2020

Bremerton

Strategic Road Safety Plan

February 20, 2020

PREPARED FOR:

CITY OF BREMERTON

BREMERTON
WASHINGTON

DKS

TABLE OF CONTENTS

LIMITATIONS ON USE

PREPARED BY DKS ASSOCIATES

Brian Chandler, National Director for Transportation Safety
Veronica Sullivan, Transportation Engineer and Planner
Caleb Trapp, Engineering Assistant

INTRODUCTION

The City of Bremerton is committed to reducing the number and severity of roadway collisions on its city streets. The City has developed this Strategic Road Safety Plan using the framework established in Washington State's Target Zero effort to provide data driven collision reduction strategies on the City's roads.

The purpose of the Strategic Road Safety Plan is to analyze crash data in the City to effectively identify trends, contributing factors, 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 correlation of crash trends to the associated contributing factors, risk factors, and roadway deficiencies supports efficiency identification of crash reduction strategies and implementation of infrastructure-based countermeasures to improve road safety.

The following plan includes a summary of existing safety conditions in Bremerton, identification of safety needs, and recommended treatments to address high-priority collision types and locations.

STEP 1: ANALYZE SUMMARY DATA TO IDENTIFY FOCUS/PRIORITIES

To effectively minimize future collisions on the City's roadways, the City must first understand the history of those collisions and other related sources of potential risk. WSDOT provided the following data sets.

1. WSDOT City Safety Summary, 2014-2018 (provided by Ed Spilker, WSDOT Local Programs)
2. WSDOT database of all crashes on City of Bremerton Roads, 2014-2018 (provided by Julie Brown, WSDOT Transportation Data, GIS & Modeling)

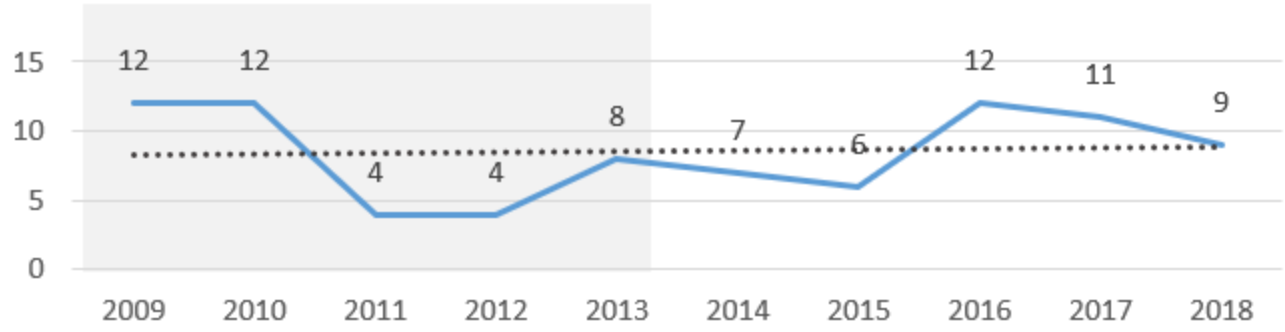
Additionally, the City compiled the previous 3 years of citizen complaints related to roadway safety as a supplement to reported crashes. This feedback from the public provides another source of potential risk.

DATA ANALYSIS OVERVIEW

As illustrated in Figure 1, over the past 10 years the number of fatal and serious injury collisions in the City has ranged from 4 to 12 annually. After a peak of 12 in 2016, that number decreased the following years to 9 in 2018. The general trend between 2009 and 2018 was a slight increase.

The total number of reported crashes (regardless of severity) has ranged between 578 and 739. This number peaked in 2015. In the most recent year of data available, 2018, the City experienced 646 reported crashes. The 10-year trend is relatively flat.

Bremerton: Fatal and Serious Injury Crashes



Bremerton: All Crashes

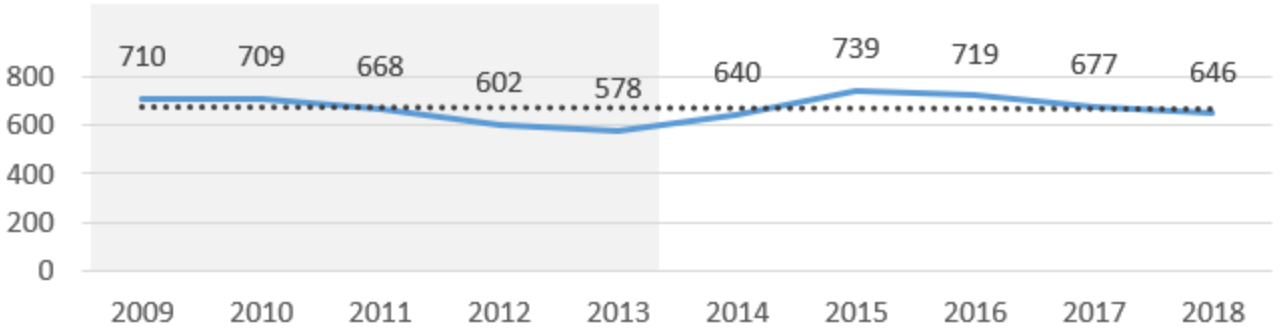


FIGURE 1. COLLISIONS IN BREMERTON, 2014-2018

Figures 2 and 3 show the location of all reported collisions and the location of all fatal and serious injury collisions, respectively.

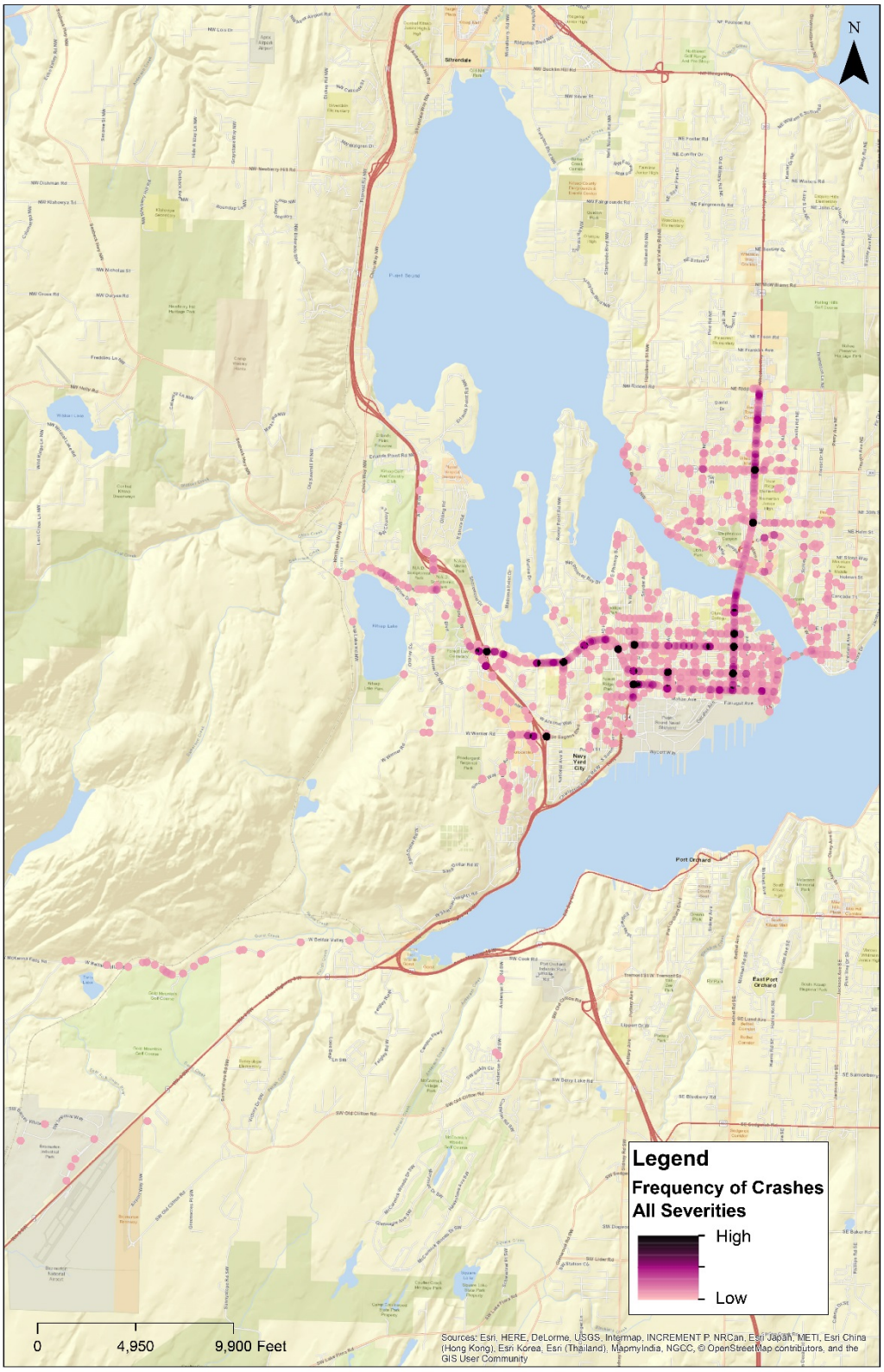


FIGURE 2. HEAT MAP OF BREMERTON CITY STREET CRASH FREQUENCY, ALL SEVERITIES, 2014-2018

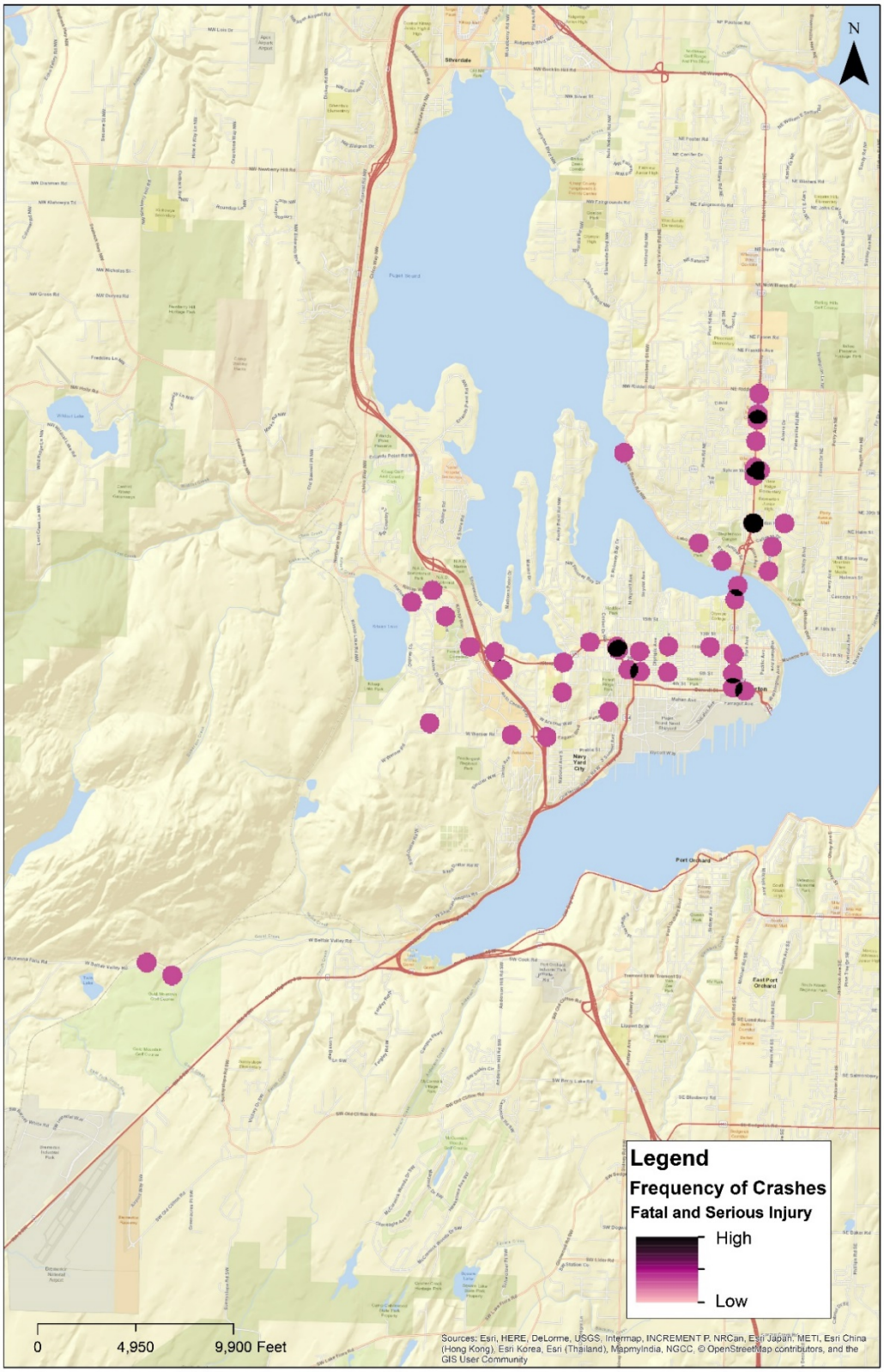


FIGURE 3. HEAT MAP OF BREMERTON CITY STREET CRASHES, FATAL/SERIOUS INJURY, 2014-2018

COMMON COLLISION TYPES

Figure 4 shows the City of Bremerton's most common collision types in fatal and serious injury crashes during the 5-year period from 2014 to 2018. Following is a description of the top five types.

1. **Hit Pedestrian** includes crashes involving a person walking along the roadway or crossing the road. Pedestrian crashes were only 2.1% of all crashes (regardless of severity), but pedestrians were involved in more than 20% of fatal and serious injury collisions.
2. **Angle (Left Turn)** was involved in 20% of fatal/serious collisions and more than 11% of all crashes – both of which are above the average for Westside Cities in Washington.[1]
3. **Hit Fixed Object** shows up on the list because the City of Bremerton includes some roads with higher speeds and more rural roadway characteristics than other cities in the region.
4. **Hit Cyclist** includes crashes involving a bicyclist along the roadway or at an intersection or driveway. Though less than 1% of total crashes involve bicyclists, bicyclists were involved in 11% of fatal and serious injury collisions.
5. **Rear-end** collisions occur most often at intersections and driveways, and many involved inattentive or distracted drivers. Most rear-end collisions were reported along the city's major arterials.

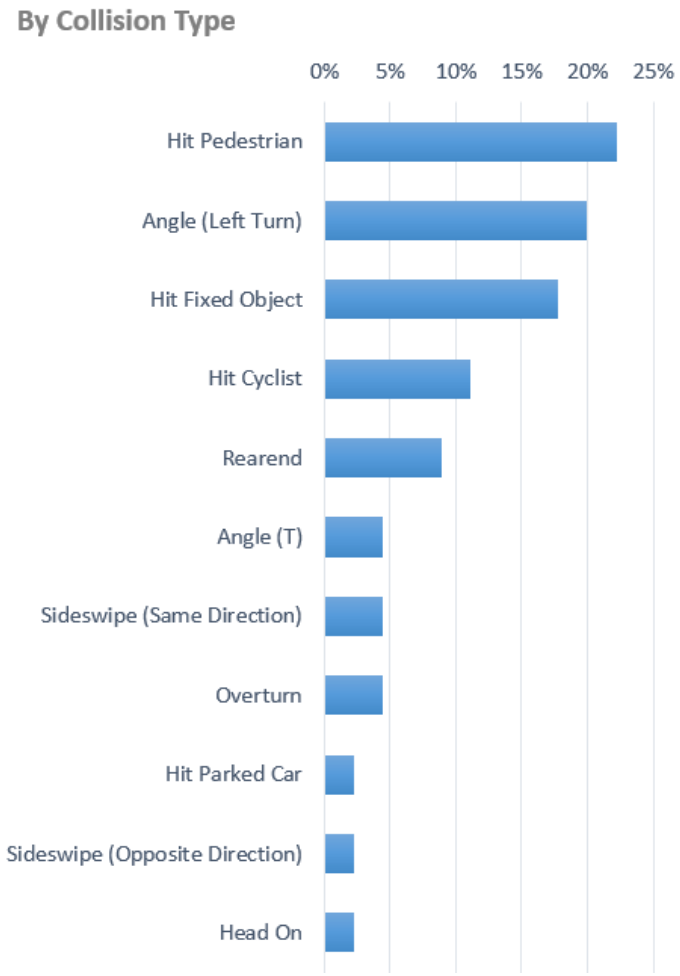


FIGURE 4. MOST COMMON FATAL/SERIOUS INJURY COLLISIONS, 2014-2018

[1] Westside Cities are generally defined by WSDOT as those cities west of the Cascade Range.

CITIZEN COMPLAINTS

Citizens of the city are an important source for traffic safety concerns. They have a vested interest in keeping travel safe for themselves and their families, and they bring a first-hand experience to road safety. In particular, citizens identify issues occurring at night and on weekends that agency staff may not see during typical weekday reviews. Of the 57 traffic safety-related complaints the City received, most focused on the following topics and subtopics:

- **Pedestrian Safety**
  - Students walking to and from school, including safety on roads adjacent to the schools during drop-off and pick-up.
  - Request for sidewalk infill along roads that currently do not have pedestrian facilities.
  - Request for enhanced pedestrian crossings.
  - Request for improved pedestrian and bicycle facilities near schools.
  - Request for sidewalk maintenance at locations with potential trip hazards.
- **High Vehicle Speeds**
  - Request for speed limit signs, change to posted speed limit, and traffic calming devices like speed humps.
- **Dark Roadway Conditions**
  - Request to maintain or improve pavement marking.
  - Request to add lighting for pedestrians.
- **Sight Distance**
  - Sign visibility (STOP, YIELD) issues due to parked cars near intersections.
  - Restrictions due to on-premise vegetation near intersections.
  - Request for 4-way stop due to near-collisions at 2-way stops with limited sight distance.

The following locations in the city were most commonly asked about in citizen complaints:

- 11th Street
- 13th Street
- Callahan Drive
- Kitsap Way
- Sylvan Way
- Trenton Avenue
- Wheaton Way
- Schools: Olympic College, High School, elementary schools

STEP 2: ANALYZE INDIVIDUAL FATAL/SERIOUS CRASHES TO IDENTIFY RISK FACTORS

The City compared collision attributes in fatal/serious injury crashes in Bremerton with statewide, citywide, and westside city proportions. Table 1 shows an excerpt of those contributors that show up in Bremerton at a higher proportion than roadways in other Westside Washington cities.

TABLE 1. OVER-REPRESENTED COLLISION ATTRIBUTES, 2014-2018

		Fatal Serious		Total Crashes	
Data Element	**Attribute**	**Bremerton**	**Westside Cities**	**Bremerton**	**Westside Cities**
Collision Type	Angle (Left Turn)	20%	9%	12%	10%
Light Condition	Dark-No Street Lights	9%	4%	3%	2%
Fixed Object Hit	Utility Pole	13%	11%	16%	9%
	Ran Over Embankment	13%	3%	9%	2%
Contributing Circumstance	Inattention / Distraction	31%	25%	45%	35%
	Under Influence of Alcohol / Drugs	15%	11%	4%	4%
Motor Vehicle Type	Motorcycle	18%	11%	1%	1%
Posted Speed Limit	25 MPH	34%	22%	45%	25%
	30 MPH	30%	24%	28%	24%
Traffic Control	Signals	38%	30%	30%	31%
Pedestrian-Involved: Contributing Circumstances	Inattention / Distraction	43%	22%	32%	28%
	Under Influence of Alcohol / Drugs	29%	7%	24%	7%
Bicycle-involved: Contributing Circumstances	Inattention / Distraction	33%	29%	44%	27%
Pedestrian-Involved: Facility Used	Roadway	58%	40%	30%	26%
	Other	25%	5%	5%	4%
Bicycle-involved: Facility Used	Roadway	80%	49%	57%	39%

STEP 3: SELECT MOST COMMON RISK FACTORS

Based on an analysis of the summary data and individual fatal/serious injury crash events, proportion of risk factors and comparison to other cities, and the citizen complaints log, the City selected the following seven priority collision attributes to use in network analysis:

1. Dark conditions
2. Left turns
3. Rear-end
4. Fixed objects
5. Pedestrians
6. Bicyclists
7. Motorcyclists

STEP 4: ANALYZE ROADWAY NETWORK FOR PRESENCE OF RISK FACTORS

Following WSDOT's recommended procedure,[2] the City applied the most common risk factors in fatal/serious injury crashes to the entire network using two methods:

1. Frequency of collisions based on the most common risk factors / collision attributes
2. Review of citizen complaints

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

STEP 5: CREATE PRIORITIZED LIST OF ROADWAY LOCATIONS

Tables 2 and 3 list 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 of Bremerton roadway network. An additional point was added if that location was identified as a citizen concern.

[2] WSDOT Local Road Safety Plans Guidance
https://www.wsdot.wa.gov/sites/default/files/2014/02/27/LP_Local-Road-Safety-Plans.pdf

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

Intersection	Dark Conditions	Left Turns	Rear-end	Fixed Objects	Pedestrians	Bicyclists	Motorcyclists	Citizen Complaint	Total
A. Sylvan Way & Wheaton Way (SR 303) [3]	✓	✓	✓		✓	✓	✓	✓	7
B. Sheridan Rd & Wheaton Way (SR 303) [3]	✓		✓	✓	✓		✓		5
C. Burwell St (SR 304) & Pacific Ave	✓		✓	✓		✓	✓		5
D. Burwell St & N Callow Ave	✓	✓		✓			✓	✓	5
E. 13th St & Wheaton Way (SR 303) [3]	✓		✓	✓		✓			4
F. 11th St & N Callow Ave	✓	✓	✓		✓				4
G. Kitsap Way & SR 3 Ramp Terminals [4]	✓	✓	✓	✓					4
H. 6th St & Naval Ave	✓	✓			✓		✓		4
I. 6th St & Wheaton Way (SR 303) [3]	✓			✓		✓			3
J. W Loxie Eagans Blvd & SR Ramp Terminals	✓	✓					✓		3
K. Kitsap Way & Marine Dr/Adele Ave [4]	✓		✓		✓				3
L. Kitsap Way & National Ave N [4]	✓		✓	✓					3
M. 6th St & N Callow Ave	✓				✓		✓		3
N. 11th St & Wheaton Way (SR 303) [3]	✓		✓						2
O. Burwell St & Naval Ave	✓			✓					2

[3] Within City of Bremerton's upcoming SR 303 safety study area.

[4] Previously funded under Bremerton's Kitsap Way / Warren Avenue safety project.

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

Corridor	Dark Conditions	Left Turns	Rear-end	Fixed Objects	Pedestrians	Bicyclists	Motorcyclists	Citizen Complaint	Total
Wheaton Way (SR 303): NE Riddell Rd to the bridge midspan [3]	✓	✓	✓	✓	✓		✓	✓	7
Kitsap Way: Northlake Way NW to 11th St [5]	✓		✓	✓		✓		✓	5
6th St: N Callow Ave to Warren Ave (SR 303)	✓	✓	✓		✓		✓		5
Burwell St: Washington Ave to N Callow Ave	✓	✓		✓			✓	✓	5
Warren Ave (SR 303): Bridge midspan to Burwell St (SR 304) [6]	✓		✓	✓		✓			4
11st St: Washington Ave to Kitsap Way	✓				✓	✓		✓	4
Silvan Way: Pine Rd NE to Olympus Dr NE	✓				✓			✓	3
13th St: Naval Ave to Park Ave				✓				✓	2
Charleston Blvd: Burwell St (SR 304) to SR 3 [7]									-

As shown above, the City identified 15 intersections and nine corridors whose risk factors matched those exhibited by fatal and serious injury crashes in the City. Figure 5 plots each of these locations on a map.

[5] Partially funded (east side, SR 3 to 11th St) under Bremerton's Kitsap Way / Warren Avenue Safety Project.

[6] Within City of Bremerton's upcoming SR 303 safety study area.

[7] The WSDOT collision data set did not include this section. It is included here as a placeholder for future analysis.

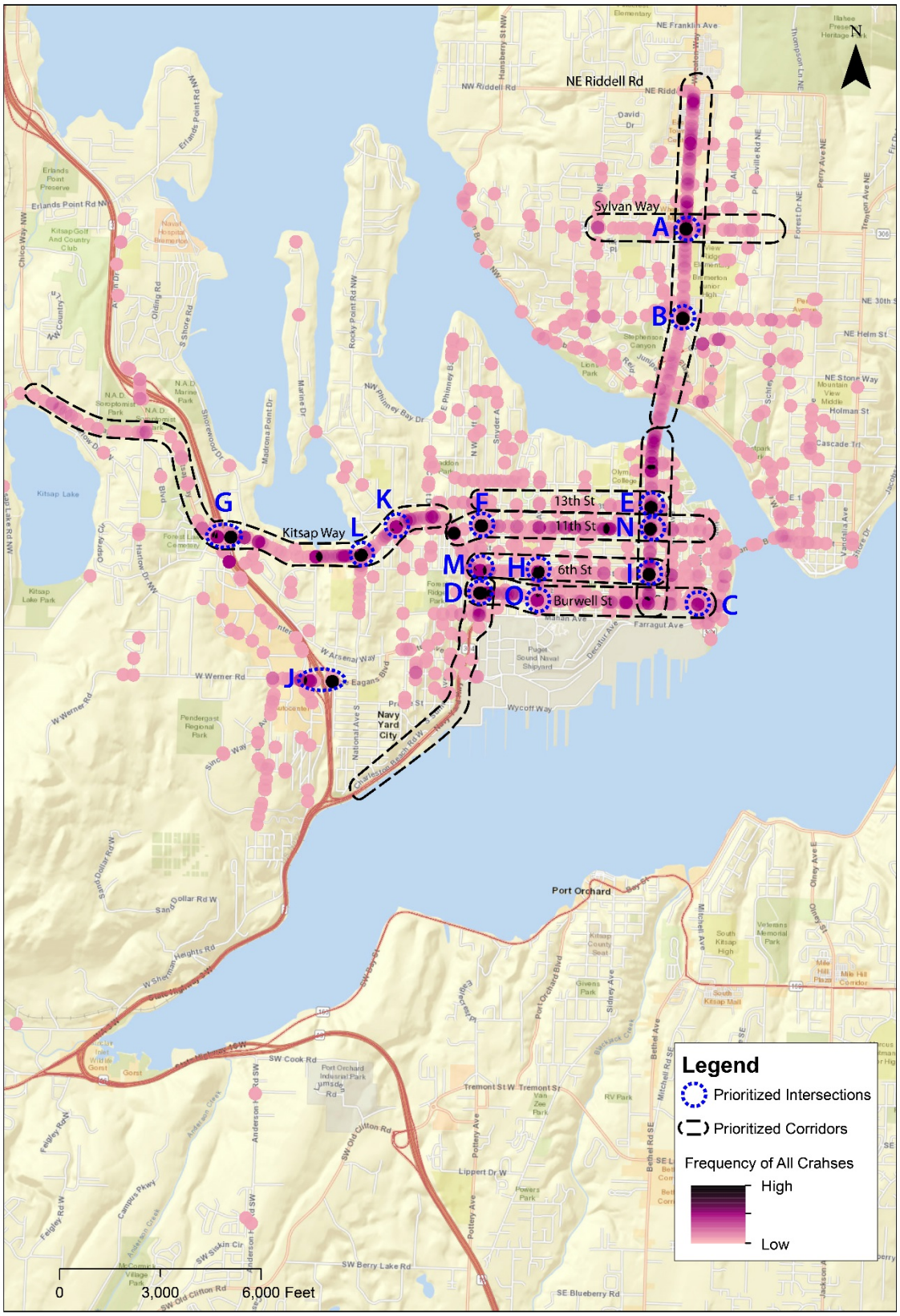


FIGURE 5. PRIORITIZED INTERSECTIONS AND CORRIDORS

STEPS 6 & 7: IDENTIFY COUNTERMEASURES TO ADDRESS PRIORITIZED LOCATIONS & DEVELOP A PRIORITIZED LIST OF PROJECTS

The City compared the list of prioritized intersections and corridors to recent and already-funded safety projects to identify the most pressing current needs. The City identified five priority projects for the 2020 Strategic Road Safety Plan.

1. Burwell St Adaptive Signal System
2. 6th St Rechannelization
3. 11th St & Callow Intersection Improvements
4. 13th St and Sylvan Way Corridors: Systemic Pedestrian Safety Treatments
5. Citywide: Systemic Roadway Departure Safety Treatments

The following sections detail existing conditions, countermeasures, and quantified project costs, monetary value of safety benefits, and the benefit/cost ratio of each safety project. Detailed calculations for each treatment are available in Appendix B.

BURWELL ST ADAPTIVE SIGNAL SYSTEM

Burwell St is a 1.35-mile corridor that runs from Callow Ave to Washington Ave. This street is one of the main east-west corridors in downtown Bremerton that connects the Bremerton Ferry Dock along SR 304 to Charleston Blvd. There are eight signalized intersections along the study corridor and a total of 220 crashes occurred at intersections along the corridor. The City has previously installed a pedestrian hybrid signal and an RRFB on Burwell St.

Table 4 below provides a summary of crash data for collisions along the Burwell St study corridor.

TABLE 4. CRASH DATA SUMMARY FOR BURWELL ST CORRIDOR FROM WASHINGTON AVE TO CALLOW AVE, 2014-2018

Category	Number of Crashes
Total Number of Crashes along Burwell St	338
Crash Severity	Fatal = 1
	Serious Injury = 0
	Minor Injury = 13
	Possible Injury = 70
	No Injury = 243
	Unknown = 11
Crash Type	Rear-end = 133
	Entering at angle = 58
	Making Left Turn = 54
	Sideswipe = 45
	Other = 22
	Fixed object = 13
	Vehicle Hits Pedestrian = 9
	Pedalcyclist =2

Category	Number of Crashes
	Vehicle Overturned =2
Year	2014 = 57
	2015 = 63
	2016 = 64
	2017 = 73
	2018 = 81
Weather	Clear or Partly Cloudy = 228
	Raining = 86
	Overcast = 20
	Fog or Smog or Smoke = 2
	Snowing = 2
Lighting Conditions	Daylight = 244
	Dark-Street Lights On = 79
	Dawn = 8
	Dusk =7
Location	At intersection and Related = 197
	Not at Intersection and Not Related = 67
	Intersection Related but Not at Intersection = 32
	At Intersection and Not Related = 23
	At Driveway = 19
Roadway Conditions	Dry = 221
	Wet = 113
	Ice = 3
	Standing Water = 1
Movement Type	43% were reported "Inattention" 13% were reported "Did not grant right-of-way to vehicle" 2% were reported "under the influence of alcohol" 9.7% were reported "following too closely"
Making Left-Turn Collisions Only	Road Surface Conditions: Dry Road Surface = 89 Ice Road Surface = 1 Wet Road Surface =2
	Lighting Conditions: Daylight =104 Dark- Street Lights On = 22 Dawn = 6 Dusk =1

Figure 6 illustrates the type and severity of collisions along the Burwell St study segment.

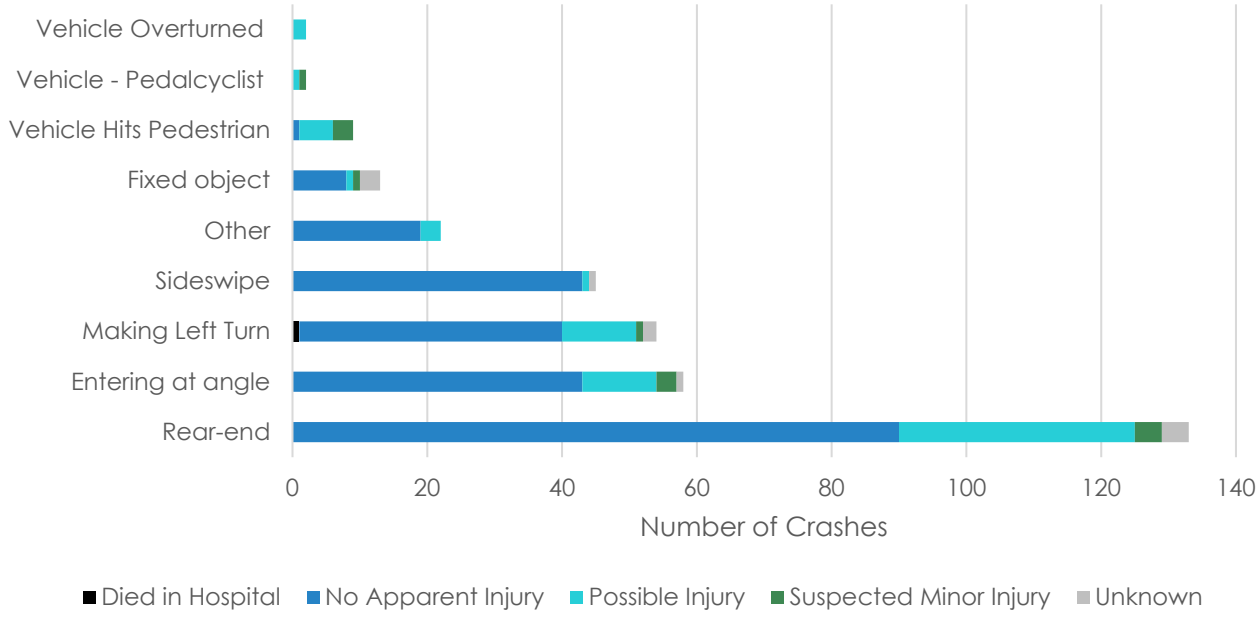


FIGURE 6. BURWELL ST COLLSIONS BY CRASH TYPE AND SEVERITY, 2014-2018

Burwell St Countermeasure: Adaptive Signal System

Project Description

Adaptive signal control coordinates signals along a corridor based on real-time changing traffic conditions. This can **reduce crashes** by smoothing the flow of traffic.

Cost Estimate

$2.3M [8]

Benefit / Cost Ratio

2.89

Time Frame

Long-term

Crash Reduction

21%

Reduction in intersection crashes.

History: 338 crashes observed from 2014-2018 (67.6 crashes per year).

Expected Benefit: 14.2 fewer crashes per year

[8] Cost estimate based on 2018 Washington Federal Lands Access Program (FLAP) application for a similar adaptive signal system on SR 304, then escalated for inflation.

6TH ST RECHANNELIZATION

6th St is a minor arterial route that spans 1.07 miles from N Callow Ave to Park Ave. This corridor is a main pathway through Downtown Bremerton with a posted speed limit of 25 mph and includes eight signalized intersections. Table 5 and Figure 7 below provide a summary of crash data.

TABLE 5. CRASH DATA SUMMARY FOR 6TH ST FROM PARK AVE TO N CALLOW AVE, 2014-2018

Category	Number of Crashes
Total Number of Crashes along 6th St from Park Ave to N Callow Ave	189
Crash Severity	Serious Injury = 3
	Minor Injury = 12
	Possible Injury = 43
	No Injury = 127
	Unknown = 4
Crash Type	Entering at angle = 57
	Rear-end =43
	Making Left Turn =39
	Sideswipe = 23
	Other = 10
	Fixed object = 7
	Vehicle Hits Pedestrian = 4
	Pedalcyclist =1
	Vehicle Overturned =1
Year	2014 = 27
	2015 = 53
	2016 = 48
	2017 = 35
	2018 = 26
Weather	Clear or Partly Cloudy = 133
	Raining = 35
	Overcast = 18
	Fog or Smog or Smoke = 2
	Snowing = 1
Lighting Conditions	Daylight = 137
	Dark - Street Lights On = 43 (Including 2 out of the 3 suspected serious Injuries)
	Dusk = 4
	Dawn = 2
	Dark - Street Lights Off = 2
	Dark – No Street Lights On = 1
Location	At intersection and Related = 130
	At Driveway = 23
	Not at Intersection and Not Related = 18
	At Intersection and Not Related = 12
	Intersection Related but Not at Intersection = 2
	Driveway Related but Not at Driveway = 4

Category	Number of Crashes
Roadway Conditions	Dry = 129
	Wet = 57
	Ice = 2
	Unknown = 1
Movement Type	32% were reported "Inattention" 16% were reported "Did not grant right-of-way to vehicle" 3% were reported "under the influence of alcohol" 6.8% were reported "improper turn" 9.7% were reported "following too closely"
Entering at Angle Collisions Only	Road Surface Conditions: Dry Road Surface = 37 Ice Road Surface = 1 Wet Road Surface =19
	Lighting Conditions: Daylight =40 Dark- Street Lights On = 14 Dark- Street Lights Off = 2 Dusk =1

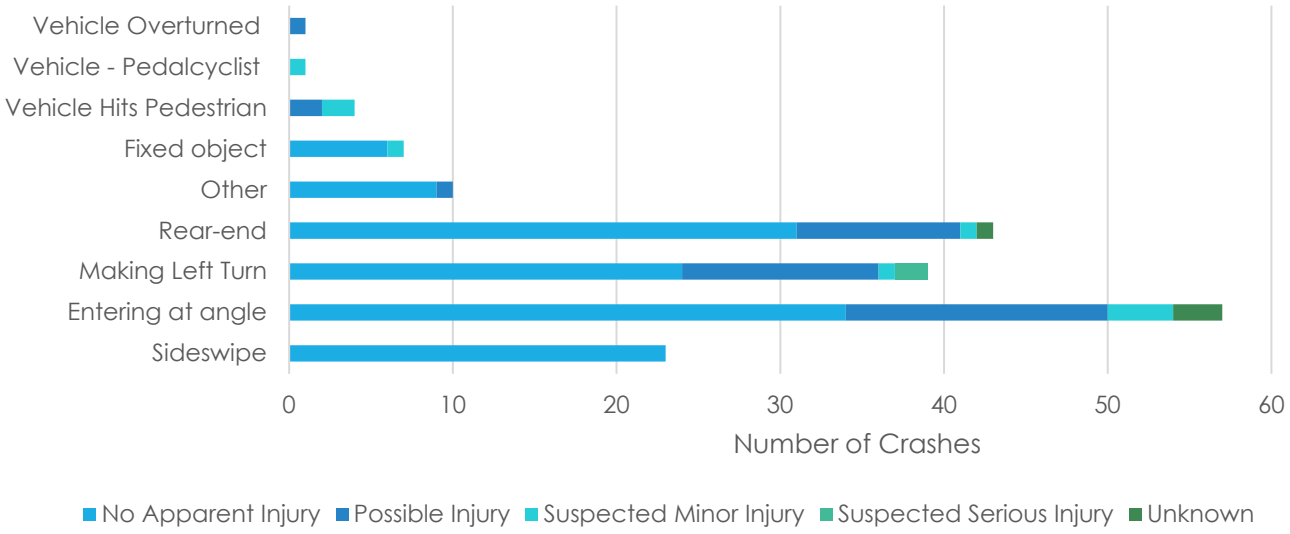


FIGURE 7. 6TH ST COLLSIONS BY CRASH TYPE AND SEVERITY, 2014-2018

The existing corridor consists of four 11-foot travel lanes, two per direction, with a maximum grade of 10% through the study area. There are 5-ft sidewalks with curb-and-gutter on both sides of 6th St.[9] The 2007 Bremerton Non-Motorized Transportation Plan proposed a rechannelization along the study corridor that includes a center left-turn lane and two bike lanes within the existing right-of-way. Following are cost and benefit estimates for this treatment.

6th St Countermeasure: Rechannelization

Project Description

A rechannelization typically includes reducing the number of general purpose travel lanes to improve safety for all road users.

Cost Estimate [10]

$600,000 (assuming pavement overlay required)

Benefit / Cost Ratio

18.98

Time Frame

Long-term

Crash Reduction

29%

Reduction in intersection crashes.

History: 189 crashes observed from 2014-2018 (37.8 crashes per year).

Expected Benefit: 10.9 fewer crashes per year

[9] 6th St/ 11th St Corridor Study Draft Report, Transportation Solutions Inc., 2019

[10] FHWA, How Much Does a Road Diet Cost? https://safety.fhwa.dot.gov/road_diets/resources/fhwasa16100/fhwasa16100.pdf

11TH ST & N CALLOW AVE INTERSECTION TREATMENTS

11th St and N Callow Ave intersection consists of four approaches, as illustrated in Figure 8.

FIGURE 8. 11TH ST & N CALLOW AVE EXISTING LANE CONFIGURATION

The 11th St eastbound approach consists of 2 lanes of eastbound traffic and the westbound approach two through lanes and a left-turn pocket. N Callow Ave northbound approach has one through lane, a left-turn pocket and a right turn pocket. The southbound approach has a shared through-right lane and a left-turn pocket. The northbound and westbound signal phasing includes a protected left-turn phase. Left-turning vehicles on the southbound and eastbound approaches are permissive-lefts only, requiring motorists to yield to oncoming traffic.

From 2014 to 2018, there were a total of 59 crashes located at the intersection. Table 6 and Figures 9, 10, and 11 below provide a summary of the collision history at this location.

TABLE 6. CRASH DATA SUMMARY FOR 11TH ST AND CALLOW AVE, 2014-2018

Category	Number of Crashes
Total Number of Crashes at 11th St and N Callow Ave	59
Crash Severity	Serious Injury =0
	Minor Injury = 7
	Possible Injury = 14
	No Apparent Injury = 32
	Unknown = 6
Crash Type	Making Left-Turn = 27
	Rear-end =17
	Entering at angle = 8
	Vehicle Hits Pedestrian = 4 (3 of the 4 collisions involved a vehicle hitting a pedestrian crossing a marked crosswalk on the east side of the intersection)
	Fixed Object = 1 (Utility Pole)
	Making a Right Turn = 1
	Head-on = 1
Year	2014 = 6
	2015 = 15
	2016 = 18
	2017 = 11
	2018 = 9
Weather	Clear or Partly Cloudy = 37
	Raining = 16
	Overcast = 6

Category	Number of Crashes
Lighting Conditions	Daylight = 39
	Dark - Street Lights On = 18 (2 of 3 suspected serious injury collisions were reported under Dark-Street Lights On)
	Dusk = 1
	Dark – No Street Lights = 1
Location	At intersection and Related = 48
	Intersection Related but Not at Intersection = 5
	Driveway within Major Intersection = 5
	At Intersection and Not Related = 1
Roadway Conditions	Dry = 38
	Wet = 21
Movement Type	32% were reported "Inattention" 17% were reported "Did not grant right-of-way to vehicle" 1% were reported "Under the influence of drugs" 6.8% were reported "Improper turn"
Making Left-Turn Collisions Only	Road Surface Conditions: Dry Road Surface = 15 Wet Road Surface = 12
	Lighting Conditions: Daylight = 12 Dark- Street Lights On = 14 Dusk =1

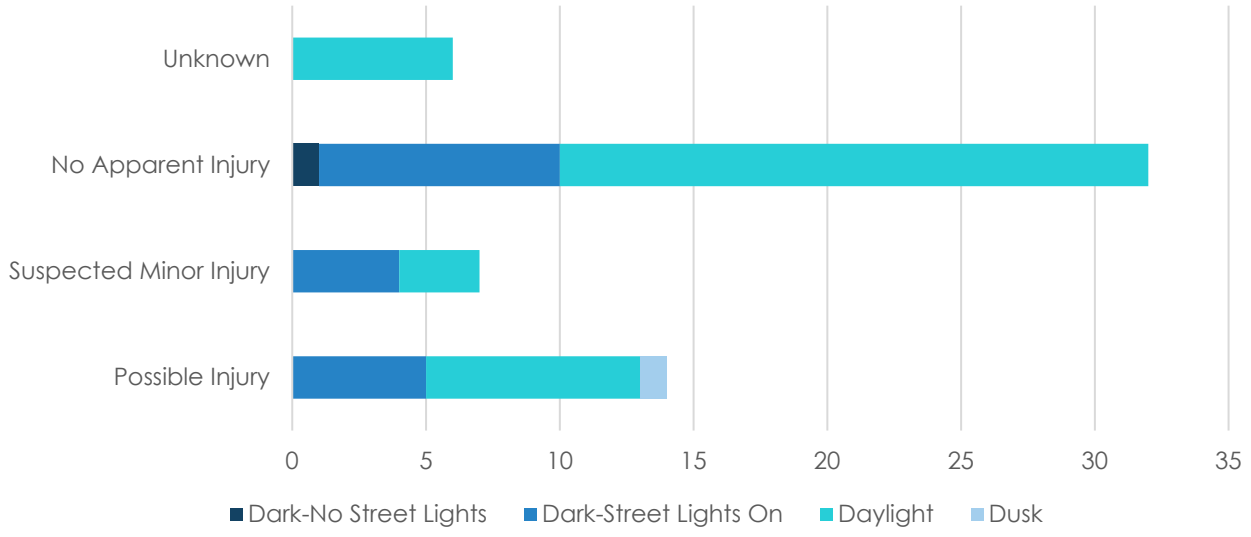


FIGURE 9. NUMBER AND SEVERITY OF CRASHES BY LIGHTING CONDITION, 11TH ST & CALLOW AVE, 2014-2018

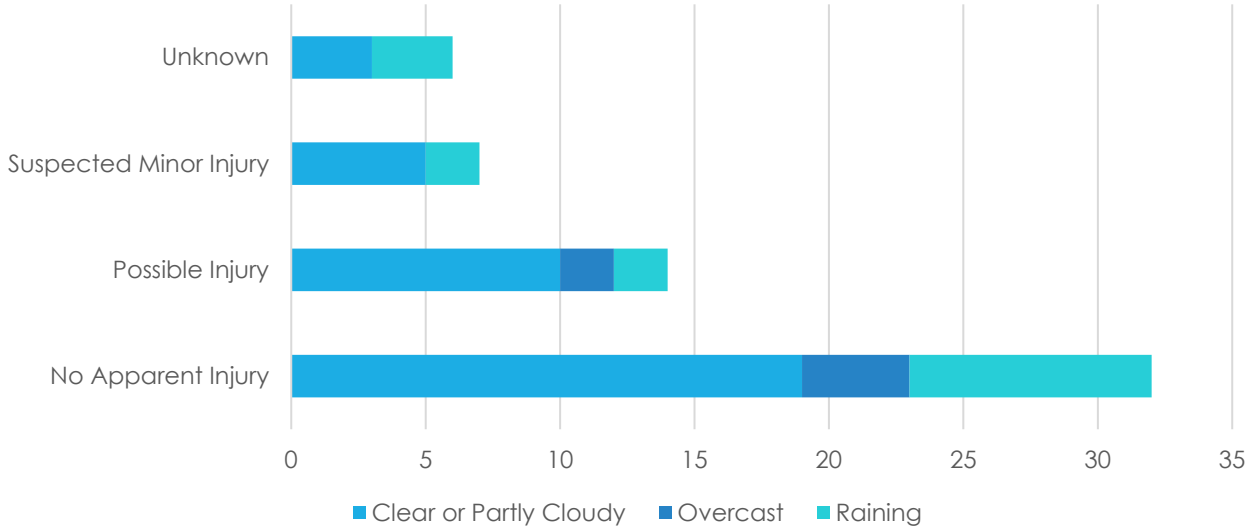


FIGURE 10. NUMBER AND SEVERITY OF CRASHES BY WEATHER CONDITION, 11TH ST & CALLOW AVE, 2014-2018

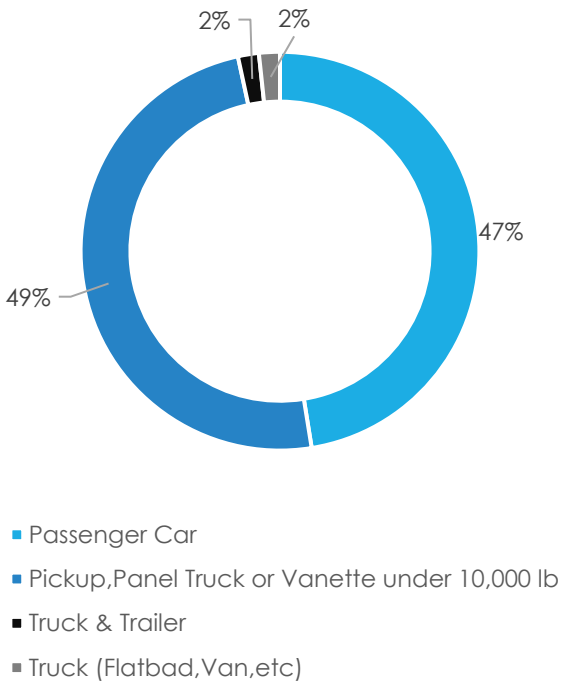


FIGURE 11. CRASH INVOLVEMENT BY VECHICLE TYPE, 11TH ST & CALLOW AVE, 2014-2018

11th St & Callow Ave: Intersection Countermeasures

Project Description

Installing an exclusive left-turn lane and using **Flashing Yellow Arrow** for the eastbound [11] intersection approach can reduce rear-end and left-turning crashes.

Cost Estimate

$1.1 million (includes moving signal poles, potential right-of-way purchase)

Benefit / Cost Ratio

0.54

Time Frame

Long-term

Crash Reduction [12]

64%

Combined reduction in left turn collisions for left-turn lane and flashing yellow arrow.

History: 11 left turn crashes observed from 2014-2018 (2.2 crashes per year). No rear-end collisions observed.

Expected Benefit: 1.34 fewer crashes per year

Project Description

Adding a **protected left turn phase and using Flashing Yellow Arrow** for the NB and SB left turn permissive phases reduces left-turn conflicts.

Cost Estimate

$15,000

Benefit / Cost Ratio

22.22

Time Frame

Short-term [13]

Crash Reduction

35%

Reduction in SB left turn movements.

History: 6 left turn crashes observed from 2014-2018 (1.2 crashes per year).

Expected Benefit: 0.48 fewer left-turn crashes per year

Project Description

Adding **advance warning of the signalized intersection** of EB 11th St ahead, and tying that warning to the signal controller, reduces the risk of rear-end and angle crashes

Cost Estimate

$45,000

Benefit / Cost Ratio

16.48

Time Frame

Long-term

Crash Reduction

62%

Reduction in EB angle crashes.

History: 10 angle crashes observed from 2014-2018 (2 crashes per year).

Expected Benefit: 1.24 fewer angle crashes per year.

[11] Identified as "From West to North" in the collision database.

[12] http://www.cmfclearinghouse.org/detail.cfm?facid=264

[13] Short-term treatments may be feasible for completion by City forces and/or within the current operations budget.

13TH ST AND SYLVAN WAY CORRIDORS – SYSTEMIC PEDESTRIAN TREATMENTS

Two corridors were identified for systemic pedestrian treatments in the City of Bremerton. The first is 13th St, which spans approximately 0.75 miles east-west from Naval Ave to Park Ave. There are sidewalks on both sides of the street along 13th St whose conditions vary; some sections have a large grass buffer from the roadway and others are very narrow and directly abutting the roadway. Also, the intersections along 13th St have a varied number of marked crosswalks. The 13th St corridor has access to transit and provides access to Bremerton High School and Olympic College. From 2014 to 2018, there was one pedestrian collision reported at 13th St and High Ave on September 3, 2016 at 1:25pm. The collision was a suspected minor injury that involved a vehicle travelling southbound on High Ave on dry road surface conditions. More recently (and outside the 2014-2018 data set analyzed), a second pedestrian-involved collision occurred at Chester Ave & 13th St.

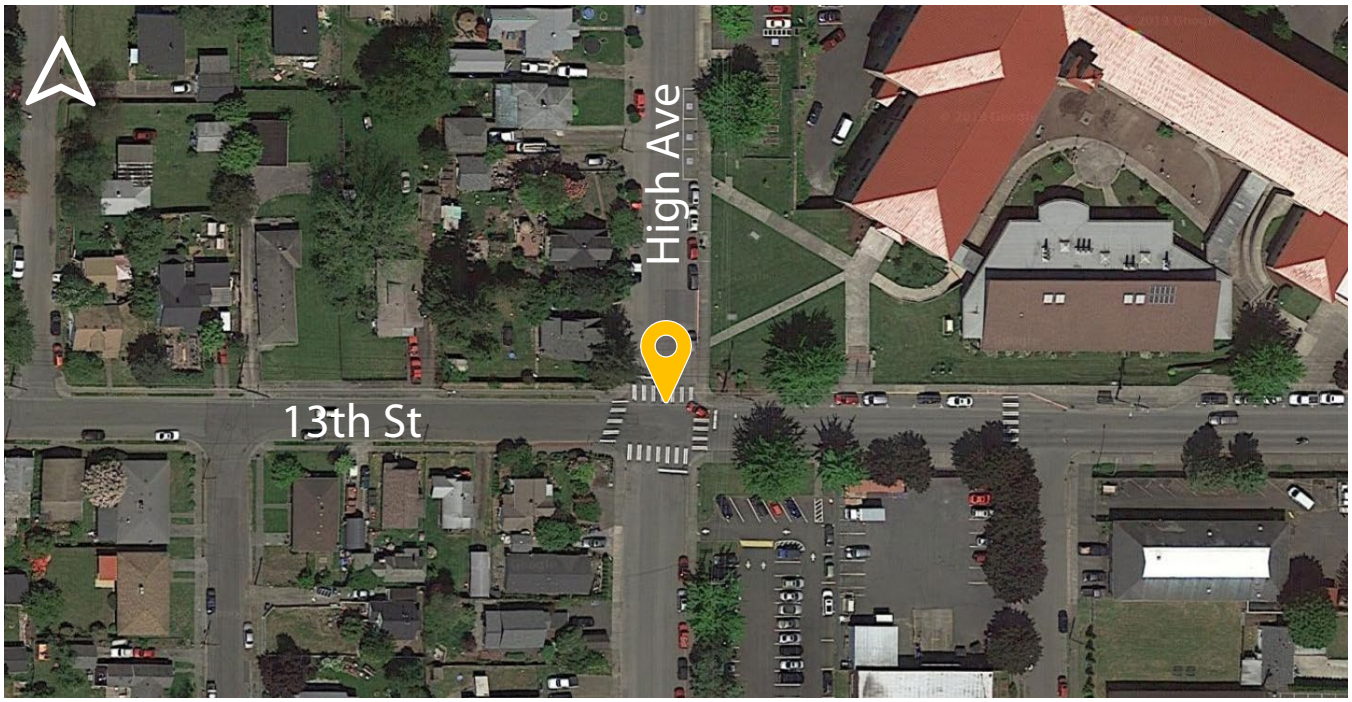


FIGURE 12. PEDESTRIAN COLLISION AT 13TH ST AND HIGH AVE

The second identified segment is 1 mile of Sylvan Way from Pine Rd NE to Olympus Dr NE. There are approximately 4,600 ft of sidewalk from Olympus Dr NE to Gillette Ave along the southside of Sylvan Way and 2,900 ft on the northside of Sylvan Way from Olympus Dr NE to SR 303. There are marked crosswalks for all approaches at Sylvan Way/SR 303 and the westbound and southbound approaches at both the Pine Rd NE and Spruce Ave intersections. The Sylvan Way corridor has transit access and is near Kitsap Regional Library, View Ridge Elementary Arts Academy and Sylvan Way Baptist Church. From 2014 to 2018, there were five pedestrian collisions reported, including two on back-to-back days in 2014. Following are the most common contributors:

- 2 of the 5 pedestrian collisions involved a vehicle making a right turn and the remainder were going straight
- 3 collisions involved a driver that was reported with inattention while driving
- 3 collisions involved a pedestrian crossing at an intersection on a marked crosswalk

Table 7 below provides a summary of the reported pedestrian-involved collisions on Sylvan Way from 2014 to 2018.

TABLE 7. CRASH DATA SUMMARY FOR SLYVAN WAY (PINE RD NE TO OLYMPUS DR NE), 2014-2018

No.	Date	Time	Severity	Weather	Roadway Conditions	Crash Type	Contributing Circumstances
1	7/1/2014	6:41PM	Suspected Minor Injury	Clear or Partly Cloudy	Dry	Vehicle going eastbound through hits pedestrian	Driver reported "inattention"
2	8/15/2014	2:54PM	Possible Injury	Clear or Partly Cloudy	Dry	Westbound vehicle turning right hits pedestrian	Driver reported "Fail to Yield Row to Pedestrian" and "Inattention"
3	8/16/2014	11:32AM	Possible Injury	Clear or Partly Cloudy	Dry	Westbound vehicle going straight hits pedestrian at crosswalk	Pedestrian reported to be "crossing at intersection against signal"
4	6/15/2017	5:46PM	Suspected Minor Injury	Raining	Wet	Westbound vehicle turning right hits pedestrian	Driver reported "Fail to Yield Row to Pedestrian" and "Inattention"
5	1/25/2018	6:08PM	Suspected Serious Injury	Raining	Wet	Vehicle going westbound through hits pedestrian	Pedestrian reported "Under the influence" and "Inattention"

FIGURE 13. PEDESTRIAN COLLISIONS ON SYLVAN WAY

Systemic Pedestrian Countermeasures – 13th St and Sylvan Way Corridors

Project Description

Adding a Lead Pedestrian Interval (LPI) to 13th & Warren Ave and Sylvan & WA-303 increase visibility of pedestrians during an adjacent vehicle's green phase.

Cost Estimate

$20,000 ($10k per location)[14]

Benefit / Cost Ratio

22.05

Time Frame

Short-term[15]

Crash Reduction

59%

Reduction in pedestrian crashes.

History: 3 pedestrian intersection crashes observed from 2014-2018 (0.6 crashes per year).

Expected Benefit: 0.35 fewer pedestrian crashes per year

Project Description

Adding a **rectangular rapid flash beacon (RRFB)** can increase driver yielding behavior at crosswalks.

Cost Estimate

$540,000 ($90k per installation (6) includes crosswalk, signs, ADA ramps)[16]

Benefit / Cost Ratio

8.24

Time Frame

Long-term

Crash Reduction

47%

Reduction in pedestrian crashes.

History: 6 pedestrian crashes observed from 2014-2018 (1.2 crashes per year).

Expected Benefit: 0.56 fewer pedestrian crashes per year

Project Description

Sidewalk Infill for the north side of Sylvan Way from Birch Ave to Pine Rd N (1632 ft) provides a more comfortable and protected facility for pedestrians.

Cost Estimate

$200,000 (approximately $90/ft + contingency)

Benefit / Cost Ratio

1.49

Time Frame

Long-term

Crash Reduction

11%

Reduction in all crashes.

History: 22 crashes observed from 2014-2018 (4.4 crashes per year).

Expected Benefit: 0.48 fewer crashes per year

[14] Seattle DOT, https://sdotblog.seattle.gov/2019/06/17/a-big-step-forward-for-pedestrian-safety

[15] Short-term treatments may be feasible for completion by City forces and/or within the current operations budget.

[16] Cost estimate includes RRFB devices, signs, posts, and ADA curb ramps (average of 4 per installation).

CITYWIDE SYSTEMIC SOLUTIONS FOR FIXED OBJECT COLLISIONS

Fixed object hits were a factor in 306 collisions during the study period, and more than 18% of all fatal and serious injury collisions in the City of Bremerton included a vehicle striking a fixed object. Figure 14 presents the top 10 types of fixed objects hit. The most common objects struck were utility poles, with 47 crashes. The next most prominent fixed objects hit were trees, fences, and embankments.

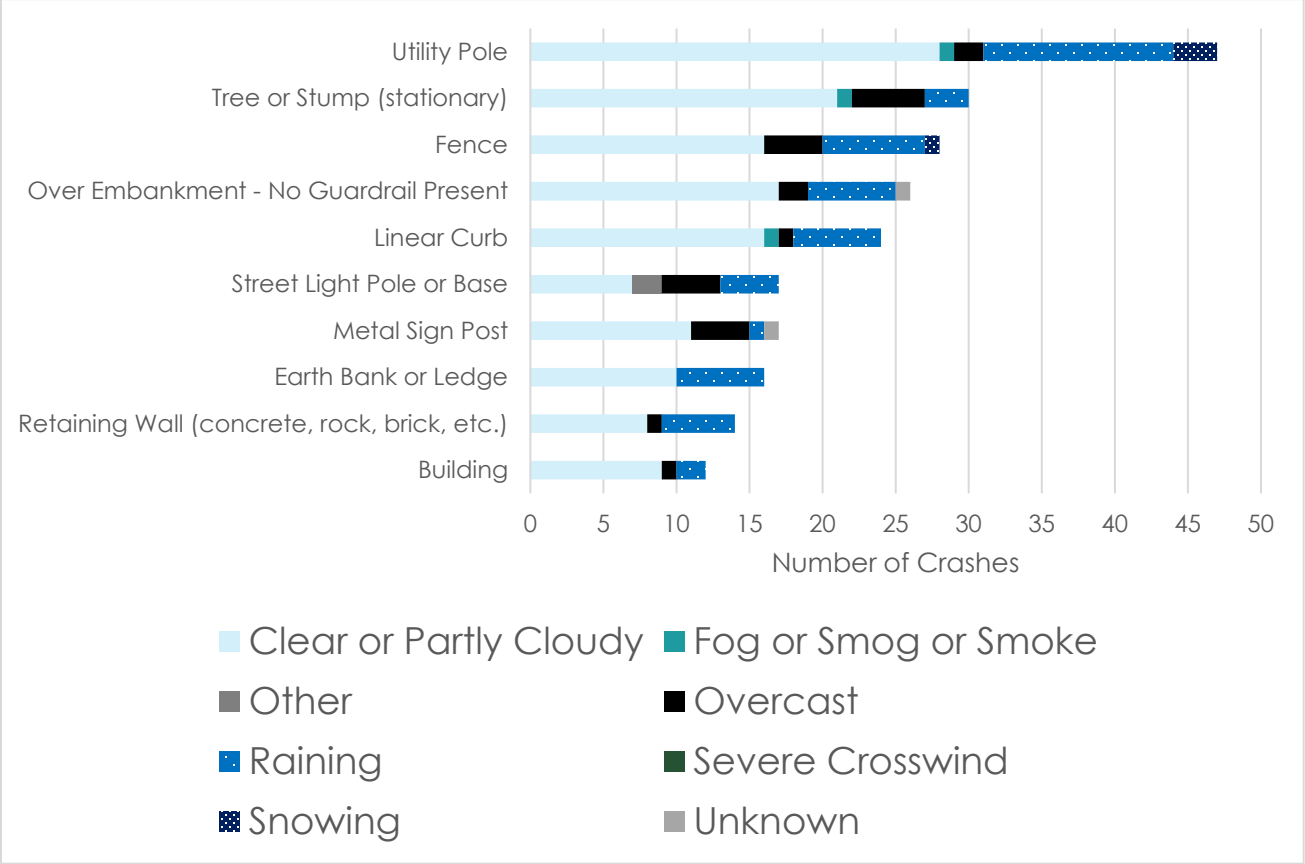


FIGURE 14. FIXED OBJECT CRASHES AND ASSOCIATED WEATHER CONDITIONS, 2010 – 2018

Following are the most common contributing circumstances in fixed object collisions.

- 164 of 306 (54%) collisions were reported in non-daylight conditions and 10% of crashes occurred in the dark with street lights on
- 23 of 306 (14%) collisions were reported with a driver that exceeded the reasonable safe speed
- 69 of 306 (23%) collisions were reported with a driver under the influence of alcohol
- 116 of 206 (38%) collisions involved a pickup truck under 10,000lb

Belfair Valley Rd experienced 28 collisions from 2014-2018 from Division Ave W to the west city limit. This road has one lane for both directions with a speed limit of 45 mph. This segment is generally rural in nature with no residential housing and few driveways, with trees and earthen banks approximately 5-10 ft from the travel way. 18 of the 28 collisions involved a vehicle striking a fixed object. Of those objects, 12 were an embankment or ditch and 5 were a tree or stump.

The following countermeasures can address fixed object crashes.

Paved Shoulders and Rumble Strips on Belfair Valley Rd

Paved shoulder of any width is a proven safety countermeasure to run-off-road crashes. The treatment provides a clear recovery area for vehicles that depart their travel lane, which can help prevent fixed object hits and rollover collisions. Although some segments within the study corridor may not have space for shoulders, and the City will need to consider stormwater regulations regarding the addition of impervious surface, this is an excellent treatment to install as much as feasible because any addition provides a safety benefit.

Rumble strips are installed just off the pavement stripe (or in the case of Rumble Stripes, underneath the pavement marking) to provide a tactile and audible warning that a driver has left the traveled way. WSDOT policy provides feasibility criteria for the use of rumble strips with paved shoulder, including a requirement to provide at least 4 ft of usable shoulder to accommodate bicyclists. Providing 6 ft of shoulder allows for both shoulder rumble strips and bicycle use.[17] This project would be most efficient if combined with the reconstruction of Belfair Valley Rd.

Project Description

Add paved 2 ft shoulder and rumble strips along Belfair Valley Rd from Division Ave W to the west city limit

Cost Estimate

$4,528,384 (rumbles are $1600/mi & shoulders are $808,000/mi for 2.8 miles)

Benefit / Cost Ratio

1.33

Time Frame

Long-term

Crash Reduction

31%

Reduction in all crashes.

History: 28 crashes observed from 2014-2018 (5.6 crashes per year).

Expected Benefit: 1.75 fewer crashes per year

Fixed Object Treatments

AASHTO's Roadside Design guide provides a hierarchy of countermeasures to deal with roadside fixed objects.

1. Remove the obstacle.
2. Redesign the obstacle so it can be safely traversed.
3. Relocate the obstacle to a point where it is less likely to be struck.
4. Reduce impact severity by using an appropriate breakaway device.
5. Shield the obstacle with a longitudinal traffic barrier designed for redirection or use a crash cushion.
6. Delineate the obstacle if the previous alternatives are not appropriate.

[17] WSDOT Design Policy for Rumble Strips and Rumble Stripes. https://www.wsdot.wa.gov/Design/Policy/RumbleStrips.htm

Further study of each fixed object near the roadway will help determine the most appropriate level of treatment. Likely treatments along the corridor include the following:

- Removing or moving some objects (e.g., utility poles, trees)
- Re-grading ditches, where possible (keeping environmental concerns in mind), to reduce the severity of slopes.
- Delineating utility poles, light poles, sign posts and other fixed objects that are difficult to move.

Utility Pole Delineation

Fixed object markers can delineate the location of utility poles so that drivers may more easily avoid colliding with them. A variety of markers have been used, from MUTCD object markers (e.g., Type 2 Object Marker OM2-1V) to pole wraps and other assorted combinations as illustrated in the figure below.

FIGURE 15. UTILITY POLE OBJECT MARKERS[18]

Utility Pole Clear Zone Agreements

To regulate placement of utility poles near the roadway, the City could develop agreements with utility companies. A system of coordination between the City and utility companies should include a methodology to identified prioritized roadway safety risks, a process for issuing new utility franchise documents and replacing expired documents, and an annual mitigation plan.

The State of Washington, led by the Department of Transportation and Attorney General, developed the *Above-Ground Utility Object Mitigation Agreement* that can be used by local agencies and utility companies for this purpose.[19]

---

[18] NCHRP Report 500 Volume 8, A Guide for Reducing Collisions Involving Utility Poles

[19] WSDOT Local Programs provided a utility agreement template to the City.

PRIORITIZED SAFETY COUNTERMEASURE PROJECTS

After identifying a list of safety needs and potential treatments by location, the City compared each treatment to the others to determine its relative cost-effectiveness. The standard method for this comparison is the Benefit/Cost Ratio (BCR) calculation, which considers the societal benefit of roadway safety projects (calculated as a monetary value of crash reduction) and the cost of the project (design, installation, and ongoing maintenance) over that same time period.

The City also conducted a feasibility analysis of each potential safety treatment based on local conditions; state and local standards, policies, and procedures; and early feedback from leadership. Table 8 and Table 9 summarize the prioritized, recommended safety projects identified for city streets in Bremerton.

TABLE 8. SUMMARY OF RECOMMENDED SPOT LOCATION SAFETY PROJECTS, PRIORITIZED BY BENEFIT/COST RATIO

RANK	PROJECT DESCRIPTION	COST ESTIMATE	BENEFIT/COST RATIO
1	11TH ST & CALLOW AVE: NB AND SB FLASHING YELLOW ARROW *	$15,000	22.22
2	13TH ST & WARREN AND SYLVAN & WA-303: LEAD PEDESTRIAN INTERVAL AT SIGNALS *	$20,000	22.05
3	6TH ST RECHANNELIZATION	$600,000	18.98
4	11TH ST & CALLOW AVE: ACTUATED ADVANCE WARNING FOR EB APPROACH	$45,000	16.48
5	BURWELL ST ADAPTIVE SIGNAL SYSTEM	$2,300,000	2.89
6	11TH ST & CALLOW AVE: EB LEFT TURN LANE AND FLASHING YELLOW ARROW	$1,100,000	0.54

** Short-term treatment that could be implemented with City forces and/or operations budget.*

TABLE 9. SUMMARY OF RECOMMENDED SYSTEMIC SAFETY PROJECTS, PRIORITIZED BY BENEFIT/COST RATIO

RANK	PROJECT DESCRIPTION	COST ESTIMATE	BENEFIT/COST RATIO
1	13TH ST AND SYLVAN WAY CORRIDORS: RRFBS AT 6 LOCATIONS	$540,000	8.24
2	SYLVAN WAY (BIRCH AVE TO PINE RD N): SIDEWALK INFILL	$200,000	1.49
3	BELFAIR VALLEY RD (DIVISION AVE W TO CITY LIMIT): PAVED SHOULDER AND RUMBLE STRIPS	$4,528,000	1.33

CONCLUSION

The City of Bremerton is committed to roadway safety, and the Strategic Road Safety Plan provides the framework to identify safety needs and infrastructure solutions. Implementation of these safety projects will reduce the number and severity of roadway collisions in the City, and further evaluation and analysis over time will support a safety management program to continue improving safety in Bremerton.

APPENDIX A. HEAT MAP OF CRASHES BY TYPE

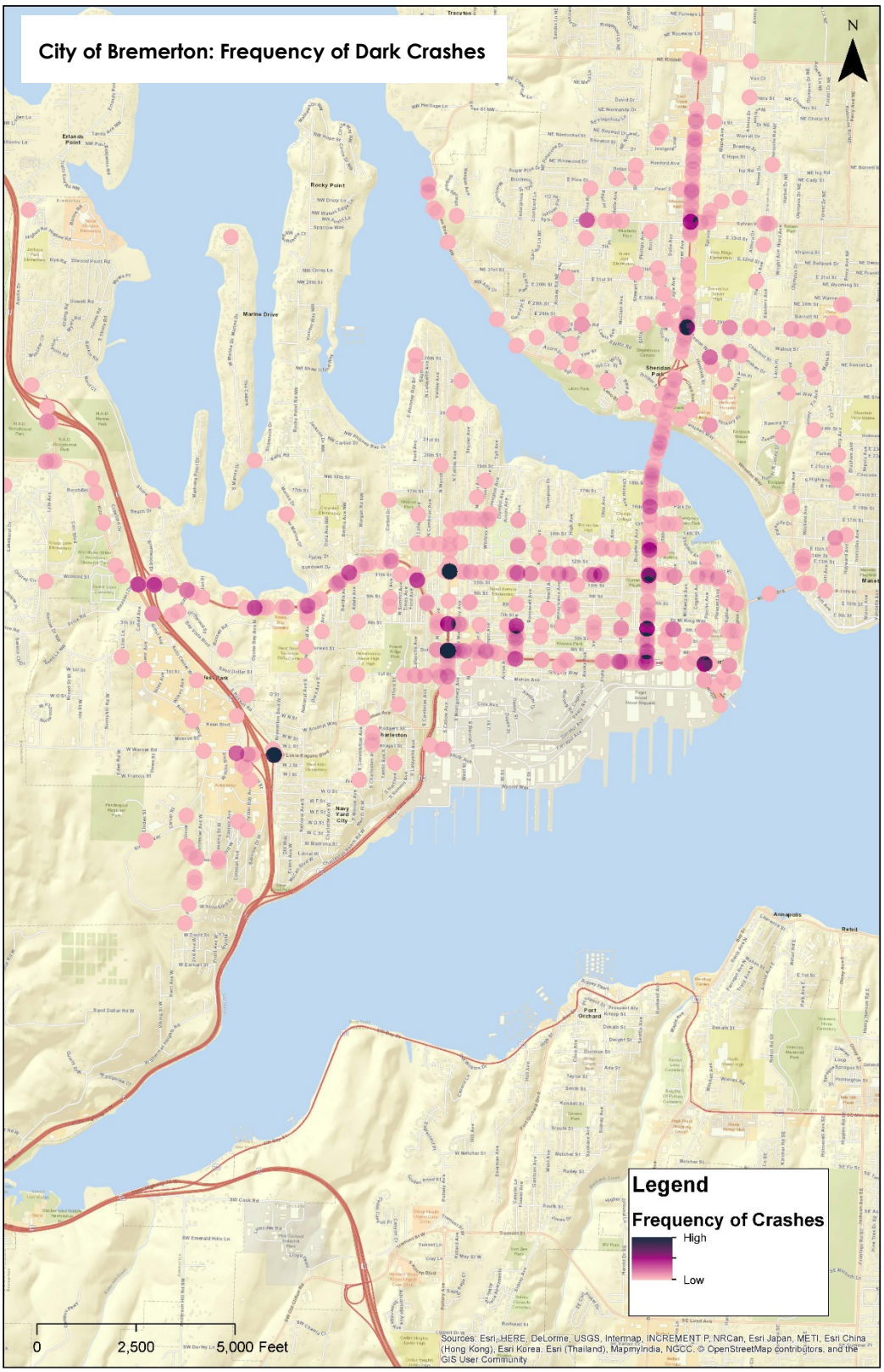


FIGURE 16. HEAT MAP OF DARK CRASHES, 2014-2018

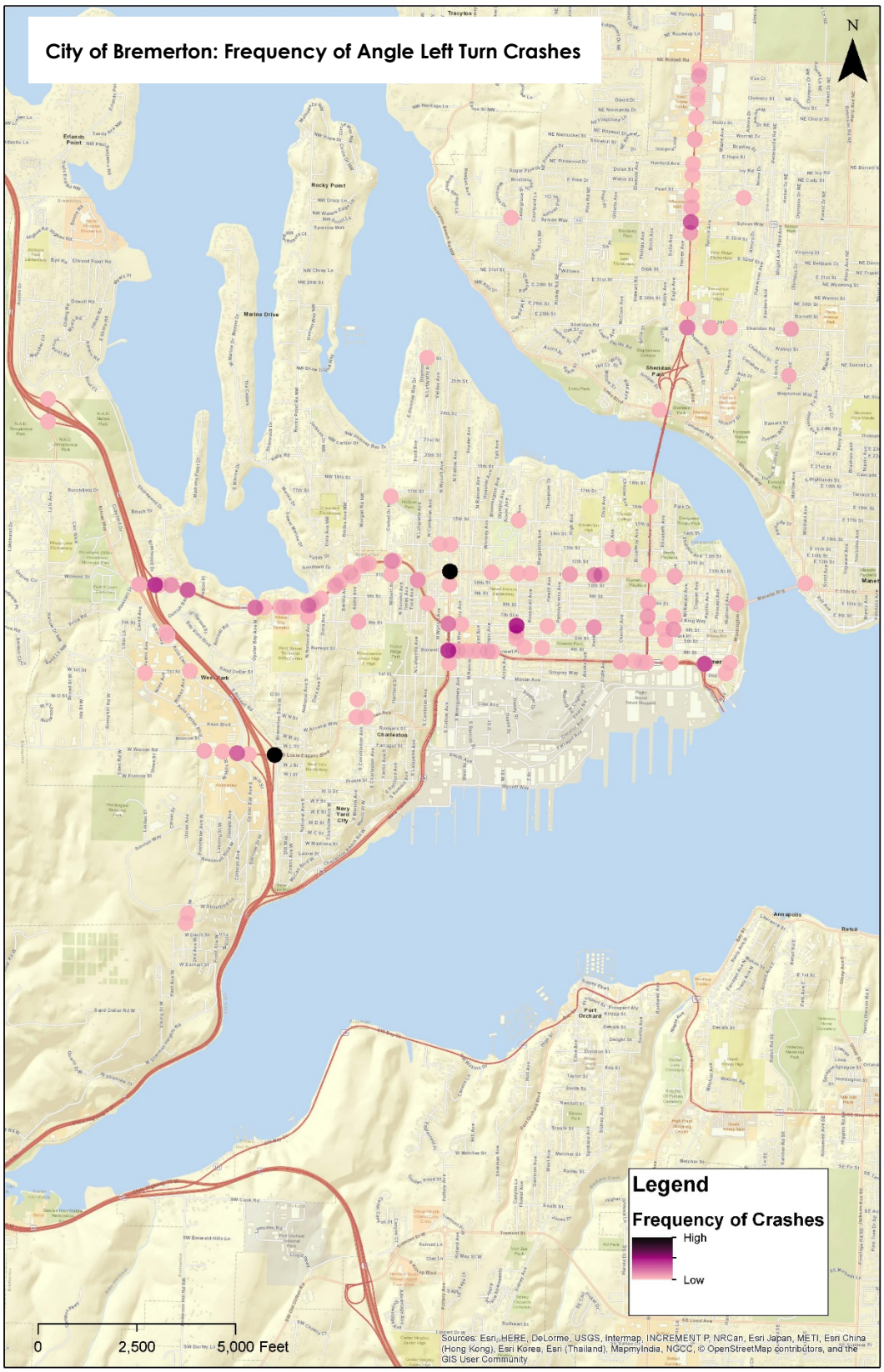


FIGURE 17. HEAT MAP OF ANGLE LEFT TURN CRASHES, 2014-2018

FIGURE 18. HEAT MAP OF REAR-END CRASHES, 2014-2018

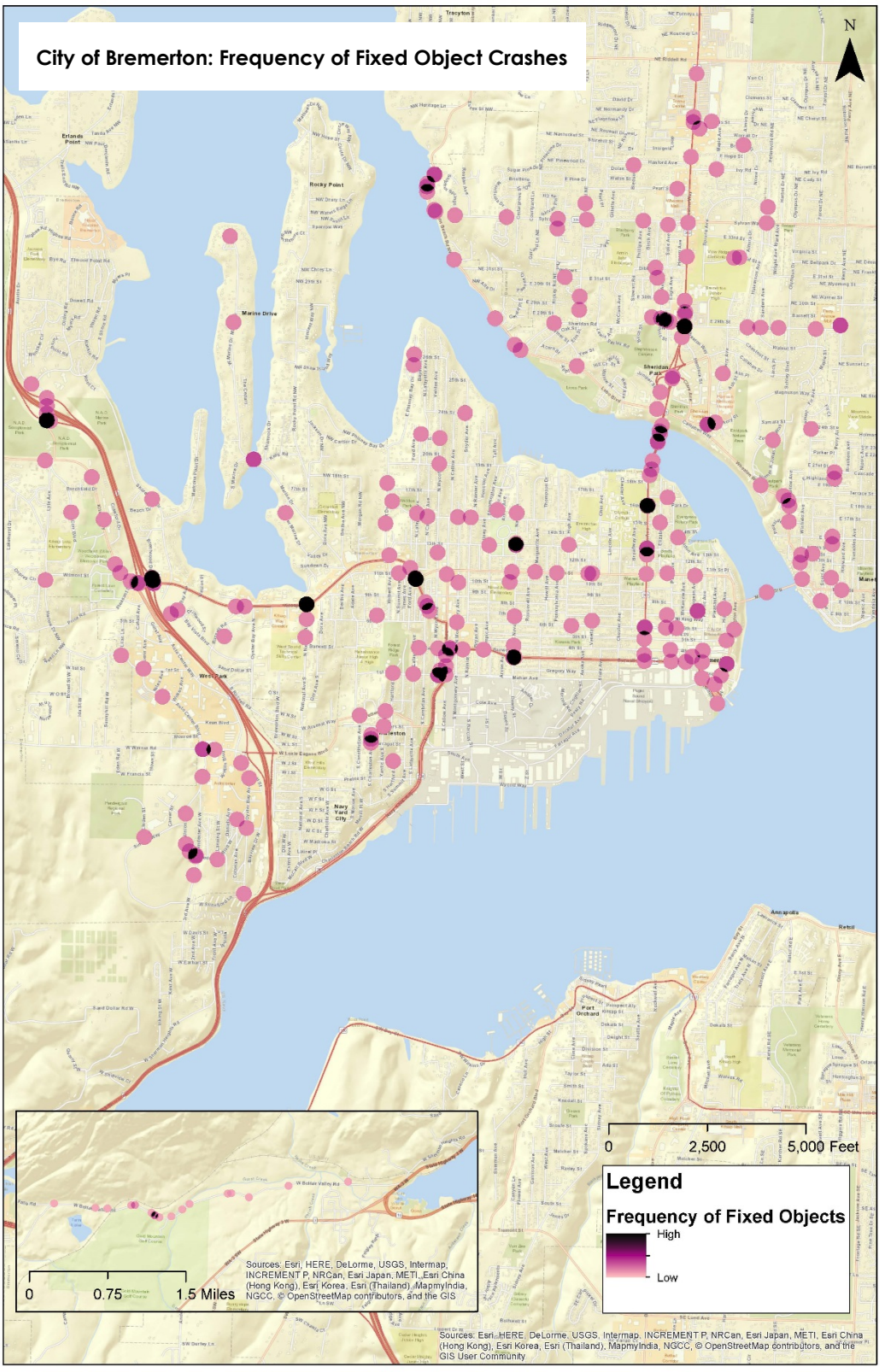


FIGURE 19. HEAT MAP OF FIXED OBJECT CRASHES, 2014-2018

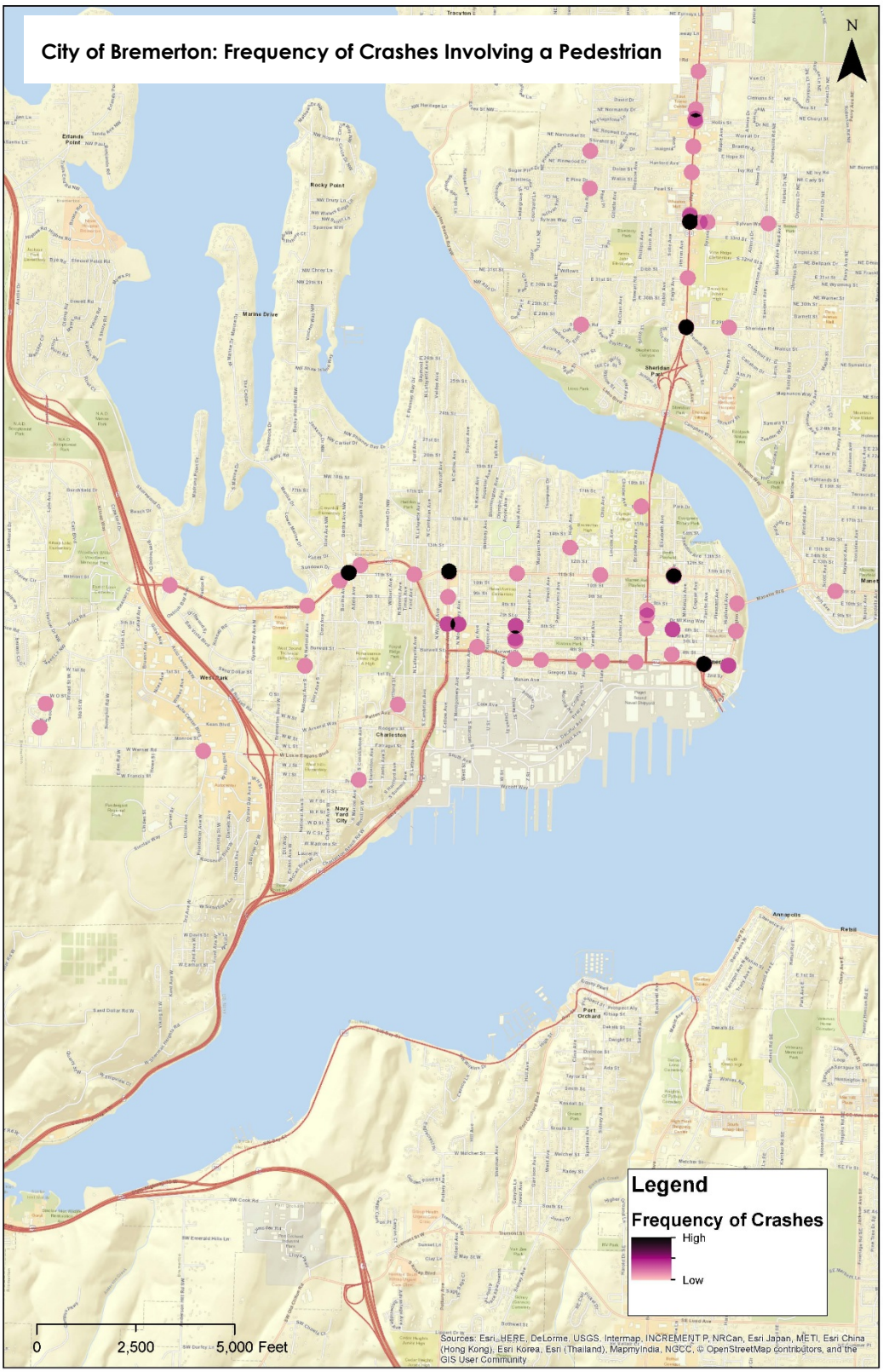


FIGURE 20. HEAT MAP OF CRASHES INVOLVING A PEDESTRIAN, 2014-2018

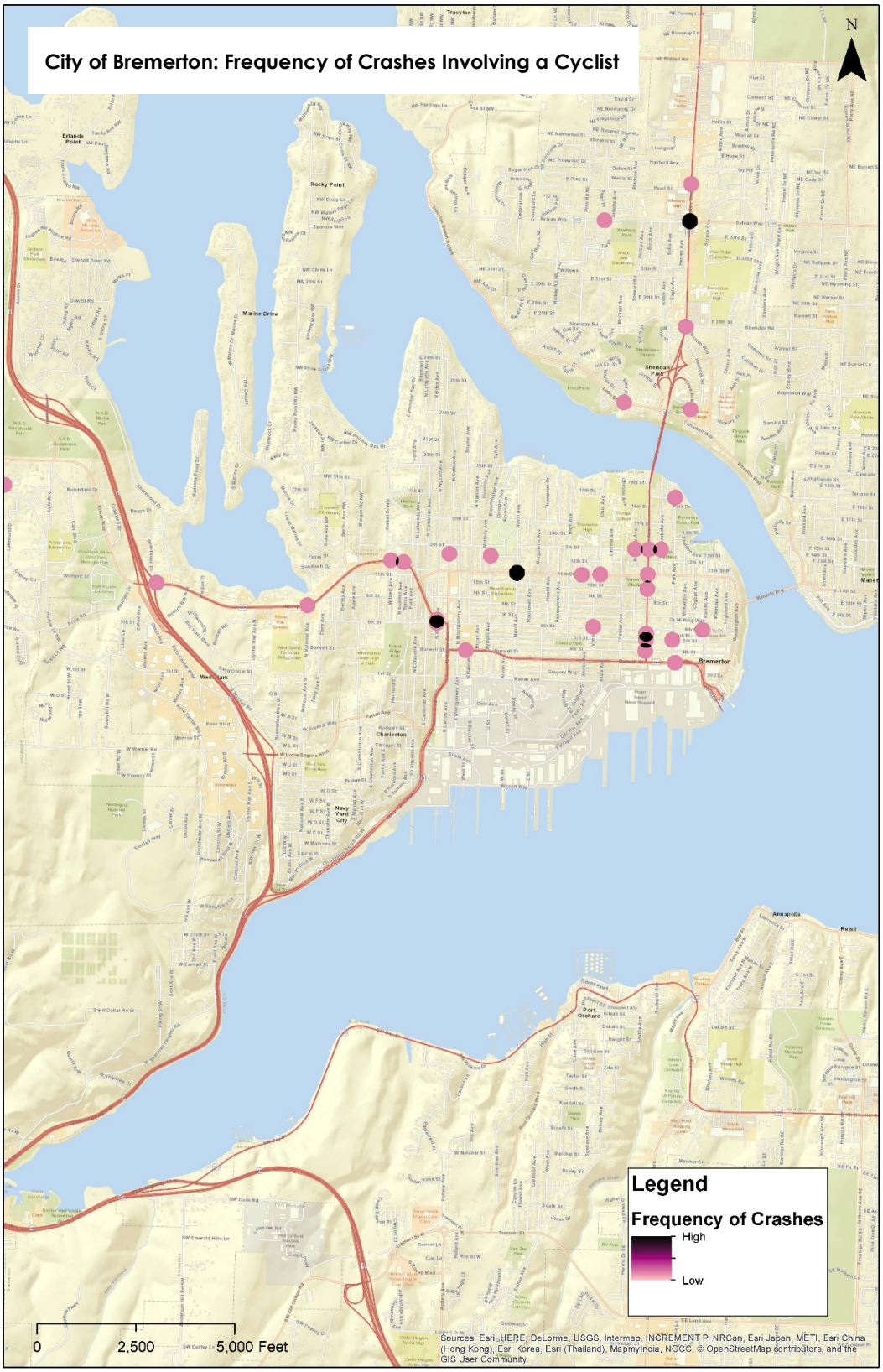


FIGURE 21. HEAT MAP OF CRASHES INVOLVING A CYCLIST, 2014-2018

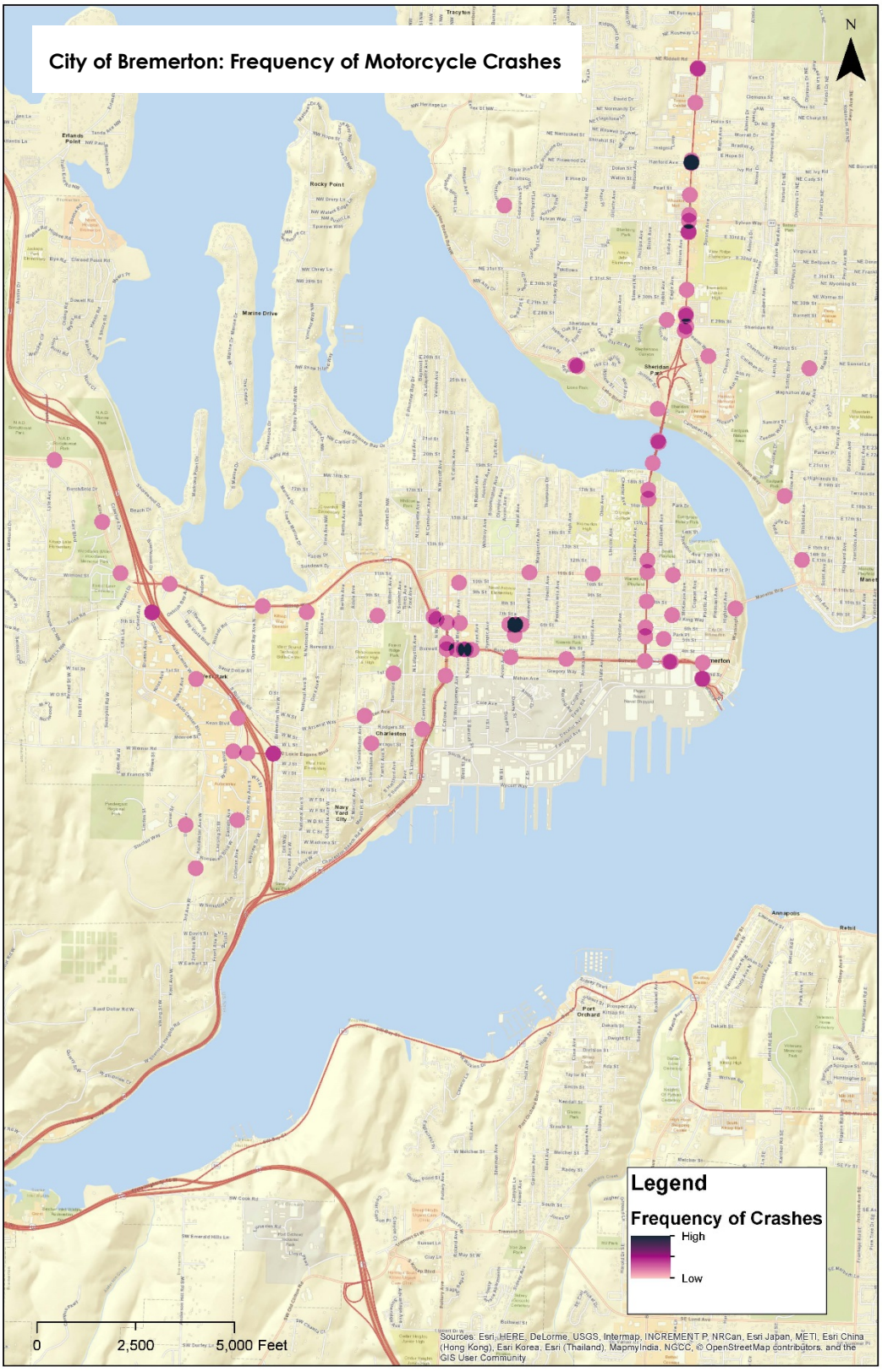


FIGURE 22. HEAT MAP OF CRASHES INVOLVING A MOTORCYCLE, 2014-2018

APPENDIX B. BENEFIT/COST RATIO CALCULATIONS

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	Belfair Valley Rd from Division Ave W to West City Limit, Paved Shoulder and Shoulder Rumble Strips				
Application year:					
Agency:	City of Bremerton				
Improvement:	Add paved 2' shoulder and shoulder rumble strips along corridor				
Evaluator:	Brian Chandler, Veronica Sullivan			**Date:**	1/8/2020
1a. Initial Total Project Cost, I:	**$4,528,384**		**1b. Year 11 Cost, J:**	$0	
2. Annual Op. Costs, H:	**$0**				

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	1	0.20	0.688	0.14	0.06
b) Suspected serious injury	1	0.20	0.688	0.14	0.06
c) Suspected minor injury	4	0.80	2.752	0.55	0.25
d) Possible Injury	9	1.80	6.192	1.24	0.56
e) Property damage only	13	2.60	8.944	1.79	0.81
Totals	28.00		19.26		1.75

4. Societal Costs Per Crash:

5. Annual Safety Benefits by Costs of Crashes:

Crash Type	Cost	Benefit
a) Fatality (K)	$2,900,000	$180,960
b) Suspected serious injury (A)	$2,900,000	$180,960
c) Suspected minor injury (B)	$155,000	$38,688
d) Possible Injury ©	$60,000	$33,696
e) Property damage only (O)	$10,000	$8,112
	Yearly Benefits=	**$442,416**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$4,528,384
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$6,012,433
10. Net Benefit = PWOB-PWOC:	$1,484,049
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**1.33**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	13th/Warren Ave and Sylvan/WA-303 Lead Pedestrian Interval				
Application year:					
Agency:	City of Bremerton				
Improvement:	Adding a lead pedestrian interval (LPI) to 13th & Warren Ave and Sylvan & WA-303				
Evaluator:	Brian Chandler, Veronica Sullivan			**Date:**	1/8/2020
1a. Initial Total Project Cost, I:	**$20,000**		**1b. Year 11 Cost, J:**	$0	
2. Annual Op. Costs, H:	**$0**				

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	0	0.00	0	0.00	0.00
c) Suspected minor injury	1	0.20	0.41	0.08	0.12
d) Possible Injury	2	0.40	0.82	0.16	0.24
e) Property damage only	0	0.00	0	0.00	0.00
Totals	3.0 crashes at Sylvan Way and SR 303 (signalized intersection)		1.23		0.35

4. Societal Costs Per Crash:

5. Annual Safety Benefits by Costs of Crashes:

Crash Type	Cost	Benefit
a) Fatality (K)	$2,900,000	$0
b) Suspected serious injury (A)	$2,900,000	$0
c) Suspected minor injury (B)	$155,000	$18,290
d) Possible Injury ©	$60,000	$14,160
e) Property damage only (O)	$10,000	$0
	Yearly Benefits=	**$32,450**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$20,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$440,996
10. Net Benefit = PWOB-PWOC:	$420,996
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**22.05**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	Rectangular Rapid Flashing Beacon (RRFB) at Pedestrian crossings				
Application year:					
Agency:	City of Bremerton				
Improvement:	Adding rectangular rapid flash beacon at 6 locations				
Evaluator:	Brian Chandler, Veronica Sullivan			**Date:**	2/3/2020
1a. Initial Total Project Cost, I:	**$540,000**		**1b. Year 11 Cost, J:**	$0	
2. Annual Op. Costs, H:	**$0**				

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	1	0.20	0.53	0.11	0.09
c) Suspected minor injury	3	0.60	1.59	0.32	0.28
d) Possible Injury	2	0.40	1.06	0.21	0.19
e) Property damage only	0	0.00	0	0.00	0.00
Totals	6.00		3.18		0.56

4. Societal Costs Per Crash:

Crash Type	Cost
a) Fatality (K)	$2,900,000
b) Suspected serious injury (A)	$2,900,000
c) Suspected minor injury (B)	$155,000
d) Possible Injury ©	$60,000
e) Property damage only (O)	$10,000

5. Annual Safety Benefits by Costs of Crashes:

Benefit
$0
$272,600
$43,710
$11,280
$0

Yearly Benefits= **$327,590**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$540,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$4,451,948
10. Net Benefit = PWOB-PWOC:	$3,911,948
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**8.24**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	Sylvan Way from Birch Ave to Pine Rd N Sidewalk Infill				
Application year:					
Agency:	City of Bremerton				
Improvement:	Adding rectangular rapid flash beacon at 6 intersections.				
Evaluator:	Brian Chandler, Veronica Sullivan			**Date:**	2/3/2020
1a. Initial Total Project Cost, I:	**$200,000**		**1b. Year 11 Cost, J:**	$0	
2. Annual Op. Costs, H:	**$0**				

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	0	0.00	0	0.00	0.00
c) Suspected minor injury	4	0.80	3.56	0.71	0.09
d) Possible Injury	4	0.80	3.56	0.71	0.09
e) Property damage only	14	2.80	12.46	2.49	0.31
Totals	22.00		19.58		0.48

4. Societal Costs Per Crash:

5. Annual Safety Benefits by Costs of Crashes:

Crash Type	Cost	Benefit
a) Fatality (K)	$2,900,000	$0
b) Suspected serious injury (A)	$2,900,000	$0
c) Suspected minor injury (B)	$155,000	$13,640
d) Possible Injury ©	$60,000	$5,280
e) Property damage only (O)	$10,000	$3,080
	Yearly Benefits=	**$22,000**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$200,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$298,980
10. Net Benefit = PWOB-PWOC:	$98,980
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**1.49**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	6th Street Rechannelization
Application year:	
Agency:	City of Bremerton
Improvement:	Converting 4-lane undivided road to 2-lanes plus turning lane
Evaluator:	Brian Chandler, Veronica Sullivan
Date:	1/9/2020

1a. Initial Total Project Cost, I:	**$600,000**	**1b. Year 11 Cost, J:**	$0
2. Annual Op. Costs, H:	**$0**		

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	3	0.60	2.13	0.43	0.17
c) Suspected minor injury	12	2.40	8.52	1.70	0.70
d) Possible Injury	43	8.60	30.53	6.11	2.49
e) Property damage only	131	26.20	93.01	18.60	7.60
Totals	189.00		134.19		10.96

4. Societal Costs Per Crash:

5. Annual Safety Benefits by Costs of Crashes:

Crash Type	Cost	Benefit
a) Fatality (K)	$2,900,000	$0
b) Suspected serious injury (A)	$2,900,000	$504,600
c) Suspected minor injury (B)	$155,000	$107,880
d) Possible Injury ©	$60,000	$149,640
e) Property damage only (O)	$10,000	$75,980
	Yearly Benefits=	**$838,100**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$600,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$11,389,779
10. Net Benefit = PWOB-PWOC:	$10,789,779
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**18.98**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	11th St & N Callow Ave EB signal warning and tying that warning to signal controller
Application year:	
Agency:	City of Bremerton
Improvement:	Adding advanced warning of the signalized intersection of EB 11th St ahead, and tying that warning to the signal controller
Evaluator:	Brian Chandler, Veronica Sullivan

Date: 1/9/2020

1a. Initial Total Project Cost, I:	**$45,000**	**1b. Year 11 Cost, J:**	$0
2. Annual Op. Costs, H:	**$0**		

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	0	0.00	0	0.00	0.00
c) Suspected minor injury	2	0.40	0.76	0.15	0.25
d) Possible Injury	1	0.20	0.38	0.08	0.12
e) Property damage only	7	1.40	2.66	0.53	0.87
Totals	10.00		3.80		1.24

4. Societal Costs Per Crash:

Crash Type	Cost
a) Fatality (K)	$2,900,000
b) Suspected serious injury (A)	$2,900,000
c) Suspected minor injury (B)	$155,000
d) Possible Injury ©	$60,000
e) Property damage only (O)	$10,000

5. Annual Safety Benefits by Costs of Crashes:

Benefit
$0
$0
$38,440
$7,440
$8,680

Yearly Benefits= **$54,560**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$45,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$741,470
10. Net Benefit = PWOB-PWOC:	$696,470
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**16.48**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	11th St & N Callow Ave NB and SB FYA (with protected phase)
Application year:	
Agency:	City of Bremerton
Improvement:	Adding a protected LT phase and using Flashing Yellow Arrow for permissive phase
Evaluator:	Brian Chandler, Veronica Sullivan **Date:** 2/3/2020

1a. Initial Total Project Cost, I:	**$15,000**	**1b. Year 11 Cost, J:**	$0
2. Annual Op. Costs, H:	**$0**		

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	0	0.00	0	0.00	0.00
c) Suspected minor injury	1	0.20	0.598	0.12	0.08
d) Possible Injury	2	0.40	1.196	0.24	0.16
e) Property damage only	3	0.60	1.794	0.36	0.24
Totals	6.00		3.59		0.48

4. Societal Costs Per Crash:

5. Annual Safety Benefits by Costs of Crashes:

Crash Type	Cost	Benefit
a) Fatality (K)	$2,900,000	$0
b) Suspected serious injury (A)	$2,900,000	$0
c) Suspected minor injury (B)	$155,000	$21,462
d) Possible Injury ©	$60,000	$9,648
e) Property damage only (O)	$10,000	$2,412
	Yearly Benefits=	**$24,522**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$15,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$333,254
10. Net Benefit = PWOB-PWOC:	$318,254
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**22.22**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	Burwell St Corridor, Install Adaptive Signal Control				
Application year:					
Agency:	City of Bremerton				
Improvement:	Install Adaptive Signal Control along Burwell St from Washington Ave to Callow Ave (8 existing signalized intersections)				
Evaluator:	Brian Chandler and Veronica Sullivan		**Date:**	2/3/2020	
1a. Initial Total Project Cost, I:	**$2,300,000**		**1b. Year 11 Cost, J:**	$0	
2. Annual Op. Costs, H:	**$0**				

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	1	0.20	0.79	0.16	0.04
b) Suspected serious injury	0	0.00	0	0.00	0.00
c) Suspected minor injury	13	2.60	10.27	2.05	0.55
d) Possible Injury	70	14.00	55.3	11.06	2.94
e) Property damage only	254	50.80	200.66	40.13	10.67
Totals	338.00		267.02		14.20

4. Societal Costs Per Crash:

5. Annual Safety Benefits by Costs of Crashes:

Crash Type	Cost	Benefit
a) Fatality (K)	$2,900,000	$121,800
b) Suspected serious injury (A)	$2,900,000	$0
c) Suspected minor injury (B)	$155,000	$84,630
d) Possible Injury ©	$60,000	$176,400
e) Property damage only (O)	$10,000	$106,680
	Yearly Benefits=	**$489,510**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$229,800
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$6,652,441
10. Net Benefit = PWOB-PWOC:	$4,352,441
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**2.89**

WSDOT Safety Program Benefit/Cost Worksheet

For Crash Reduction

Project name:	11th St & N Callow Ave Eastbound Left Turn Lane and Flashing Yellow Arrow				
Application year:					
Agency:	City of Bremerton				
Improvement:	Installing an exclusive left-turn lane for the eastbound intersection approach				
Evaluator:	Brian Chandler, Veronica Sullivan		**Date:**	2/3/2020	
1a. Initial Total Project Cost, I:	**$1,100,000**		**1b. Year 11 Cost, J:**	$0	
2. Annual Op. Costs, H:	**$0**				

3. Annual Safety Benefits in Number of Collisions:

Crash Type	Existing Raw #	Existing Calculated	After Raw #	After Calculated	Difference
a) Fatal injury	0	0.00	0	0.00	0.00
b) Suspected serious injury	0	0.00	0	0.00	0.00
c) Suspected minor injury	1	0.40	0.3887	0.08	0.12
d) Possible Injury	2	0.40	0.7774	0.16	0.24
e) Property damage only	8	1.60	3.1096	0.62	0.98
Totals	11.00		4.28		1.34

4. Societal Costs Per Crash:

Crash Type	Cost
a) Fatality (K)	$2,900,000
b) Suspected serious injury (A)	$2,900,000
c) Suspected minor injury (B)	$155,000
d) Possible Injury ©	$60,000
e) Property damage only (O)	$10,000

5. Annual Safety Benefits by Costs of Crashes:

Benefit
$0
$0
$18,950
$14,671
$9,781

Yearly Benefits= **$43,402**

7. Salvage Value, T

Feature	Cost		Factor	
a) Right of Way (from cost estimate)	$0	x	0.45 =	$0
b) Grading & Drainage (from cost estimate)	$0	x	0.40 =	$0
c) Structures (from cost estimate)	$0	x	0.43 =	$0
			d) Total, T:	**$0**

8. Present Worth of Costs (PWOC) = I + .68J + 13.59H - T:	$1,100,000
9. Present Worth of Benefits (PWOB) = 13.59 x Yearly Benefits:	$589,837
10. Net Benefit = PWOB-PWOC:	($510,163)
11. Benefit Cost Ratio, B/C = PWOB/PWOC:	**0.54**