CITY OF TACOMA

LOCAL ROAD SAFETY PLAN

A STRATEGIC RISK-BASED ASSESSMENT

APRIL 2018


LEFT TURN
YIELD
ON GREEN
SO 15TH ST
CAUTION
IF YOU CAN'T SEE
MY MIRRORS
I CAN'T SEE YOU
SHARED
LANE
NAILS
FREE

Contents

Introduction

The City of Tacoma is committed to ending traffic-related deaths and serious injuries on City streets. Traffic collisions can be prevented through smarter street design, targeted enforcement, and meaningful public engagement. This Local Road Safety Plan is intended to serve as a precursor to a Vision Zero plan, which the City is committed to developing in the near future. There are two approaches to collision reduction – conducting spot treatments where previous collisions have occurred, and a systemic safety approach, which determines project locations based on high-risk roadway features correlated with specific serious collision types. This plan is based on the latter, systemic safety approach.

This is a data driven plan that uses collision trends and contributing risk factors to identify City street segments with characteristics that may lead to a higher risk of collisions. These street segments are then narrowed down to a discrete list of projects that the City can prioritize, which is key for implementing successful collision reduction strategies.

This program of improvements was developed using a strategy similar to the Washington State's Vision Zero plan – *Target Zero: Washington State Strategic Highway Safety Plan*, which highlights the importance of data driven collision reduction strategies. WSDOT's City Safety Program funds low-cost, systemic, near-term projects that will improve roadway safety.

What is Vision Zero?

Vision Zero is a strategy to eliminate all traffic fatalities and serious injuries by promoting safe roadway design and smart behaviors. It encourages a culture of shared responsibility, where roadway designers, policymakers, and roadway users all work together to reduce serious and fatal collisions.

The Vision Zero concept originated in Sweden, where it was adopted as a national strategy in 1997. Several cities throughout the U.S. have adopted the Vision Zero goal, including Seattle, Portland, New York, San Francisco, Chicago, and Los Angeles. Despite the progress that has been made, pedestrian fatalities as a percentage of all collisions have been increasing nationally since 2007[1]. One explanation is increasing numbers of vehicle miles traveled. Researchers from the Governors Highway Safety Association found that the growing use of cell phones by drivers and pedestrians is a significant distraction that may be contributing to higher fatalities. This study also found that low light conditions and alcohol use are also contributing circumstances to recent fatal pedestrian collisions. While the City cannot directly change driver and pedestrian behavior, changes to the streetscape and surrounding land use can help reduce both collision frequency and severity. These increasing fatality rates show the importance of making Vision Zero a central priority for Tacoma, Washington State, and the nation at large.

[1] *Spotlight on Highway Safety*. Governors Highway Safety Association (2016)

Limitations on Use

Under 23 U.S. Code § 409 and 23 U.S. Code § 148, safety data, reports, surveys, schedules, lists compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential crash sites, hazardous roadway conditions, or railway-highway crossings are not subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

Identification of Potential Risk Factors

To effectively reduce future collisions, the City must first understand the history of collision patterns. To do this, five years of collision data were combined with available land use and roadway data to analyze contributing factors and pull out the most pertinent trends. These were then organized into potential risk factors for fatal and serious injury collisions, and the City's street network was analyzed to identify locations with the most risk factors.

WSDOT Summary Data Trends

WSDOT provided a Collision Database Summary for the City of Tacoma for the years 2012-2016. It included information such as collision type (e.g. hit pedestrian; rear end; hit fixed object), roadway characteristics (e.g. roadway curvature; lighting; posted speed limit), and contributing circumstances to the collisions (e.g. inattention; failure for pedestrian to use crosswalk; under the influence of alcohol or drugs). The data provided does not account for roadway geometry, such as number of travel lanes, intersection characteristics, nearby land uses, or any data normalization across the comparisons.

Of the collisions that occurred on "Tacoma responsible streets", about two percent of collisions involved victims killed or seriously injured (KSI). Over the five-year period, there were 334 KSI collisions and 14,647 non-serious injury collisions. Of all collisions, there were 236 collisions involving a bicyclist and 481 involving a pedestrian, a combined total of about five percent of all collisions.

The Collision Database Summary was examined to determine the most frequent roadway and circumstance characteristics in KSI collisions. Collision characteristics that were higher than the statewide or regional average (**Table 1**) or that occurred most frequently within the City (**Table 2**) were identified as potential priority areas for the City to examine. These also informed the risk factor analysis discussed later in the plan.

The collision characteristics that stood out as more common in the City of Tacoma compared to statewide were the percentage of KSI collisions occurring on 30 MPH roadways, cyclists disregarding signals, pedestrians failing to use the crosswalk, pedestrians crossing in unmarked crosswalks, and dark conditions with streetlights on. The most common circumstances reported in KSI collisions contributed by drivers were inattention/distraction and exceeding posted speed limits. A common factor in citywide KSI collisions was hitting a fixed object, such as striking a curb or raised traffic island.

Table 1: KSI Collision Conditions Based on Comparison to State and Western Washington

Category	Collision Conditions	City of Tacoma (% of KSI Collisions)	State of WA (% of KSI Collisions)	Western WA (% of KSI Collisions)	Difference
Posted speed per driver	30 MPH roadways	44%	28%	26%	16%
Pedestrian contributing circumstance	Pedestrian failure to use crosswalk	22%*	7%	7%	15%
Pedal-cyclist contributing circumstance	Disregard signal	15%*	5%	5%	10%
Pedestrian facility use	Collisions in unmarked crosswalks	17%*	12%	8%	9%
Light condition	Dark – street lights on	41%	35%	35%	6%
Primary collision type	Angle (T)	18%	15%	14%	3%

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
Fehr & Peers, 2018.

* Does not refer to the percentage of all KSI collisions citywide, but rather the share of KSI collisions for this category.

Table 2: KSI Collision Conditions Based on Frequency

Category	Collision Conditions	City of Tacoma (% of KSI Collisions)	Notes
Driver contributing circumstance	Inattention / distraction	14%*	The most common circumstance reported in KSI collisions contributed by drivers.
Driver contributing circumstance	Exceeding safe / stated speed	9%*	The second most common circumstance reported in KSI collisions contributed by drivers.
Fixed object first struck	Curb / raised traffic island	20%*	This is also a common factor for all citywide collisions – 18% of collisions that occur citywide due to hitting a fixed object involve striking the curb or raised traffic island first.
Driver contributing circumstance	Driver failing to yield	8%*	

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
Fehr & Peers, 2018.

* Does not refer to the percentage of all KSI collisions citywide, but rather the share of KSI collisions for this category.

Methodology for Identifying Risk Factors

After identifying collision characteristics that warranted further review, the City looked at the complete WSDOT collision dataset for 2012-2016. When examining the data, it became apparent that there were different patterns pertaining to all KSI collisions and collisions involving a bicycle or pedestrian. While KSI collisions include collisions involving a bicycle or pedestrian, the City analyzed all collision data for bicyclists and pedestrians rather than just KSI collision data – these users are more vulnerable, and a change in conditions or situation can very quickly result in serious injury or fatality for these users. Therefore, reducing all bicycle and pedestrian collisions is complementary to Target Zero initiatives. For these reasons, Tacoma divided its risk factors into two categories – KSI collisions and all bicycle/pedestrian collisions.

To identify potential risk factors associated with KSI and bicycle/pedestrian collisions, the collision data were aggregated and analyzed for patterns. The WSDOT collision data were joined spatially in GIS to nearby contextual data, which included the following variables[2]:

- Bicycle facility type
- Signalized intersections
- Land use zoning, including Mixed Use and Regional Growth Centers
- Street classification
- Posted speed limit
- Location and type of street lighting

The frequency of a collision characteristic for KSI or bicycle/pedestrian collisions was compared with the average across all collisions to determine if there were factors specific to KSI or bicycle/pedestrian collisions. Factors that stood out could be indicators of risk factors present in the built environment that may lead to more KSI or bicycle/pedestrian collisions. Multiple variables were cross-referenced to analyze correlations, such as higher incident rates on certain street classifications and in proximity to certain land uses to pull out more nuanced data. Data were also normalized when possible, so that a predominance of one roadway type did not artificially inflate the results. Posted speed limit, roadway classification, and bike facility were normalized by the total lane-miles in the City to find the number of collisions per lane-mile. Land use was normalized by area.

While factors like time of day and weather were evaluated, they were not included in the final risk factor list, as the City can do little to control these variables. Likewise, most driver behavior characteristics (i.e. distracted driving) were removed from the risk factor list. Roadway characteristics and land use patterns are variables that the City can actively modify to create a safer roadway network.

[2] While the City would have liked to analyze additional contextual variables, it was limited by data availability.

The risk factors identified are:

KSI Collision Risk Factors

1. Posted Speed Limit – Greater than or equal to 30 MPH
2. Land Use – Mixed Use and Regional Growth Centers
3. Street Classification - Arterials
4. Lighting Conditions
5. Alcohol use

All Bicyclist/Pedestrian Collision Risk Factors

1. Pedestrians Crossing the Roadway – Low Intersection Density
2. Lighting Conditions
3. Land Use – Intersections in Mixed Use and Regional Growth Centers
4. Posted Speed Limit – Intersections with speeds of 25 MPH to 35 MPH
5. Lack of Bicycle Facility on the Roadway
6. Intersections on Arterials

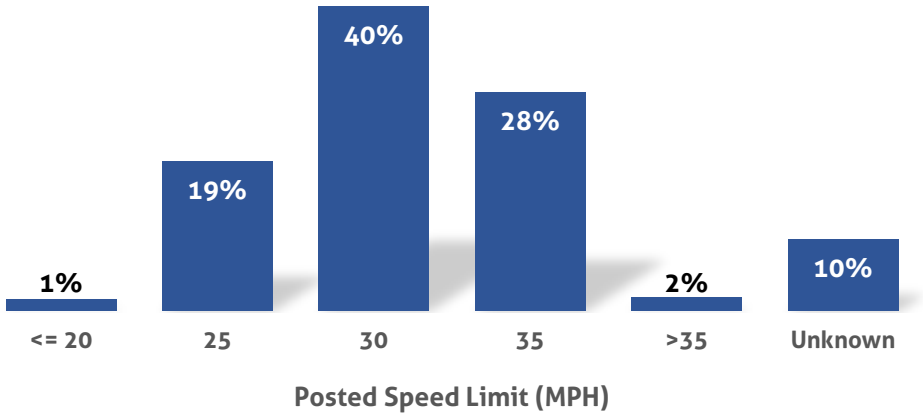
Fatal and Serious Injury Collision Risk Factors

1. *Posted Speed Limit – Greater than or equal to 30 MPH*

Posted speed limits greater than or equal to 30 MPH are considered a risk factor for KSI collisions.

The collision database indicated that 70% of KSI collisions occurred on streets that had a posted speed limit of 30 MPH and 30% of KSI collisions occurred on streets that had a posted speed limit of 35 MPH and over. The majority of streets in Tacoma have a posted speed limit of 30 MPH (41%), 35 MPH (25%) and 25 MPH (22%). The percentage of KSI collisions that occurred on 30+ MPH streets was greater than the percentage of all collisions on these roadways.

Figure 1: KSI Collisions by Facility's Posted Speed Limit



2. *Land Use – Mixed Use and Regional Growth Centers*

To be located within a Regional Growth Center or a Mixed Use Center is considered a risk factor for KSI collisions.

The number of KSI collisions per square mile in Mixed Use and Regional Growth Centers was much higher than the citywide average for all land uses. Focusing only on areas that have been classified as Mixed Use Centers and Regional Growth Centers, the most KSI collisions per square mile occurred within Regional Growth Centers. Mixed Use Centers make up 4.3 percent of the City's total area, and Regional Growth Centers make up 5.9 percent.

Table 3: Collisions Per Square Mile within Mixed Use and Regional Growth Centers

	Total Collisions per sq. mi.	KSI Collisions per sq. mi.
Mixed Use Center	561.06	14.38
Regional Growth Center	959.14	18.83
Neither	254.89	5.68
Citywide Average	**303.25**	**6.76**

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
City of Tacoma GIS, 2018.
Fehr & Peers, 2018.

3. *Street Classification – Arterials*

Minor and Principal Arterials are considered risk factors for KSI collisions.

A large proportion of KSI collisions occurred on streets classified as minor and principal arterials. This was true for the total number of KSI collisions and for average KSI collisions per mile of roadway. These two street classifications usually have more lanes, more traffic, and faster speeds.

Table 4: KSI Collisions by Street Classification

Street Classification	KSI Collisions	Percentage of KSI Collisions	Total miles of roadway	KSI Collisions per mile
Local	71	21%	2044.0	0.03
Collector	55	16%	336.0	0.16
Minor Arterial	54	16%	93.4	**0.58**
Principal Arterial	154	**46%**	397.7	**0.39**

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
City of Tacoma GIS, 2018.
Fehr & Peers, 2018.

4. *Lighting Conditions*

Widely spaced lighting with insufficient wattage is considered a risk factor for KSI collisions.

The analysis found that 41% of KSI collisions occurred in the dark when streetlights were on. While most streets in Tacoma have some streetlights present, lights that are spaced too far apart or that do not have high enough wattage may pose a risk of increased collisions. The majority of KSI collisions (22%) happened during the PM peak hour of 3:00 pm to 6:00 pm, and more KSI collisions occurred in the dark during the winter months and during the daylight for summer months, which is an important

consideration when planning for vulnerable users like cyclists and pedestrians. Locations in Tacoma that do not meet this analysis' lighting criteria are mapped in **Figure 2.**

Figure 2: Street Lighting Citywide

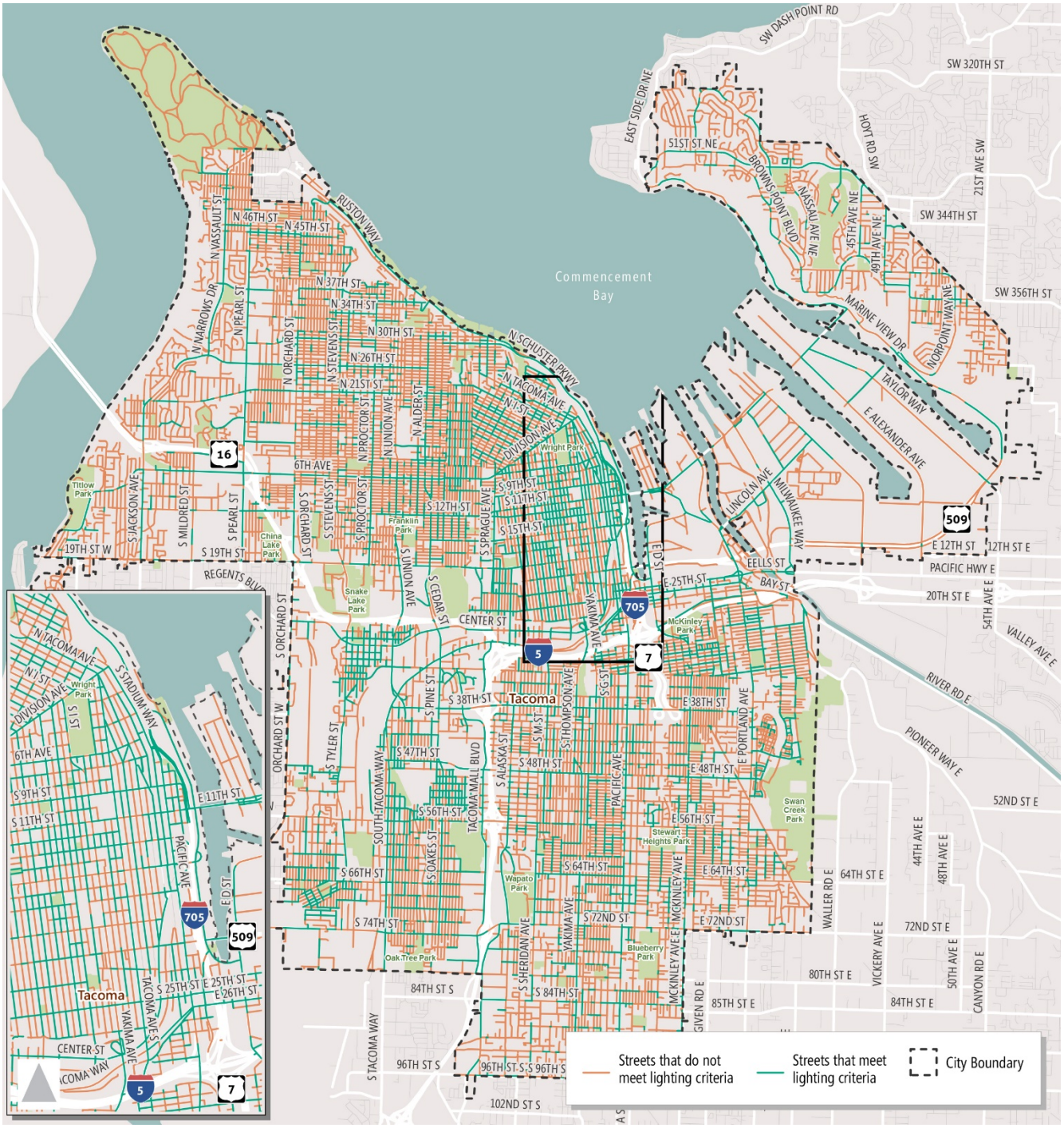
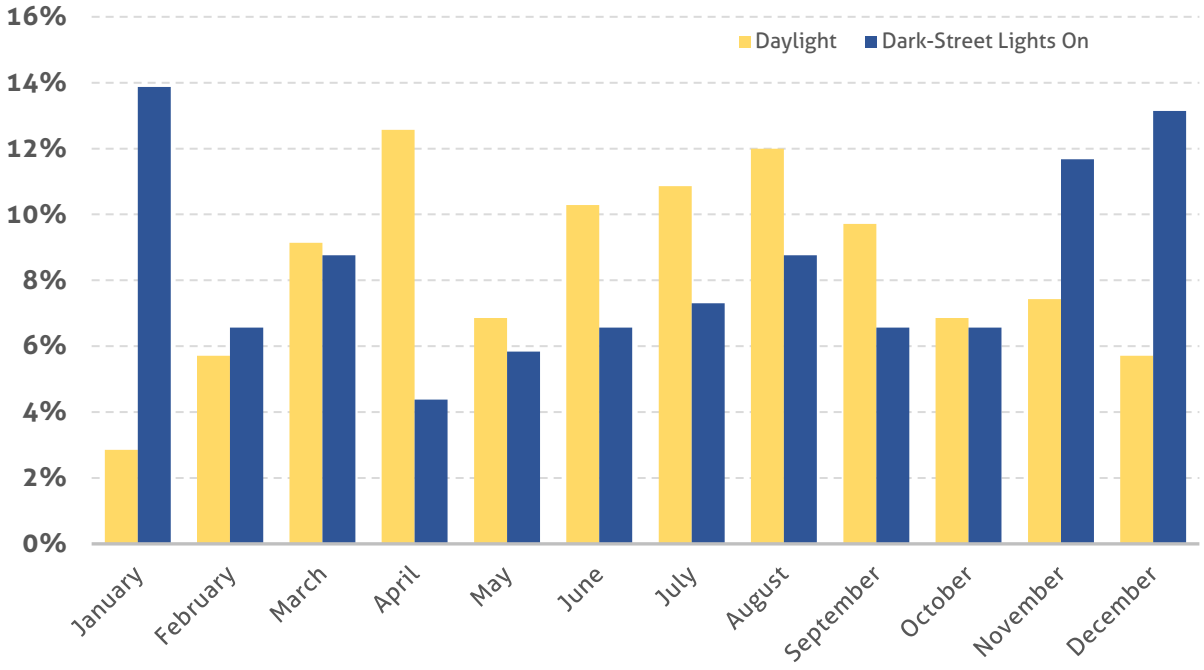


Figure 3: KSI Collisions by Month and Lighting Conditions



5. *Alcohol use*

Being "under the influence" of alcohol is considered a risk factor for KSI collisions.

Consumption of alcohol, drugs, or medications was a contributing circumstance in 13% of KSI collisions, compared to 5% of all collisions. Alcohol use was much more frequent than drug and medication use in these collisions. While this risk factor is not present in the roadway network, engineering solutions can be countermeasures to behavioral risk factors. Locations in Tacoma that have high instances of collisions relating to alcohol use are mapped in **Figure 4**.

Figure 4: Density of Alcohol Related Collisions

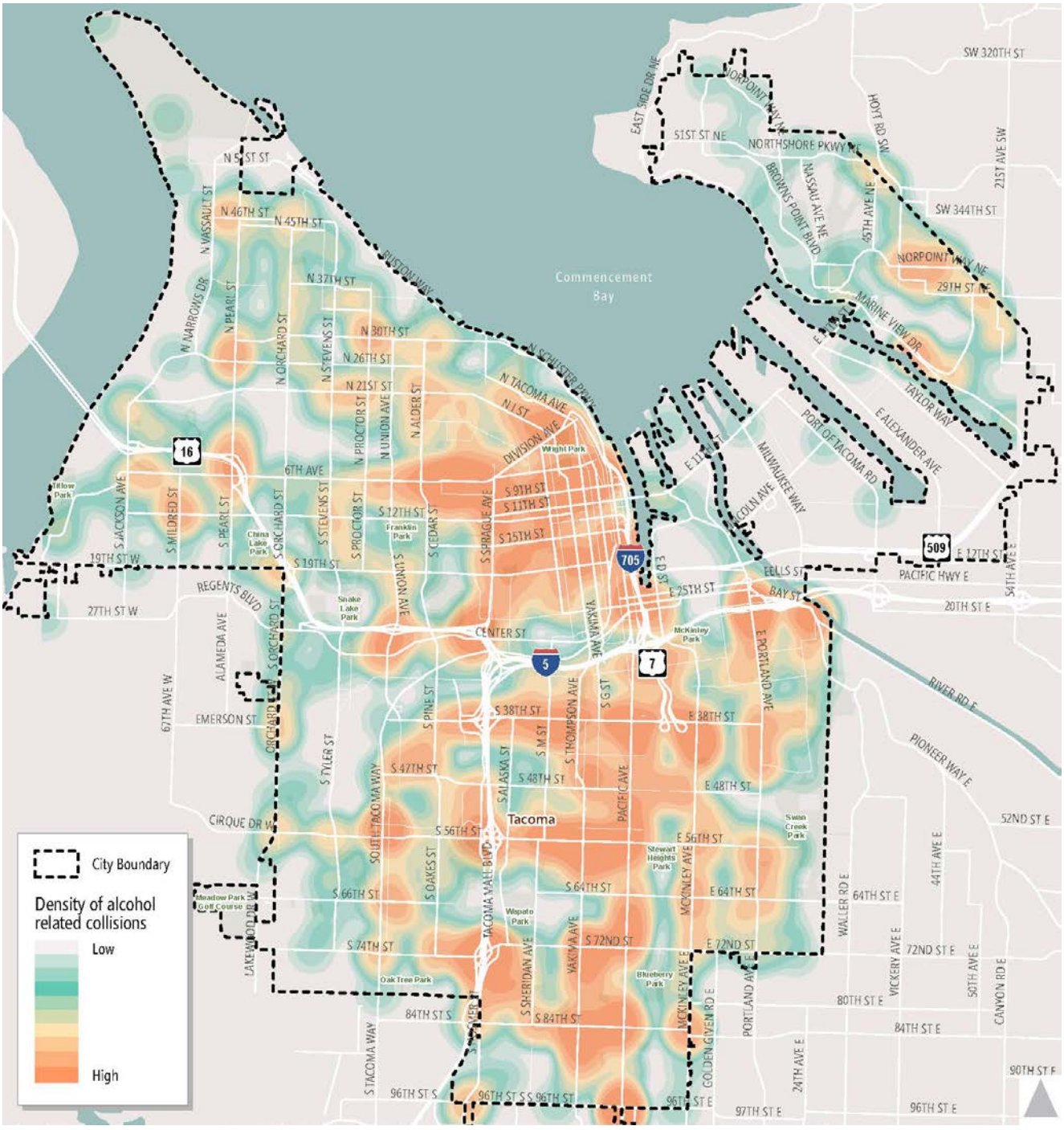


Table 5: "Under the Influence" Collisions

	All Collisions	KSI Collisions
Alcohol	715	39
Drugs	53	3
Medication	11	1
Total Collisions	14981	334
Percentage "under the influence"	5%	13%

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
City of Tacoma GIS, 2018.
Fehr & Peers, 2018.

Bicycle and Pedestrian Collision Risk Factors

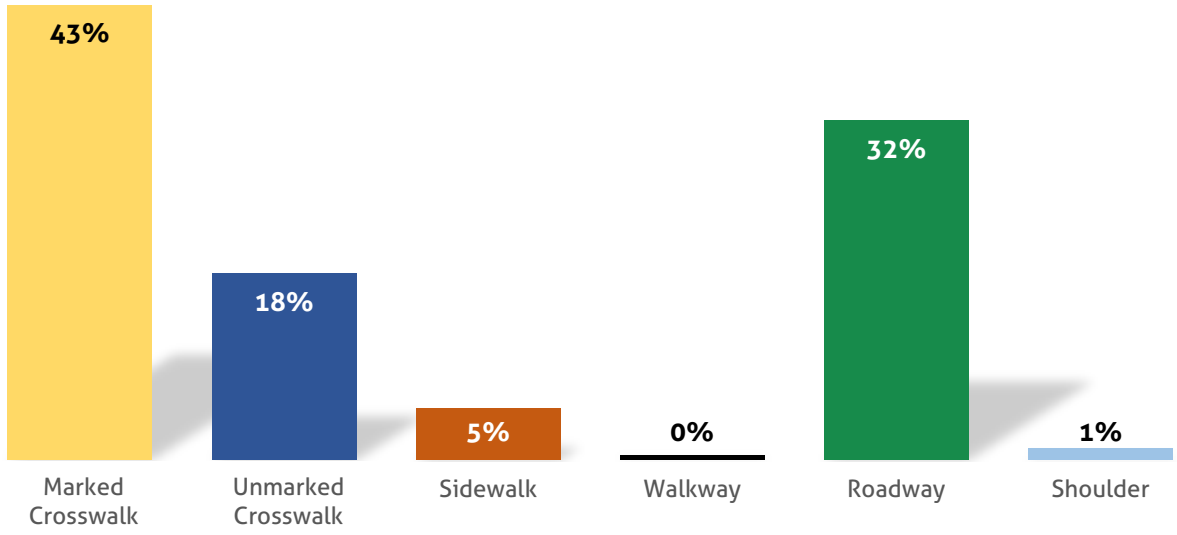
For the identification of pedestrian and bicycle risk factors, all collisions involving a pedestrian or a bicyclist were used instead of KSI collisions because the dataset is smaller, and the majority of collisions that involve a pedestrian or bicyclist result in injury.

1. *Pedestrians on the Roadway – Low Intersection Density*

Pedestrians on the "roadway" are considered a risk factor for pedestrian collisions.

While the greatest portion of collisions occurred in marked crosswalks, the City does not have a data inventory on marked or unmarked crosswalks, so this analysis could not consider these collision types. The next largest portion of collisions that involved a pedestrian occurred outside of a marked crosswalk or designated pedestrian facility (sidewalk/walkway). 32% occurred on the roadway, which is classified as jaywalking or a person walking in the lane (as opposed to the shoulder). This could be indicative of a lack of safe crossing opportunities in a given location, so this risk factor was evaluated by looking at intersection density – areas with the greatest spacing between intersections would contribute to pedestrians crossing the roadway outside of the marked crosswalk or intersection.

Figure 5: Pedestrian Collisions Based on Location

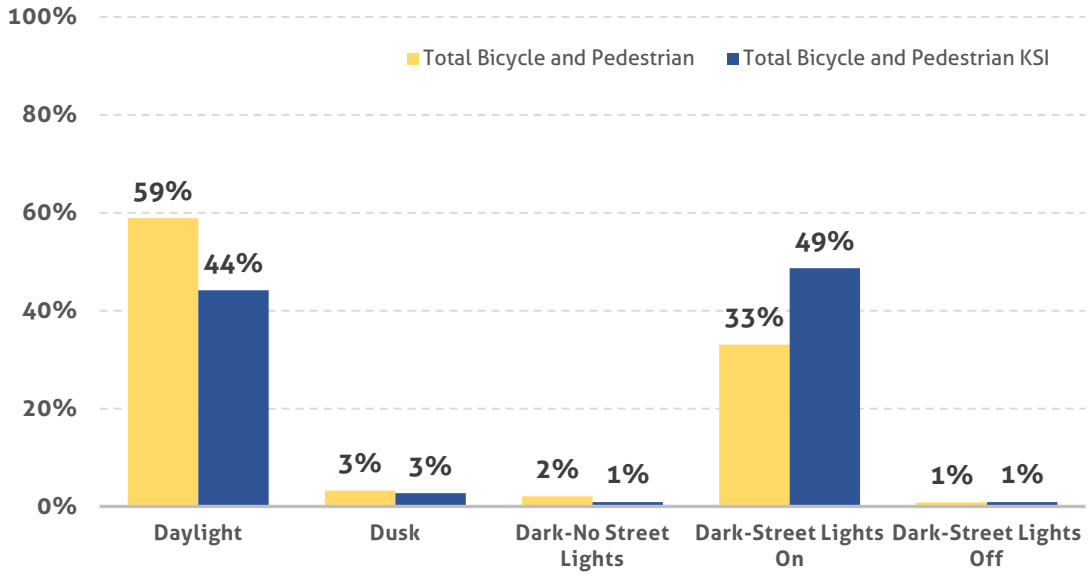


2. *Lighting Conditions*

Widely spaced lighting with insufficient wattage is considered a risk factor for pedestrian collisions.

Analysis showed that 33% of all pedestrian and bicycle collisions and 49% of KSI pedestrian/bicycle collisions occurred during the dark with street lights on. Street light spacing and adequate wattage are important factors in determining if lighting could be contributing to collisions along the roadway.

Figure 6: Collisions by Lighting Category



3. *Land Use – Intersections in Mixed Use and Regional Growth Centers*

Intersections in Mixed Use and Regional Growth Centers are considered a risk factor for pedestrian and bicycle collisions.

Both bicycle and pedestrian collisions were highest at signalized intersections in the Regional Growth Centers and Mixed Use Centers. This was identified as a risk factor because the proportion of bicycle and pedestrian collisions per square mile in Mixed Use and Regional Growth Centers was higher than the citywide average for all land uses.

Table 6: Bicycle Collisions per Square Mile

	Signalized	Unsignalized	Midblock
Mixed Use Center	**6.12**	4.24	4.71
Regional Growth Center	**6.85**	2.40	3.42
Neither	4.58	4.96	4.87

Table 7: Pedestrian Collisions per Square Mile

	Signalized	Unsignalized	Midblock
Mixed Use Center	**18.36**	7.53	9.89
Regional Growth Center	**23.28**	7.53	9.24
Neither	8.43	9.99	9.76

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
City of Tacoma GIS, 2018.
Fehr & Peers, 2018.

4. *Posted Speed Limit – Intersections 25 MPH to 35 MPH*

Intersections with posted speed limits from 25 MPH and 35 MPH are considered a risk factor for pedestrian and bicycle collisions.

The majority of pedestrian and bicycle collisions were on streets with a posted speed limit of 25 MPH to 35 MPH. This differed from the KSI risk factor, as 25 MPH streets were a more common location for bicycle and pedestrian collisions specifically.

Figure 7: Pedestrian Collisions by Location and Posted Speed Limit

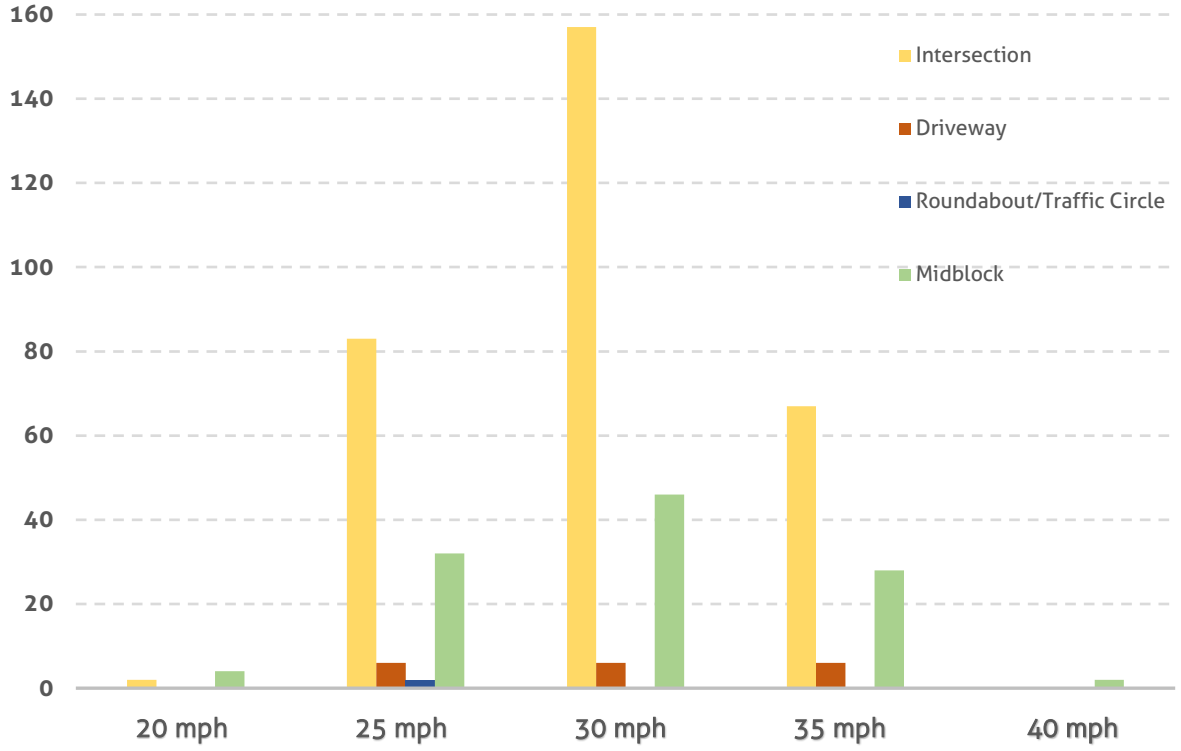
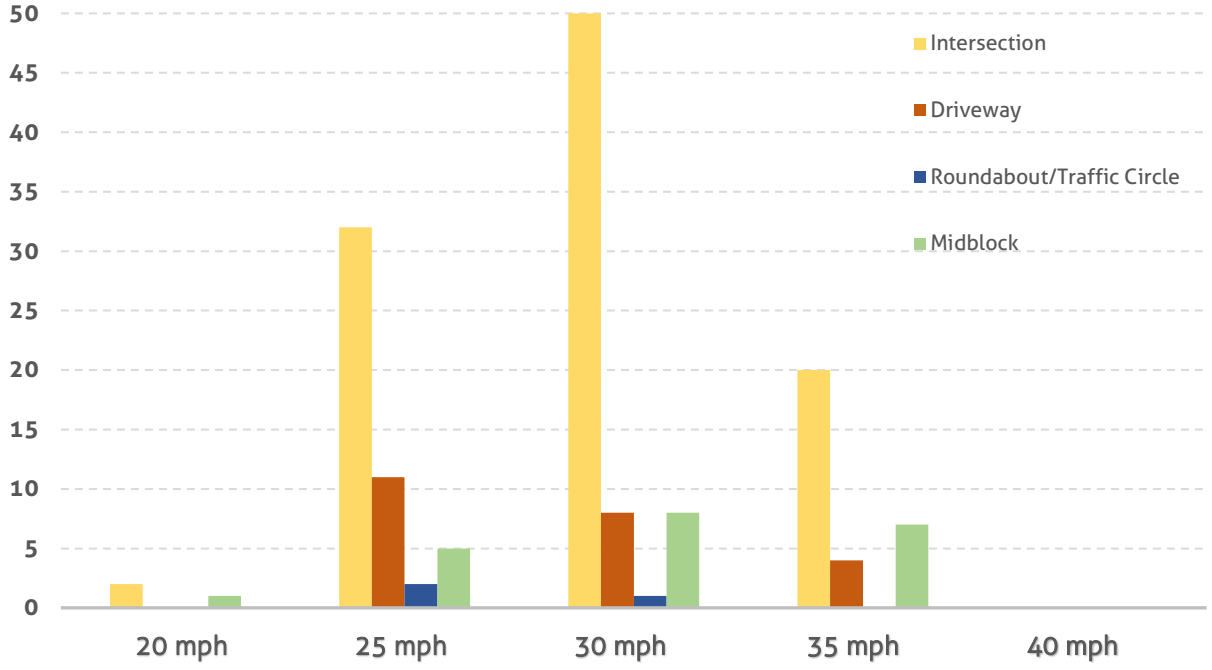


Figure 8: Bicycle Collisions by Location and Posted Speed Limit



5. *Lack of Bicycle Facility on the Roadway*

Lack of a bicycle facility on a Minor or Principal Arterial is considered a risk factor for bicycle collisions.

78% of bicycle collisions in Tacoma occurred on streets that were not part of Tacoma's bicycle infrastructure network. When bicycle collisions were further evaluated by roadway classification, the highest proportion per lane-mile occurred on minor and principal arterials that lacked bicycle infrastructure.

Figure 9: Bicycle Facility on the Roadway Where the Collision Occurred

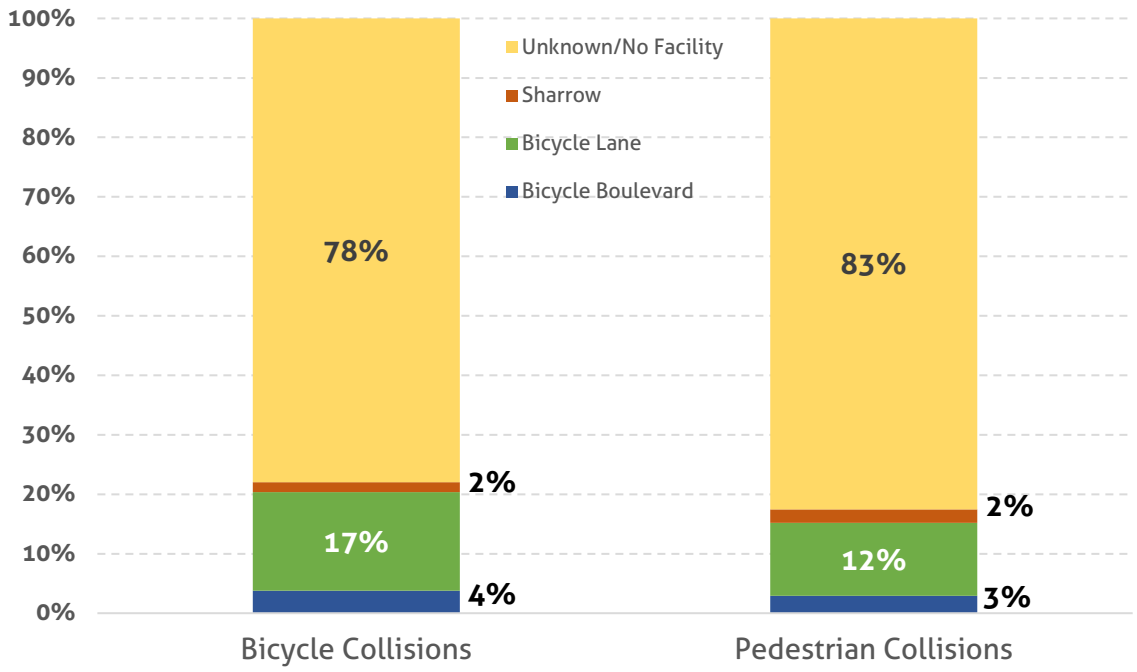


Table 8: Bicycle Collisions by Bicycle Facility and Road Classification

	Local	Collector	Minor Arterial	Principal Arterial
Bicycle Boulevard	0%	0%	1%	1%
Bike Lane	0%	3%	20%	3%
Sharrow	0%	0%	4%	0%
Unknown/No Facility	3%	12%	**25%**	**27%**

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
City of Tacoma GIS, 2018.
Fehr & Peers, 2018.

6. *Intersections on Arterials*

Intersections on a Minor or Principal Arterial are considered a risk factor for bicycle collisions.

When normalizing for amount of lane miles, Minor and Principal Arterials were found to be the most common location for bicycle collisions. Along all streets, 19% of bicycle collisions occurred at driveways, compared to only 8% of total collisions.

Table 9: Bicycle Collisions by Location and Street Classification

Location	Local	Collector	Minor Arterial	Principal Arterial
Intersection	42	33	25	57
Driveway	8	5	7	24
Roundabout/Traffic Circle	2	1	0	0
Midblock	5	3	6	18

Source:
WSDOT, "Crash Data Summary for 2012-2016 for City of Tacoma," 2018.
City of Tacoma GIS, 2018.
Fehr & Peers, 2018.

Priority Project Selection

Citywide Roadway Network Analysis

Utilizing the risk factors identified, all streets in Tacoma city limits were evaluated for the number of risk factors present. Roadways were flagged as high risk locations for KSI collisions if they had a posted speed greater than or equal to 30 MPH, were located in Mixed Use or Regional Growth Centers, were classified as a minor or principal arterial, had certain lighting conditions[3], or a high density of alcohol-related collisions[4]. (See **Figure 10** for the locations that have the greatest number of KSI risk factors.) Roadway segments were flagged as high risk locations for bicycle and pedestrian collisions if they had certain lighting conditions[4], low intersection density[5], and lack of bicycle facility as risk factors. Intersections were flagged as high risk locations for bicycle and pedestrian collisions if they had a posted speed of 25-35 MPH (inclusive), were located on arterials, or were located in Mixed Use or Regional Growth Centers. (See **Figure 11** for the locations that have the greatest number of bicycle and pedestrian risk factors.)

Figure 12 shows the cumulative breakdown of risk factors citywide. These locations include risk factors for both KSI and bicycle/pedestrian collisions and could benefit from a comprehensive improvement project.

[3] After discussion with City staff, lighting conditions that could be improved is defined as local and collector roadways that have streetlights with 100W or less, spaced more than 100 feet apart, and arterials that have streetlights with 150W or greater, spaced more than 150 feet apart.
[4] This risk factor flags roadways with the highest density of alcohol-related collisions (top 10%).
[5] Low intersection density was defined as locations with less than 150 intersections per square mile (the intersection density of a typical urban downtown). Source: Allan B. Jacobs, *Great Streets,* MIT Press, Cambridge, MA 1993.

As there were some shared risk factors between the KSI and Bicycle/Pedestrian criteria, these were combined for a total maximum risk factor score of seven. The locations that had the greatest number of total risk factors are shown in **Figure 13**.

Figure 10: Locations with the Greatest Number of KSI Risk Factors Present

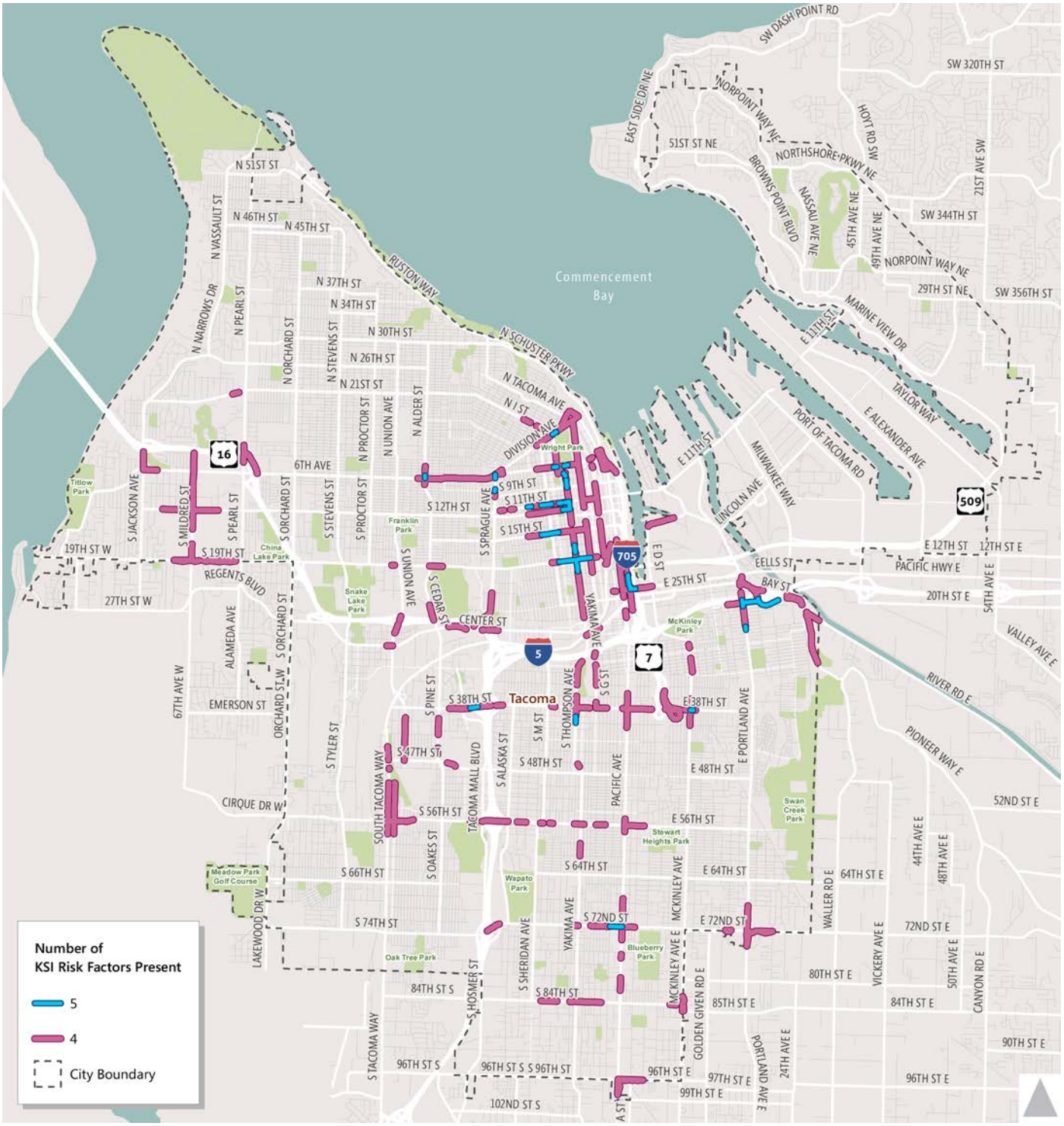


Figure 11: Locations with the Greatest Number of Bicycle and Pedestrian Risk Factors Present

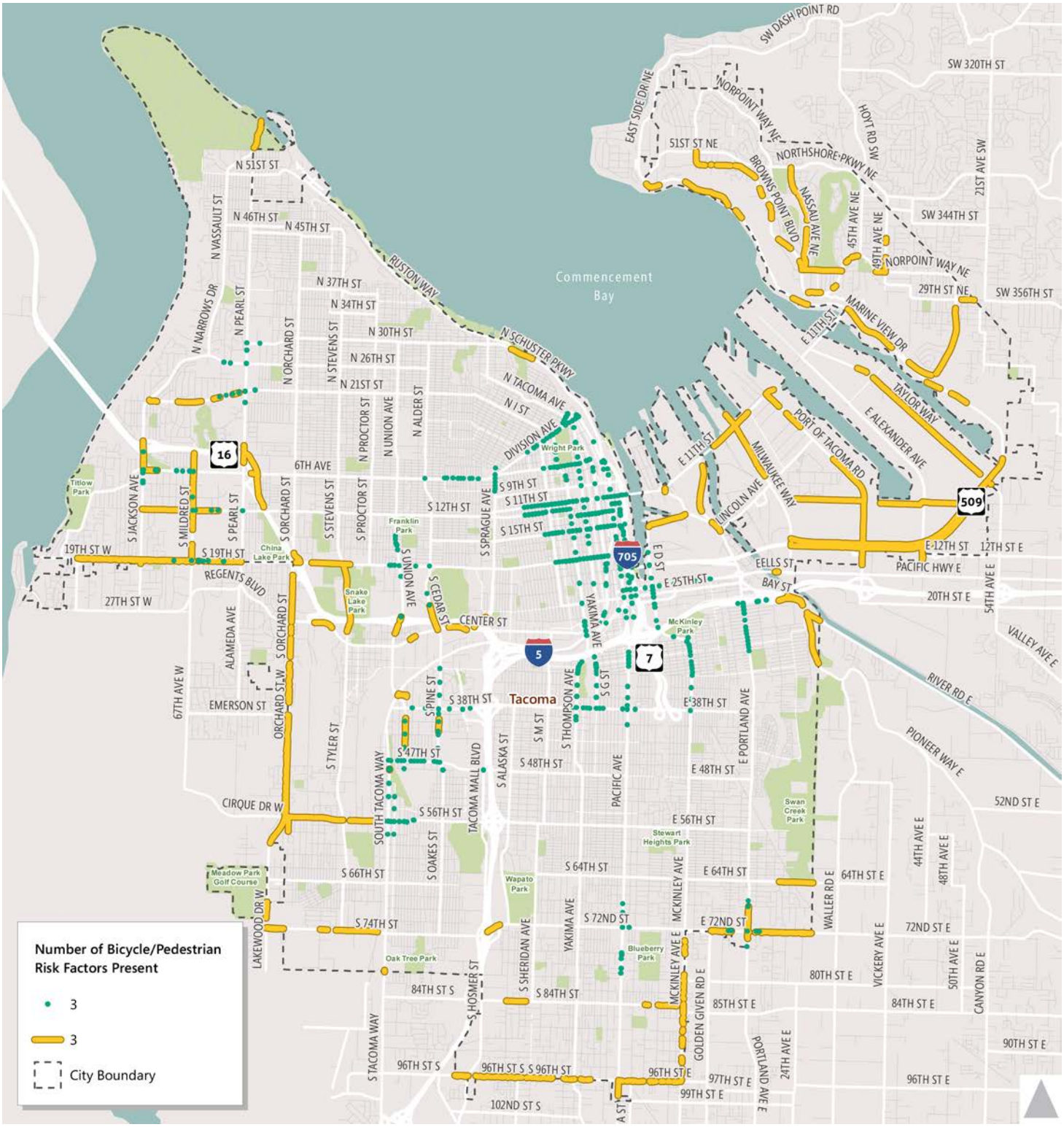


Figure 12: Map of All Risk Factors Citywide

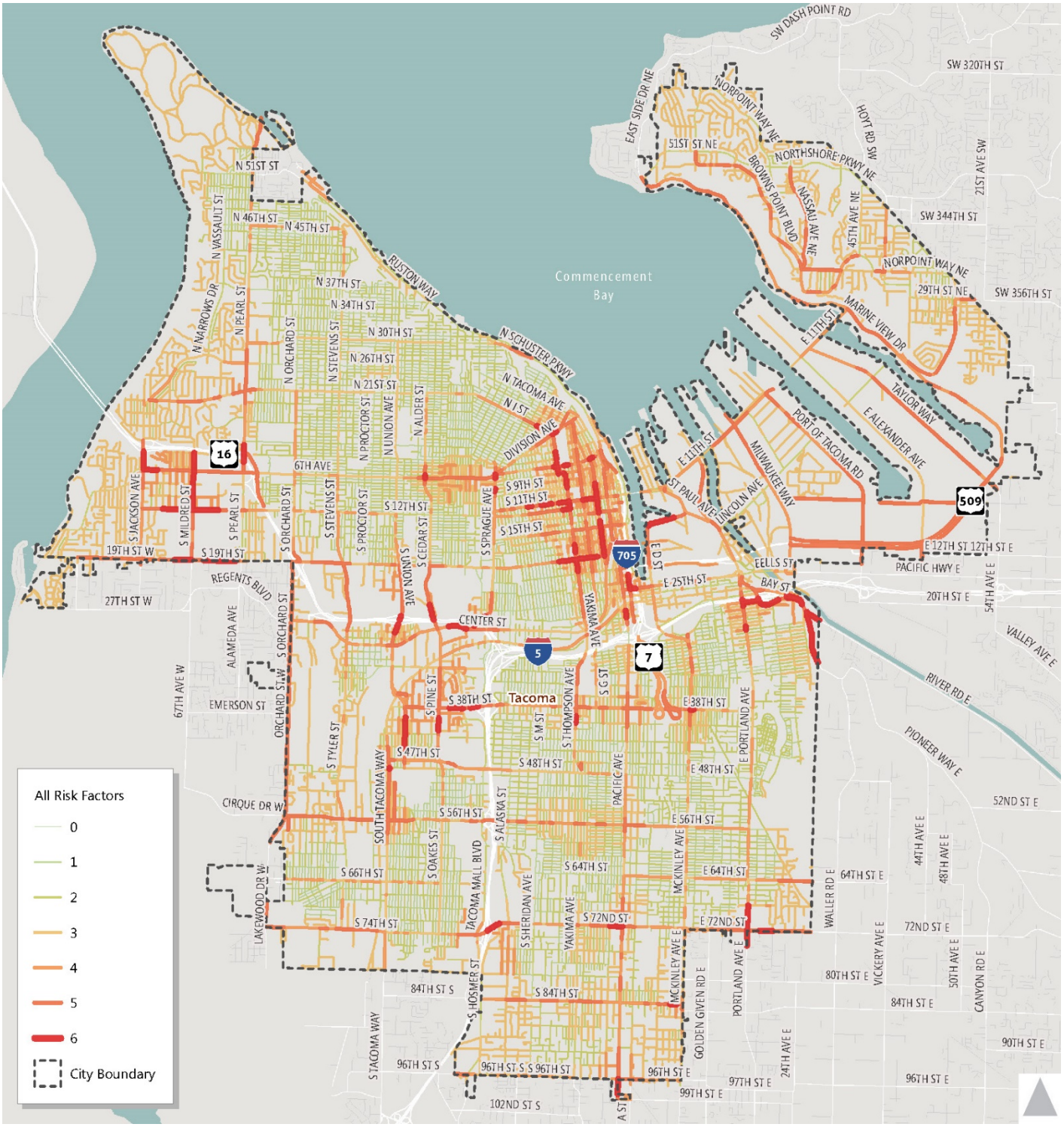
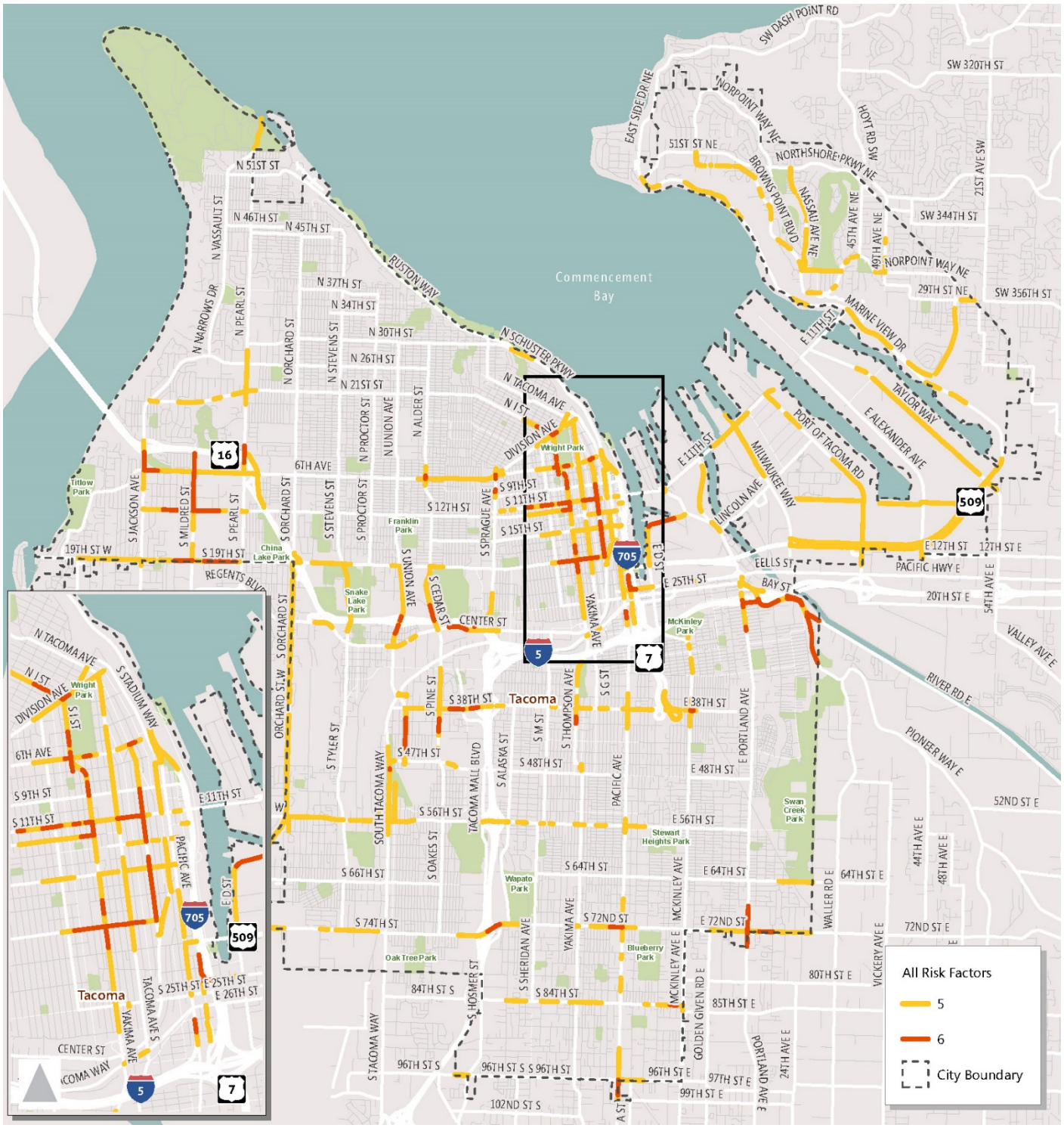


Figure 13: Map of Locations with Greatest Number of Risk Factors



Priority Segments

The Priority Segments listed below were chosen due to the high frequency of risk factors within the segment and professional judgement based on knowledge of these segments. There were no segments in the City that had all seven risk factors, so the list contains segments that have a combination of five and six risk factors. **Figure 14** shows these locations on a map.

While all of these segments are City priorities, they are listed in order of priority:

1. McKinley Avenue E from E 36th Street to E 40th Street, and S 38th Street from McKinley Avenue E to E Spokane Street
2. S 19th Street from L Street to Jefferson Avenue
3. N Pearl Street from N 11th Street to N 9th Street (under SR 16)
4. S Pine Street from South Tacoma Way to S 47th Street
5. S Cedar Street from S 19th Street to Center Street
6. Pioneer Way from Bay Street to city limits, also including River Road from Pioneer Way to city limits
7. 72nd Street E from Golden Given Road E to city limits
8. S Warner Street from S 38th Street to S 47th Street
9. Mildred Street from N 9th Street (Scott Pierson Trail) to S 12th Street (a continuation of the existing S 19th Street to S 12th Street project)
10. S 72nd Street at I-5, from S Prospect Street to S Alaska Street

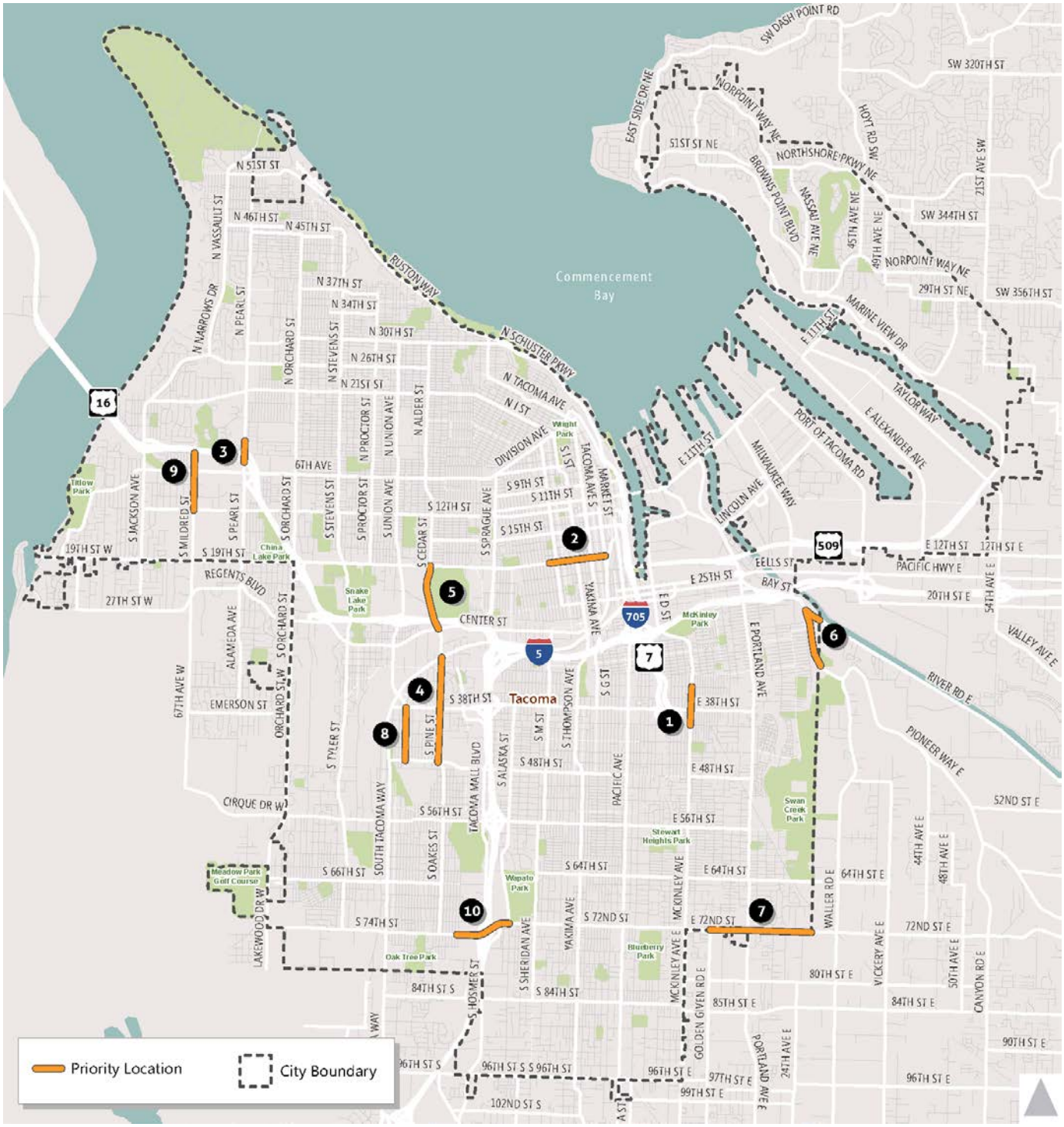
Other High Risk Locations

These projects were not chosen for the priority project list but could be locations for future funding and safety projects and so are included for reference.

1. Division Avenue from S MLK Jr Way to Broadway
    - Sound Transit TLE project
2. 6th Avenue from S MLK Jr Way to Broadway
    - Good candidate for resurfacing and restriping with bike lanes
3. St Helens Ave/Market Street from S 6th Avenue to 19th Street
    - Pierce Transit HCT project likely
4. S 11th Street from S Sheridan Avenue to Court C
    - Streetscape Corridor Improvement project potential location
5. Earnest S Brazill Street from S Sheridan Avenue to Yakima Avenue
    - Links to Opportunities project potential location
6. E 15th Street from SR 509 to St Paul Avenue
7. S Union Avenue from S Center Street to S 19th Street
8. Portland Avenue from E 32nd Street to I-5
    - HSIP project underway

9. S 38th Street from Warner Street to I-5 northbound on/off ramps
    - Likely for a different HSIP project, but candidate for a complementary project
10. S Center Street from S Cedar Street to S Wilkeson Street
11. S Pacific Avenue from city limits to S 88th Street
    - HSIP project underway
12. S Thompson Avenue from the I-5 bridge to 40th Street
    - Good candidate for resurfacing and restriping with bike lanes
13. E Portland Avenue from 68th Street to 74th Street
    - HSIP project underway
14. N Alder Street from N 7th Street Alley to S 7th Street
15. S Sprague Avenue from S 8th Street to Division Avenue
    - Possible roundabout location
16. Pacific Avenue from 27th Street to 28th Street
17. S 72nd Street from D Street to Pacific Avenue
18. 84th Street from F Street to G Street
19. S Jackson Avenue from SR 16 to 6th Avenue, continuing along 6th Avenue to S Meyers Street
    - Likely for a different HSIP project, but candidate for a complementary project
20. S 12th Street from S Jackson Street to S Pearl Street
    - Good candidate for resurfacing and restriping with bike lanes
21. S 19th Street from Grandview Drive W to S Pearl Street
22. I Street from N 4th Street to Yakima Avenue; Yakima Avenue from I Street to S 27th Street
23. S Tacoma Way at 48th Street
24. 56th Street from S Hood Street to Washington Street
    - Current project underway

Figure 14: Priority Segment Locations



Countermeasures

Countermeasures are actions that the City can take to potentially reduce the number and severity of KSI and bicycle/pedestrian collisions. These include a variety of roadway, lighting, and pedestrian facility changes, but also include programmatic actions such as education.

Countermeasure Identification

To identify potential countermeasures, the City referenced material from WSDOT Target Zero[6] and from recent Vision Zero studies in California cities including Sunnyvale, CA[7] and Sacramento, CA[8]. Countermeasures included changes to signage, physical access and speed restrictions, modifications to lanes, upgrades to signals, new or improved bicycle and pedestrian facilities, and education.

Over 40 countermeasures were selected based on their ability to address the risk factors identified within the City of Tacoma. The countermeasures applied to a location must be geographically and financially feasible and work with the City's priorities for the transportation network.

The countermeasures were evaluated based on efficacy, cost, and complexity. While the City is seeking low cost, low complexity, and highly effective safety improvements that target the primary risk factors, countermeasures that fall outside this criteria were still considered and could be appropriate depending on a priority location's unique circumstances. **Table 10** shows the list of countermeasures considered and their scoring.

Application Along Priority Segments

Once countermeasures were identified and evaluated, these were cross-referenced with the ten priority locations to determine which measures were most appropriate along each corridor. Discussion with City staff, an understanding of needs and location priorities, and engineering best practice narrowed the countermeasure list for each location. When considering projects, the priorities mapped in the Tacoma Transportation Master Plan were considered for planned automobile, transit, and bicycle corridors.[9] Projects improving pedestrian safety were considered in all locations.

Appendix A shows the countermeasures considered for each priority location.

[6] Washington State Strategic Highway Safety Plan "Target Zero" (2016)
[7] Sunnyvale Vision Zero (draft)
[8] Sacramento Vision Zero (draft 2018)
[9] City of Tacoma Transportation Master Plan (2015), page 104.

Table 10: Countermeasures Considered

Countermeasure Group	Candidate Engineering Countermeasure	Efficacy	Cost	Complexity
Guide and Feedback Signs	Speed indicator signs	Med	Med	Low
	Reduce posted speed limit	Low	Low	Low
Physical Access Restrictions	Median treatment	High	High	High
Physical Devices for Speed Maintenance	Speed humps, speed cushions, and speed tables	High	Low	Low
	Chicanes and narrowed intersections	High	Med	High
Turning Movement Modifications	Right turn on red restriction	Med	Low	Low
	Protected turns (turn pockets & signal phasing)	Med	Low	Low
	Left turn restrictions	High	Low	Low
Traffic Signal Upgrade (Minor Operational Change)	Leading bike interval	Med	Low	Low
	Leading pedestrian interval	Med	Low	Low
	Dilemma Zone Detection	Med	Med	Low
	Bicycle signal detection (pushbutton, loop detector)	n/a	Low	Low
	Add additional pedestrian crossing time	Med	Low	Low
	Add back plates with retro-reflective borders to signals, and improve visibility of signals and signs at intersections	Low	Low	Low
	Implement automated enforcement (photo red-light cameras) of red-light	Low	Low	High
Traffic Signal Upgrade (Major Operational Change)	New traffic signal	High	High	Med
	Signal timing improvements	High	Low	Low
	Add bicycle signals	Med	Med	Low
Crosswalk Installation and/or Upgrade	Pedestrian Hybrid Beacon	High	Med	Low
	New uncontrolled crosswalk (unsignalized)	Med	Low	Low
	High visibility crosswalks with advance stop or yield lines	Med	Low	Low
	New sidewalks to fill gaps	n/a	Med	Med
	Intersection, street-scale lighting	High	Med	Low

Countermeasure Group	Candidate Engineering Countermeasure	Efficacy	Cost	Complexity
	Pedestrian refuge islands and medians and shortening crossing distance	Med	Med	Low
Corner Modifications	Curb radius reduction with low-cost materials	n/a	Low	Low
	Bulb outs with low-cost materials	High	Low	Low
"Rotary" Intersection Conversion	Roundabouts	High	High	High
New Bicycle Facilities	Bike lanes	Med	Med	Low
	Buffered bike lanes	Med	High	Med
	Create bicycle boulevards on low volume, low speed streets	Med	Low	Med
	Separate shared-use or bicycle path	High	High	High
Bicycle Facility Upgrade (Minor)	Bike box	High	Low	Low
	Two-stage turn queue box	n/a	Med	High
	Green colored pavement	n/a	Med	Low
	Bike lane intersection treatments (mixing zones, bend-in/out, dashed line striping)	n/a	Low	Low
Road and Striping Modification	Lane narrowing	Med	Med	Med
	Increase road surface skid resistance using high friction surface treatments	n/a	High	High
	Install or increase illumination at locations with night time collisions	Med	Med	Med
	Redesign intersection approaches to improve sight distances and improve intersection visibility on approaches	Med	Low-High	Low-High
	Road diet	High	Med	High
Education	Implement Safe Routes to School programs and invest in constructing pedestrian and bicycle facilities near school	High	Med	Med
	Targeted Educational Campaigns (DD, Rideshare, Transit)	n/a	n/a	High

Efficacy is referencing the Crash Modification Factors Clearinghouse (FHWA, 2018). Efficacy is defined as follows:

- High = Proven to be effective based on several evaluations with consistent results
- Med = Generally accepted to be effective based on evaluations or other sources
- Low = Lower quality rating; limited evaluation or evidence; experimental; outcomes inconsistent and inconclusive between studies
- n/a = No source found

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Prioritized Project List

The list below contains the City of Tacoma's project priorities with an estimated cost for each. The projects are not listed in order of priority. **Please note that additional engineering study is needed prior to permit, design, and construction phases of any of the projects listed in this plan. Cost estimates are planning-level, so further analysis will be needed prior to design and construction.**

The City of Tacoma did not have a data inventory of some circumstantial geospatial data that could have better informed this analysis. This project list includes funding requests for data collection projects for use in future collision studies.

Table 11: Priority Project List

ID	Location	Project Description	Cost Estimate[10]
Location-Based Projects			
1a.	McKinley Ave E from E 36th St to E 40th St	On McKinley Avenue at 37th Street, add ADA curb ramps, bulb outs, and additional street lighting at crossing, which would require shifting the bus stop to the south.	$75,000
1b.	McKinley Ave E from E 36th St to E 40th St	Install an RRFB across McKinley Avenue at 36th Street, assuming guidance is met. Add ADA curb ramps, bulb outs and additional street lighting at crossing.	$95,000
1c.	McKinley Ave E from E 36th St to E 40th St	Add bike lanes on McKinley Avenue. Parking removal or widening would be needed.	$14,000 (assumes parking removal)
2a.	S 19th St from L St to Jefferson Ave	At 19th Street/Fawcett Avenue, add enhancements to pedestrian crossings across 19th Street, such as RRFBs or PHBs.	$237,000
2b.	S 19th St from L St to Jefferson Ave	At the 19th Street/Tacoma Avenue and 19th Street/Yakima Avenue intersections, add protected left-turn phasing (which would include signal cabinet/controller replacement), and high visibility crosswalks across all legs.	$241,000 (per intersection)
2c.	S 19th St from L St to Jefferson Ave	At the 19th Street/J Street and 19th Street/M.L.K. Jr Way intersections, add protected left-turn phasing (which would include signal cabinet/controller replacement).	$203,000 (per intersection)
2d.	S 19th St from L St to Jefferson Ave	At the 19th Street/G Street and the 19th Street/I Street intersections, add enhanced pedestrian crossings across 19th Street including RRFBs or PHBs. At I Street, the crosswalk would need to be on the east leg due to vertical curvature.	$237,000 (per intersection)
2e.	S 19th St from L St to Jefferson Ave	At the 19th Street/Market Street intersection, add protected left-turn phasing (which would include signal cabinet/controller replacement) and high	$335,000

[10] 35% was added to the cost to account for preliminary engineering and construction engineering

ID	Location	Project Description	Cost Estimate[10]
		visibility crosswalks across all legs, ADA compliant curb ramps, and ADA compliant pushbuttons.	
2f.	S 19th St from L St to Jefferson Ave	At the 19th Street/Jefferson Avenue intersection, add high visibility crosswalk striping across all legs, ADA compliant curb ramps, and potentially a median refuge island on 19th Street.	$70,000
2g.	S 19th St from L St to Jefferson Ave	Install speed indicator signs in downhill portions of roadway (2 eastbound, 1 westbound).	$41,000
3a.	N Pearl St from N 11th St to N 9th St (under SR 16)	Add the following trail crossing improvements: Widen both curb openings on each side of Scott Pierson Trail to 8 feet or more. (This may require one relocation and one additional drainage inlet.) Move the stop bar back from the crosswalk by a minimum of 8 feet to increase visibility. Consider relocating the chain link fence on the west side of the trail crossing back to increase sight lines. Add push button for bikes on the west side of Pearl Street on the south side of trail.	$62,000
3b.	N Pearl St from N 11th St to N 9th St (under SR 16)	Increase lighting of the trail crossing location.	$41,000
3c.	N Pearl St from N 11th St to N 9th St (under SR 16)	Add a raised median on N Pearl Street between Bantz Boulevard and N 11th Street where left turns are not possible, maintaining access to Westside Estates driveway.	$135,000
3d.	N Pearl St from N 11th St to N 9th St (under SR 16)	Reconstruct driveway at entrance to Westside Estates to improve pedestrian crossing across the driveway.	$5,000
3e.	N Pearl St from N 11th St to N 9th St (under SR 16)	Tighten the turn radius of the northeast corner of the Bantz Blvd & N Pearl Street intersection and remove the taper to slow down right turning vehicles and shorten pedestrian crossing distance.	$85,000
3f.	N Pearl St from N 11th St to N 9th St (under SR 16)	Add ADA compliant curb ramps at N Pearl Street and N 11th Street. Consider adding crosswalk on south leg.	$71,000
4a.	S Pine St from S Tacoma Way to S 47th St	At the Pine Street/Tacoma Way, Pine Street/35th Street, Pine Street/36th Street, and Pine Street/38th Street intersections, add high visibility crosswalks, ADA compliant curb ramps, and APS where applicable.	$297,000
4b.	S Pine St from S Tacoma Way to S 47th St	Install pedestrian hybrid beacon at 40th Street, 42nd Street, or 43rd Street across S Pine Street. If at 40th Street, it would need to be located on the south leg of the intersection.	$237,000
4c.	S Pine St from S Tacoma Way to S 47th St	Add pedestrian crossing across the north leg of the Pine Street/45th Street intersection to better serve bus stops, restripe the existing crosswalks on the east and south legs, and add pedestrian push buttons.	$60,000

ID	Location	Project Description	Cost Estimate[10]
4d.	S Pine St from S Tacoma Way to S 47th St	Fill sidewalk gaps on S Pine Street from S Tacoma Way to just south of S 36th Street.	$374,000
5a.	S Cedar St from S 19th St to Center St	Install sidewalks on the west and east side of Cedar Street from Center Street to just north of the SR 16 overcrossing.	$272,000
5b.	S Cedar St from S 19th St to Center St	Replace narrow sidewalk on west side of Cedar Street from just north of the SR 16 overcrossing to the Allenmore Ridge Driveway.	$380,000
5c.	S Cedar St from S 19th St to Center St	Implement road diet from 19th Street to Center Street going from two lanes in each direction with a center turn lane to a single lane in each direction, maintaining the turn lane. Add video vehicle detection for new lane configuration at S 19th Street, S 23rd Street, and Center Street intersections. Add buffered protected bike lanes (striped buffer with vertical separator) for entire corridor.	$159,000
5d.	S Cedar St from S 19th St to Center St	Upgrade the traffic signal at 23rd Street & Cedar Street in the form of 12-inch signal heads with back plates with retro-reflective borders, APS pushbuttons, and countdown pedestrian heads. At this intersection, also add high visibility crosswalk striping, and upgrade curb ramps to be ADA compliant.	$231,000
6a.	Pioneer Way from Bay St to city limits	Multimodal accommodations and connection improvements – add shared use path on west side of Pioneer Way along the entire corridor. This may require some retaining walls and significant drainage (ditch and culvert) construction. Add pedestrian scale lighting to the sidewalk. Select a fixture that minimizes light intrusion. At Pioneer Way & SR 167, compress the signal footprint and enhance pedestrian crossing(s).	$7,830,000
7a.	72nd St E from Golden Given Rd E to city limits	Provide the following pedestrian improvements: Fill sidewalk gaps from Portland Avenue to city limits. On 72nd Street at the intersections with 12th Avenue E, 20th Avenue E, and E Grandview Avenue, add appropriate uncontrolled pedestrian crossing treatments, which will include ADA compliant curb ramps to serve the transit stops and may also include context-appropriate signing, striping, and beacons.	$2,132,000
7b.	72nd St E from Golden Given Rd E to city limits	Implement a 4 to 3 lane road diet east of Portland Ave.	$45,000
7c.	72nd St E from Golden Given Rd E to city limits	At the intersection of 72nd Street/Portland Avenue, add ADA ramps on the east side corners and crosswalks to all legs.	$31,000

ID	Location	Project Description	Cost Estimate[10]
8a.	S Warner St from S 38th St to S 47th St	Provide intersection improvements at Warner Street & 38th Street, such as signal modifications, pedestrian crossing improvements, and ADA accommodation.	$405,000
8b.	S Warner St from S 38th St to S 47th St	Install buffered bike lanes from S 38th Street to S 47th Street. This will require removing parking from S 38th Street to S 40th Street, and removing the center turn lane south of S 40th Street. Add video vehicle detection for new lane configuration at 47th Street intersection.	$72,000
8c.	S Warner St from S 38th St to S 47th St	Install buffered bike lanes from 40th Street to 47th Street.	$36,000
8d.	S Warner St from S 38th St to S 47th St	At the Warner Street/40th Street and Warner Street/45th Street intersections, add corner bulb outs and high visibility crosswalks at 40th Street, 43rd Street, and 45th Street.	$176,000
8e.	S Warner St from S 38th St to S 47th St	Close sidewalk gaps on both sides of Warner Street between 43rd Street and 47th Street.	$465,000
8f.	S Warner St from S 38th St to S 47th St	At the Warner Street/47th Street intersection, add high visibility crosswalks on all legs, install ADA compliant curb ramps, and add vehicle video detection for new ramp positions.	$85,000
9a.	Mildred St from N 9th St (Scott Pierson Trail) to S 12th St	Road diet from 6th Avenue to S 12th Street, reducing vehicle lanes from two in each direction to one in each direction plus a center turn-lane/median. Add video vehicle detection for new lane configuration at the intersection of 6th Avenue & Mildred Street. Add buffered bike lanes from N 9th Street to S 12th Street.	$75,000
9b.	Mildred St from N 9th St (Scott Pierson Trail) to S 12th St	Install sidewalk on the west side of N Mildred Street from 6th Avenue to N 9th Street.	$257,000
9c.	Mildred St from N 9th St (Scott Pierson Trail) to S 12th St	Improve the N 9th Street/N Mildred Street intersection by removing the northbound free right-turn, adding curb extensions, adding ADA compliant curb ramps, and highlighting/enhancing the connection across N 9th Street to the Scott Pierson Trail.	$23,000
9d.	Mildred St from N 9th St (Scott Pierson Trail) to S 12th St	Improve the 6th Avenue/Mildred Street intersection by upgrading pedestrian push buttons, adding ADA compliant curb ramps, and striping crosswalks.	$227,000
9e.	Mildred St from N 9th St (Scott Pierson Trail) to S 12th St	At the S 8th Street/S Mildred Street intersection or the S 10th Street/Mildred Street intersection, add an enhanced pedestrian crossing (RRFB, flashing LED sign, PHB, etc.), potentially add a median refuge island, and install ADA compliant curb ramps.	$119,000 (per intersection)
10a.	S 72nd St at I-5	Add auxiliary lane for westbound traffic starting at S Hosmer St turning right northbound onto I-5.	$680,000

ID	Location	Project Description	Cost Estimate[10]
Data Request Projects			
11.	Citywide	Add permanent bike counters at specific locations within the City (6 in-road locations and 6 trail locations). This project could be scaled back if necessary.	$109,000
12.	Citywide	Conduct AM peak, mid-day, and PM peak pedestrian and bicycle counts at 20 key locations. This project could be scaled back if necessary.	$11,000
13.	Citywide	Conduct a median and traffic island inventory.	$26,000
14.	Citywide (240 centerline miles of arterials & 570 centerline miles of non-arterials)	Conduct a clear zone and fixed object inventory. Data collection on fixed objects within the clear zone, such as utility poles, trees, irrigation structures, etc. This project could be scaled back if necessary.	$48,000 (arterials) $113,000 (non-arterials)
15.	Citywide (240 centerline miles of arterials)	Conduct a sidewalk and crosswalk inventory to identify where there are gaps in the network. This project could be scaled back if necessary.	$36,000 (arterials)
Other Projects			
16.	190 sites	Add raised pavement markers to the 190 known locations of traffic islands and medians.	$12,000

Conclusion

Data propels the City to seek low cost, low complexity, and highly effective safety improvements that target the primary risk factors in Tacoma. The City identified and prioritized streets utilizing these specific risk criteria and selected countermeasures with opportunity to mitigate risk. The City will use this plan to inform future updates of the Transportation Master Plan, which is updated every two years in conjunction with the Comprehensive Plan update.

Appendix A: Countermeasure-Project Pairing

The following table pairs the 10 priority project locations with the countermeasures that would be most likely to be implemented in each location based on corridor characteristics, roadway geometry, and the risk factors present. Lowercase 'x' indicates potential countermeasures that were not chosen for the final project list but could be considered for future projects, while uppercase '**X**' indicates countermeasures that were included on the project list.

Countermeasure Group	Candidate Countermeasure	Mildred St	19th St	Cedar St	Warner St	Pine St	Pioneer Way/ River Rd	E 72nd St	Pearl St	McKinley Ave	S 72nd St
Guide and Feedback Signs	Speed indicator signs	x	**X**	x		x		x			x
	Reduce posted speed limit	x			x	x				x	
Physical Devices for Speed Maintenance	Speed humps, speed cushions, and speed tables				x					x	
	Chicanes and narrowed intersections				x					x	
Turning Movement Modifications	Right turn on red restriction		x	x					x		
	Protected turns (turn pockets & signal phasing)		**X**	x							
	Left turn restrictions			x							
Traffic Signal Upgrade (Minor Operational Change)	Leading bike interval	x		x		x					
	Leading pedestrian interval	x	x	x		x		x			

Countermeasure Group	Candidate Countermeasure	Mildred St	19th St	Cedar St	Warner St	Pine St	Pioneer Way/ River Rd	E 72nd St	Pearl St	McKinley Ave	S 72nd St
Traffic Signal Upgrade (Minor Operational Change)	Bicycle signal detection (pushbutton, loop detector)	x		x		x			**X**		
	Add additional pedestrian crossing time		x	x							x
	Add back plates with retro-reflective borders to signals, and improve visibility of signals and signs at intersections		x	**X**		x	x	x	x		x
	Implement automated enforcement (photo red-light cameras) of red-light		x	x	x	x	x	x	x	x	x
Traffic Signal Upgrade (Major Operational Change)	Signal timing improvements				**X**			x	x		
	Add bicycle signals			x		x					
Crosswalk Installation and/or Upgrade	Pedestrian Hybrid Beacon	**X**	**X**	x	x	**X**				**X**	
	New uncontrolled crosswalk (unsignalized)		x		x	x					
	High visibility crosswalks with advance stop or yield lines	**X**	**X**	**X**	**X**	**X**	x	**X**	**X**	**X**	
	New sidewalks to fill gaps	**X**		**X**	**X**	**X**	x	**X**			
	Intersection, street-scale lighting							x	**X**	**X**	x
	Pedestrian refuge islands and medians and shortening crossing distance	**X**	**X**		x	x			**X**		x

Countermeasure Group	Candidate Countermeasure	Mildred St	19th St	Cedar St	Warner St	Pine St	Pioneer Way/ River Rd	E 72nd St	Pearl St	McKinley Ave	S 72nd St
Corner Modifications	Curb radius reduction with low-cost materials		x		x	x					
	Bulb outs with low-cost materials	**X**	x		**X**	x				**X**	
New Bicycle Facilities	Bike lanes									**X**	
	Buffered bike lanes	**X**		**X**	**X**	x				x	**X**
	Separate shared-use or bicycle path			x		x	**X**			x	**X**
Road and Striping Modification	Lane narrowing	x		x	x		x		x		
	Increase road surface skid resistance using high friction surface treatments		x	x		x					
	Install or increase illumination at locations with night time collisions	x	x	x	x	x	**X**	x	x	x	x
	Redesign intersection approaches to improve sight distances and improve intersection visibility on approaches		x								
	Road diet	**X**		**X**	x			**X**			

Countermeasure Group	Candidate Countermeasure	Mildred St	19th St	Cedar St	Warner St	Pine St	Pioneer Way/ River Rd	E 72nd St	Pearl St	McKinley Ave	S 72nd St
Education	Implement Safe Routes to School programs and invest in constructing pedestrian and bicycle facilities near school	x							x	x	
	Targeted Educational Campaigns (DD, Rideshare, Transit)	x	x				x		x	x	x

Source:
Fehr & Peers, 2018


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