five years of collision history, there were 81 collisions along this segment. Of these collisions, 26 collisions (31%) resulted in a rear-end, including one resulting in serious injury. The contributing circumstances were mostly either caused by inattention/distractions or following too closely. The second most frequent collision type was entering at an angle, at 18 collisions (22% of collisions along this segment). Of these collisions, the most common contributing circumstance was not granting right-of-way to vehicle (6 occurrences).

On this segment, three collisions involved a vehicle striking a pedestrian while executing a turn at an intersection. The most severe crashes resulted in suspected minor injury, which occurred in two of the three collisions. For one occurrence at the

intersection of E Street and 20th Street, the driver was executing a left-turn from E Street onto 20th Street when a rollerblader/skateboarder was struck in the crosswalk. Another pedestrian-related collision happened at the intersection of Evergreen Way (D Street) and 32nd Street (at which time was the site of a work zone) when a vehicle struck a pedestrian at the crossing during rainy/wet conditions. Lastly, another pedestrian-involved collision involved a distracted driver performing a right-turn and striking a pedestrian on a motorized wheelchair in a marked crossing at the Washougal River Road intersection. This collision resulted in no apparent injury.

Of the eight total bicycle-related collisions in Washougal during 2018-2022, three of them occurred along this segment and all resulted in possible injury. One collision happened at 39th Street/Evergreen Way, when the driver was turning after stopping at the intersection and collided with a bicyclist that was traveling in the opposite direction on the sidewalk. A similar collision took place at the intersection at 29th Street, when a driver was turning right from 29th Street onto E Street and collided with a bicyclist traveling on the sidewalk. The third occurrence happened at a driveway near the intersection at Washougal River Road, where a driver collided with a bicyclist traveling in the same direction in the bicycle lane.

The third most common collision type involved vehicles performing left turns, from either the minor street or major street. This accounts for 14 collisions (17%) of collisions along this segment, 8 of which are either due to the driver not granting right-of-way to vehicle, or improper turn/merge. While one collision resulted in suspected minor injury, about half resulted in no apparent injury, while 43% resulted in possible injury. 6 collisions occurred at the intersection with Washougal River Road.

Potential Safety Treatments. To address the identified needs along E Street and Evergreen Way, the City will consider the following safety countermeasures:

- ***Access Management.*** Reduce the number of access points by consolidating driveways along the corridor.
- ***Median Islands*.** Median islands are protected spaces where vehicles are restricted in their turning movement opportunities. Consider installing median pedestrian refuge islands with mid-block pedestrian crossings (similar to the one located near 20th Street) to support safer and comfortable pedestrian movements.
- ***Speed Feedback Signs.*** Speed feedback signs can encourage drivers to slow down along the corridor and pay attention to their driving speeds.

PRIORITY 2: SYSTEMIC STOP-CONTROLLED INTERSECTION TREATMENTS

Identified Safety Needs. In Washougal, entering at angle collisions were a high proportion of collisions, contributing to 20% of all collisions (regardless of severity) during the study period. Over two-thirds of entering at angle collisions (40 of 57 collisions) took place at an intersection and were related. The most common corridors where these occurrences took place were 32nd Street, E Street, and Washougal River Road.

Potential Safety Treatments. Two-way stop-controlled intersections with patterns of angle collisions can be related to the lack of driver awareness of the presence of the intersection. The ability of approaching drivers to perceive the vehicles waiting on the side-street can be enhanced by installing low-cost systemic safety countermeasures such as doubled-up signs, additional pavement marking, double-wide stop bars, advance warning signs, oversize signs, and improving intersection sight distance to the intersection (clear sight triangle). Installing these treatments, shown in Figure 7, is a Federal Highway Administration (FHWA) Proven Safety Countermeasure.

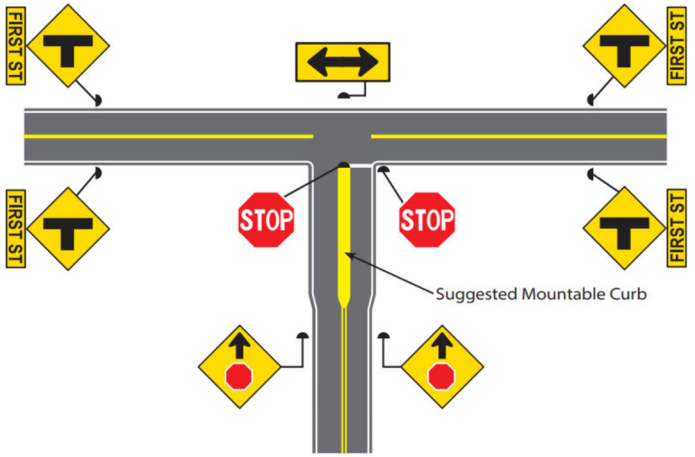


Figure 7. Low-Cost Intersection Treatments

To address the safety risks at intersections and take advantage of the low cost of recommended treatments, the City will consider a combination of these countermeasures at the following stop-controlled intersections (and others with similar features):

- 3rd Street and C Street
- 32nd Street and Addy Street
- 32nd Street and A Street
- 32nd Street and B Street
- 32nd Street and W Street
- 28th Street and F Street
- 28th Street and H Street
- Washougal River Road and A Street
- Washougal River Road and C Street
- 49th Street and P Street

PRIORITY 3: N SHEPHERD RD FROM N LEBRUN BLVD TO N WASHOUGAL RIVER RD

Identified Safety Needs. N Shepherd Road, seen in Figure 8, is a two-lane east-west corridor that partially runs parallel to the Washougal River, and primarily serves residential communities in northeast Washougal. While the north shoulder of the road has some sidewalk facilities, the south road shoulder adjacent to the river is mostly a narrow, soft shoulder with no sidewalks present. Along this segment is the site of a popular summertime destination, Sandy Swimming Hole Park, with access to the Washougal River. In addition to the park, the Riverside Christian School campus and the Riverside Seventh-day Adventist Church are also nearby points of interest.

Figure 8. Westbound N Shepherd Road with the Sandy Swimming Hole parking lot to the left and the beginning of the school zone.

During the study period, there were four collisions along this segment. The portion of the segment near the Sandy Swimming Hole Park was the site of two pedestrian fatalities in an alcohol-related collision in June 2019. The driver of a Jeep departed the roadway and struck a fence, continued into the park, and struck two pedestrians. In addition to this collision, two collisions were speed-related: one where a driver struck a parked vehicle and another where the driver struck a deer.

Potential Safety Treatments. To address the identified needs along this segment, the City will consider the following safety countermeasures:

- ***Sidewalk Installations with Curb Extensions.*** With a school zone present, providing a pedestrian walkway that connects between the school and the parking lot to the Sandy Swimming Hole Park on the northern side of the road could provide some infrastructure for pedestrians already walking along the soft shoulder. Since increased foot traffic is expected to for pedestrians to travel to and from the park to off-site parking locations, crosswalk installations within the school zones would also be required.
- ***Raised Crosswalks.*** Pedestrians are expected to be crossing N Shepherd Road at the park. Installing two crossings with raised crosswalks just west of the intersection at N 4th Court and N Shepherd Road and just east of the park would provide the opportunity for drivers to slow down. Rectangular rapid-flashing beacon (RRFB) devices could also be installed to enhance driver awareness of pedestrians.
- ***Speed Feedback Signs.*** Prior discussions from the City of Washougal mention that the 85th percentile speed was 35mph, where the posted speed limit is 25mph at this segment. Furthermore, given that half of collisions between 2018-2022 were speed-related, installing at least two speed feedback signs along the segment and within the school speed zone would be appropriate in reducing speeds.

PRIORITY 4: N WASHOUGAL RIVER ROAD FROM N 18TH STREET TO E STREET

Identified Safety Needs. Washougal River Road, shown in Figure 9, is a primary north-south corridor in Washougal and provides one of the two bridge crossings over Washougal River to reach the northern area of the city. From E Street to N Shepherd Road, the two-lane road is wide with paved sidewalks on both sides. Land use is mixed with low-density residential and commercial. North of N Shepherd Road, lanes are narrow and there are no sidewalks present.

Figure 9. Facing northbound on Washougal River Road and approaching bridge crossing.

During the study period, there were 33 collisions along this segment. There were 10 non-intersection-related collisions, including two suspected serious injuries. One of these collisions was alcohol-involved and resulted in a head-on collision near the intersection of H Street. Another suspected serious injury occurred when a vehicle going straight struck a pedestrian just north of the intersection at E Street.

The most common collision type involved vehicles making left turns, which accounted for eight collisions. Furthermore, rear-end collisions and collisions with parked vehicles have occurred along N Washougal River Road north of G Street, where this section of the street transitions from a three-lane section with a two-way left-turn lane to a two-lane section with parking on both sides of the street.

Nine out of 33 total collisions occurred in dark conditions, and seven occurred when road surface conditions were wet.

Potential Safety Treatments. To address the identified needs along this segment, the City will consider the following safety countermeasures:

- ***Improved Segment Lighting.*** With collisions in dark conditions prominent, analyzing and improving lighting along the corridor, particularly near the bridge, would support safety at night.
- ***Improve Protection Bridge at Rail Endpoints.*** Currently, the bridge rail ends at a blunt face with a yellow/black object marker to warn drivers of the fixed object. Improving the protection for the bridge rail endpoints and/or providing delineation or lighting along the bridge would help drivers see the bridge curvature at night.
- ***Profiled Edge Line and Center Line Striping***. This technique to raise the profile of edge line striping can provide some audible and vibratory warning to drivers leaving their travel lane.
- ***Curb Extensions.*** The northwest corner of the three-legged intersections at G Street and H Street can be improved to accommodate a curb extension where on-street parking begins.
- ***Pedestrian Crossing Locations at G Street and H Street.*** Some points of interest in these areas where a crosswalk could be appropriate include Elizabeth Park and St. Matthew Lutheran Church. These crosswalks would also facilitate movement across Washougal River Road where there are currently no crosswalks present.

PRIORITY 5: SYSTEMIC ROADWAY DEPARTURE

Roadway departure collisions were the most common collision type, contributing to 31% of all collisions (regardless of severity) during the study period. Additionally, 3.9% of fatal and serious injury collisions involved roadway departure. Figure 10 illustrates the frequency and density of roadway departure collisions. The most common locations for roadway departures happen along the following corridors:

- N Washougal River Road (12 collisions)
- E Street/Evergreen Way (7 collisions)
- N Lebrun Drive (4 collisions)

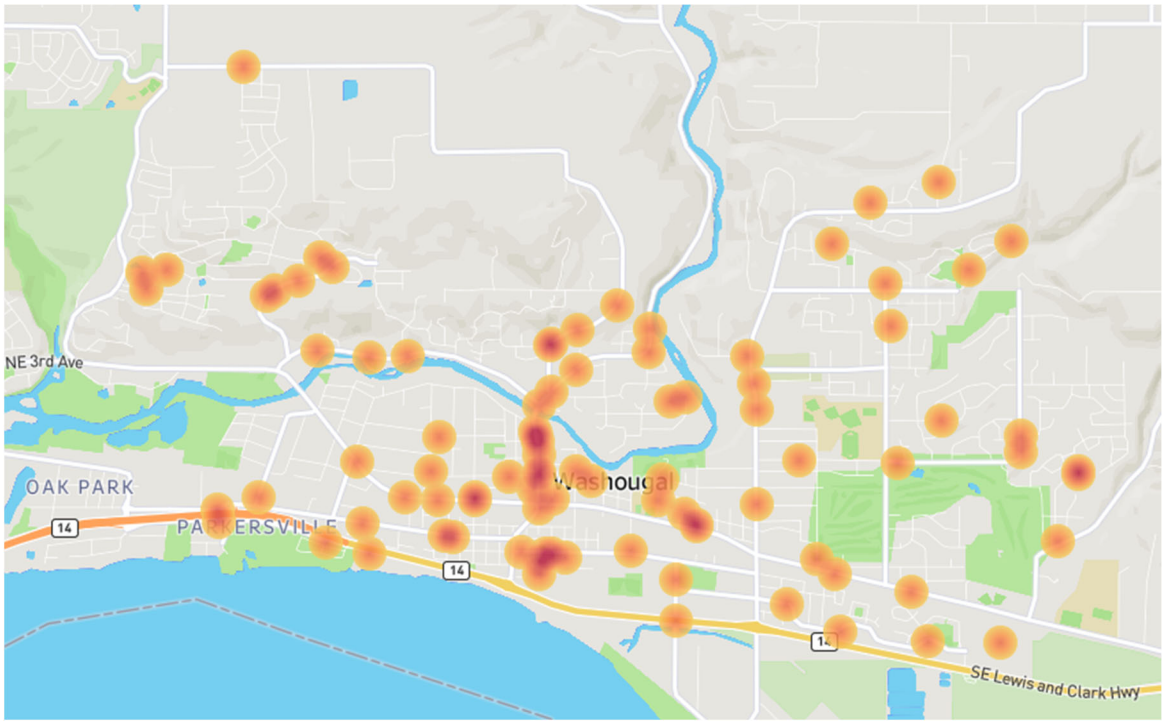


Figure 10. Roadway Departure Collisions, Washougal, 2018-2022.

Citywide Horizontal Curve Safety Improvements

The City proposes a project to address speed on horizontal curves and install various horizontal curve safety improvements to provide current MUTCD standard curve warning signs at all horizontal curves on arterials and major collectors in the city limits (approximately 30 curves).

- Conduct a horizontal curve inventory study and advisory speed study to assess existing conditions
    - Collect advisory speed data for each curve
    - Collect operating speeds near each curve and turn, then analyze that data using current methodologies to determine the most appropriate advisory speed
    - Calculate the difference between advisory speed and posted speed limit (per MUTCD)
- Design signing treatments
    - Determine the required (shall) and recommended (should) sign package for each curve per MUTCD Table 2C-5 (e.g., advanced warning sign, advisory speed plaque, chevrons, and/or one direction large arrow).
    - Confirm sign placement feasibility via field review
    - Produce plans, specifications, and estimates (PS&E) for curve signing
- Install advance curve warning signs and chevron signs

Combined Roadway Departure Treatments Along Select Corridors

Low-cost roadway departure treatments focus primarily on keeping vehicles on the road and in their lane, and since motorists can depart the roadway at an infinite number of locations (versus the finite number of intersections in a jurisdiction), blanketing an entire corridor with roadway departure treatments can prevent future collisions, even at locations that have not experienced run-off the road type collisions in the past. The following treatments should be considered along select corridors.

- ***Enhanced Curve Safety Package.*** On top of the minimum requirements, horizontal curve signing will be enhanced to provide additional warning for motorists. This treatment may include doubled-up signs, oversized signs fluorescent yellow sheeting, chevrons alignment signs, flexible delineators, flashers, speed feedback warning, or pavement marking. Additionally, high friction surface treatment may be appropriate at select curves.
- ***Rumble Strips or Profiled Pavement Marking.*** Provide visual, tactile, and auditory feedback to drivers - either via rumble strips or profiled pavement marking - depending on the surrounding land use.
- ***Nighttime Delineation.*** Provide delineation via vertical delineators or products added to current appurtenances (e.g., guardrail) to improve visibility of roadway alignment in dark conditions.

- ***Fixed Object Treatments.*** For each fixed object within the right-of-way (with priority for those objects in the clear zone), address each using the following hierarchy per the AASHTO Roadside Design Guide[4]:
    a. Remove the obstacle.
    b. Redesign the obstacle so it can be safely traversed.
    c. Relocate the obstacle to a point where it is less likely to be struck.
    d. Reduce impact severity by using an appropriate breakaway device.
    e. Shield the obstacle with a longitudinal traffic barrier designed for redirection or use a collision cushion.
    f. Delineate the obstacle if the previous alternatives are not appropriate.

The City has identified these priority corridors for systemic roadway departure treatments.

- N Lebrun Drive
- N Washougal River Road
- Addy Street
- SE Sunset View Road
- 32nd Street
- N Shepherd Road

[4] Roadside Design Guide, American Association of State Highway and Transportation Officials, 4th Edition. 2011.

PRIORITY 6: 39TH STREET FROM EVERGREEN WAY TO J STREET

Identified Safety Needs. This segment of 39th Street, south of Washougal High School and Gause Elementary School, lacks sidewalks to support pedestrian travel, including students and their families navigating the roadway before and after school.

Potential Safety Treatments. Approximately 0.5 miles of sidewalk in-fill from Evergreen Street to J Street–along one or both sides of the road–would provide a safe path for pedestrian travel on this corridor. Enhancing existing crossings, such as the one shown in Figure 11, would also provide a safety benefit, making pedestrians more visible when crossing 39th Street.

Figure 11. 39th Street, looking northbound, one block south of schools

PRIORITY 7: 27TH STREET FROM SR-14 TO INDEX STREET TERMINUS

Identified Safety Needs. Pedestrians and bicyclists use the two-lane 27th Street, shown in Figure 12, to walk and/or bike to Captain William Clark Park on the Columbia River. This same route is used by trucks to travel to and from the port, which introduces potential conflicts (increased risk) between heavy trucks and vulnerable road users.

There were two recorded collisions along this segment, which both resulted in no apparent injury. One collision resulted in a roadway departure due to speeding. Another took place during dark lighting conditions where the motoris collided with the SR-14 bridge pier. Neither collision involved a pedestrian or bicyclist.

Figure 12. Facing northbound on 27th Street north of Index Street

Potential Safety Treatments. To address the identified need, the City proposes a 10-foot separated shared use path on the east shoulder of 27th Street from the railroad tracks north to SR-14.

OTHER LOCATIONS TO CONSIDER

The following intersections have been identified by the City as potential safety needs to be considered for future grant funding opportunities.

E Street and 32nd Street Intersection. This location, shown in Figure 13, operates as an offset 4-leg intersection (one leg is a commercial driveway) and is located very close (approximately 225 feet) to a busy signalized intersection at D Street and 32nd Street.

A project on 32nd Street between B Street and D Street (Evergreen Way) directly south of the intersection was recently funded. The project will create a railroad underpass that separates the vehicle roadway from the existing at-grade rail crossing on this segment, allowing for a redesign of 32nd Street to include roundabouts at Main Street/B Street and D Street (Evergreen Way), improvements at the A Street, E Street, and F Place intersections, and a sidewalk and multi-use path.

Figure 13. E Street and 32nd Street Intersection

Main Street and Washougal River Road Intersection. This signalized intersection, shown in Figure 14, could benefit from signal adjustments such as retiming and protected left phasing. Red light running is an issue. Treatments may include additional all-red clearance time and addition of protected-only left turn phasing.

Signalized Intersection: E Street and Washougal River Road Intersection. Located near the center of the city, this is a busy four-leg signalized intersection with left-turn lanes on all approaches, as shown in Figure 15. The signal has protected-permissive left turn phasing with flashing yellow arrows. Crash data from 2018 to 2022 revealed that collisions were primarily angle/turning collisions, and more than half of the collisions involved a left-turning vehicle and an opposing straight vehicle. There have also been issues regarding intersection capacity.

Treatments may include protected left turn phasing, gap detection, countdown pedestrian signals, and leading pedestrian intervals.

Figure 14. Main Street and Washougal River Road Intersection

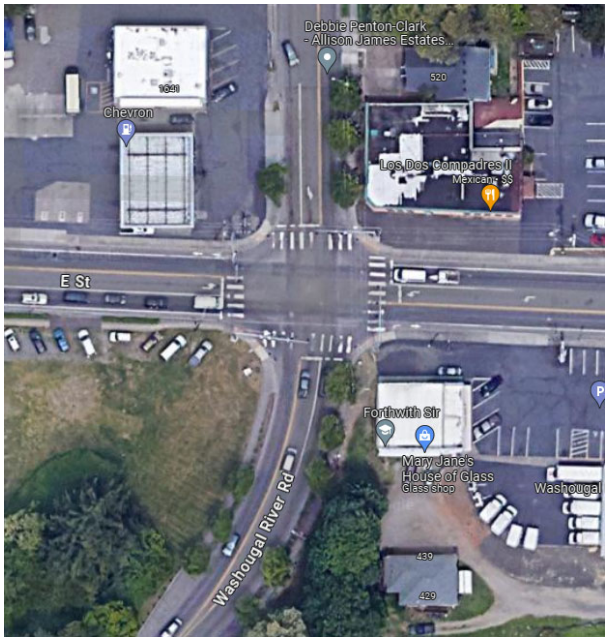


Figure 15. E Street and Washougal River Road Intersection

APPENDICES

APPENDIX A: Safety Countermeasures Toolbox

APPENDIX B: Grant Programs

APPENDIX C: Collision Heat Maps

Appendix A Countermeasures Toolbox

Signalized Intersections

S1. Improve Intersection Lighting

A permanent source of artificial light applied to signalized intersections that have a disproportionate number of night-time crashes and do not currently provide sufficient lighting at the intersection or at its approaches.

Benefit-Cost

» Implementation of this treatment reduces nighttime injury crashes by 38% and nighttime pedestrian crashes by 42%. (WSDOT)

» 20 years of expected life

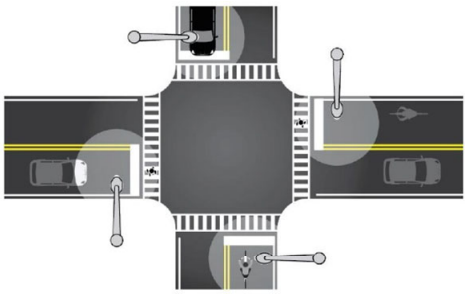
» Estimated $75,000

» The provision of lighting involves both a fixed cost for lighting installation and an ongoingmaintenance and power cost which results in a moderate to high cost.

Sources: CA-Local Roadway Safety Manual, FHWA, WSDOT

EXISTING CONDITION

IMPLEMENTATION



S2. Improve Signal Hardware (lenses, back-plates, mounting, size, number of heads)

Applicable at signalized intersections with a high frequency of right-angle and rear-end crashes because drivers are unable to see traffic signals sufficiently in advance to safely negotiate the intersection being approached. Examples include increasing the size of indications from 8 in. to 12 in. and adding supplemental heads (e.g., side-mount, near-side mount).

Benefit-Cost

» Implementation of this treatment can reduce crashes by 3-7% (WSDOT).

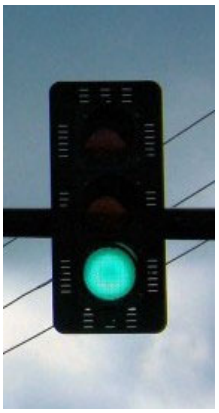
» 10 years of expected life

» Estimated $40,000 per intersection

» Cost varies based on size/number of signal heads.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION



IMPLEMENTATION

S3. Improve Signal Timing (coordination, phasing, clearance intervals)

EXISTING CONDITION

Effective at locations that have a crash history at multiple signalized intersections. Signalization improvements may include adding phases, lengthening clearance intervals, eliminating or restricting higher-risk movements, and coordinating signals at multiple locations. This treatment addresses all types of crashes that occur on the approaches / influence area of the new signal timing. For projects coordination signals along a corridor, the crashes related to side-street movements should not be applied.

Benefit-Cost

» Implementation of this treatment reduces all crashes by 16%, and particularly angle crashes by 32% (WSDOT).

» 10 years of expected life

» Estimated $1,000 per intersection

» Cost variation based on number of signal heads and number of movements.

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

S4. Install Left-turn Lane and Add Turn Phase

EXISTING CONDITION

Installed at signalized intersections that have a significant crash problem and the only alternative is to change the nature of the intersection itself. This treatment addresses all type of crashes and the measure can be very effective at intersection with complex geometry and intersection with frequent left-turn movements. A properly timed protected left-turn phase can also help reduce rear-end, broadside, and sideswipe crashes between left-turning vehicles and the through vehicles as well as vehicles behind them. This countermeasure only applies to crashes occurring on the approaches / influence area of the new left turn phases.

Benefit-Cost

» Implementation of this treatment reduces all crashes by 35% and head on crashes by 69% (WSDOT).

» 20 years of expected life

» Estimated $12,000 per intersection

» If the existing traffic signal only requires a minor modification to allow for a protected left-turnphase, then the cost would also be low (installation is short because no actual construction). In-house signal maintainers can perform this operation once the proper signal phasing is determined so the cost is low.

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

S5. Pavement Marking and RPMs through Intersection

Raised Pavement Markers (RPMs) and pavement marking installed in intersections where the lane designations are not clearly visible to approaching motorists. Can also be applied at intersections noted as being complex and experiencing crashes that could be attributed to a driver's unsuccessful attempt to navigate the intersection.

Benefit-Cost

» Implementation of this treatment reduces run off road, opposite direction and night crashes by 21% (WSDOT).

» 10 years of expected life

» Estimated $2,000 per installation

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

S6. Improve Pavement Friction (High Friction Surface Treatment

Improvement for signalized Intersections noted as having crashes on wet pavements or under dry conditions when the pavement friction available is significantly less than needed for roadway approach speeds. This treatment is intended to target locations where skidding and failure to stop is determined to be a problem in wet or dry conditions and the target vehicle is unable to stop due to insufficient skid resistance. In addition, treatment also addresses night crashes all other crashes. This treatment does not apply to standard chip-seal or open-graded maintenance projects for long segments of corridors or structure repaving projects intended to fix failed pavement.

Benefit-Cost

» Implementation of this treatment reduces crashes by 40% (WSDOT).

» 10 years of expected life

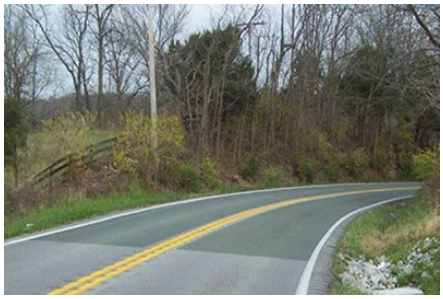
» Estimated $5,000 per intersection for materials and equipment

» Cost variation based on size of intersection and material (Estimated $30/sq.yd.).

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION



S7. Add Median Openings to Allow or Restrict Left-turns and U-turns

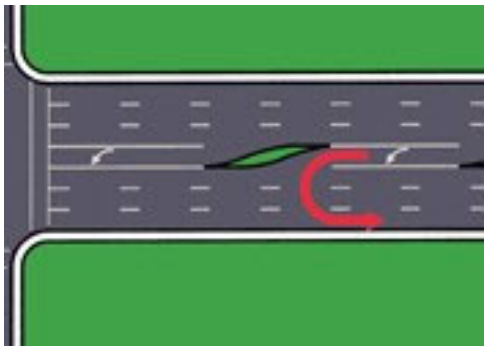
Install medians to reduce crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) type crashes. This treatment only applies to crashes occurring in the intersection/influence area of the new directional openings.

EXISTING CONDITION

Benefit-Cost

- Implementation of this treatment reduces crashes by 51% (WSDOT).
- 20 years of expected life
- Estimated $75,000 per installation
- The cost of this strategy will depend on the treatment.

IMPLEMENTATION



Sources: CA-Local Roadway Safety Manual

S8. Install Right-turn Lane

Setting up right-turn lane may be appropriate in situations where there are an unusually high number of rear-end collisions on a single major road approach. The need for right turn lanes should be assessed on an individual approach basis. It is also important to ensure that the right-turn lanes are of sufficient length to allow vehicles to decelerate and "queue up" before turning, ideally without affecting the flow of through traffic. This treatment addresses read-end crashes. When considering new right-turn lanes, potential impacts to non-motorized user should be considered and mitigated as appropriate.

EXISTING CONDITION

Benefit-Cost

- Implementation of this treatment reduces crashes by up to 8% for all crashes and 17% for fatal/injury crashes (WSDOT).
- 20 years of expected life
- Estimated $300,000 per right turn lane
- Installing right turn lanes require substantial time for development and construction that canvary the cost.

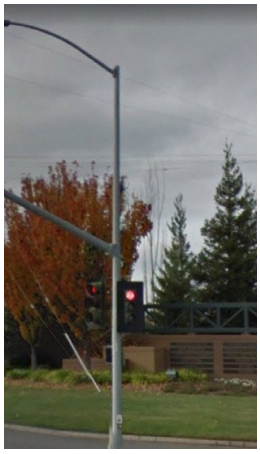
IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

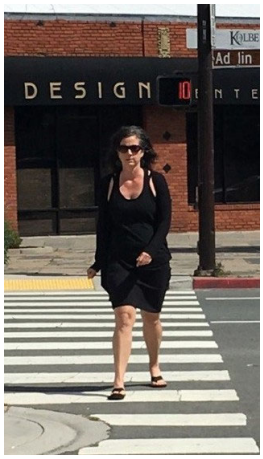
S9. Install Pedestrian Countdown Signal Heads

Install at signals that have signalized pedestrian crossing with WALK / DON'T WALK indications and where there have been pedestrian-vehicle crashes. The countermeasure addresses both pedestrian and bicycle collisions. This countermeasure only applies to "Ped & Bike" crashes occurring in the intersection/crossing with the newcountdown heads.

EXISTING CONDITION



IMPLEMENTATION



Benefit-Cost

- Implementation of this treatment reduces pedestrian crashes by 70% (WSDOT).
- 20 years of expected life
- Estimated $1,500 per signal head (does not include push button or pole cost)
- Costs and time of installation will vary based on the number of intersections included in this strategy and if it requires new signal controllers capable of accommodating the enhancement. This countermeasure can be effectively and efficiently implemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek stateor federal funding.

Sources: CA-Local Roadway Safety Manual

S10. Flashing Yellow Arrow Left Turn Signal

Flashing yellow arrow (FYA) traffic signals feature a flashing yellow arrow in addition to the standard red, yellow, and green arrows. When illuminated, the flashing yellow arrow allows waiting motorists to make a left-hand turn after yielding to oncoming traffic.

A national study demonstrated that drivers found flashing yellow left-turn arrows more understandable than traditional yield-on-green indications (green ball). Flashing yellow arrow treatment at signalized intersections can reduce the likelihood of left-turn crashes during permissive left-turn phasing. They can be used in either permissive-only or protected-permissive left-turn phasing schemes.

EXISTING CONDITION

IMPLEMENTATION

Benefit-Cost

- Implementation of this treatment reduces left turn crashes by 19% (WSDOT).
- 10 years of expected life
- Estimated $200,000 per intersection (assuming 4 new installations)
- Depending on the existing signal heads, signal controller, and signal cabinet, this treatment may require a controller replacement, which would increase the cost of installation.

Sources: FHWA, NACTO, Minnesota DOT

S11. Leading Pedestrian Interval

A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter the crosswalk at an intersection 3-7 seconds before vehicles are given a green indication. Using this "head start," pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn right or left.

LPIs provide increased visibility of crossing pedestrians and increased likelihood of motorists yielding to pedestrians. This results in reduced conflicts between vehicles and pedestrians, improving intersection safety. LPI is particularly useful at signalized intersections with a high volume of turning movements.

Benefit-Cost

» Implementation of this treatment reduces pedestrian-vehicle crashes by 13-48% (FHWA, WSDOT, City of Seattle).

» 10-20 years of expected life

» Estimated $200-10,000 (based on whether existing controller can accommodate the change)

Sources: FHWA, City of Seattle, WSDOT

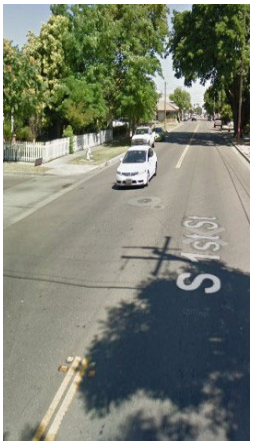
IMPLEMENTATION

Countermeasures for Non-Signalized Intersections

NS1. Add Intersection Lighting

Effective at unsignalized intersections that have a disproportionate number of nighttime crashes and do not currently have lighting. This treatment improves the safety of the intersection during nighttime by making drivers more aware of the surroundings at the intersection, enhancing driver'savailable sight distances and improving the visibility of non- motorists. This countermeasure only applies to nightcrashes (all types) occurring within limits of the proposed roadway lighting 'engineered' area.

EXISTING CONDITION



IMPLEMENTATION

Benefit-Cost

- Implementation of this treatment reduces nighttime injury crashes by 38% and nighttime pedestrian crashes by 42% (WSDOT).
- 20 years of expected life
- Estimated $8,000 per intersection
- Cost variation based on cost for lighting installation and an ongoing maintenance and powercost.

Sources: CA-Local Roadway Safety Manual

NS2. Convert to All-way Stop Control

Applicable at unsignalized intersection locations (currently with two-way stop control or two-way yield control) with a crash history and have no controls on the major roadway approaches. The all-way stop control is suitable only at intersections with moderate and relatively balanced volume levels on the intersection approaches. This treatment addresses to all type of crashes and only applies to crashes occurring in the intersection and /or influence area ofthe new control. All-way stop warrant should be considered.

EXISTING CONDITION

IMPLEMENTATION

Benefit-Cost

- Implementation of this treatment reduces crashes by 18-75% (ODOT).
- 10 years of expected life.
- Estimated $5,000 per intersection.
- Cost variation based on numbers of locations.

Sources: CA-Local Roadway Safety Manual

NS3. Install Roundabout

Effective at intersections that have a high frequency of right-angle and left-turn type crashes, primarily at unsignalized intersections with moderate-volumes. This countermeasure only applies to crashes occurring inthe intersection and/or influence area of the new control and is not eligible for use at existing all-waystop intersections.

Benefit-Cost

» Implementation of this treatment at 2-way stop controlled intersection reduces crashes by 25% and fatal/injury crashes by 35% (WSDOT).

» 20 years of expected life.

» Estimated $750,000 per intersection.

» Cost variation based on the environmental process, right-of-way acquisition and implementationunder an agency's long-term capital improvement program.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS4. Implement Unsignalized Intersection Signing and Marking Improvements

Target unsignalized intersections with patterns of rear-end, right- angle, or turning collisions related to lack of driver awareness of the presence of the intersection. The set of low-cost countermeasures is designed to increase drivers' alertness to the presence of the intersection and reduce potential conflicts with other entering vehicles. These treatments can include advanced intersection warning signs, oversized signs, doubled-up signs, stop ahead signs or painted on side street to supplement STOP sign.

Benefit-Cost

» Implementation of this treatment reduces crashes by 25% (WSDOT).

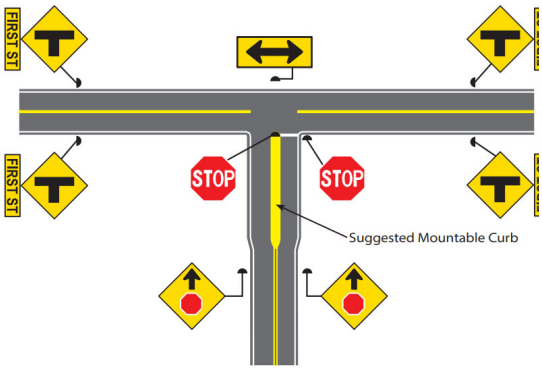
» 10 years of expected life.

» Estimated $700 per intersection.

» Cost variation based on the number of signs.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION



NS5. Install Transverse Rumble Strips

Transverse rumble strips are installed in the travel lane for providing an auditory and tactile sensation for each motorist approaching the intersection. They can be used at any stop or yield approachintersection, often in combination with advance signing to warn of the intersection ahead. This countermeasure applies to all crashes occurring on the approach / influence area of the new rumble strips.

Benefit-Cost

- Implementation of this treatment reduces all crashes by up to 6% and fatal/injury crashes by 7% (WSDOT).
- 10 years of expected life.
- Estimated $5,000 per intersection.
- Cost variation based on the length of the rumble strips.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS6. Install Raised Median

Used at Intersections noted as having turning movement crashes near the intersection as a result of insufficient access control. Application of this countermeasure should be based on current crash data and a clearly defined need to restrict or accommodate the movement. Angle crashes are addressed through this countermeasure. When agencies opt to install landscaping in conjunction with new raised medians, these locations must be excluded from their federally funded HSIP application scope. This countermeasure only applies to crashes occurring on the approaches / influence area of the new raised median.

Benefit-Cost

- Implementation of this treatment reduces all crashes by up to 39% and fatal/injury crashes by 44% (WSDOT).
- 20 years of expected life.
- Estimated $200,000+ (depends on length, right-of-way, and surface treatment).
- Cost variation based on the size of the new median.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS7. Install Right-turn Lane

Applicable when many collisions at unsignalized intersections are related to right-turn maneuvers. This countermeasure provides exclusive right-turn lanes, particularly on high-volume and high-speed major-roadapproaches to minimizing the collisions and applies to crashes occurring on the approaches / influence area of the new right-turn lanes.

Benefit-Cost

» Implementation of this treatment reduces all crashes by up to 8% and fatal/injury crashes by 17% (WSDOT).

» 20 years of expected life.

» Estimated $200,000 per intersection.

» Cost variation based on how wide the new right lane.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

NS8. Install Enhanced Pedestrian Crossing wish Advanced Features

Applicable at non-signalized intersections without a marked crossing, where pedestrians are known to cross, that involve significant vehicular traffic. They are important at school crossings and intersections with right and/or left turns pockets. Rectangular rapid flashing beacons (RRFBs), overhead flashing beacons, curb extensions, advanced stop or yield lines and other safety features should be added to complement the standard crossing elements. This countermeasure reduced pedestrian crashes occurring in the crossing (influence area) with the new enhanced safety features.

Benefit-Cost:

» Implementation of this treatment reduces pedestrian crashes by 40% (WSDOT).

» 20 years of expected life

» Estimated $ 50,000 per intersection

» Cost variation based on the length of the pedestrian crossing and the amount of safety signs.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION

NS9. Install Pedestrian Crossing (signs and markings only)

Applicable when many collisions at unsignalized intersections are related to left-turn maneuvers. This countermeasure provides exclusive left-turn lanes, particularly on high-volume and high-speed major-road approaches to minimizing the collisions. This countermeasure applies to crashes occurring on the approaches /influence area of the new left- turn lanes, but is not eligible for use at existing all-way stop intersections.

Benefit-Cost

- Implementation of this treatment reduces pedestrian crashes by 40% (WSDOT).
- 20 years of expected life
- Estimated $200,000 per intersection
- Cost variation based on how wide the new left lane.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

Countermeasures for Roadway Segments

R1. Add Segment Lighting

Applied to night-time crashes. In particular, patterns of rear-end, right-angle, turning or roadway departure collisions on the roadways may indicate that night-time drivers can be unaware of the roadway characteristics. This treatment addresses only to all night type crashes.

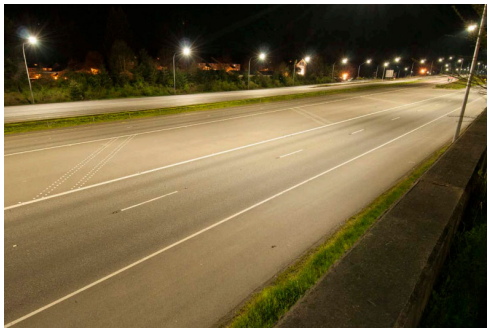
Benefit-Cost

- Implementation of this treatment reduces injury crashes by 28% (HSM).
- 20 years of estimated life
- Estimated $8,000 per installation
- Cost variation depending if lighting connected to signal box.

Sources: CA-Local Roadway Safety Manual, Highway Safety Manual

EXISTING CONDITION

IMPLEMENTATION



R2. Remove or Relocate Fixed Objects

Applicable to known locations or roadway segments prone to collisions with fixed objects such as utility poles, drainage structures, trees, and other fixed objects, such as the outside of a curve, end of lane drops, and in traffic islands. This treatment addresses fixed object crashes that occur within the current clear zone.

Benefit-Cost

- Implementation on this treatment reduces run off road crashes by 38% (WSDOT).
- 20 years of expected life
- Varies. Up to estimated $50,000 per deployment
- Costs will generally be low, assuming that in most cases the objects to be removed are within the right-of-way.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

R3. Install Guardrail

Guardrail is installed to reduce the severity of lane departure crashes. This treatment addresses fixed object and run-off road crashes. Its value in reducing collisions should only be applied to locations where past crash data or engineering judgement suggests the guardrail may result in a few or less severe crashes because the guardrail itself is a fixed object.

Benefit-Cost

- Implementation on this treatment reduces run off road crashes by 7-34% (ODOT).
- 20 years of expected life
- Estimated $50,000 per installation

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

R4. Install Roadside Impact Attenuators

Impact attenuators are typically used to shield rigid roadside objects such as concrete barrier ends, steel guardrail ends and bridge pillars from oncoming automobiles. This treatment addresses fixed object and run-off road that occur with the limits of the new attenuators. This countermeasure and corresponding collision reduction benefits should only be applied to locations where past crash data or engineering judgement applied to existing conditions suggests the upgraded attenuators may result in a few or less severe crashes.

Benefit-Cost

- Implementation of this treatment reduces crashes by 25%.
- 10 years of expected life
- Estimated $5,000 for steel railing, $2,500 for traffic barrels
- Costs depending on the scope of the project, type(s) used, and associated ongoing maintenance costs.

Sources: CA-Local Roadway Safety Manual

EXISTING CONDITION

IMPLEMENTATION

R5. Add 2 ft Paved Shoulder

Installed in roadways that have a frequent incidence of vehicles leaving the travel lane resulting in an unsuccessful attempt to reenter the roadway. The probability of a safe recovery is increased if an errant vehicle is provided with an increased paved area in which to initiate such a recovery. This type of countermeasure addresses Fixed object, Run-off Road, and Sideswipe collisions.

Benefit-Cost

- Implementation on this treatment reduces crashes by 5-13% (ODOT).
- 20 years of expected life.
- Estimated $150,000 (cost depends on need for right-of-way or if roadside modification isneeded).
- Shoulder widening costs would depend on whether new right-of-way is required and whether extensive roadside modification is needed. Since shoulder widening can be a relatively expensive treatment, one of the keys to creating a cost-effective project with at least a medium B/C ratio is targeting higher-hazard roadways.

EXISTING CONDITION

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

R6. Add Unpaved Shoulder

Appropriate to roadways with a frequent incidence of vehicles leaving the travel lane resulting inan unsuccessful attempt to reenter the roadway. This countermeasure addressed all types of crashes. Unless shoulder widening requires additional right-of-way and environmental impacts, these treatments can be implemented in a relatively short timeframe. This countermeasure only applies to crashes occurring within the limits of the new shoulder.

Benefit-Cost

- Implementation on this treatment reduces crashes by 3-6% (ODOT).
- 20 years of expected life
- Estimated $50,000 (varies)
- The cost of adding a navigable non-paved shoulder would depend whether extensive roadside modification and shoulder stabilization are required.

IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

R7. Install Chevron Signs on Horizontal Curves

IMPLEMENTATION

Set up on roadways that have an unacceptable level of crashes on relatively sharp curves during periods of light and darkness. Ideally this type of safety countermeasure would be combined with other sign evaluations and upgrades (install warning signs, delineators, markers, beacons, and relocation of existing signs per MUTCD standards). This treatment can address all types of crashes; but, specifically, run-offroad crashes occurring near curves. This treatment only applies to crashes occurring within the influence area of the new signs (i.e. only through the curve).

Benefit-Cost:

- Implementation of this treatment reduces crashes by 64% (WSDOT).
- 10 years of expected life.
- Estimated $1,000 per curve
- Costs for implementing this strategy are nominal and depend on the number of signs. When considered at a single location, these low-cost improvements are usually funded through localfunding by local maintenance crews. However, this treatment can be effectively and efficientlyimplemented using a systematic approach with numerous locations, resulting in moderate cost projects that are more appropriate to seek state or federal funding.

Sources: CA-Local Roadway Safety Manual

R8. Add Speed Feedback Signs

IMPLEMENTATION

This type of treatment addresses all crashes caused by motorist traveling too fast, including horizontal curves. Before choosing this treatment, the agency needs to confirm the ability to provide power to the site (solar may be an option).

Benefit-Cost

- Implementation on this treatment reduces crashes by 46% (WSDOT).
- 10 years of expected life
- Estimated $20,000-100,000
- Cost varies by type of implementation.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION

R9. Install Edge Line and Centerline Pavement Marking

Applicable on any road with a history of run-off-road right, head-on, opposite-direction-sideswipe, or run-off-road-left crashes is a candidate for this treatment. This treatment addresses all types, specifically impacts head-on and run-off road crashes. It only applies to crashes occurring within the limits of the new centerlines and/or edge lines. The treatment is not intended to be used for general maintenance activities (i.e. the replacement of existing striping) and must include upgraded safety features over the existing striping. For two lane roadways allowing passing, a striping audit must be done to ensure the passing limits meeting the MUTCD standards. Both the centerline and edge lines are expected to be upgraded.

Benefit-Cost

» Implementation on this treatment reduces run off road, opposite direction and nighttime crashes by 21% (WSDOT).

» 10 years of expected life

» Estimated $4,000 (depends on number and length of segment, as well as striping material)

» Costs for implementing this strategy are nominal and depend on the number and length of segment as well as the striping material (paint, thermoplastic, etc.). This countermeasure can be effectively implemented using a systemic approach with numerous and long locations.

Sources: CA-Local Roadway Safety Manual

IMPLEMENTATION

R10. Install No Passing Zone

Installed on roadways that have a high percentage of head-on crashes suggesting that many head-on crashes may relate to failed passing maneuvers. No Passing Zones should be installed where drivers' "passing sight distance" is not available due to horizontal or vertical obstructions. This treatmentaddresses all types of crashes that occur when drivers cannot differentiate the centerline markings between passing and no-passing area. This treatment only applies to crashes occurring within the limits of the new or extended no-passing zones.

Benefit-Cost

» Implementation of this treatment reduces crashes by 45%.

» 10 years of expected life

» Estimated $2,000 (varies)

» When considered at a single location, these low cost improvements are usually funded through local funding by local maintenance crews. However, This treatment can be effectivelyand efficiently implemented using a systematic approach with numerous and long locations, resulting in low to moderate cost projects that are more appropriate to seek state or federalfunding.

R11. Install Centerline Rumble Strips/Stripes

IMPLEMENTATION

Center Line rumble strips/stripes should be used on segments with a history of head-on crashes. This treatment addresses head-on and opposite-direction side-swipe crashes by alerting drivers who travel into the oncoming travel lane.

Benefit-Cost

- Implementation of this treatment reduces crashes by 20%.
- 10 years of expected life
- Estimated $3,000 per mile
- Costs for implementing this strategy are nominal and depend on the number and length oflocations.

Sources: CA-Local Roadway Safety Manual

R12. Install Edge Line Rumble Strips/Stripes

IMPLEMENTATION

Shoulder and edge line milled rumble strips/stripes should be used on roads with a history of roadway departure crashes. This treatment addresses run-off road crashes by providing an auditory and tactile warning when driven on, alerting drivers drifting outside their travel lanes.

Benefit-Cost

- Implementation of this treatment reduces opposite direction crashes by 40% and fatal/injury crashes by 8%.
- 10 years of expected life
- Estimated $3,000 per mile
- Costs for implementing this strategy are nominal and depend on the number and length oflocations.

Sources: CA-Local Roadway Safety Manual

R13. Rail Crossing Treatments

IMPLEMENTATION

Four Quadrant Gates extend across all roadway lanes on both the approach and the departure side of the crossing. Unlike two-quadrant gate systems, four-quadrant gates provide additional visual constraints and inhibit most traffic movements over the crossing after the gates have been lowered. Safe guards are put in place to ensure vehicles are not trapped on the tracks.

Four Quadrant Gate

Wayside Horns can be used as an adjunct to train-activated crossing warning systems to provide audible warning of an approaching train for traffic on each approach to the highway-rail crossing. A wayside horn system consists of a horn or series of horns located at a public highway-rail crossing and directed at oncoming motorists. The wayside horn system simulates a train horn and sounds at a minimum of 15 seconds prior to the train's arrival at the highway-rail crossing, until the lead locomotive has traversed the crossing. It is typically used at locations where the train horn is not sounded.

Wayside Horn

Benefit-Cost

- Quantified benefits unknown.
- 10 Years of expected life
- Estimated $700,000 for four quadrant gate system
- Estimated $500,000 for wayside horn system

Sources: FHWA, FRA

R14. No Passing Zone Signs

IMPLEMENTATION

A No Passing Zone, indicated by a solid yellow line on the left side of the driver's direction of travel, indicates a zone through which sight distance is restricted or where other conditions make overtaking and passing inappropriate. No Passing Zones are regulatory and legally enforceable.

In situations where head-on collision history is observed, a NO PASSING ZONE pennant can provide additional information to drivers at the beginning of the No Passing Zone, discouraging passing maneuvers. The NO PASSING ZONE sign is installed on the left side of the roadway.

Additionally, DO NOT PASS signs can be added as a supplement to No Passing Zone pavement markings to emphasize the restriction on passing. It can be installed at the beginning of, and at intervals within, the No Passing Zone.

Benefit-Cost

- Quantified benefits unknown.
- 10 Years of expected life
- Estimated $200 per sign

Sources: FHWA

Figure Links

S1a https://www.aaroads.com/california/ca-238.html S1b https://www.aaroads.com/california/ca-262.html
S2a https://safety.fhwa.dot.gov/provencountermeasures/lighting.cfm
S2b http://wishtv.com/2016/02/16/new-traffic-signals-aim-to-reduce-crashes/
S3a http://www.k-state.edu/roundabouts/ada/news/USNews.htm
S3b https://parade.com/19072/marilynvossavant/what-would-traffic-light-synchronization-cost/
S4a https://www.fhwa.dot.gov/publications/research/safety/09036/index.cfm
S4b http://www.madriverunion.com/samoa-boulevard-traffic-light-system-changed-up/
S5a https://dohanews.co/qatars-civil-defense-junction-is-now-a-proper-intersection/
S5b http://www.gulf-times.com/story/461946/Ashghal-opens-signal-controlled-intersection-on-New-Rayyan-Road
S6a http://www.cochraneeagle.com/article/Cochrane-familes-celebrate-cultural-diversity-20170803
S6b https://rspcb.safety.fhwa.dot.gov/noteworthy/html/edccasestudy_ky.aspx
S7a https://bouldercolorado.gov/transportation/median-maintenance
S7b Unknown
S8a Google Streetview
S8b https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/through-bike-lanes/
S9a Google Streetview
S9b Google Streetview
S10 https://www.sacbee.com/news/local/article239121918.html
S11 https://safety.fhwa.dot.gov/provencountermeasures/lead_ped_int.cfm

NS1a Google Streetview
NS1b Google Streetview
NS2a Google Streetview
NS2b http://www.ite.org/uiig/types.asp
NS3a https://www.flickr.com/photos/repowers/2933707788/
NS3b Google Streetview
NS4a https://alchemistsdiary.wordpress.com/2017/07/22/
NS4b https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa09020/fhwasa09020.pdf
NS5a http://www.cleveland.com/berea/index.ssf/2012/11/berea_changes_stop_sign_parkin.html
NS5b https://radiobintangsembilan.com/2016/03/07/hindari-kecelakaan-anak-sekolah-warga-minta-garis-kejut/
NS6a http://www.jurist.org/hotline/2014/03/zachary-heiden-maine-panhandling.php
NS6b https://www.edmonton.ca/transportation/on_your_streets/neighbourhood-traffic-concerns.aspx
NS7a Google Streetview
NS7b https://ux.stackexchange.com/questions/42867/how-does-the-projection-angle-of-road-arrows-change-drivers-expectations-of-the
NS8a https://en.wikipedia.org/wiki/Uncontrolled_intersection
NS8b https://safety.fhwa.dot.gov/provencountermeasures/crosswalk-visibility.cfm
NS9a Google Streetview
NS9b https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/major-street-crossing/

R1a https://www.shutterstock.com/nb/video/clip-9830723-4k-driving-car-on-highway-roadway-night
R1b https://www.wsdot.wa.gov/research/reports/fullreports/847.1.pdf
R2a Google Streetview
R2b Google Streetview
R3a Google Streetview
R3b https://www.reddit.com/r/funny/comments/4zcplq/a_local_plumbers_truck_decal/
R4a Unknown
R4b http://lslee.com/attenuators/Impact-Attenuators
R5a Unknown
R5b https://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa11018/
R6b https://www.fhwa.dot.gov/publications/research/safety/15030/009.cfm

R7b https://safety.fhwa.dot.gov/provencountermeasures/enhanced_delineation.cfm
R8b https://www.fhwa.dot.gov/publications/research/safety/15030/009.cfm
R9b https://www.fhwa.dot.gov/publications/research/safety/15030/009.cfm
R10b https://www.shutterstock.com/nb/search/double+yellow+lines
R11b https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/bike_ig/
R12b https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/bike_ig/
R13a https://cms.cityoftacoma.org/PublicWorks/RR_Crossing/Dome_OldTown/Option4_S_C_St_Poster_1of2.pdf
R13b https://safety.fhwa.dot.gov/hsip/xings/com_roaduser/fhwasa18040/
R14a https://safety.fhwa.dot.gov/older_users/fhwasa15088/ch4.cfm
R14b https://driving-tests.org/road-signs/do-not-pass-sign/

Appendix B Grant Programs

Based on the projects included in the City Safety Plan, the City may be eligible to submit projects to the following grant programs.

WSDOT City Safety Program

WSDOT Local Programs sends out a call for projects each even-numbered year. This program's funding is for projects enhancing safety on city streets by reducing the severity of crashes and utilizing transportation engineering improvements and countermeasures.
https://wsdot.wa.gov/LocalPrograms/Traffic/CitySafetyProgram

WSDOT Pedestrian and Bicycle Program

WSDOT Active Transportation Program sends out a call for projects each even-numbered year. The Pedestrian and Bicycle Program objective is to improve the transportation system to enhance safety and mobility for people who choose to walk or bike.
https://wsdot.wa.gov/LocalPrograms/ATP/funding.htm

WSDOT Safe Routes to School Program

WSDOT sends out calls early in even numbered years for project awards in the following biennium. The purpose of the Safe Routes to Schools program is to improve safety and mobility for children by enabling and encouraging them to walk and bicycle to school. Funding from this program is for projects within two-miles of primary, middle and high schools (K-12).
https://wsdot.wa.gov/LocalPrograms/SafeRoutes/funding.htm

WSDOT Railway-Highway Crossings Program

Open call for projects depends on future federal funding and Washington State priorities. This program's funding is for projects enhancing safety at public grade crossings by reducing the severity of crashes and installing or upgrading protective mechanisms at railroad crossings.
https://wsdot.wa.gov/localprograms/traffic/railway-crossings-program

Transportation Improvement Board (TIB) Complete Streets

The Complete Streets Award is a funding opportunity for local governments that have an adopted complete streets ordinance. Board approved nominators may nominate an agency for showing practice of planning and building streets to accommodate all users, including pedestrians, access to transit, cyclists, and motorists of all ages and abilities.
http://www.tib.wa.gov/grants/grants.cfm?inav=3#other2

Surface Transportation Block Grant (STBG) - Urban

STBG – Urban is for jurisdictions above 5,000 population. The grant is approximately $6 million per year, with grant applications due in July and grant awards in September. Previous funded projects include bringing urban roads and intersections up to urban standards. Projects need to have a balance of capacity, safety, and economic development to get funding.
https://www.rtc.wa.gov/programs/tip/docs/tipcrit21.pdf

STBG - Rural

STBG – Rural is for smaller jurisdictions and rural areas awards approximately $1 million every other year (even-numbered years). Selection occurs with applications due in July and grant awards in September. Criteria are less stringent than urban, but support capacity, safety, and economic development. It has funded downtown improvements in smaller cities and for arterial preservation/safety on county road arterials that access cities.
https://www.rtc.wa.gov/programs/tip/call/

Congestion Mitigation and Air Quality (CMAQ) Improvement Program

This is available for projects that improve air quality. Available funding is approximately $3 million per year, with applications due in July and September grant awards. CAQ has the same criteria as STBG-Urban, but air quality points are tripled. Mostly funded projects are signalized intersections and transit-related projects.
https://www.rtc.wa.gov/programs/tip/call/

Transportation Alternatives (TA)

Approximately $1.3 million available every odd year (2023, 2025, etc.). Grant application due in April with grant awards in July. Criteria and process is outlined in https://www.rtc.wa.gov/programs/tap/docs/taGuidebook.pdf. Has funded pedestrian/bicycle improvements.

APPENDIX C: Collision Heat Maps

Following WSDOT's recommended procedure, the City applied the most common attributes present in fatal/serious injury collisions to the entire network by mapping collisions based on those attributes.

Figures C1 through C5 show the locations of collisions with these attributes.

Figure C1 illustrates that roadway departure collisions are most common along E Street (SR 14), Washougal River Road, and S 32nd Street.

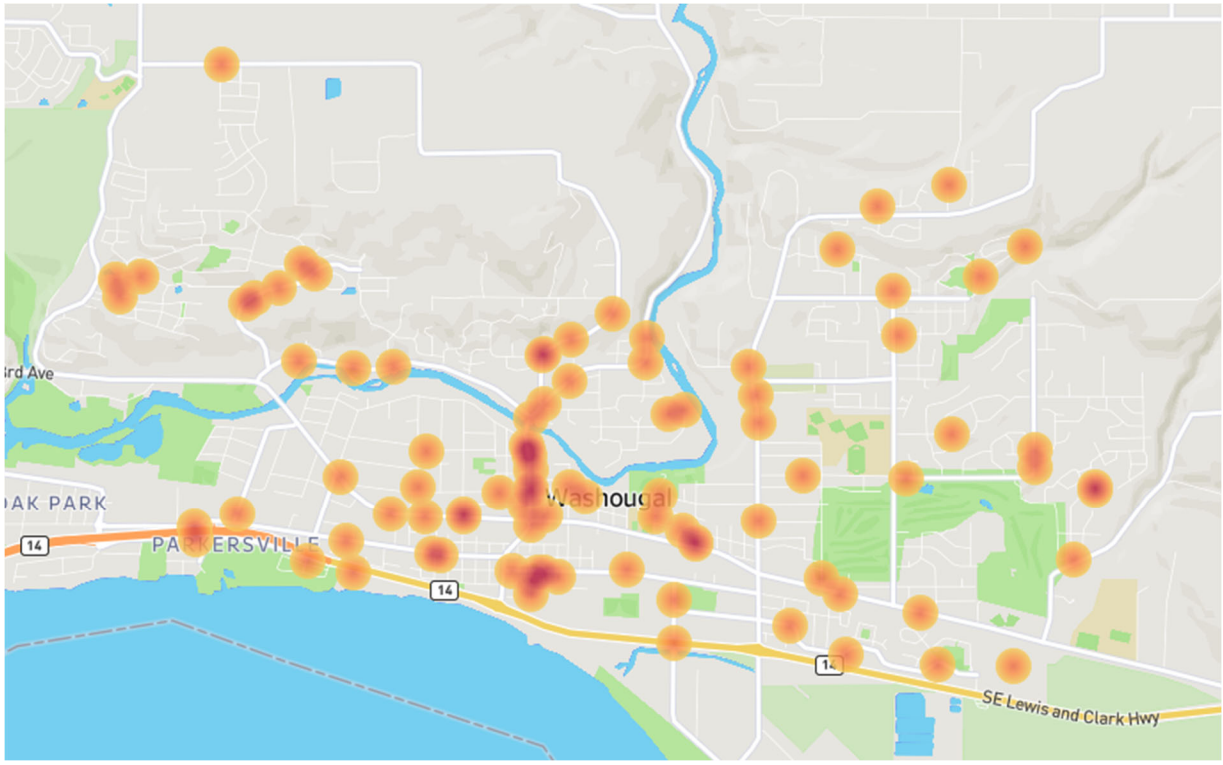


Figure C1. Roadway Departure Collisions, Washougal, 2018-2022.

Figure C2 shows some hot spots of at-intersection or intersection-related collisions.

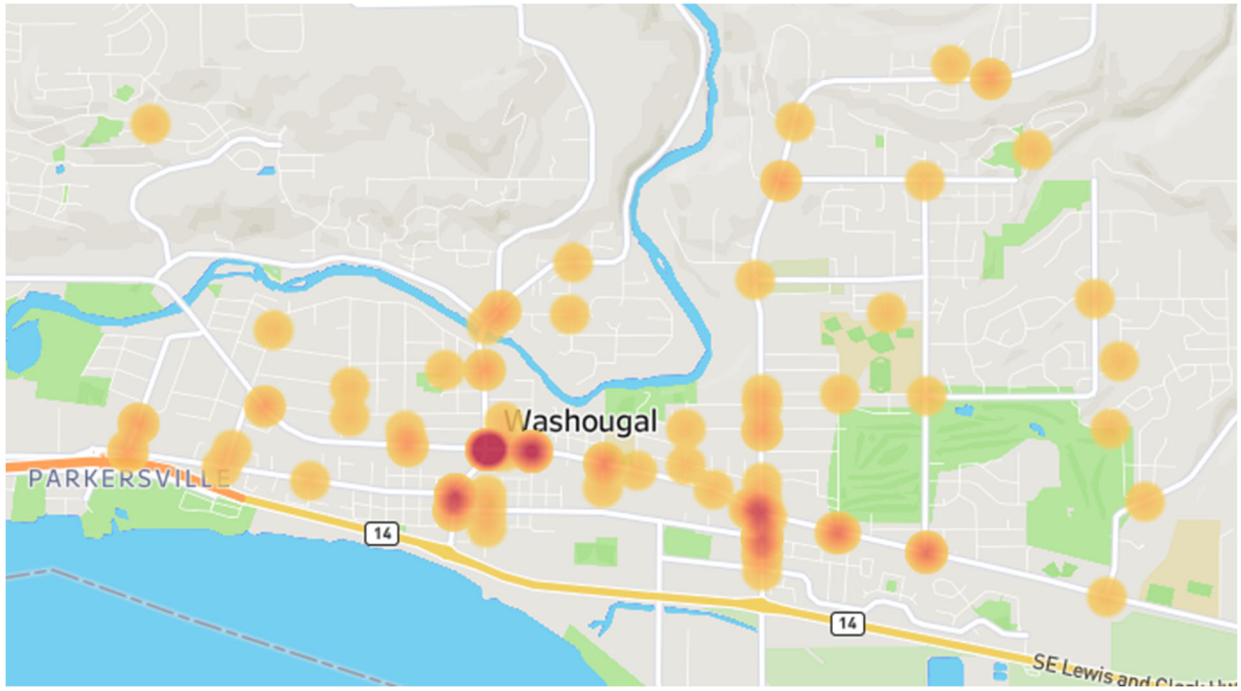


Figure C2. At Intersection or Intersection-Related Collisions, Washougal, 2018-2022.

Figure C3 presents the heat map of where the collision type was entering at an angle.

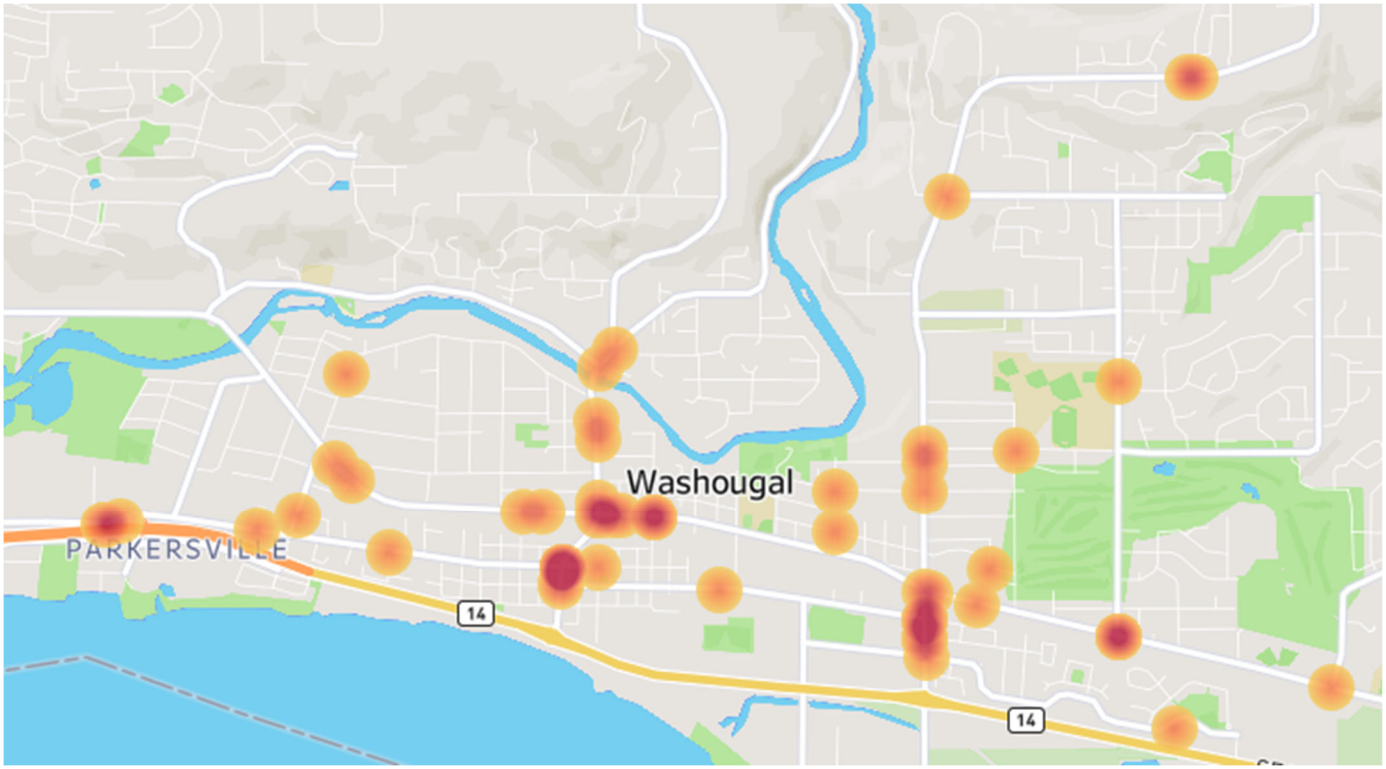


Figure C3. Collisions where the type was entering at an angle, Washougal, 2018-2022.

There are several clusters of collisions that occurred due to distraction or inattention, as shows in Figure C4. Examples include intersection around and including E Street (SR 14) and Washougal River Road, as well as 32nd Street from Evergreen Way to Addy Street.

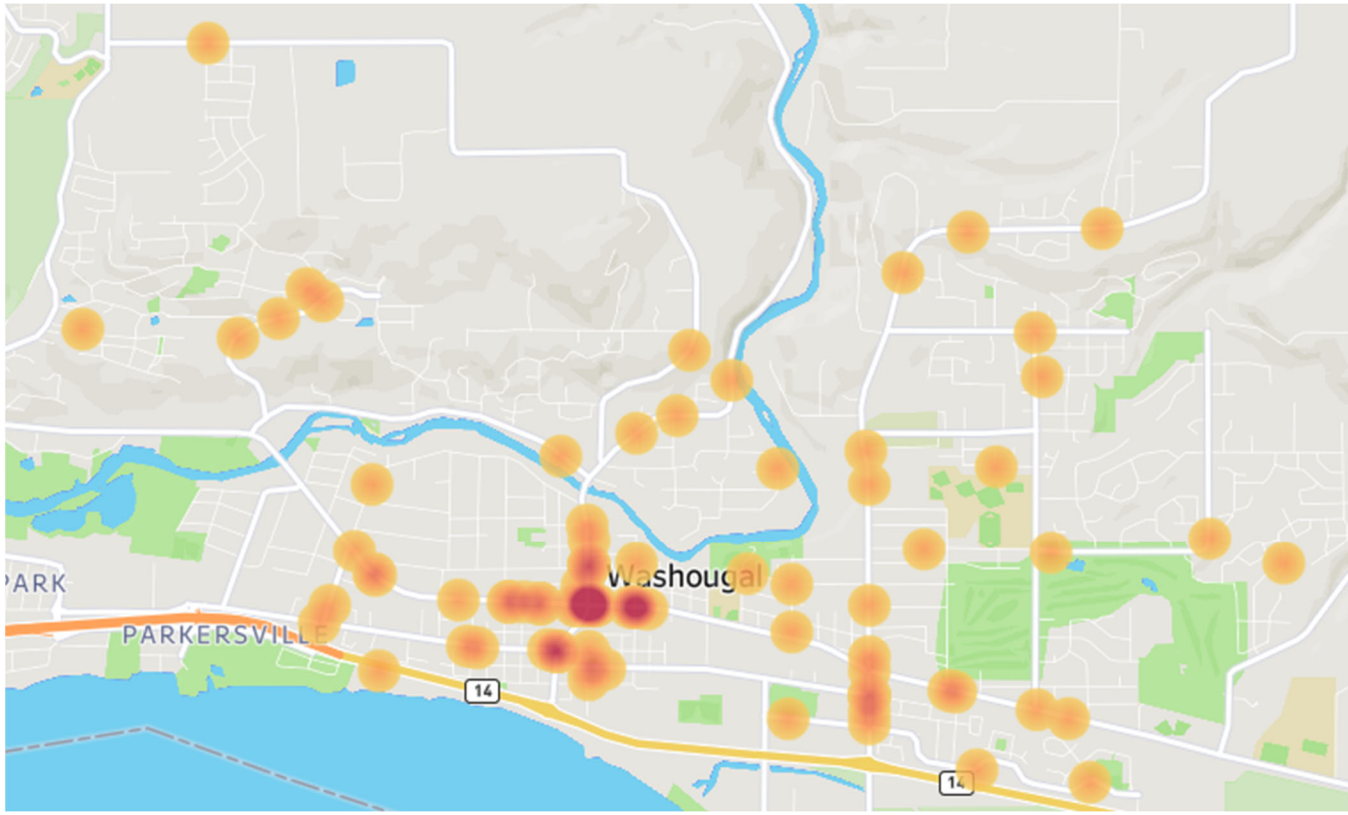


Figure C4. Distraction/Inattention Collisions, Washougal, 2018-2022.

Figure C6 shows that speeding related collisions are scattered throughout the city. Some areas of note include along 32nd Street, E Street (SR14), and 12th Street.

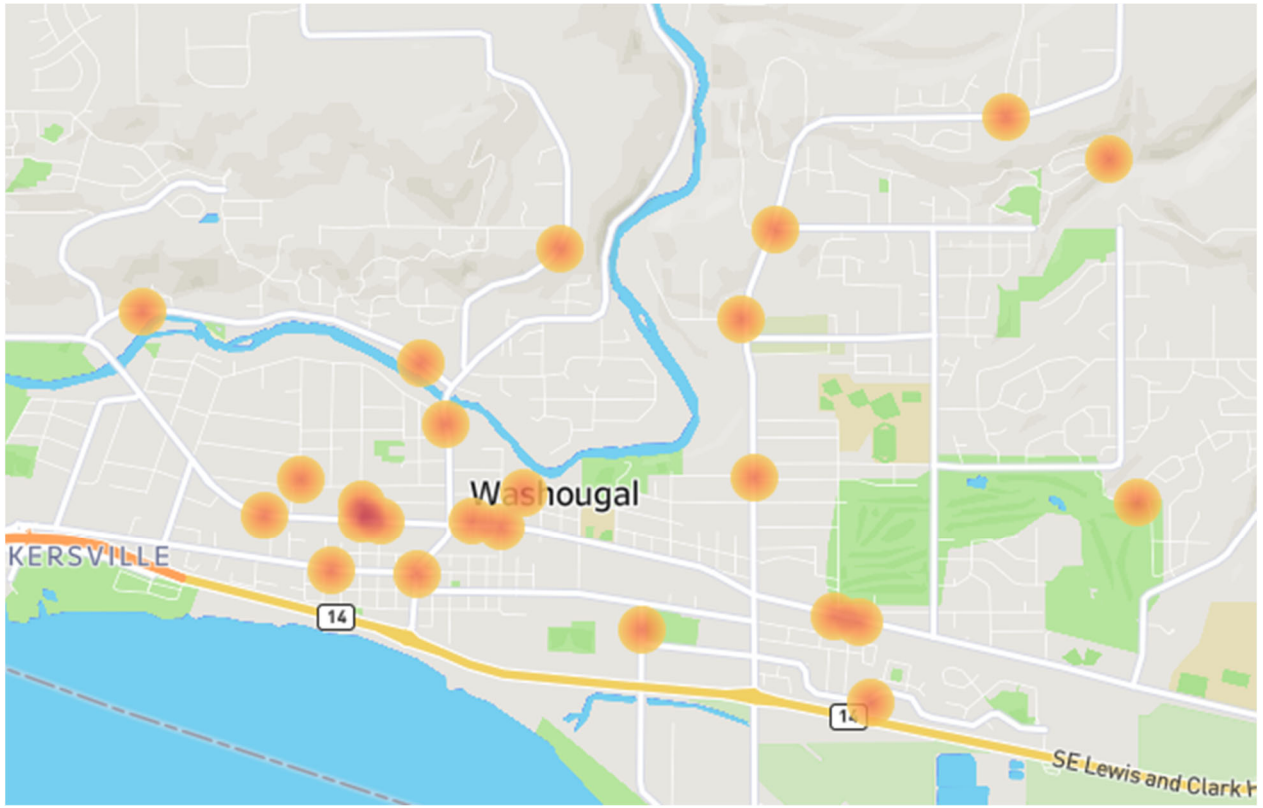


Figure C5. Speeding Related Collisions, Washougal, 2018-2022.