CITY SAFETY PLAN

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PREPARED FOR THE CITY OF CAMAS

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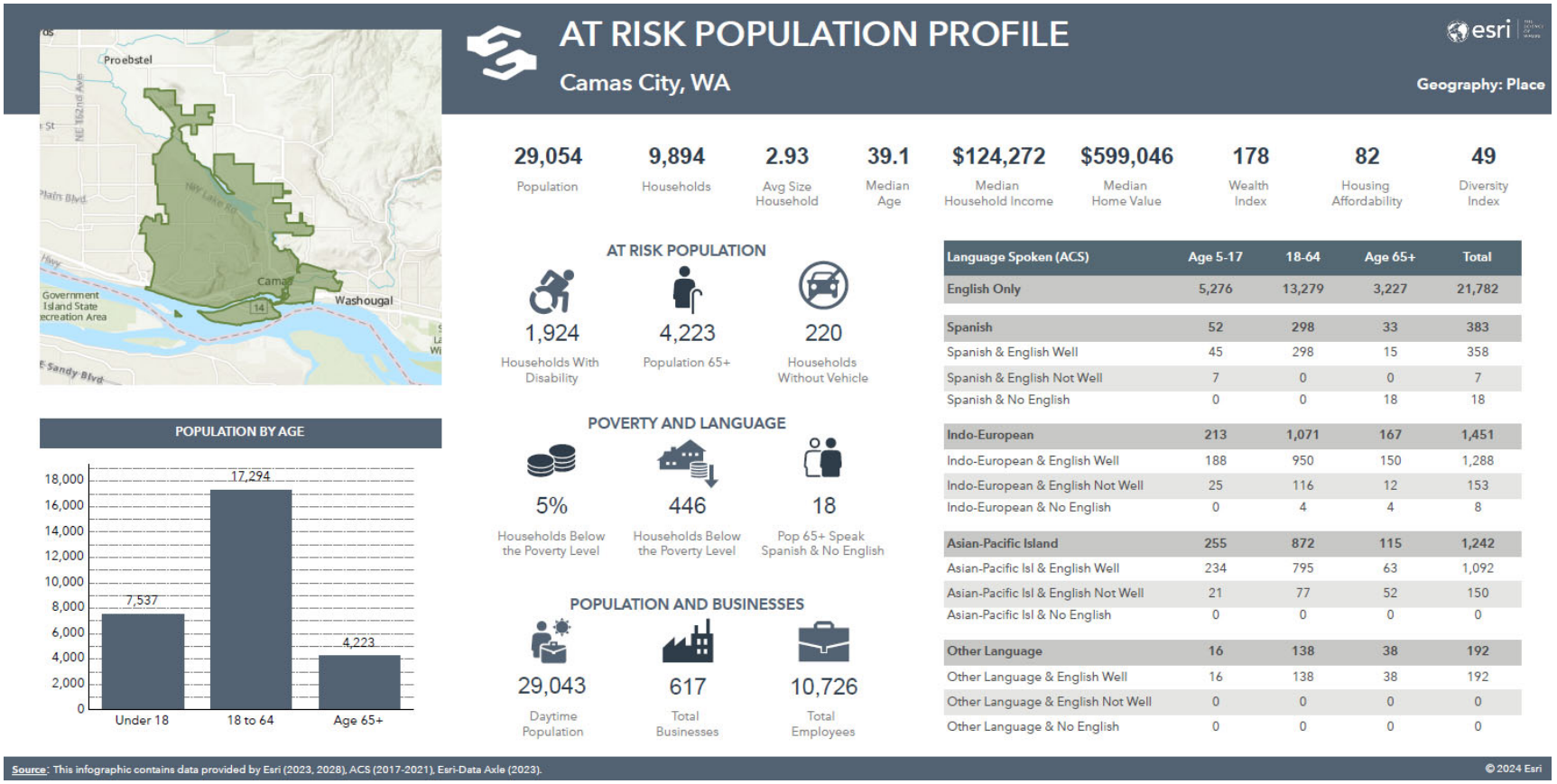
INTRODUCTION

The City of Camas is located along the Columbia River and east of Vancouver, Washington. Camas is home to approximately 29,000 residents with more than 600 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	5,276	13,279	3,227	21,782
Spanish	52	298	33	383
Spanish & English Well	45	298	15	358
Spanish & English Not Well	7	0	0	7
Spanish & No English	0	0	18	18
Indo-European	213	1,071	167	1,451
Indo-European & English Well	188	950	150	1,288
Indo-European & English Not Well	25	116	12	153
Indo-European & No English	0	4	4	8
Asian-Pacific Island	255	872	115	1,242
Asian-Pacific Isl & English Well	234	795	63	1,092
Asian-Pacific Isl & English Not Well	21	77	52	150
Asian-Pacific Isl & No English	0	0	0	0
Other Language	16	138	38	192
Other Language & English Well	16	138	38	192
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 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 crash reduction. The following plan includes a summary of existing safety conditions in Camas, 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.

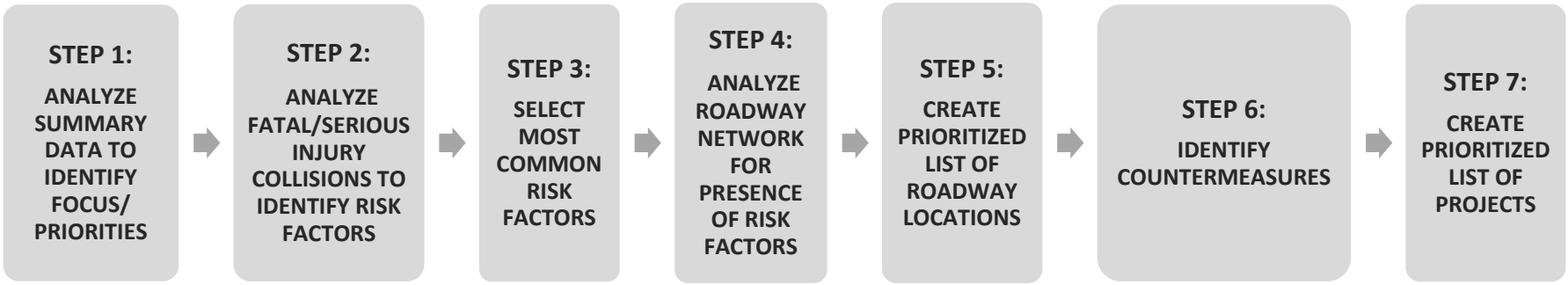


Figure 1. City Safety Plan Prioritization Process.

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]

- 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 crash modification factor.

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 Camas, Southwest Washington Regional Transportation Council (RTC), and WSDOT Transportation Data to acquire the following data sets.

- WSDOT database of all collisions on City of Camas streets, January 2018 - December 2022 (provided by Julie Brown, WSDOT Transportation Data)

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

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

DATA ANALYSIS OVERVIEW

As illustrated in Figure 2, over the past five years, the number of fatal and serious injury collisions on city streets has ranged from zero to four annually. It is important to note that the year 2022 has seen the highest number of fatal and serious injury collisions.

The number of all reported collisions (regardless of severity) has ranged between 74 and 113, as shown in Figure 3. In 2022, the city experienced 86 reported crashes (a 24% decline from 2018). Moreover, the previous study period between 2016-2020 showed 516 total recorded collisions, while the current study period is a total of 482 recorded collisions, a 6.6% decrease overall.

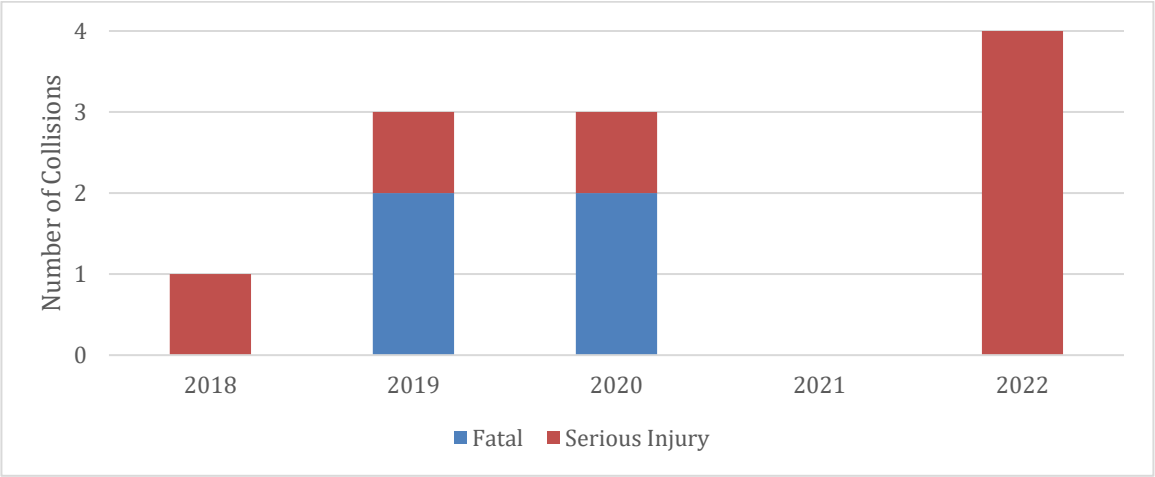


Figure 2. Fatal and Serious Injury Collisions in Camas, 2018-2022.

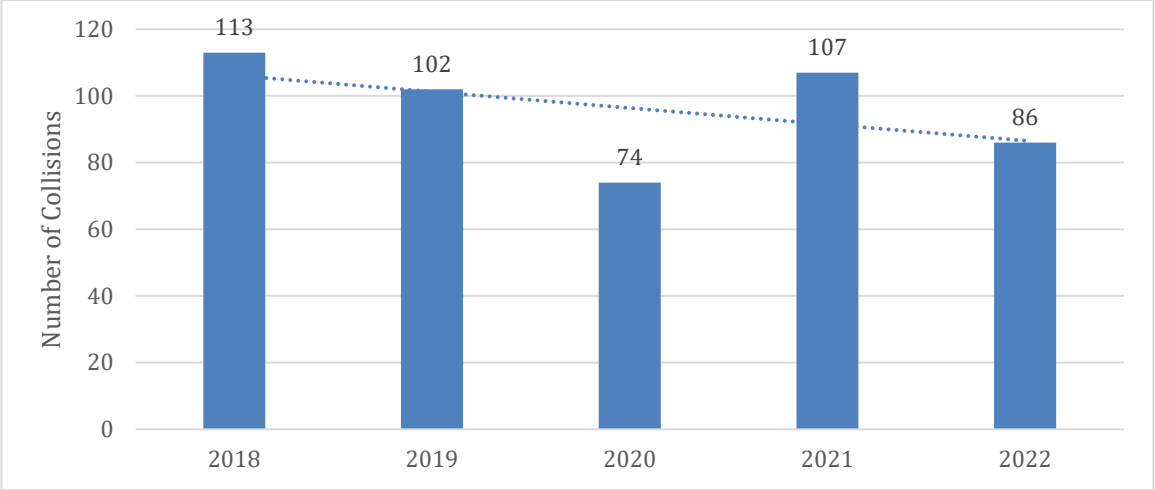


Figure 3. Total Collisions in Camas, 2018-2022.

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

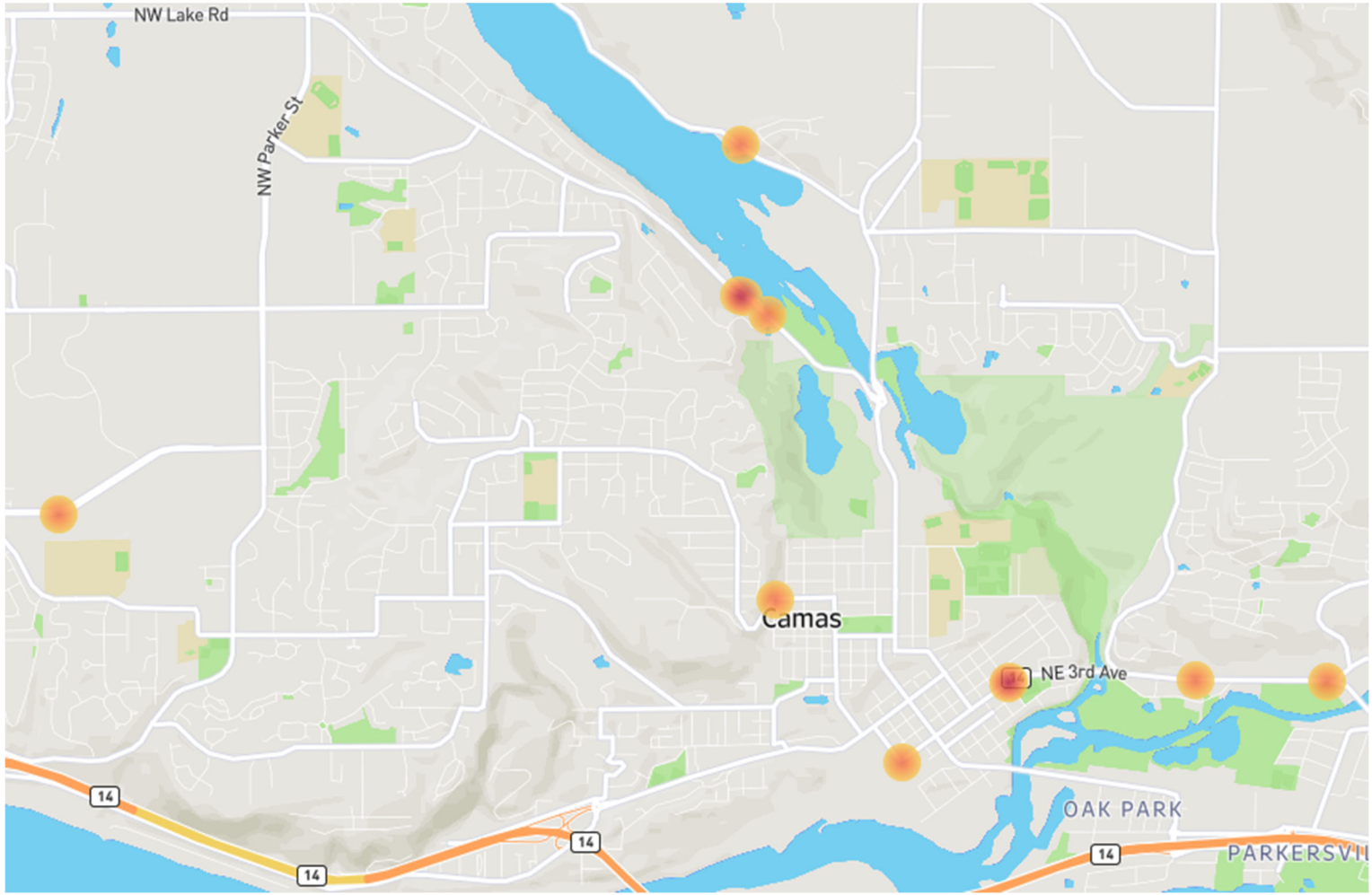


Figure 4. Heat Map of Fatal and Serious Injury Collisions in Camas, 2018-2022.

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

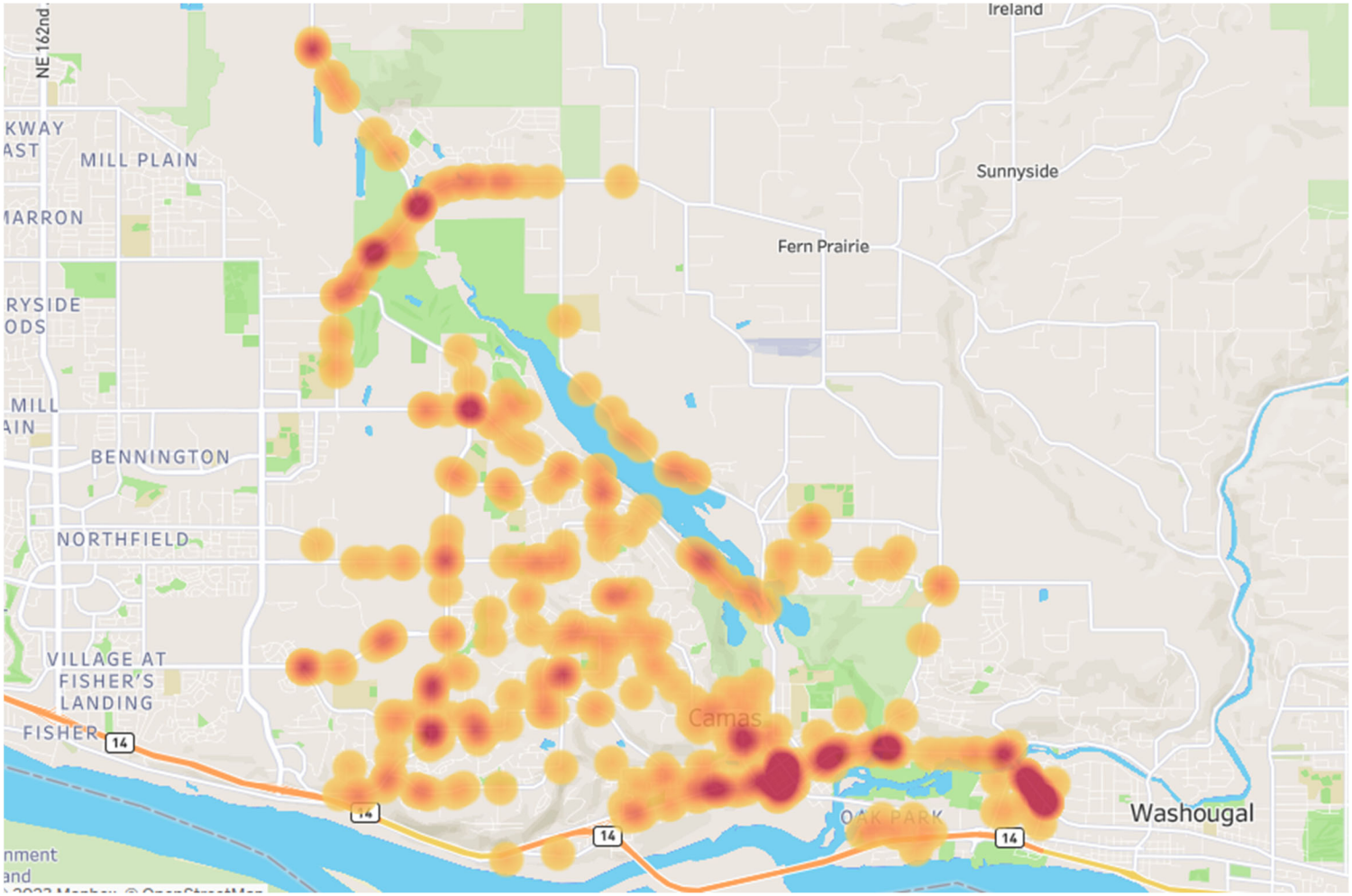


Figure 5. Heat Map of All Reported Collisions in Camas, 2018-2022.

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 Camas. Collision attributes with a notably higher percentage of serious injury collisions versus all-severity collisions have an increased likelihood of contributing to serious injury crashes.

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

Data Element	Collision Attribute	Total Collisions	Fatal Collisions (F)	Serious Injury Collisions (SI)	Percent of all Camas Collisions with this Attribute [1]	Percent of F&SI Camas Collisions with this Attribute [2]
Citywide	*Any*	482	4	7		
Collision Type	Roadway Departure	183	1	5	38.0%	54.6%
	Head-On	5	2	0	1.0%	18.2%
	Entering at Angle	99	0	1	20.5%	9.1%
	Overturning	11	1	1	2.3%	18.2%
Contributing Circumstance (For at least one vehicle)	Exceeding Reasonable Safe Speed or Exceeding Stated Speed Limit	51	2	3	10.6%	45.5%
	Alcohol-Impaired [3]	62	0	1	12.9%	9.1%
	Drug-Impaired [3]	4	0	0	0.8%	0.0%

Data Element	Collision Attribute	Total Collisions	Fatal Collisions (F)	Serious Injury Collisions (SI)	Percent of all Camas Collisions with this Attribute [1]	Percent of F&SI Camas Collisions with this Attribute [2]
	Inattention / Distraction	130	1	1	27.0%	18.2%
Motor Type Involved	Motorcycle	11	1	1	2.3%	18.2%
	Heavy Vehicle	13	0	0	2.7%	0.0%
Lighting Condition	Dark/Dusk/Dawn	187	1	4	38.8%	45.5%
Intersection	At Intersection or Intersection Related	193	0	1	40.0%	9.1%
	Signalized Intersection	44	0	0	5.6%	0.0%
	Unsignalized Intersection	149	0	1	30.9%	9.1%
Road User	Pedestrian Involved	8	0	0	1.7%	0.0%
	Bicyclist Involved	11	0	0	2.3%	0.0%
Roadway Surface	Wet	129	1	2	26.8%	27.3%
	Ice	16	0	1	3.3%	9.1%
Age	Driver Age 16 to 25 Involved	216	2	2	44.9%	36.4%
	Driver Over Age 65 Involved	72	0	1	15.0%	9.1%
Restraint (Seat Belt) Usage	No Restraints Used	12	1	1	2.5%	18.2%

(1) For example, in Camas 38% of all collisions involved roadway departure.

(2) For example, in Camas 18.2% of all fatal and serious injury collisions were head-on crashes.

(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:

- Over half of fatal and serious injury crashes were roadway departures. 80% of these crashes were speed-related.
- Nearly half of fatal and serious injury crashes were speed-related.
- Nearly half of fatal and serious injury crashes took place in dark/dusk/dawn lighting conditions. Three of the five crashes that were speed-related took place in dark conditions with streetlights on.

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. Speeding
3. Dark/Dusk/Dawn Lighting Conditions
4. Driver Age 16-25
5. Entering at an Angle
6. At Intersection or Intersection-Related
7. Wet Road Conditions

In the following steps, these seven collision attributes are referred to as the most common risk factors.

Low-frequency, Severe-outcome Collision Attributes. Several collision attributes were associated with a relatively high number of fatal and serious injury collisions, but a low overall frequency of those types or attributes. Therefore, evaluating these contributors for the entire city would not provide valuable location-specific information.

The following attributes were associated with a lower frequency of collisions, but a higher percentage of fatal and serious injury outcomes than most others:

- Head-on collisions (2 of 5 were fatal or serious injury collisions)
- Motorcycle-involved (2 of 11 were fatal or serious injury collisions)
- No Restraints Used (2 of 12 were fatal or serious injury collisions)

Pedestrian and Bicycle Safety. Of the 482 reported collisions during the study period, 19 involved a pedestrian or bicyclist, and none of those reported crashes resulted in a fatality or serious injury. To identify locations for potential infrastructure treatments under the WSDOT City Safety Program, at least one fatal or serious injury collision must be present in the database.

STEP 4: ANALYZE ROADWAY NETWORK FOR PRESENCE OF RISK FACTORS (COLLISION ATTRIBUTES)

Following WSDOT's recommended procedure,[3] the City applied the most common risk factors in fatal/serious injury crashes to the entire network using frequency of collisions based on the most common risk factors / collision attributes.

The City mapped crash frequency based on the seven most common risk factors in fatal and serious injury crashes. The maps in Appendix C illustrate the locations of crashes with these attributes.

[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 identify intersections and corridors ranked by the number of risk factors / collision attributes identified. A location received a "point" for a risk factor if it experienced a relatively high frequency of crashes 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 7 RISK FACTORS

Intersection	Number of Crashes	Roadway Departure	Speeding	Dark/Dusk/ Dawn	Driver Age 16-25	Entering at angle	Inter-section Related	Wet Road Conditions	At Least 1 Fatal or Serious Injury Crash	Total
NW 3rd Avenue and NE Joy Street	3	✓	-	✓	✓	✓	✓	✓	✓	**7**
NW 16th Avenue and NW Brady Road [4]	6	-	-	✓	✓	✓	✓	✓	-	**5**
NE Ingle Road and NE Goodwin Road [5]	9	-	-	✓	✓	✓	✓	✓	-	**5**
NW 6th Avenue and NE Adams Street	2	-	-	✓	✓	✓	✓	✓	-	**5**

[4] Recently improved, including a new signal installation in 2018
[5] Recently improved, including a new signal installation in 2023

Intersection	Number of Crashes	Roadway Departure	Speeding	Dark/Dusk/ Dawn	Driver Age 16-25	Entering at angle	Inter-section Related	Wet Road Conditions	At Least 1 Fatal or Serious Injury Crash	Total
NW 38th Avenue and NW Parker Street	5	-	✓	✓	✓	-	✓	✓	-	**5**
NW Leadbetter Drive and NW Howard Street	2	-	✓	✓	✓	-	✓	-	-	**4**

TABLE 3: PRIORITIZED CORRIDOR SAFETY NEEDS BY NUMBER OF IDENTIFIED 7 RISK FACTORS

Segment	Number of Crashes	Roadway Departure	Speeding	Dark/Dusk/ Dawn	Driver Age 16-25	Entering at angle	Inter-section Related	Wet Road Conditions	At Least 1 Fatal or Serious Injury Crash	Total
NW Lake Road from NW Leadbetter Drive to NE Everett Street	22	✓	✓	✓	✓	✓	✓	✓	✓	**8**
NE 3rd Avenue from NE Garfield Street to SE Crown Drive	18	✓	✓	✓	✓	✓	✓	✓	✓	**8**
SE Leadbetter Road from SE Everett Street to NE 232nd Avenue	11	✓	✓	✓	✓	✓	-	✓	✓	**7**
NE Goodwin Road	29	✓	-	✓	✓	✓	✓	✓	-	**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 current safety needs, and then analyzed collision data and existing conditions at the locations shown in Table 4.

TABLE 4: PRIORITIZED SAFETY STUDY LOCATIONS

Location	Number of Crashes	Roadway Departure	Inattention/ Distraction	Dark/ Dusk/ Dawn	Driver Age 16-25	Entering at angle	Inter-section Related	Wet Road Conditions	At Least 1 Fatal or Serious Injury Crash	Total
Segment: NW Lake Road from NW Leadbetter Drive to NE Everett Street	22	✓	✓	✓	✓	✓	✓	✓	✓	**8**
Segment: NE 3rd Avenue from NE Garfield Street to SE Crown Road	18	✓	✓	✓	✓	✓	✓	✓	✓	**8**
Segment: SE Leadbetter Road from SE Everett Street to NE 232nd Avenue	11	✓	✓	✓	✓	✓	-	✓	✓	**7**

Location	Number of Crashes	Roadway Departure	Inattention/ Distraction	Dark/ Dusk/ Dawn	Driver Age 16-25	Entering at angle	Inter-section Related	Wet Road Conditions	At Least 1 Fatal or Serious Injury Crash	Total
Intersection: NW 6th Avenue and NE Adams Street	2	-	-	✓	✓	✓	✓	✓	-	**5**

STEP 7: DEVELOP A PRIORITIZED LIST OF PROJECTS

Upon completion of the 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.

Projects to address system roadway departures were fulfilled by the previous grant funding for WSDOT City Safety Program. These projects included treatments for citywide Manual on Uniform Traffic Control Devices (MUTCD) curve signing updates, rumble strips, and profiled pavement markings.

TABLE 5: SAFETY PROJECTS TO PURSUE

Prioritized Location or Systemic Collision Type	Safety Project Including Proven Countermeasures	Next Step
1. NW Lake Road from NW Leadbetter Drive to NE Everett Street	Horizontal Curve Signing, Profiled Pavement Marking, Illumination	Apply for 2024 WSDOT City Safety Program grant funding
2. NE 3rd Avenue from NE Garfield Street to SE Crown Road	Roadway Reconfiguration, Crosswalks with Rectangular Rapid-Flashing Beacons (RRFBs)	Consider other funding opportunities in Appendix B
3. Systemic Stop-controlled Intersections	Signing, Pavement Marking	Consider other funding opportunities in Appendix B
4. Intersection: NE 6th Avenue and NE Dallas Street	Crosswalks, Curb Extensions, Speed Feedback Signs, Overhead Flasher Removal	Consider other funding opportunities in Appendix B
5. Intersection: NE 6th Avenue and NE Adams Street	Lighting, Mini Roundabout	Consider other funding opportunities in Appendix B

PRIORITY 1: NW LAKE ROAD FROM NW LEADBETTER DRIVE TO NE EVERETT STREET

Identified Safety Needs. This segment of NW Lake Road is mostly a narrow, two-lane, hilly, tree-lined roadway through the woods that connects lakeside residential properties to Heritage Park and NE Everett Street (SR 500). Along this segment, there were 22 total collisions, where there were three fatal collisions and four reported possible injuries.

Figure 6. Horizontal Curve on NW Lake Road.

Overall, the most common collision type was a rear-end type crash, which accounted for 5 collisions (23%), followed by a collision with a fixed object, such as a street light pole or linear curb. Also, 4 collisions (18%) involved the collision of two vehicles traveling in opposite directions. Furthermore, the most common contributing circumstance was inattention/distraction (7 crashes). 9 out of the 22 total collisions (41%) took place in dark/dusk/dawn conditions.

Collision history shows that this segment was the site of three fatal collisions taking place in close proximity along NW Lake Road north of Lacamas Lane. The first crash in March 2019 involved the death of a 19-year-old motorcyclist speeding along NW Lake Road and lost control, overturned, and impacted the guardrail. The second crash took place in August 2020 where a distracted driver was traveling westbound near the intersection at Lacamas Lane when the vehicle crossed the center line and struck another sedan traveling eastbound. At least three others were treated for minor injuries. The third fatal crash occurred just a few months later in November 2020 in another head-on collision near the 600 block of NW Lake Road. The driver was traveling west when the vehicle was

overcorrecting/oversteering and struck a vehicle after crossing into the lane of opposing traffic.

Safety Treatments. To address collisions along NW Lake Road, most of which involve a motorist departing their lane and either running off the road or colliding with an oncoming vehicle, the City will consider the following treatments:

- ***Horizontal Curve Signing.*** Horizontal curve warning signs for each curve, as appropriate, including advance curve warning, advisory speed plaques, and chevron alignment signs. This provides additional information to drivers at curves and turns.
- ***No Passing Zone Signs.*** There is some evidence that the head-on collision involved illegal passing along the corridor. Adding No Passing Zone signs could supplement the existing double-yellow pavement marking.
- ***Profiled Pavement Marking.*** This treatment can address lane departure crashes by providing an auditory and tactile warning when driven on, alerting drivers drifting outside their travel lanes. Profiled pavement markings do not result in as much noise outside the vehicle as rumble strips. Installation of profiled pavement markings will be focused on the segment of NW Lake Road from NW Sierra Street to NE Everett Street.
- ***Install Illumination.*** Identify gaps that create "dark spots" along the segment and fill in with new lighting. It is important to note, however, that an ongoing project at the NW Lake Road and NW Sierra Street will include illumination at the intersection's vicinity.
    - ***Focus segment: NW Lake Road between Lacamas Lane to the Lacamas Lake Lodge parking lot***. While there is sparse lighting along this section of NW Lake Road, the present lighting configuration may not provide adequate intersection lighting to Lacamas Lane, the parking lots to Camas Heritage Park and Lacamas Lake Lodge. Of all 22 collisions along this segment, about half of crashes took place between 600 feet north of the intersection of NW Lake Road and NW Lacamas Lane, south to NE Everett Street (13 crashes). 3 of these 13 crashes took place in dark lighting conditions.

Future Consideration: Shoulder Widening. Although this treatment has a low benefit-cost ratio, adding shoulders provides additional recovery area for drivers to return the roadway after departing the traveled way. The City may choose to consider this treatment when future funding opportunities arise.

PRIORITY 2: NE 3RD AVENUE FROM NE GARFIELD STREET TO SE CROWN ROAD

Identified Safety Needs. This segment of NE 3rd Avenue is an east-west corridor that serves downtown Camas, and ultimately connects east to Washougal. The land use is both commercial and residential. This segment is currently a four-lane section with two lanes in each direction and no marked crossings other than at a signalized intersection. Based on the past five years of collision history, there have been 18 crashes along this segment.

Figure 7. Eastbound NE 3rd Avenue and NE Joy Street.

The most common collision types were entering at an angle (7 crashes), rear-end (6 crashes), and collision with a fixed object, such as a guardrail, curb, mailbox, or tree (4 crashes). There was one crash at NE 3rd Avenue and NE Joy Street, shown in Figure 7, that involved a single vehicle and resulted in the two fatalities of a driver and their passenger while traveling westbound along NE 3rd Avenue when their vehicle departed the roadway and struck a tree. Speed was the contributing circumstance of this crash.

Furthermore, there was one crash that resulted in a suspected serious injury and took place at the intersection of NE 3rd Avenue and NE Joy Street. The driver was making a northbound right turn from NE Joy Street onto NE 3rd Avenue when they struck another vehicle traveling eastbound on NE 3rd Avenue.

Safety Treatments. To address the identified needs at this intersection, the City will consider the following safety countermeasures:

- **Roadway Reconfiguration**. At this location, average daily traffic (ADT) is approximately 9,000 vehicles. Reducing the current four-lane configuration to three-lanes, with one lane in each direction and a center two-way left-turn lane is feasible with this ADT, especially since the width of the roadway at this location is about 46 feet. Bike lanes may also be added. This configuration

may accommodate safer and easier left-turn movements and ultimately reduce rear-end and angle crashes. In addition, with just a single through lane in each direction, this design provides traffic calming and slower vehicle speeds along the segment. It is also important to note that the section of NE 3rd Avenue directly to the west has already been converted to a three-lane section.

- **Marked Crosswalks with Rectangular Rapid-Flashing Beacons (RRFBs)**. Since there are only marked crosswalks at signalized intersections within this segment, there are some locations where improved pedestrian crossings would be beneficial. Two potential locations have been identified: the intersections of NE 3rd Avenue/NE Joy Street and NE 3rd Avenue/E 1st Avenue. Both intersections would provide pedestrian access to Louis Bloch Park and would serve the Lacamas Creek Trail. Installing RRFB equipment in addition to marked crosswalks would be beneficial for heightened driver awareness of pedestrians.

PRIORITY 3: SYSTEMIC STOP-CONTROLLED INTERSECTIONS

Identified Safety Needs. In Camas, intersection and intersection-related collisions are the second most common collision attribute to occur for all crash severities, after young drivers aged 16-25. Of all of the collisions in the City, 31% occurred at unsignalized intersections. This includes one collision that resulted in a serious injury at the intersection of NE 3rd Avenue and NE Joy Street, where a driver was making a northbound right turn from NE Joy Street onto NE 3rd Avenue when they struck another vehicle traveling eastbound on NE 3rd Avenue.

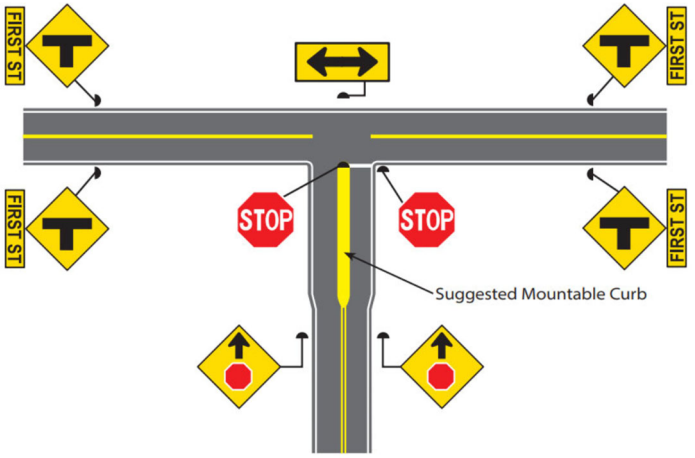


Figure 8. Low-Cost Intersection Treatments

Potential Safety Treatments. Low-cost systemic safety countermeasures at unsignalized intersections consists primarily of signing and pavement marking. Installing these treatments, shown in Figure 8, is a Federal Highway Administration (FHWA) Proven Safety Countermeasure. Treatments include doubled-up signs, additional pavement marking, fluorescent yellow sign sheeting for warning signs, advance warning signs, oversize signs, and a narrow median on the side street.

To address the safety risks at intersections and the low cost of the recommended treatments, the City will consider a combination of these treatments at the following stop-controlled intersections:

- NE Goodwin Road and NW Alexandra Lane
- NE 3rd Avenue and SE Weir Street
- NE 3rd Avenue and NE Joy Street
- NW 3rd Avenue and NE Ione Street
- NE 6th Avenue and Division Street
- NE 6th Avenue and NE Dallas Street
- NW 23rd Avenue and NW Astor Street

Example Intersection Locations

NE Goodwin Road and NW Alexandra Lane. Located within a horizontal curve, this T-intersection has limited sight distance for all three approaches. Westbound Alexandra Lane takes a sharp reverse curve as it approaches the Stop sign. Southbound Goodwin Road has a left curve that limits sight distance approaching Alexandra Lane. Northbound Goodwin Road has a right curve just south of the Alexandra Lane intersection. Collision types include rear-ends and roadway departures. This intersection is also near a trailhead that attracts pedestrian traffic. Low-cost signing and pavement marking treatments would provide safety benefits at this location.

Figure 9. Southbound Goodwin Road Approaching Alexandra Lane

PRIORITY 4: NE 6TH AVENUE AND NE DALLAS STREET

Identified Safety Needs. Just near Camas' downtown core, NE 6th Avenue and NE Dallas Street is a NW-SE stop-controlled intersection supplemented by overhead flashing yellow and red indicators. This intersection is situated along a section of NE Dallas Street where drivers traveling southwest into downtown are met with a relatively steep grade. This intersection is near both residential and commercial land uses, with two parking lots on the south side, and residential properties on the north side. Prior discussion with the City of Camas indicates that drivers approach the intersection mistakenly think it is all-way stop-controlled, and overhead flashers cause confusion.

Based on the past five years of recorded crash history, there were 10 total collisions at this intersection, all of which were entering at an angle. One of these crashes resulted in a suspected minor injury. This crash happened when a driver was traveling southbound on NE Dallas Street when they struck a vehicle traveling westbound on NE 6th Avenue. The driver stopped at the intersection, and then proceeded to travel through the intersection, when this approach was not stop-controlled. This is one example of driver confusion when approaching the intersection, since NE Dallas Street is not stop-controlled.

Figure 10. NE 6th Avenue and NE Dallas Street.

To address the identified needs at this intersection, the City will consider the following safety countermeasures:

- ***Crosswalk Installation***. Pedestrian traffic accessing commercial retail businesses and parking lots south of NE 6th Avenue could be better served by installing crosswalks across NE 6th Avenue.
- ***Speed Feedback Signs.*** Although crash history does not show speeding as a risk factor at this location, southbound traffic may be traveling at speeds above the posted speed limit due to the steep hill. Adding a speed feedback sign on Dallas Street south of 7th Avenue may be an effective traffic calming measure to help reduce the frequency and severity of crashes at the intersection.
- ***Overhead Flasher Removal.*** City staff noted that the overhead flashers may be confusing drivers of the intersection's operation and will consider removing them. Removing the flashers may also be an effective countermeasure in combination with "STOP" or "STOP AHEAD" pavement markings on NE 6th Avenue.

PRIORITY 5: NE 6TH AVENUE AND NE ADAMS STREET

Identified Safety Needs. Located in an industrial/commercial area of Camas, NE 6th Avenue and NE Adams Street has atypical traffic control, as shown in Figure 11. The northbound approach is free (through, left, and right) while the other three intersection legs are stop-controlled. This could introduce some confusion to drivers, though each stop sign includes a "Cross Traffic Does Not Stop" plaque. There were two total crashes at this intersection. The first crash resulted in no apparent injury and took place in 2019 where a vehicle turning left onto NE 6th Avenue from NE Adams Street was struck by an east-bound traveling vehicle that proceeded through the intersection after the stop sign. The second crash in 2021 took place in dark and rainy conditions when an intoxicated driver struck a concrete barrier while turning left onto NE 6th Ave, which resulted in possible injury.

Figure 11. NE Adams Street Northbound Approach at NE 6th Avenue

In addition to its collision history, Camas citizens have expressed concerns about the safety of this intersection.

To address the identified needs at this intersection, the City will consider the following safety countermeasures:

- ***Mini Roundabout.*** *See Figure 12 on the next page.* The amount of pavement at this location makes it conducive to a compact roundabout installation. Roundabouts are a proven countermeasure to reduce the frequency and severity of intersection crashes by reducing operating speeds and flattening the angle of conflict. It will be important for this design to accommodate freight truck movements.
- ***Improved Intersection Lighting.*** Improving lighting at the intersection will help reduce the risk of dark, dusk, and dawn crashes.

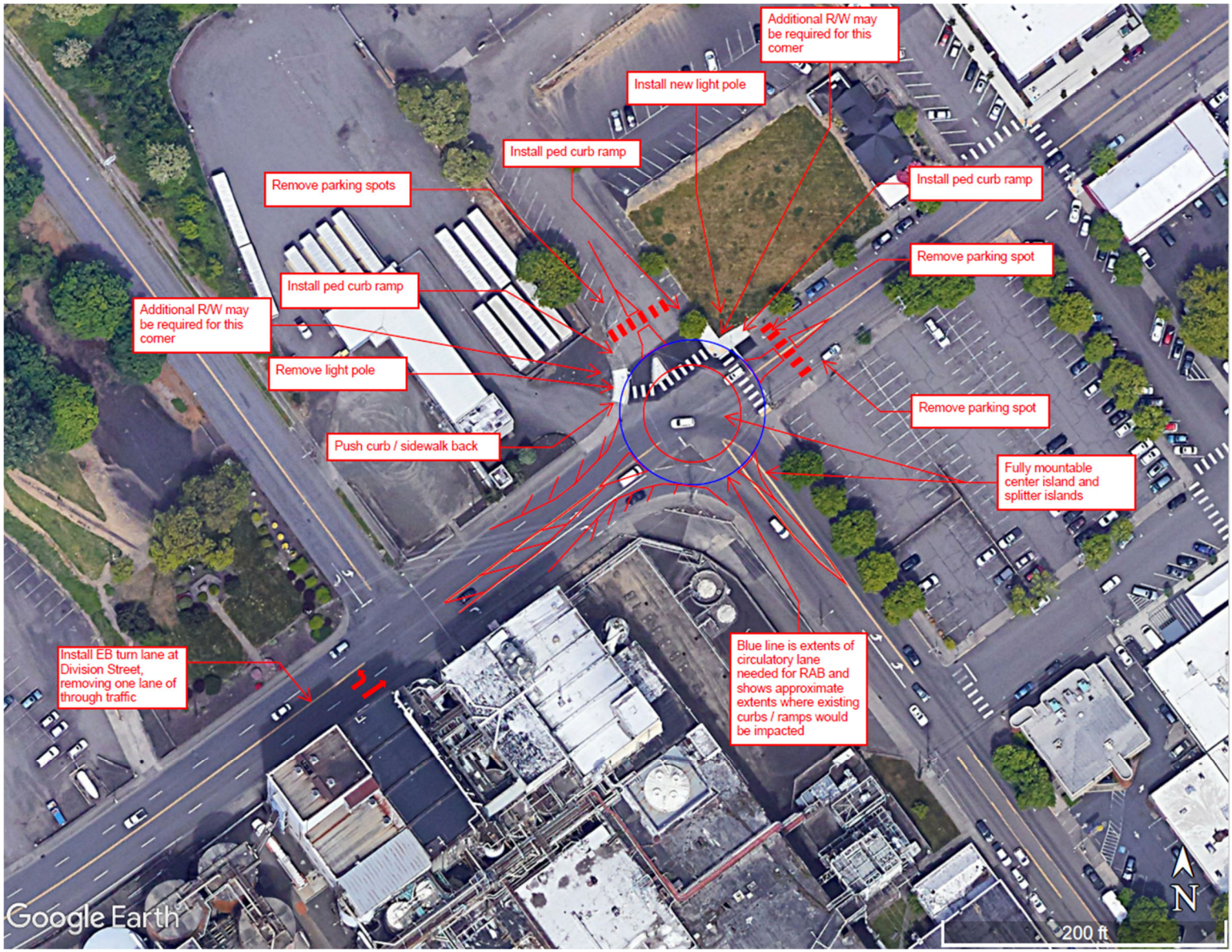


Figure 12. Conceptual Layout and Notes for a Mini Roundabout at NE 6th Avenue and NE Adams Street

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

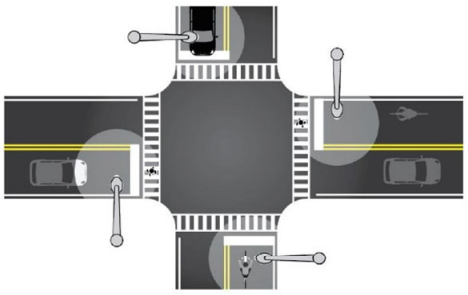
» Estimated $75,000

» 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).

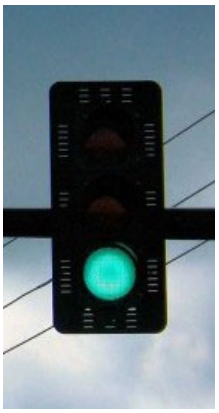
» 10 years of expected life

» 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

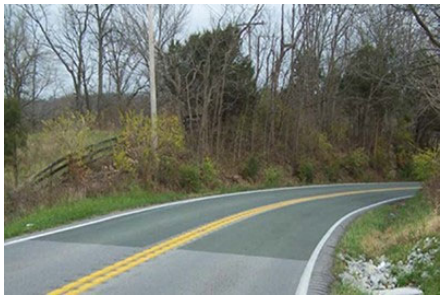
» Estimated $5,000 per intersection for materials and equipment

» 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

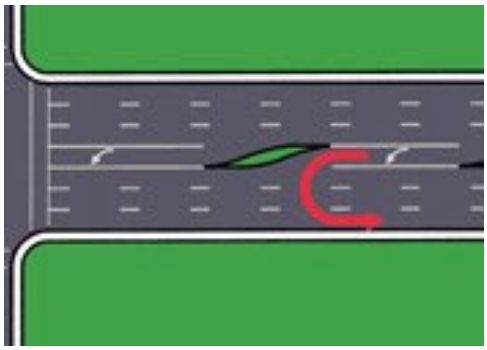
Install medians to reduce crashes related to turning maneuvers include angle, rear-end, pedestrian, and sideswipe (involving opposing left turns) type crashes. This treatment only applies to crashes occurring in the intersection/influence area of the new directional openings.

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.

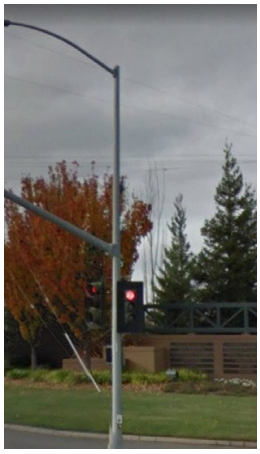
IMPLEMENTATION

Sources: CA-Local Roadway Safety Manual

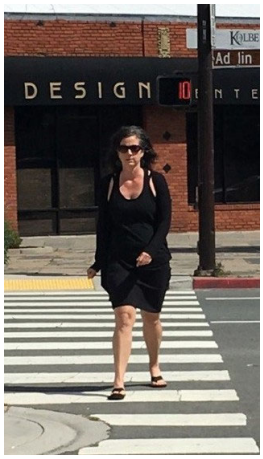
S9. Install Pedestrian Countdown Signal Heads

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

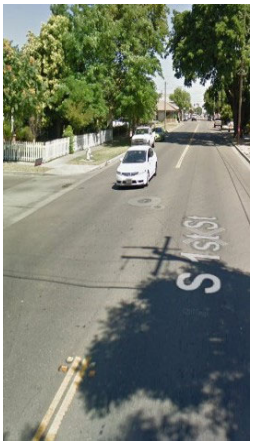
IMPLEMENTATION

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).

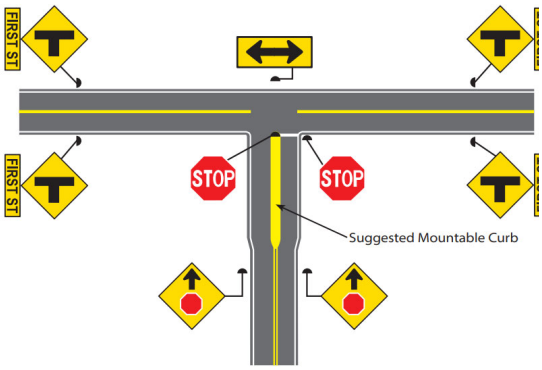
» 10 years of expected life.

» 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.

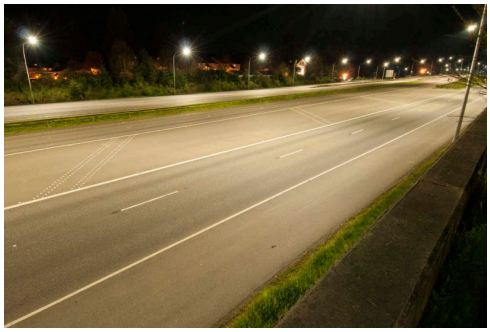
Benefit-Cost

- 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 consultant support team 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 C6 show the locations of crashes with these attributes.

Collisions involving roadway departure are shown in Figure C1. There are many roadway departure collision hotspots throughout the City, including on NE Ingle Road, NE Goodwin Road, NE Leadbetter Road, and NE 3rd Avenue.

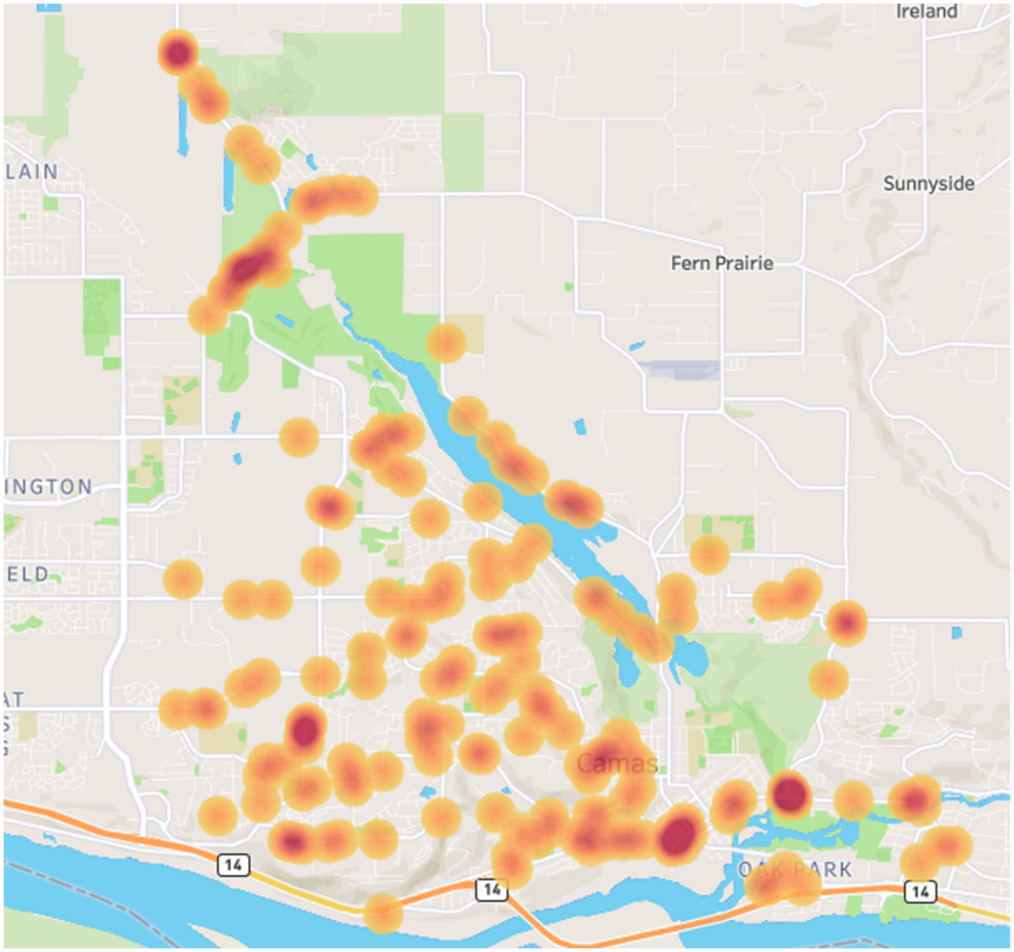


Figure C1. Roadway Departure Collisions, Camas, 2018-2022.

Figure C2 shows hotspots of dark/dusk/dawn collisions at the following locations:

- NW Lake Road
- NW Parker Street
- NE Goodwin Road
- NE Leadbetter Road
- NE 3rd Avenue and SE Crown Road
- NE 3rd Avenue and NE Dallas Street

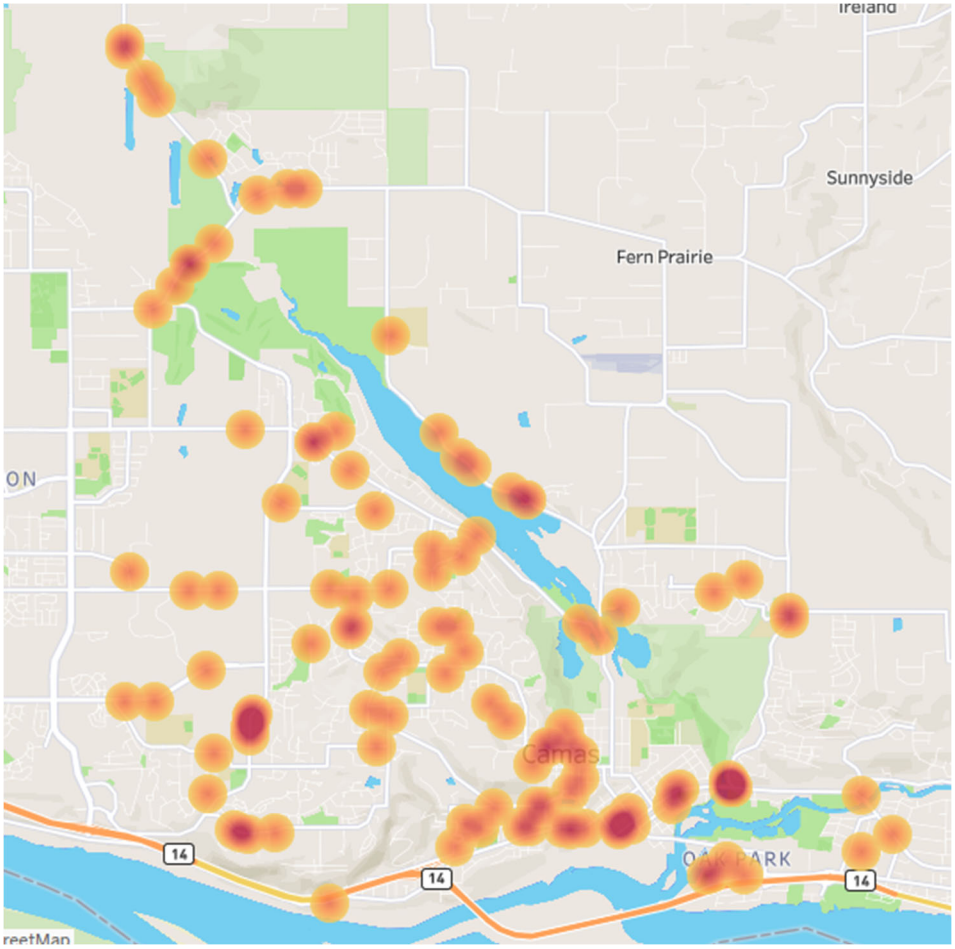


Figure C2. Dark/Dusk/Dawn Collisions, Camas, 2018-2022.

There are three main clusters of speeding related collisions shown in Figure C3:

- NE 3rd Avenue
- NW Lake Road
- NE Goodwin Road

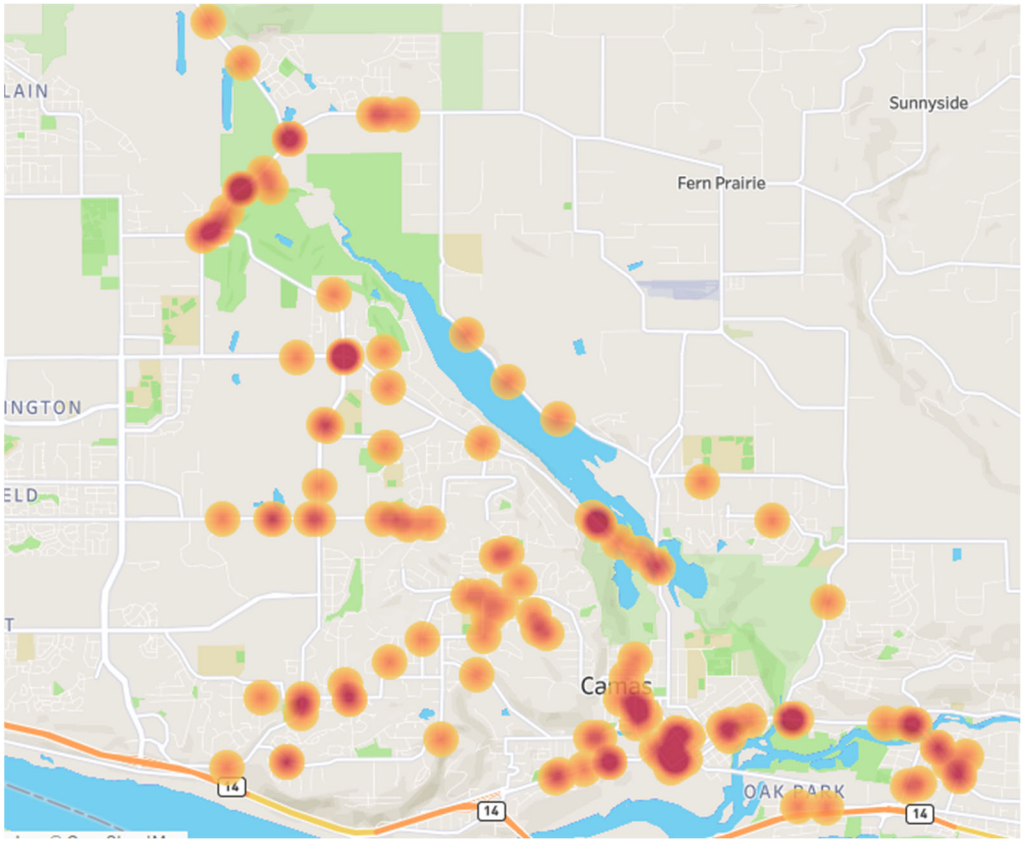


Figure C3. Speeding Related Collisions, Camas 2018-2022.

Collisions where the driver at fault was between ages 16 to 25 are clustered on NE Ingle Road, SE Leadbetter Road, and NE 3rd Avenue, as shown in Figure C4.

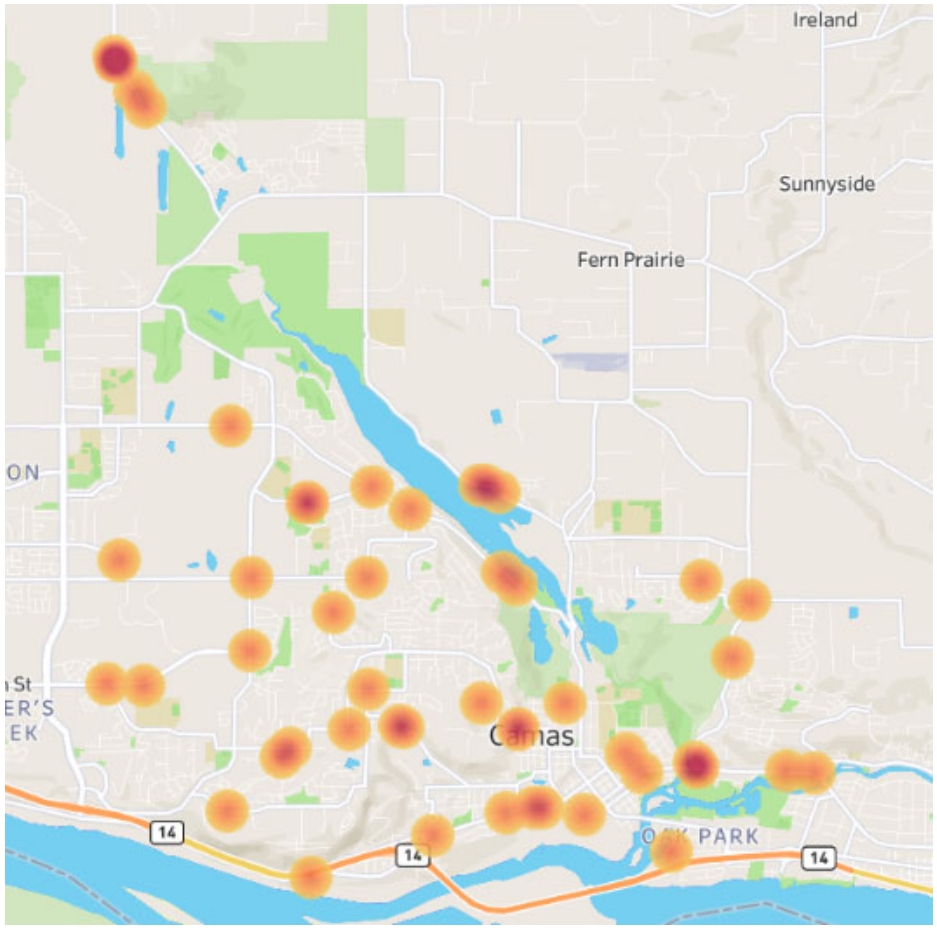


Figure C4. Collisions where driver at fault was between ages 16-25, Camas, 2018-2022.

Figure C5 presents the heat map of collisions that occurred on wet roads during the study period. The majority occurred along the follow corridors:

- NE Ingle Road
- NE Goodwin Road
- NW Lake Road
- NW Parker Street
- NE 3rd Avenue

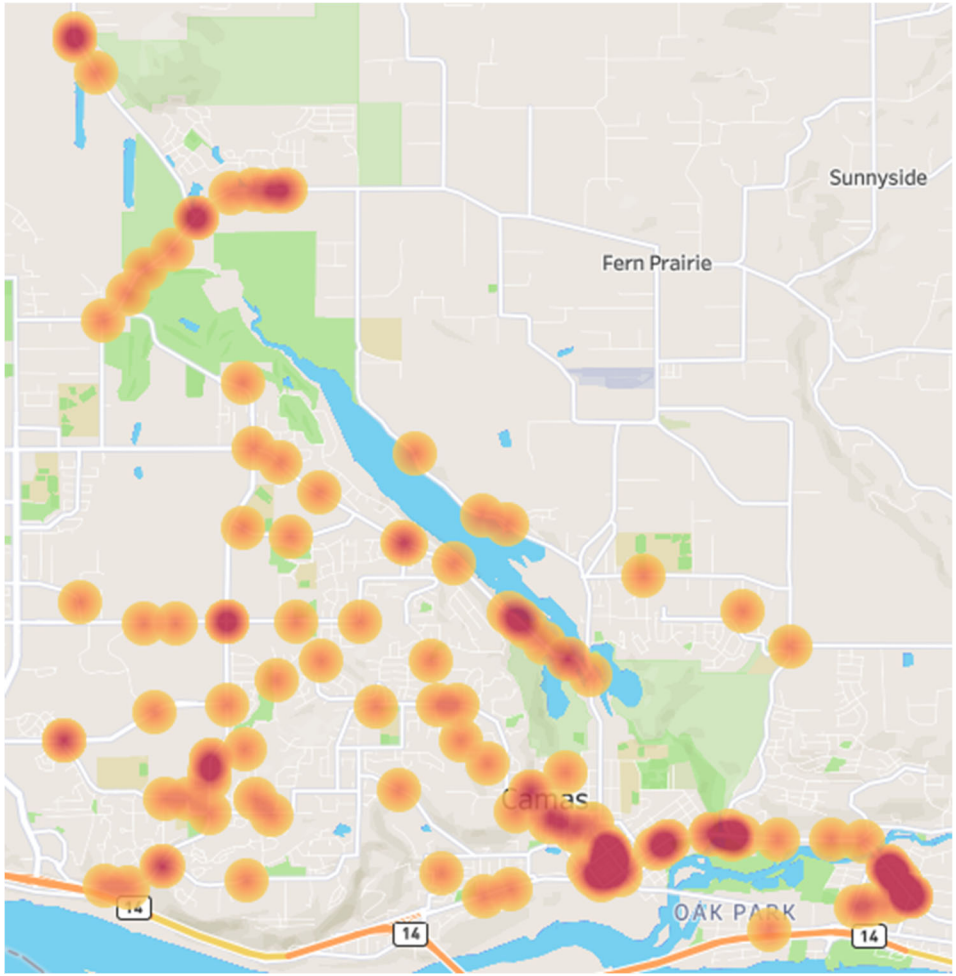


Figure C5. Collisions on Wet Roads, Camas, 2018-2022.

Figure C6 shows the heat map of all angle collisions. These collisions are concentrated in Camas's downtown area near NE Everett Street and NE Garfield Street, with other hotspots on NE 3rd Avenue east of the Washougal River and at the intersection of NE Ingle Road and NE Goodwin Road/NE 28th Street.

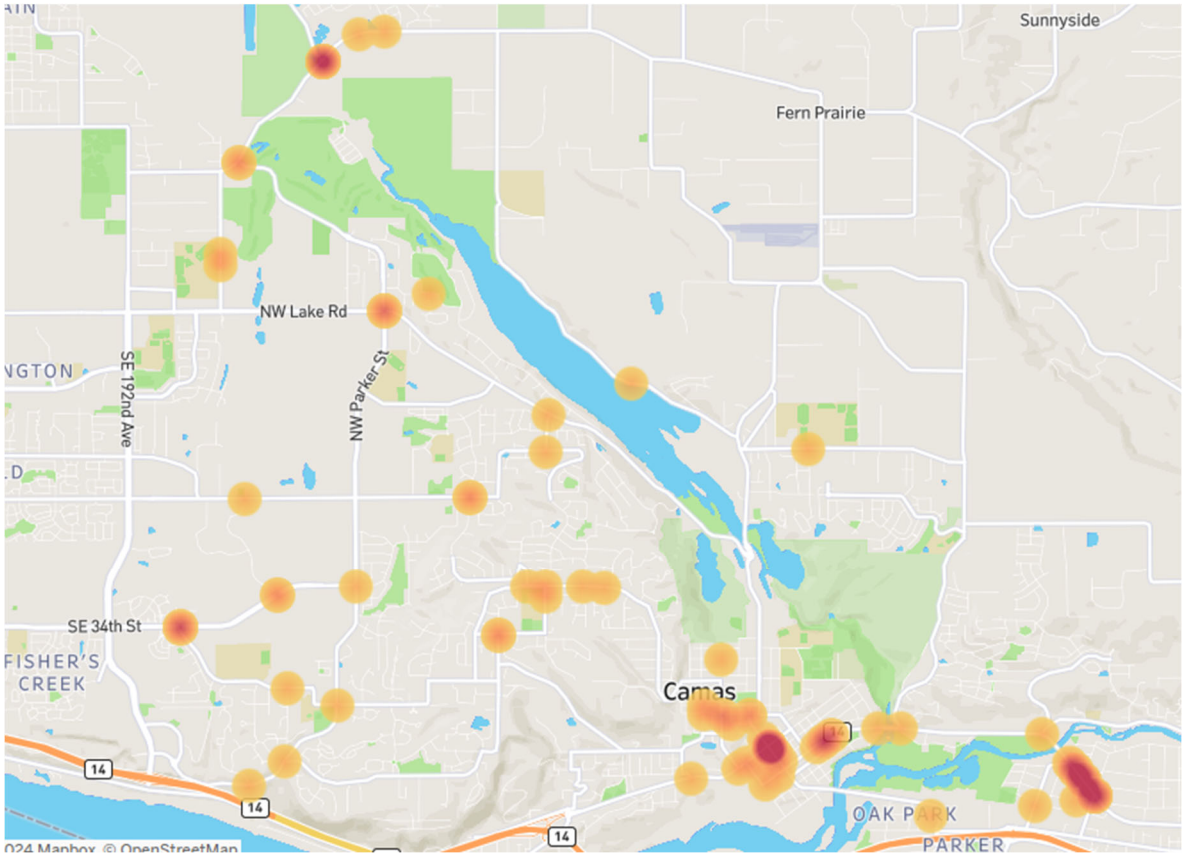


Figure C6. Entering at an angle collisions, Camas, 2018-2022.