Alameda
Vision Zero Action Plan

APPENDIX F. DETAILED CRASH ANALYSIS

VISION ZERO
ALAMEDA
SAFER STREETS FOR ALL

November 3, 2021

To: Rochelle Wheeler and Lisa Foster, City of Alameda
From: Megan Wooley-Ousdahl, AICP, Jessica Zdeb, AICP, Frank Proulx, PhD, Brian Almdale, Toole Design
Project: City of Alameda Active Transportation Plan and Vision Zero Action Plan

RE: Crash Analysis Summary

This memorandum provides a summary of a crash data analysis, including an overview of the crash data used in the analysis, the analysis methodology, trends for all crashes in Alameda, and trends for collisions occurring on key corridors in the City.

There are two primary components to the analysis. First, collisions are described in terms of their characteristics such as when the crash occurred, the movements of the involved parties preceding the collision, and the built environment characteristics of the location where the crash occurred. Second, high priority locations are identified using a moving window network screen. In this approach, the network is evaluated to identify portions with either very high concentrations of lower severity crashes, or moderate concentrations of higher severity crashes.

Summary of Key Findings

All-Modes Findings

- Crash frequencies were highest during peak commute times. This is expected as high crash frequencies typically occur when there is higher level of activity.
- Crashes occurred disproportionately along arterial streets. Arterial streets make up roughly 23 percent of Alameda's street network on a per mile basis, but 60 percent of all crashes occurred along these streets. This finding is also true for each mode independently.
- Automobile right of way was the most frequent violation type (22 percent of all crashes; 12 percent of KSI crashes). This violation classification consists of several different types of violations: failing to stop at a stop sign, failing to yield when pulling out of a driveway, failing to yield on a left turn, etc.
- Overall, drivers were found at fault in 74 percent of crashes, a number that's swayed by the fact that the majority of crashes only involved drivers.
- Overall, pedestrians were found at fault in 21percent of pedestrian crashes, bicyclists were at fault in 44 percent of bicycle crashes, and motorcyclists were at fault in 51 percent of motorcycle crashes.

Pedestrian and Bicyclist Crashes

- Pedestrian and bicycle crashes were disproportionately severe when compared to automobile crashes. While 2 percent of overall automobile crashes resulted in a fatality or serious injury (KSI), 12 percent of pedestrian and 8 percent of bicycle crashes, respectively, result in a KSI crash.
- Historical crash data (ten years) suggest bicycle and pedestrian crashes have remained relatively stable with a possible and marginal decline in recent years.
- Hit and run crashes were found to be a substantial problem for people walking and bicycling in Alameda.
- Weather conditions did not appear to be a significant factor in pedestrian and bicycle crashes. The majority of these crashes occurred during clear weather conditions and on dry roadway surfaces.

- Bicycle and pedestrian crashes and KSI crashes for both modes occurred most frequently at intersections, specifically at unsignalized intersections, suggesting the need for enhanced crossing countermeasures at unsignalized locations.
- Roadways with higher functional classifications had a higher share of pedestrian and bicyclists crashes in terms of frequency and severity and on a per-mile basis. These roadways typically have higher speeds and motor vehicle volumes than roadways with lower functional classifications (e.g., local or collector).
- The most common pedestrian movement-based crash types include:
  - pedestrian crossing in a crosswalk at an intersection struck by a motorist traveling straight (25 percent of all crashes),
  - pedestrian crossing in a crosswalk at an intersection struck by a motorist making a left turn (25 percent of all crashes), and
  - pedestrian crossing not in a crosswalk struck by a motorist proceeding straight (18 percent of all crashes).
- The most common bicyclist movement-based crash types include:
  - bicyclist proceeding straight and motorist proceeding straight (38 percent of all crashes),[1]
  - solo bicycle crash (17 percent of all crashes), and
  - bicyclist proceeding straight and motorist making a left turn (8 percent of all crashes)
- For pedestrian crashes, over three quarters of the reported party at fault and violation types were either coded as driver at fault - pedestrian right of way (55 percent) or pedestrian at fault - pedestrian violation (20 percent). While we understand which party was reported to be at fault, these broad categories make it difficult to understand the actions the led up to the crash.
- For bicycle crashes, 27 of the reported part at fault and violations types were either coded as bicyclist at fault – automobile right of way (14 percent) and driver at fault – bicyclist right of way (13 percent). Similar to pedestrian crashes, these broad categories make it difficult to understand the actions that led up to the crash.
- Pedestrian crash frequencies were lowest during the spring, summer, and fall months (5 percent in August) and highest during the winter months (13 percent in November and December). KSI crashes occurring during daylight conditions (18 KSI crashes) and dark lighting conditions (20 KSI Crashes) were somewhat similar. However, roughly 9 percent of crashes that occurred during daylight lighting conditions resulted in a KSI, whereas 16 percent of crashes that occurred during dark lighting conditions resulted in a KSI. This pattern suggests higher crash risk for pedestrians and might be related to varying sunset times (daylight savings) and most likely tied to dark lighting conditions during the winter months leading to higher rates of motorists not yielding or stopping to pedestrians.

Motorcycle and Automobile Crashes

- Motorcycle crashes were disproportionately severe when compared to other motor vehicle crashes. While 2 percent of motor vehicle crashes resulted in a KSI, 17 percent of motorcycle crashes result in a KSI.
- Historical crash data (ten years) suggests a possible gradual increase in motor vehicle crashes. Motorcycle crash frequencies have remained relatively stable from year to year.
- The most common automobile crash types include broadside crashes (38 percent), rear end (31 percent), and sideswipe (10 percent). The most common crash type resulting in a KSI includes broadside crashes

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[1] The top three violation types for bicycle proceeding straight and motorist proceeding straight include:

1. Driver or bicyclist must travel on the right half of the road (6 percent crashes)
2. Must yield to traffic when entering or crossing a roadway (6 percent of crashes)
3. Failure to yield or stop at a stop sign (5 percent of crashes)

(22 percent) followed by hit object[2] (22 percent). Unsurprisingly, rear end crashes have the second lowest share of KSI crashes.

- Unsafe speed, automobile right of way, and improper turning represented the top three most common violations for both motorcycle and motor vehicle crashes.
- The most common movement-based crash type for motorcycle crashes occurred when the motorcyclist proceeded straight and the motorist proceeded straight, which accounted for the largest share of crashes with 67 percent of all crashes and 52 percent of KSI crashes. The most common violations coded to this crash type include driver operating vehicle at an unsafe speed (33 percent of all crashes; 27 percent of KSI Crashes) followed by failure to yield to oncoming traffic while making a turn (14 percent of all crashes; 18 percent of KSI crashes).

Findings Related to Victims

- Victims aged between 15 and 24 were substantially over-represented in injury crashes, more than any other age cohort relative to the city's population. The majority of victims within this age cohort were passengers accounting for 43 percent of this age cohort's victims, followed by the victim being a driver (28 percent of victims).
- Younger (10-24) and older (65-84) populations were substantially over-represented in fatal and serious injury crashes as a result of traffic safety related issues leading to a crash.
- "Black", "Hispanic", and "Other" victims were disproportionately victims of traffic-related safety issues. "Black", "Other", and "White" victims were over-represented in KSI crashes.[3]

[2] Hit object can refer to a motorist striking a light pole, a barrier, traffic signal, etc.

[3] The reported races are completed by the reporting officer using their own observations and best judgment. While using personal best judgment is common practice for many reporting protocols, this method for reporting race will inevitably lead to inaccurate classification of some victims.

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Analysis Methodology

This section of the report describes the steps taken to assemble the working dataset, as well as the analytical framework used to develop the summary statistics.

Crash Data

Geocoded crash data is critical to understanding traffic safety patterns. Police reports of collisions are the primary source for crash data. While police-reported crash data is known to have problems with underreporting,[4,5] it is often the most complete data source and provides necessary details for informing engineering treatments, such as the location of the collision and dynamics between the parties involved in the crash. Additionally, underreporting may be higher for some portions of the population and possibly higher for some modes of transportation.

The crash data used in this analysis is the California Highway Patrol's (CHP) Statewide Integrated Traffic Records System (SWITRS), accessed via the Transportation Injury Mapping System (TIMS), which geocodes the data.[6] Datasets were downloaded for the 2009-2018 time period, the ten most recent years of data. The 2016-2018 data are still considered "provisional," which means that the overall numbers could change slightly if additional reports are identified and processed.[7] However, correspondence with the TIMS managers suggested that there are unlikely to be substantial changes from the current version, especially for 2016 values. Some fatal crashes have been added or corrected during a data review process with the City of Alameda and the Alameda Police Department.

The crash locations were reviewed to ensure the crashes are mapped at the correct locations. In doing so, the following subset of crashes were removed from the analysis datasets:

- Crashes that appear to be outside the City of Alameda
  - 46 overall crashes
  - 3 seriously injured crashes

The comparisons and summaries made in this analysis largely report the overall number of crashes, not the number of victims involved in the crash. The number of victims is only summarized in the victims section of this memo. Any given crash may injure multiple victims, at different levels of severity. Therefore, accurate comparisons are not able to be made between the victims section to other parts of this memo.

Network Data

To contextualize the crash data, the analysis assembled a spatial dataset including roadway characteristics and land uses. The roadway characteristics provided by the City of Alameda were spatially joined to roadway segments and to intersections to be used in identifying any potential crash patterns. The City of Alameda's GIS centerline layer and a geospatially generated intersection point layer were used as base layers in developing the

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[4] Stutts, J., & Hunter, W. (1998). Police reporting of pedestrians and bicyclists treated in hospital emergency rooms. Transportation Research Record: Journal of the Transportation Research Board, (1635), 88-92.

[5] San Francisco Department of Public Health-Program on Health, Equity and Sustainability. 2017. Vision Zero High Injury Network: 2017 Update – A Methodology for San Francisco, California. San Francisco, CA. Available at: https://www.sfdph.org/dph/files/EHSdocs/PHES/VisionZero/2017_Vision_Zero_Network_Update_Methodology_Final_20170725.pdf

[6] Tims.berkeley.edu

[7] 1,873 crashes were collected from TIMS. Of those crashes, 46 crashes were removed for being located outside the City of Alameda. The final study dataset is made up of 1,827 crashes.

analysis network datasets. These datasets were used to identify crash patterns and as the base network in developing a high injury corridor (HIC) map.

Crash Trends

This section examines temporal patterns in crashes that occurred in Alameda between 2009 and 2018.[8] The percent share of overall crashes by mode and KSI crashes by mode can be viewed in Figure 1. While it is clear that motor vehicles dominate the crash data in terms of overall crashes, those crashes were much less likely to result in a KSI outcome when compared to crashes that involved a pedestrian, bicyclist, or a motorcyclist. Motor vehicle crashes were the majority of overall crashes and accounted for 55 percent of all crashes, followed by bicyclists (21 percent), pedestrians (17 percent), and motorcycles (7 percent). However, when comparing the percent share of crashes where people were killed or serious injured (KSI), pedestrian, bicyclist, and motorcycle crashes are disproportionately severe compared to motor vehicle crashes representing 34, 27, and 19 percent of all KSI crashes respectively. Additionally, while only 2 percent of motor vehicle crashes resulted in a KSI (23 KSI crashes / 1,008 crashes), 12 percent of pedestrian crashes resulted in a KSI, 8 percent for bicyclists, and 17 percent for motorcycles (see Figure 2). This stark contrast highlights the vulnerability of non-automobile roadway users and the need for safety improvement to ensure everyone has the ability to travel throughout Alameda confidently and safely.

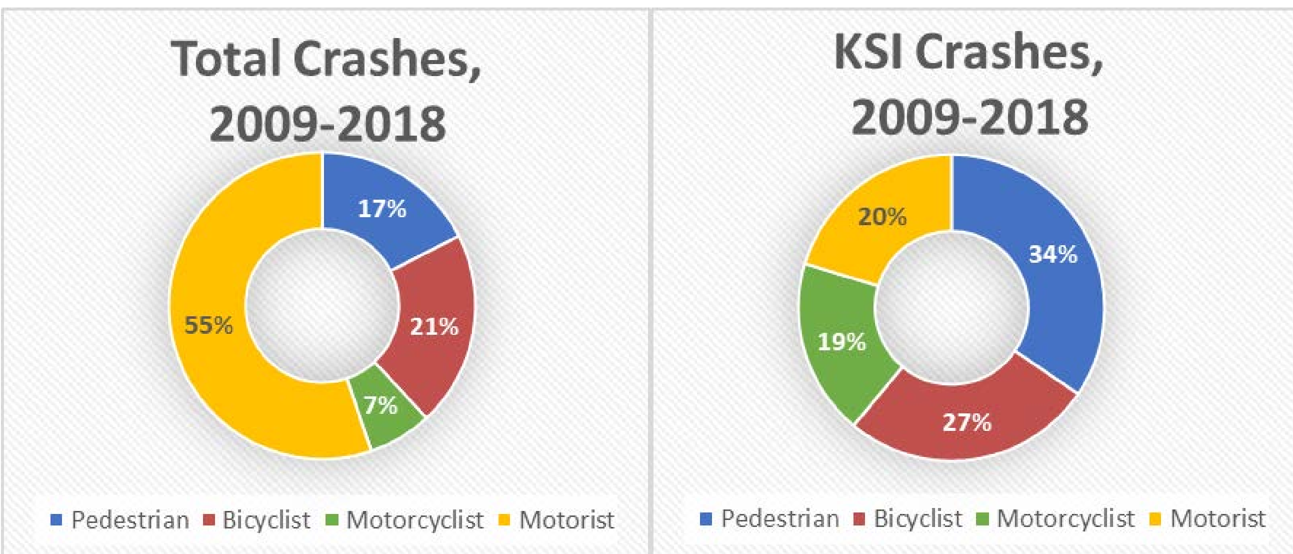

Figure 1: Percent Share of Crashes by Mode, 2009-2018

[8] Crashes used in this analysis do not include property damage only crashes as those records are not available from the crash data source (TIMS).

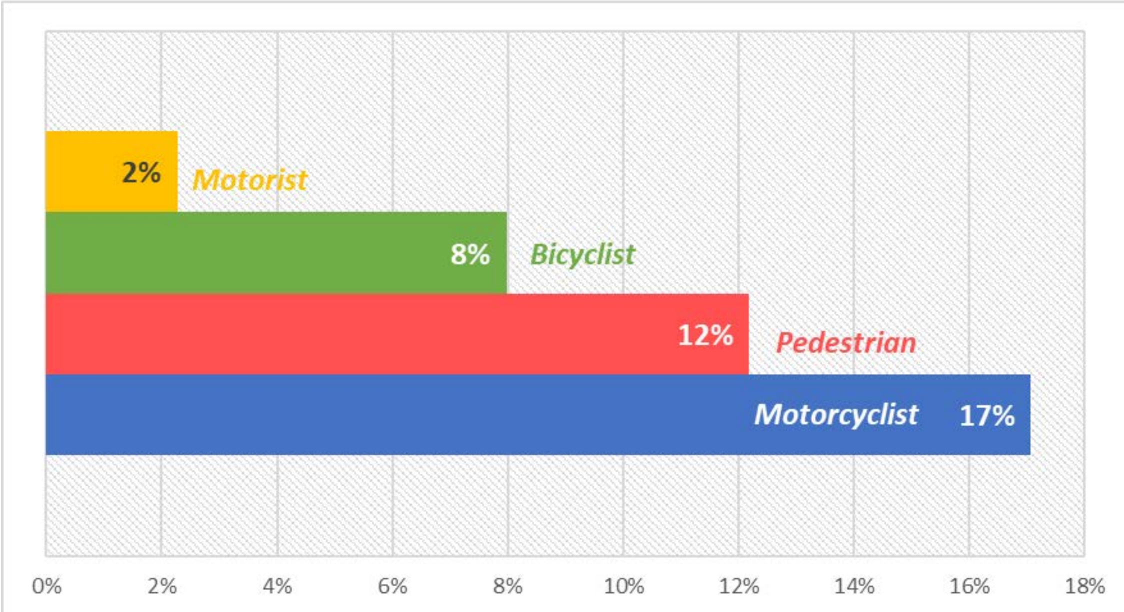

Figure 2: Percent of crashes that result in a KSI, 2009-2018

Crashes by Year

Table 1 summarizes crash frequency for all modes combined by year for the study time period and Figure 3 displays annual crashes by mode. Overall, there appears to be little annual change in the aggregate number of crashes from year to year. When reviewing overall crash patterns by mode, the same finding is true. The number of KSI crashes per year has been relatively stable staying between 8 and 14 KSI crashes per year with 2009 accounting for the fewest number of KSI crashes and 2011 accounting for the highest number of KSI crashes. When viewing crash frequencies by mode (Figure 3), crash frequencies were generally constant as well, though motor vehicle crashes appear to be have gradually increased over the ten-year period. Pedestrian and bicyclist also appear to have a very gradual reduction in crashes, though due to the small sample size this reduction might just be statistical noise.

Table 1: Crashes by Year, 2009-2018

Year	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
2009	180	10%	8	7%	172	10%
2010	160	9%	12	11%	148	9%
2011	180	10%	14	12%	166	10%
2012	186	10%	11	10%	175	10%
2013	202	11%	12	11%	190	11%
2014	173	9%	12	11%	161	9%

Year	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
2015	160	9%	13	12%	147	9%
2016	217	12%	10	9%	207	12%
2017	198	11%	9	8%	189	11%
2018	171	9%	12	11%	159	9%
Total	**1,827**	**100%**	**113**	**100%**	**1,714**	**100%**

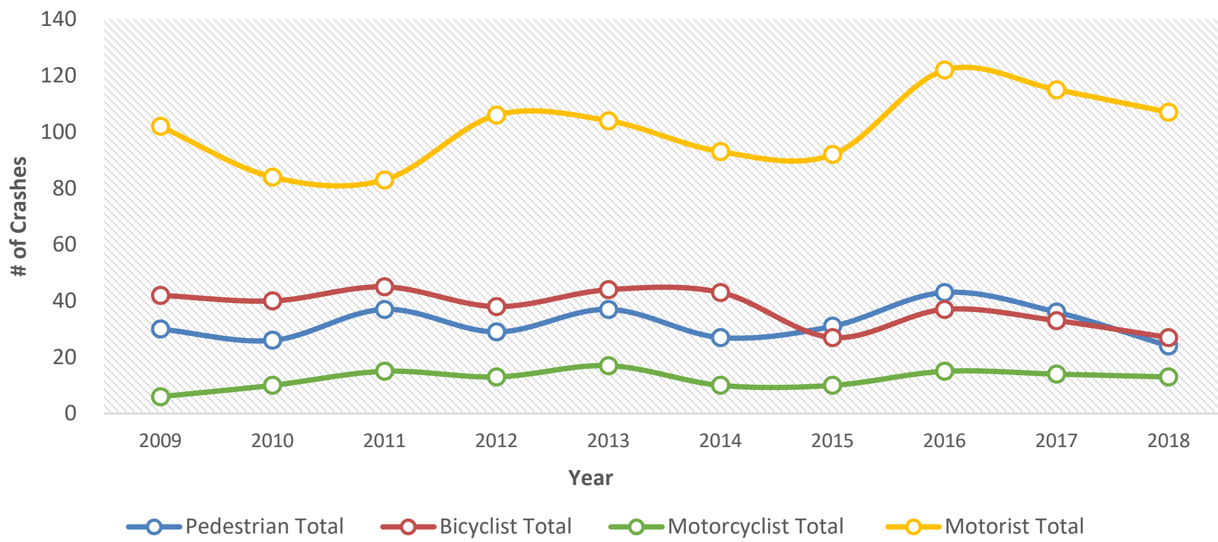

Figure 3: Crashes by Year and Mode, 2009-2018

Table 5 reports the number of crashes for each mode by crash severity. While the sample is quite small for each mode, these tables can serve as a snapshot and be used for comparison in future years to evaluate how investments made in traffic safety are impacting crash frequencies and crash severity by mode.

Table 2: Pedestrian Crashes by Year and Crash Severity, 2009-2018

Year	Total	Fatal	Severe	Other Injury[9]	Possible Injury[10]
2009	30	0	3	13	14
2010	26	0	4	17	5
2011	37	1	5	13	18
2012	29	0	3	11	15
2013	37	0	4	15	18
2014	27	2	3	8	14
2015	31	2	2	12	15
2016	43	1	3	19	20
2017	36	0	3	17	16
2018	24	2	1	7	14
Total	**320**	**8**	**31**	**132**	**149**

Table 3: Bicyclist Crashes by Year and Crash Severity, 2009-2018

Year	Total	Fatal	Severe	Other Injury	Possible Injury
2009	42	0	0	29	13
2010	40	0	3	18	19
2011	45	1	4	23	17
2012	38	0	4	21	13
2013	44	0	4	27	13
2014	43	0	2	19	22
2015	27	0	4	8	15

[9] An "injury", other than a fatal or severe injury, which is evident to observers at the scene of the collision. "Injury" crashes include: (1) Bruises, discoloration, or swelling. (2) Minor lacerations or abrasions. (3) Minor burns.

Source: California Highway Patrol. "Collision Investigation Manual." 2003.

[10] "Possible injury" could contain authentic internal, other non-visible injuries, and fraudulent claims of injury. "Possible injury" includes: (1) Persons who seem dazed, confused, or incoherent (unless such behavior can be attributed to intoxication, extreme age, illness, or mental infirmities). (2) Persons who are limping, or complaining of pain or nausea, but do not have visible injuries. (3) Any person who may have been unconscious, as a result of the collision, although it appears he/she has recovered. (4) Persons who say they want to be listed as injured but do not appear to be so.

Source: California Highway Patrol. "Collision Investigation Manual." 2003.

Year	Total	Fatal	Severe	Other Injury	Possible Injury
2016	37	1	2	21	13
2017	33	0	2	14	17
2018	27	0	3	17	7
Total	**376**	**2**	**28**	**197**	**149**

Table 4: Motorcycle Crashes by Year and Crash Severity, 2009-2018

Year	Total	Fatal	Severe	Other Injury	Possible Injury
2009	6	0	1	2	3
2010	10	0	2	5	3
2011	15	1	1	4	9
2012	13	2	0	8	3
2013	17	0	3	5	9
2014	10	0	3	2	5
2015	10	0	2	2	6
2016	15	0	2	9	4
2017	14	0	2	7	5
2018	13	0	2	5	6
Total	**123**	**3**	**18**	**49**	**53**

Table 5: Motor Vehicle Crashes by Year and Crash Severity, 2009-2018

Year	Total	Fatal	Severe	Other Injury	Possible Injury
2009	102	0	4	20	78
2010	84	0	3	17	64
2011	83	0	1	17	65
2012	106	0	2	19	85
2013	104	0	1	17	86

Year	Total	Fatal	Severe	Other Injury	Possible Injury
2014	93	0	2	20	71
2015	92	2	1	20	69
2016	122	0	1	24	97
2017	115	1	1	28	85
2018	107	1	3	21	82
Total	**1,008**	**4**	**19**	**203**	**782**

Crashes by Month

Table 6 summarizes crash frequencies for all modes combined by month during the study period. The percent share of crashes per month didn't vary much from month to month. The percent share of crashes ranged from 7 percent in February and March to 10 percent in November and December. KSI crashes occurred most frequently from May to June, in September, and from November to December.

Seasonal patterns are slightly more apparent when reviewing month crash frequencies broken out by mode (see Figure 4). Pedestrian crash frequencies were lowest during the spring, summer, and fall months (5 percent in August) and highest during the winter months (13 percent each in November and December). This pattern suggests higher crash risk for pedestrians and might be related to varying sunset times (daylight savings) and most likely tied to dark lighting conditions during the winter months leading to higher rates of motorists not yielding or stopping to pedestrians. Weather conditions did not appear to be a significant factor in pedestrian or bicycle crashes. Even in the winter, the majority of these crashes occurred during clear weather conditions. Bicyclist crash frequency was highest in September and was relatively stable during the spring and summer months. The peak in bicycle crashes might be related to favorable bicycling conditions and the dip in bicycle crashes during the winter months could be related to fewer people biking in the colder and wetter weather conditions. Motorcycle crashes varied quite a bit from month to month, but due to the relatively small sample size this is likely related to the statistical phenomena called regression towards the mean, which explains some of the rather large variations. While regression towards the mean is likely being observed, motorcycle crashes occurred most often during the summer months. Automobile crashes didn't have much seasonal variation in terms of crash frequency, although crash frequencies were lowest during the spring months.

Table 6: Crashes by Month, All Modes Aggregated, 2009-2018

Month	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
January	158	9%	8	7%	150	9%
February	121	7%	0	0%	121	7%
March	131	7%	8	7%	123	7%
April	139	8%	5	4%	134	8%

Month	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
May	161	9%	13	12%	148	9%
June	145	8%	12	11%	133	8%
July	145	8%	5	4%	140	8%
August	146	8%	9	8%	137	8%
September	159	9%	12	11%	147	9%
October	170	9%	9	8%	161	9%
November	175	10%	17	15%	158	9%
December	175	10%	13	12%	162	9%
unknown	2	0%	2	2%	0	0%
Total	**1,827**	**100%**	**113**	**100%**	**1,714**	**100%**

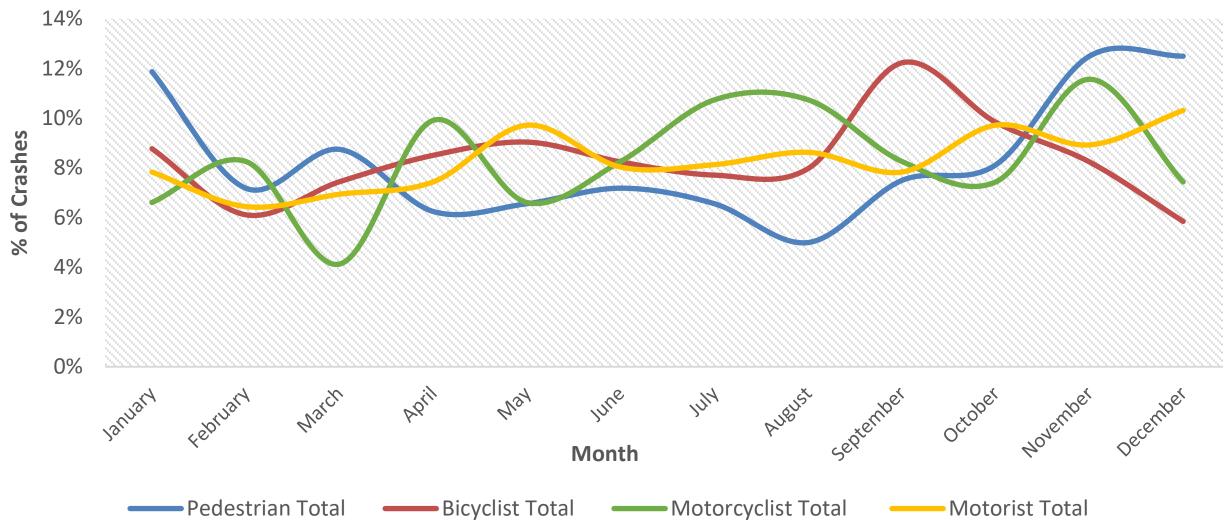

Figure 4: Crashes by Month and Mode, 2009-2018

Crashes by Day of Week

Table 7 summarizes crash frequency and crash severity by day of week for all modes combined. Crashes were evenly distributed throughout the week, though there are marginally lower frequencies occurring during the weekend, which could suggest lower levels of travel activity or risk during the weekend. Figure 5 displays crash frequencies by day of week separated out by mode. Bicyclist crashes occurred most frequently on Tuesdays (22 percent of bicyclist crashes) and were lowest on Saturdays (9 percent of weekly total), which may indicate fewer bike trips during the weekends. Pedestrian and motorcycle crash frequencies followed similar patterns during the week with the lowest frequencies at the beginning of the week, leveled out between Tuesday through Friday, but pedestrian crashes dipped on Saturday and motorcycle crashes increased on Saturday. Motor vehicle crashes were evenly distributed throughout the week with no discernable patterns.

Table 7: Crashes by Day of Week, 2009-2018

Day of Week	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
Sunday	245	13%	11	10%	234	14%
Monday	265	15%	11	10%	254	15%
Tuesday	297	16%	20	19%	277	16%
Wednesday	248	14%	9	8%	239	14%
Thursday	269	15%	20	19%	249	15%
Friday	266	15%	21	20%	245	14%
Saturday	231	13%	15	14%	216	13%
Total	**1,821**	**100%**	**107**	**100%**	**1,714**	**100%**

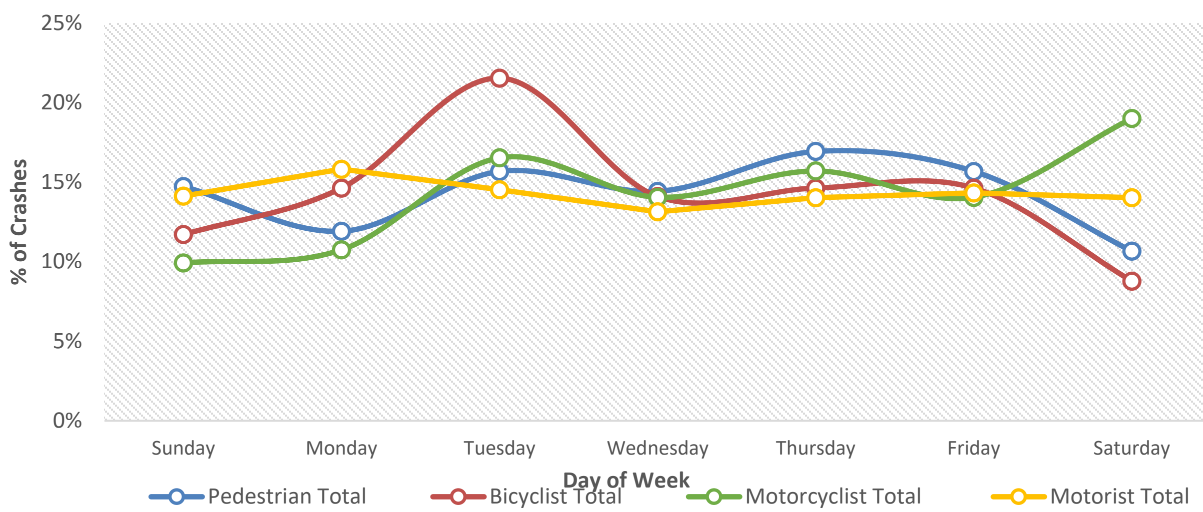

Figure 5: Crashes by Day of Week and Mode, 2009-2018

Crashes by Time of Day

Table 8 summarizes weekday crash frequency for all modes by time of day and crash severity for all modes combined. There are two observable peaks for overall crashes, KSI crashes, and injury crashes; one peak in the morning (6:00-8:59 AM) and another in the evening (3:00-5:59 PM). These morning and evening peaks are expected because these periods of time typically have the highest levels of activities (commuting to/from work, social events, running errands, school drop off/pick up, etc.). Figure **6** displays the distribution of weekday crashes for each mode by time of day. These crash patterns follow similar patterns as the aggregate crashes in

Table 8. However, the PM peak associated with pedestrian crashes extends from 3:00-8:59 PM, illustrating pedestrian vulnerability during the evening and dark lighting conditions. Bicyclist crashes are highest during the typical PM commute period (3:00-5:59 PM) but also have a relatively high peak during the AM commuter period (6:00-8:59 AM) as well. The concentration of AM and PM bicyclist crashes during these two time periods may indicate higher levels of utilitarian trips (i.e., commute to work) rather than recreational trips on weekdays. Motorcycle crashes have two peaks; one between 6:00-8:59 AM and the other peak during 3:00-5:59 PM. A third and moderately small bump is observable for motorcycle crashes during the 9:00-11:59 PM period. While the overall number of motorcycle crashes is relatively low, this late evening peak might suggest a heightened level of risk for motorcycles during the evening and during dark lighting conditions. Motor vehicle crash frequencies peak during the 3:00-5:59 PM time period. Typically, auto traffic is heavier in the afternoon commute period than morning commute period, which may explain this.

Table 8: Weekday Crashes by Time of Day, All Modes Aggregated, 2009-2018

Time of Day	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
12:00-2:59 AM	52	4%	4	5%	48	4%
3:00-5:59 AM	16	1%	4	5%	12	1%
6:00-8:59 AM	256	19%	21	26%	235	19%
9:00-11:59 AM	167	12%	7	9%	160	13%
12:00-2:59 PM	232	17%	9	11%	223	18%
3:00-5:59 PM	337	25%	18	22%	319	25%
6:00-8:59 PM	178	13%	12	15%	166	13%
9:00-11:59 PM	107	8%	6	7%	101	8%
Total	**1,345**	**100%**	**81**	**100%**	**1,264**	**100%**

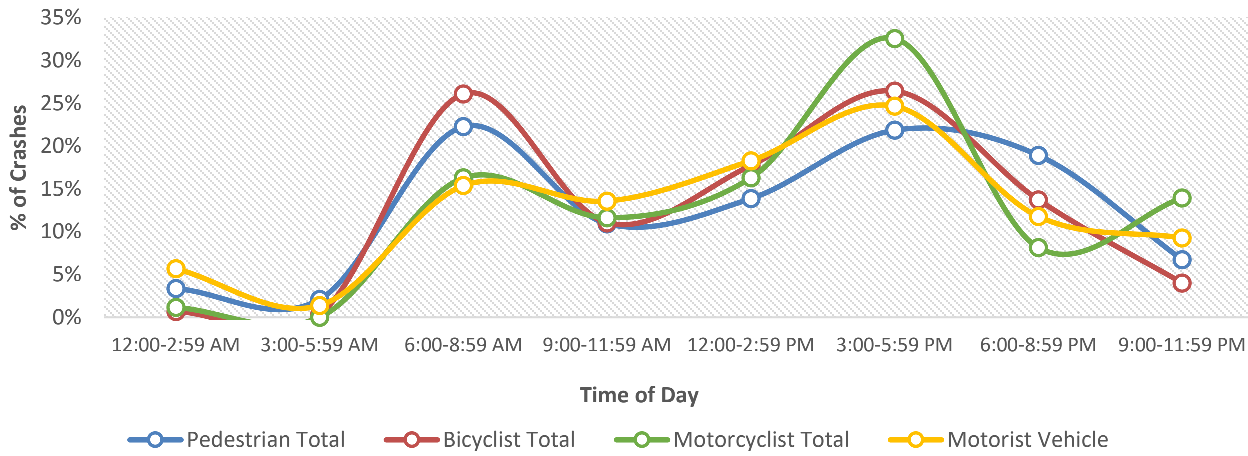

Figure 6: Crashes During Weekdays by Time of Day and Mode, 2009-2018

Table 9 summarizes weekend crashes for all modes by time of day. Unlike weekday crashes, weekend crashes occurred most often in the afternoon between 12:00-5:59 PM. KSI crashes occurred most frequently in the afternoon through the evening and ranged between 4 and 7 KSI crashes. The high number of KSI crashes in the late evening illustrates the heightened level of risk for serious injury crashes to occur during darker lighting conditions. Figure 7 displays the distribution of weekend crashes for each mode by time of day. The same time series pattern is apparent for each mode as it is for aggregate crashes, crashes occurred most frequently during the afternoon and early evening. Automobile, motorcycle, and pedestrian crashes share similar crash patterns, although pedestrian crashes had a slight increase in crashes during 6:00-8:59 PM when automobile and motorcycle crashes continued to decline. Bicycle crash frequency was more concentrated between 12:00-5:59 PM compared to other modes with 60 percent of bicycle crashes having occurred during that timeframe.

Table 9: Weekend Crashes by Time of Day, All Modes Aggregated, 2009-2018

Time of Day	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
12:00-2:59 AM	42	9%	1	4%	41	9%
3:00-5:59 AM	12	3%	1	4%	11	2%
6:00-8:59 AM	18	4%	1	4%	17	4%
9:00-11:59 AM	58	12%	1	4%	57	13%
12:00-2:59 PM	113	24%	4	15%	109	24%
3:00-5:59 PM	98	21%	7	27%	91	20%
6:00-8:59 PM	76	16%	4	15%	72	16%
9:00-11:59 PM	59	12%	7	27%	52	12%
Total	**476**	**100%**	**26**	**100%**	**450**	**100%**

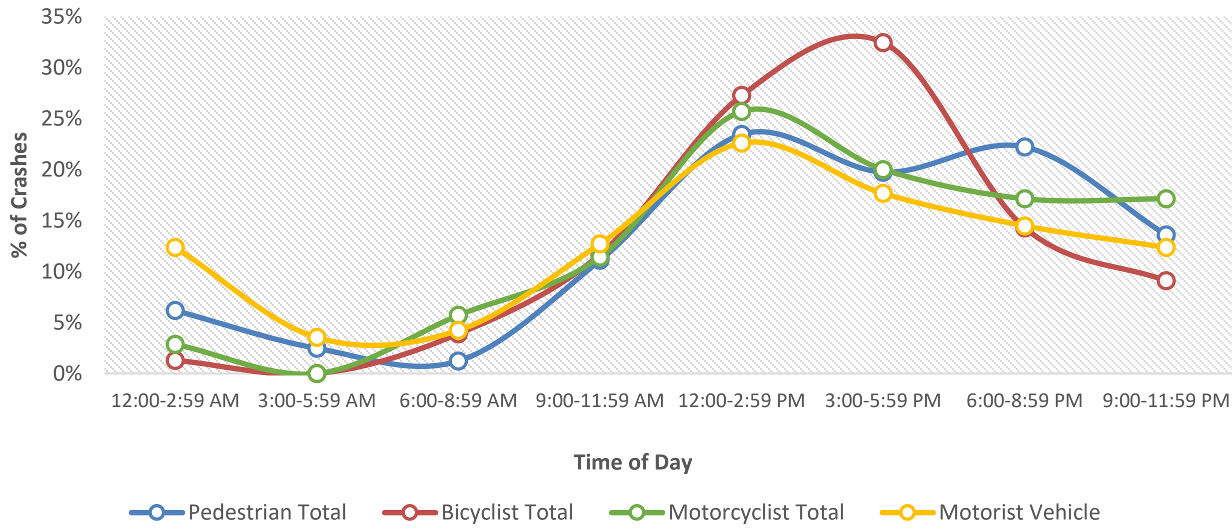

Figure 7: Crashes During Weekends by Time of Day and Mode, 2009-2018

VICTIMS

In addition to identifying conditions under which crashes have occurred and specific factors of those crashes, it is important to understand who was most affected by traffic safety issues in the City of Alameda. The comparison made in this section describing the victims on traffic safety issues are based on the *number of victims*, not the *number of crashes*, so the total numbers describing victims are different than in other analyses within this report that describe the crashes. Any given crash may injure multiple victims, at different levels of severity.[11]

The following tables compare the distribution of victim age and race to the age and race distribution of residents in the city of Alameda. The tables are used to better understand if a particular age or racial group is over-represented in traffic safety issues. To compare these victim and population distributions, the percentage of victims and of KSI victims within a given population (age and race) range is divided by the percentage share in the population overall. Values greater than 1 indicate that a given age or racial group was over-represented in the crash data.

Victim Age

During the ten-year study period, victims between the ages of 10-24 were most likely to be injured as a result of crash on average compared to other age groups. In particular, victims aged between 15 and 24 were substantially over-represented with a victim to population ratio of 2.76 and 2.22 respectively for the 15 to 19 and 20 to 24 year age ranges. The majority of victims aged between 15 and 24 were motor vehicle passengers (47 percent) followed by drivers of a motor vehicle (27 percent). Victims in younger age cohorts (10-24) and older age cohorts (65-84) were over-represented for fatal or serious injury crashes, displaying their vulnerability for crashes resulting in more serious results for those populations.

[11] The crash statistics summaries in the portions of this memo not in this section (Victims) summarize crash severity based on the highest level on injury in the crashes. The statistics summarized in this section reports on the injury severity of every victim involved in the crashes, and there is often more than one victim involved in every crash.

Table 10: Victim Age Breakdown

Age	Victims	KSI Victims	% of Victims	% of KSI Victims	Share of Population	Victims: Population Ratio	KSI Victims: Population Ratio
0 - 4	90	0	3%	0%	6%	0.53	-
5 - 9	133	1	5%	1%	6%	0.78	0.15
10 - 14	225	7	8%	6%	5%	1.57	1.23
15 - 19	335	7	12%	6%	4%	2.76	1.45
20 - 24	295	13	10%	12%	5%	2.22	2.47
25 - 29	196	6	7%	5%	7%	0.99	0.76
30 - 34	157	1	6%	1%	8%	0.73	0.12
35 - 39	127	6	4%	5%	7%	0.60	0.72
40 - 44	179	10	6%	9%	8%	0.77	1.08
45 - 49	186	5	7%	4%	8%	0.82	0.56
50 - 54	173	8	6%	7%	7%	0.88	1.02
55 - 59	126	8	4%	7%	7%	0.64	1.02
60 - 64	151	8	5%	7%	7%	0.79	1.06
65 - 69	105	8	4%	7%	5%	0.75	1.43
70 - 74	74	5	3%	4%	4%	0.68	1.16
75 - 79	66	8	2%	7%	2%	0.99	3.04
80 - 84	42	3	1%	3%	2%	0.91	1.64
85 +	60	2	2%	2%	2%	1.06	0.90
Unknown	106	6	4%	5%	-	-	-

Figure 8 summarizes the victim age breakdown by sex for all crashes during the study period. Female victims accounted for 52 percent of victims and male victims accounted for 48 percent of victims. The age distribution displayed in the plot does not show any discernable patterns than isn't immediately observable in Table 10. Female victims represented the largest percent share of victims for victims aged 20-24, the most over-represented victim age cohort. Additionally, female victims represented a larger percent of victims than male victims within the 45-49 age cohort whereas most age cohorts had a relatively close number of victims.

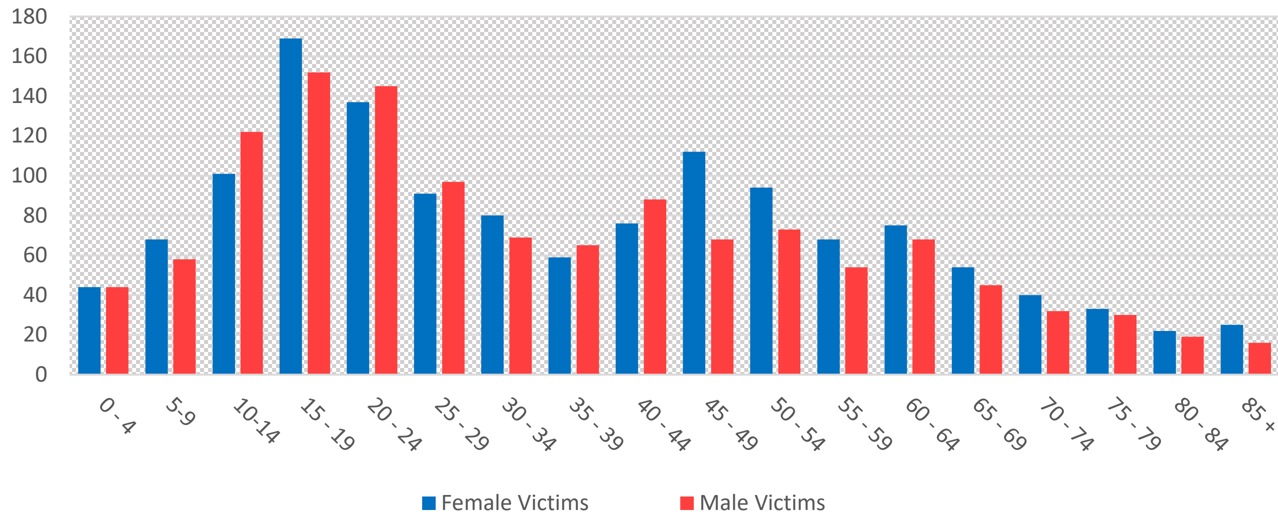

Figure 8: Victims by Age and Sex

Race

Victim data was also assessed based on race to identify whether there were any racial groups that were substantially over-represented in crashes. Please note, the police report data encodes victims race as "Asian," "Black," "Hispanic," "White," and "Other". The reported races are completed by the reporting officer using their own observations and best judgment. While using personal best judgment is common practice for many reporting protocols,[12] this method for reporting race will inevitably lead to inaccurate classification of some victims. Additionally, the racial classifications included in the police report does not cover the full range of ethnic and racial groups that individuals are able to self-report in the context of the U.S Census. As such, the comparisons of racial distributions between victim races and U.S. Census reported racial breakdown included in Table 12 and Table 13 should be used with caution. Table 11 outlines how this analysis grouped U.S. Census racial categories to fit within the TIMS racial categories.

Table 11: Census and TIMS Racial Category Mapping

U.S. Census Racial Category	TIMS Racial Category
Asian alone	Asian
Black or African American alone	Black
Hispanic or Latino	Hispanic
American Indian and Alaska Native alone, Native Hawaiian and Other Pacific Islander alone, Some other race alone	Other
White alone	White

[12] California Highway Patrol. "Collision Investigation Manual." 2003

Table 12 summarizes the victim race for overall crashes and KSI crashes compared to the City of Alameda's racial composition. The results suggest that "Black," "Hispanic," and "Other" victims were disproportionately victims of traffic-related safety issues. When looking at KSI crash victims, "Black," "Other," and "White" victims were over-represented in traffic-related crashes. These results summarized in these tables does not reflect or account for how people in one race travel in Alameda and whether one race drives significantly more than those in another race. Due to lack of understanding related to travel behaviors by race, we cannot provide a true picture of traffic risk for each racial group, thus, any conclusion drawn from this section should be caveated with recognition of a need for further research.

Table 12: Victim Racial Breakdown

Race	Victims	KSI Victims	% of Victims[13]	% of KSI Victims	Share of Population	Victims: Population Ratio	KSI Victims: Population Ratio
Asian	491	14	17%	13%	31%	0.56	0.40
Black	417	9	15%	8%	7%	2.01	1.10
Hispanic	364	9	13%	8%	12%	1.12	0.70
Other	286	9	10%	8%	7%	1.38	1.10
White	1119	67	40%	60%	43%	0.93	1.40
Not Stated	149	4	5%	4%	-	-	-

In addition to looking at the overall burden of traffic safety issues by race, Table 13 summarizes victims by race and by the mode by which those victims were traveling. The results suggest "white" victims are most likely to be a victim in a traffic-related crash while bicycling while also having the lowest percent share of passenger victims.

Table 13: Victim Racial Breakdown by Mode

Party Type	Asian		Black		Hispanic		Other		White		Not Stated	
Pedestrian	62	13%	53	13%	38	10%	36	13%	133	12%	12	8%
Bicyclist	34	7%	36	9%	36	10%	21	7%	241	22%	10	7%
Motorcyclist	6	1%	14	3%	14	4%	4	1%	80	7%	3	2%
Driver	177	36%	141	34%	128	35%	102	36%	369	33%	47	32%
Passenger	212	43%	173	41%	148	41%	123	43%	296	26%	72	48%
Other	0	0%	0	0%	0	0%	0	0%	0	0%	5	3%

Year and Mode

Figure 9 summarizes the number of injured victims by year during the study period. Victims who have are reported to not have any injuries were remove from this figure. Aside from year-to-year fluctuations in the number

[13] Percentages are assessed based on total number of victims with a stated race.

of injured victims, there appears to be no significant trend related to increases or decreases in the number of victims.

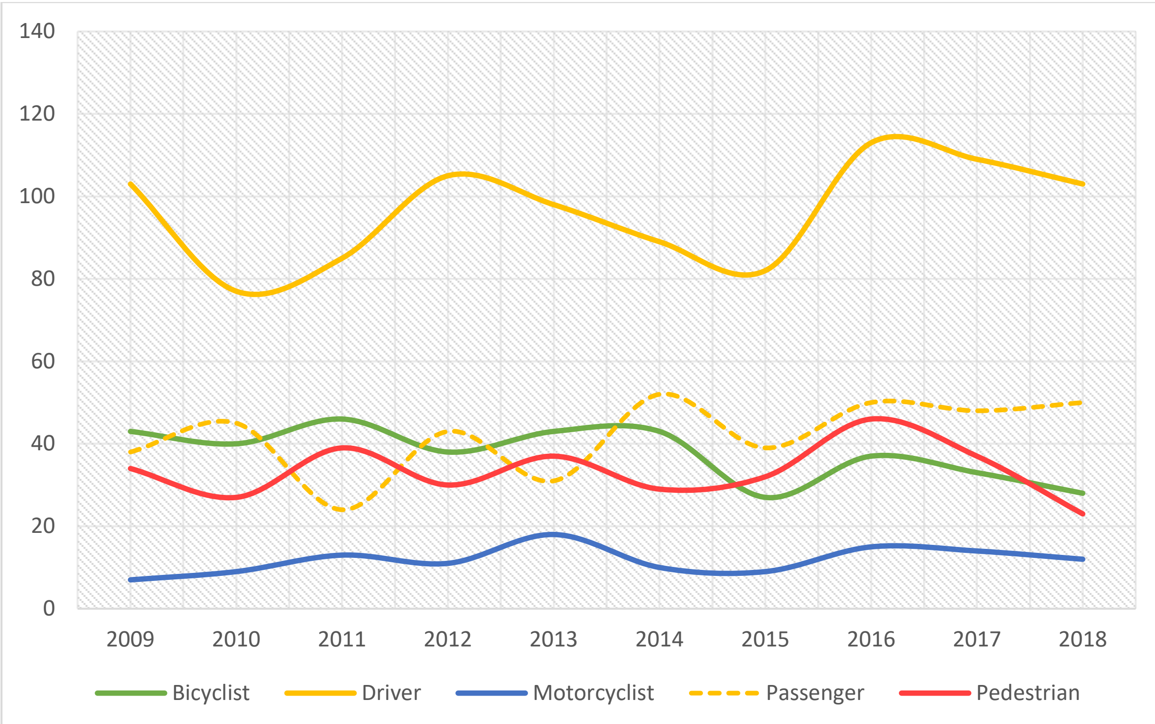

Figure 9: Victims by Year and Mode, 2009-2018

Pedestrian and Bicyclist Crashes

This section explores citywide pedestrian and bicyclist crash patterns. The crashes summarized in this section involved at least one pedestrian or bicyclist with either an automobile or motorcycle during the ten-year study period.

Behaviors

Violations

The reported party at fault and the reported violations for pedestrian crashes are presented in Table 14. Over three quarters of the reported violation types were either coded as driver (at fault) – violating pedestrian right of way[14] (55 percent) and pedestrian (at fault) – pedestrian violation[15] (20 percent). While we understand which party was reported to be at fault, these broad categories make it difficult to understand the actions the led up to the crash. Therefore, it is challenging to fully understand the behavioral factors that would lead to the selection of pedestrian safety countermeasures. For crashes coded as pedestrian - pedestrian violation, 85 percent were within 250 feet of unsignalized intersections, which may suggest that pedestrians were attempting to cross at these locations and may have had difficulty identifying suitable gaps in traffic or maybe crossed outside of the crosswalk area. However, it is difficult to say for sure, as the pedestrian action “crossing not in crosswalk” could also indicate a pedestrian crossing in a legal, but unmarked crosswalk.[16]

[14] This violation type could represent a motorist failing to yield to a pedestrian in a legal crosswalk, a motorist failing to yield to a pedestrian when driving over a sidewalk, or a pedestrian failing to yield to a motorist while not in a crosswalk. Please note that the examples listed here are not exhaustive.

[15] This violation type could represent a pedestrian crossing outside of a crosswalk and not yielding a motorist, pedestrian or motorists failing to exercise due care, motorist failing to reduce speed to ensure the safety of a crossing pedestrian, pedestrian crossing outside a crosswalk at a location between two controlled intersections, failure to obey a pedestrian crossing signal, and motorists failing to yield to a pedestrian when making a turn against a red traffic signal. The list of examples provided are is not an exhaustive list.

[16] Reporting the violation type is at the officer's discretion/understanding, and they may not be well trained in knowing that all corners have unmarked crosswalks.

Table 14: Reported Violations, Pedestrian Crashes, 2009-2018

Party at Fault – Reported Violation	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Driver – Pedestrian Right of Way	177	55%	19	49%	158	56%
Pedestrian – Pedestrian Violation	63	20%	12	31%	51	18%
Driver – Unsafe Speed	14	4%	1	3%	13	5%
Driver – Traffic Signals and Signs	10	3%	1	3%	9	3%
Driver – Unsafe Starting or Backing	7	2%	1	3%	6	2%
Unknown Mode – Unknown Violation	6	2%	2	5%	4	1%
Driver – Improper Turning	6	2%	0	0%	6	2%
Driver – Automobile Right of Way	5	2%	0	0%	5	2%
Driver – Unknown Violation	5	2%	1	3%	4	1%
Driver – Driving or Bicycling Under the Influence of Alcohol or Drug	4	1%	0	0%	4	1%
Driver – Improper Passing	4	1%	0	0%	4	1%
Unknown Mode – Other Than Driver (or Pedestrian)	3	1%	0	0%	3	1%
Driver – Other Hazardous Violation	2	1%	0	0%	2	1%
Unknown Mode – Pedestrian Right of Way	2	1%	1	3%	1	0%
Pedestrian – Automobile Right of Way	2	1%	0	0%	2	1%
Other[17]	10	3%	1	3%	10	3%

The reported violations for bicycle crashes are presented in Table 15. A large share of bicyclist crashes were coded as bicyclist (at fault) - automobile right of way violation (14 percent) and driver (at fault) – automobile right of way (violation) (13 percent),[18] which does not provide useful information that could lead to actionable insight. Aside from automobile right of way violations, the most common violation types included bicyclist - improper turning (9 percent), bicyclist - traffic signals and signs (8 percent), and bicyclist – wrong side of the road (7 percent). The wrong side of the road may be an indication for the need for safer and more convenient crossing for bicyclists.

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[17] Party at fault and reported violation categories with less than 1 percent of overall crashes have been grouped into "Other" to improve table legibility. The one pedestrian KSI crash in the "Other" category is coded as having an unknown party at fault and resulted from one mode traveling at an unsafe speed.

[18] This violation category could represent a motorists or bicyclist failing to yield to another roadway user while entering an intersection, failure to yield while making a left turn or U-turn, failure to yield to other roadway users while at a stop sign or yield right-of-way sign or failing to yield while crossing a roadway from public property or private property. The list of examples provided are is not an exhaustive list.

Table 15: Reported Violations, Bicyclist Crashes, 2009-2018

Party at Fault – Reported Violation	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Bicyclist – Automobile Right of Way	52	14%	3	10%	49	14%
Driver – Automobile Right of Way	48	13%	4	13%	44	13%
Bicyclist – Improper Turning	33	9%	1	3%	32	9%
Bicyclist – Traffic Signals and Signs	30	8%	1	3%	29	8%
Bicyclist – Wrong Side of the Road	28	7%	1	3%	27	8%
Driver – Other Hazardous Violation	25	7%	1	3%	24	7%
Unknown Mode – Other Than Driver (or Pedestrian)	22	6%	4	13%	18	5%
Bicyclist – Unsafe Speed	20	5%	2	7%	18	5%
Driver – Improper Turning	18	5%	2	7%	16	5%
Unknown Mode – Unknown	13	3%	3	10%	10	3%
Driver – Traffic Signals and Signs	13	3%	1	3%	12	3%
Unknown Mode – Automobile Right of Way	11	3%	0	0%	11	3%
Driver – Unsafe Speed	8	2%	1	3%	7	2%
Parked Vehicle – Other Hazardous Violation	6	2%	0	0%	6	2%
Bicyclist – Driving or Bicycling Under the Influence of Alcohol or Drug	5	1%	1	3%	4	1%
Driver – Driving or Bicycling Under the Influence of Alcohol or Drug	4	1%	1	3%	3	1%
Driver – Unknown	4	1%	0	0%	4	1%
Driver – Improper Passing	4	1%	0	0%	4	1%
Driver – Unsafe Starting or Backing	4	1%	0	0%	4	1%
Other[19]	28	7%	4	13%	24	6%

The high number of crashes with broad violations categories for both pedestrian and bicyclist crashes should be noted as an impediment to understanding and addressing pedestrian and bicyclist safety. It is recommended that

[19] Party at fault and reported violation categories with less than 4 overall crashes have been grouped into "Other" to improve table legibility. There were four KSI crashes grouped in "Other" category with one KSI crash in each of the following categories: "Bicyclist - Other Hazardous Violation", "Bicyclist – Unknown", "Bicyclist - Unsafe Starting or Backing", and "Motorcyclist - Improper Turning"

future efforts to make the crash reporting form more amenable to additional details will help the City have a better grasp on the crashes that occur and how to address them. Changes to this form would be a state-level effort.

Hit and Run

Hit and run crashes were a serious issue for people walking and riding a bicycle in Alameda, though a larger issue for pedestrians with 15 percent of all crashes being a hit and run and 11 percent of bicyclist crashes being a hit and run. Pedestrians had a fairly high rate of felony hit and run crashes for injury crashes (non-KSI) that accounted for 11 percent of all injury crashes.

Table 16: Pedestrian Hit and Run Crashes, 2009-2018

Hit and Run Status	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Not Hit and Run	271	85%	36	92%	235	84%
Felony	33	10%	2	5%	31	11%
Misdemeanor	15	5%	0	0%	15	5%

Table 17: Bicyclist Hit and Run Crashes, 2009-2018

Hit and Run Status	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Not Hit and Run	334	89%	26	87%	308	89%
Felony	24	6%	3	10%	21	6%
Misdemeanor	18	5%	1	3%	17	5%

Movement Types

Table 18 summarizes the frequency and severity of pedestrian crashes by the movement preceding the collision of the first motor vehicle involved and the pedestrian action. The most common pedestrian movement types for overall pedestrian crashes and KSI crashes include:

- pedestrian crossing in a crosswalk at an intersection struck by a motorist traveling straight (25 percent of all crashes),
- pedestrian crossing in a crosswalk at an intersection struck by a motorist making a left turn (25 percent of all crashes, and
- pedestrian crossing not in a crosswalk struck by a motorist proceeding straight (18 percent of all crashes).

The high share of pedestrian overall crashes and KSI crashes coded as pedestrian in crosswalk and motorist proceeding straight is likely a function of higher average operating speeds for vehicles traveling straight than turning vehicles. The combination of pedestrians crossing outside of crosswalks and motor vehicles proceeding straight, in particular, comprises a relatively large share of the fatal and injury crashes (26 percent of KSI and 16 percent of injury crashes). This points to a critical need for more safe crossing opportunities for pedestrians.

Table 18: Movement-Based Crash Type, Pedestrian Crashes, 2009-2018

Movement-Based Crash Type	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Pedestrian Crossing in Crosswalk at Intersection, Motorist Proceeding Straight	79	25%	13	33%	66	23%
Pedestrian Crossing in Crosswalk at Intersection, Motorist Making Left Turn	79	25%	6	15%	73	26%
Pedestrian Crossing Not in Crosswalk, Motorist Proceeding Straight	56	18%	10	26%	46	16%
Pedestrian Crossing in Crosswalk at Intersection, Motorist Making Right Turn	31	10%	2	5%	29	10%
Pedestrian in Road, Including Shoulder, Motorist Proceeding Straight	14	4%	1	3%	13	5%
Pedestrian Crossing Not in Crosswalk, Motorist Making Left Turn	6	2%	0	0%	6	2%
Pedestrian Crossing Not in Crosswalk, Motorist Making Right Turn	5	2%	0	0%	5	2%
Pedestrian Not in Road, Motorist Backing	5	2%	1	3%	4	1%
Other[20]	45	14%	6	15%	39	14%

Table 19 summarizes bicyclist crash frequency and severity by movement type. The most common bicycle movement-based crash type was when the bicyclist was proceeding straight and the motorist proceeding straight. This crash type accounted for the highest percent share of overall crashes and injury crashes (38 percent of crashes and 39 percent of injury crashes). Unfortunately, given the level of data available in SWITRS, it is not possible to discern whether these are mostly broadsides or sideswipe crashes. The second most frequent crash type was solo bicycle crashes, followed by bicyclist proceeding straight and motorist making a left turn, accounting for 17 percent and 8 percent of overall bicycle crashes respectively.

Solo bicycle crashes represent the largest share of KSI crashes accounting for 30 percent of all KSI crashes. Bicyclist proceeding straight and motorist proceeding straight crashes accounting for 17 percent of KSI crashes followed by bicyclist proceeding straight and motorist turning left crashes accounting for 13 percent of KSI crashes.

Table 19: Movement-Based Crash Type, Bicyclist Crashes, 2009-2018

[20] Pedestrian crashes with less than two percent share of overall crashes have been grouped in the “Other” movement type category.

Movement-Based Crash Type	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Bicyclist Proceeding Straight, Motorist Proceeding Straight	141	38%	5	17%	136	39%
Solo Bicycle Crash	65	17%	9	30%	56	16%
Bicyclist Proceeding Straight, Motorist Making Left Turn	31	8%	4	13%	27	8%
Bicyclist Proceeding Straight, Motorist Parked	26	7%	1	3%	25	7%
Bicyclist Entering Traffic, Motorist Entering Traffic	21	6%	2	7%	19	5%
Bicyclist Proceeding Straight, Motorist Making Right Turn	18	5%	1	3%	17	5%
Bicyclist Making Left Turn, Motorist Making Left Turn	11	3%	1	3%	10	3%
Bicyclist Proceeding Straight, Motorist Entering Traffic	6	2%	0	0%	6	2%
Bicyclist Making Right Turn, Motorist Making Right Turn	5	1%	0	0%	5	1%
Bicyclist Proceeding Straight, Motorist Stopped	4	1%	0	0%	4	1%
Bicyclist Proceeding Straight, Motorist Other Unsafe Turning	4	1%	0	0%	4	1%
Other[21]	40	11%	6	20%	34	10%

[21] Bicycle crashes with less than four overall crashes have been grouped in the “Other” movement type category

Environmental Conditions

Lighting condition

Lighting conditions can have a large impact on bicyclist and pedestrian safety and are often found to be contributing risk factors for serious and fatal crashes. The lighting conditions for pedestrian crashes are summarized in Table 20 by crash frequency and severity. The majority (60 percent) of overall pedestrian crashes occurred during daylight lighting conditions. While crashes that occurred during dark lighting conditions represented a smaller share of overall pedestrian crashes, these dark lighting conditions (includes dark – street lights and dusk – dawn) accounted for 52 percent of all KSI crashes. Considering that there are generally fewer trips made by pedestrians at night, and therefore fewer opportunities for a crash to occur during the night, this statistic suggests a higher risk to pedestrians traveling in dark or low-light conditions. Roughly 9 percent of crashes that occurred during daylight lighting conditions resulted in a KSI, whereas 16 percent of crashes that occurred during dark lighting conditions resulted in a KSI. These findings underscore the critical need for more lighting, brighter lighting, lighting that illuminates crossings, and high visibility crossing opportunities.

Table 20: Pedestrian Crashes by Lighting Condition, 2009-2018

Lighting Condition	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Daylight	193	60%	18	46%	175	62%
Dark - Street Lights	107	33%	19	49%	88	31%
Dusk - Dawn	14	4%	1	3%	13	5%
Dark - No Street Lights	3	1%	0	0%	3	1%
Unknown	3	1%	1	0%	2	1%

Lighting conditions for bicyclist crashes by frequency and severity are summarized in Table 21. The vast majority of overall crashes, KSI crashes, and injury crashes occurred during the daytime, and accounted for 82, 87, and 83 percent of bicyclist crashes respectively.

Table 21: Bicyclist Crashes by Lighting Condition, 2009-2018

Lighting Condition	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Daylight	310	82%	26	87%	284	82%
Dark - Street Lights	48	13%	2	7%	46	13%
Dusk - Dawn	16	4%	1	3%	15	4%
Unknown	2	1%	1	3%	1	0%

Weather Condition

Weather conditions did not appear to be a significant factor in pedestrian and bicyclist crashes in Alameda. The vast majority of crashes occurred during clear weather conditions with 80 percent of pedestrian crashes and 84 percent of bicyclist crashes having occurred during clear weather conditions. Pedestrian crashes are summarized in Table 22 and bicyclist crashes are summarized in

Table 23. The same lack of significant factors related to traffic safety issues is true for roadway conditions (dry vs. wet roadway surface), with 87 percent of pedestrian and 96 percent of bicyclist crashes having occurred on dry roadway surfaces.

Table 22: Pedestrian Crashes by Weather Condition, 2009-2018

Weather Condition	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Clear	256	80%	30	77%	226	80%
Cloudy	38	12%	7	18%	31	11%
Raining	25	8%	1	3%	24	9%
Unknown	1	0%	1	3%	0	0%

Table 23: Bicyclist Crashes by Weather Condition, 2009-2018

Weather Condition	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Clear	315	84%	23	77%	292	84%
Cloudy	52	14%	5	17%	47	13%
Raining	7	2%	1	3%	6	2%
Other	2	1%	1	3%	1	1%

Crash Location Type

Table 24 summarizes pedestrian crashes by crash location type (intersection vs. segment). Crashes that occurred within 250 feet of the nearest intersection (driveways not included) were coded as an intersection crash to be consistent with the Caltrans Highway Safety Improvement Program grant application definition. The majority of pedestrian crashes occurred at an intersection (91 percent), with most crashes having occurred at locations without a traffic signal. Additionally, intersections without a traffic signal account for the largest share of KSI crashes, suggesting the need for safer crossing conditions at unsignalized locations.

Table 24: Pedestrian Crashes by Location Type, 2009-2018

Location Type	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	# of locations	Crashes per Intersection
Intersection with a Traffic Signal	91	28%	13	33%	78	28%	83	1.096
Intersection without a Traffic Signal	203	63%	24	62%	179	64%	1,203	0.169
Segment	26	8%	2	5%	24	9%	--	--

Table 25 summarizes bicyclist crashes by crash location type. Bicycle crash locations have similar patterns to pedestrian crash locations. Most bicycle crashes occurred at an intersection location (91 percent), particularly intersections without a traffic signal (73 percent). Additionally, the majority of KSI crashes and injury crashes occurred at unsignalized intersections, accounting for 87 and 75 percent of crashes. This pattern is slightly different than the pattern observed in pedestrian crashes in that overall bicycle crashes and KSI crashes occurred more frequently at unsignalized intersections. The high share of KSI and injury crashes at unsignalized intersection may point to the need for safer and more convenient crossing opportunities for bicyclists at unsignalized intersections.

Table 25: Bicyclist Crashes by Location Type, 2009-2018

Location Type	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	# of locations	Crashes per Intersection
Intersection with a Traffic Signal	70	19%	4	13%	66	19%	83	0.843
Intersection without a Traffic Signal	274	73%	26	87%	248	72%	1,203	0.123
Segment	32	9%	0	0%	32	9%	--	--

Functional Classification

Functional classification is a hierarchical understanding of the types of roads on a street network. By definition, higher functional classifications have higher traffic volumes and speeds than lower functional class roads. Pedestrian crashes by functional classification are summarized in

Table 26. Arterial functional classifications accounted for the largest share of overall, KSI, and injury crashes accounting for 53, 59, and 51 percent of crashes. Looking at crashes on a per-mile basis, arterials had the highest number of crashes per mile (4.017) followed by collector roadways (2.65), and local roadways (0.832) respectively.

Table 26: Pedestrian Crashes by Functional Classification, 2009-2018

Functional Classification	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	Miles of Street	Crashes per Mile
Arterial	170	53%	23	59%	147	52%	42	4.017
Collector	51	16%	4	10%	47	17%	19	2.650
Local Street	99	31%	12	31%	87	31%	119	0.832

Similar to the pattern for pedestrian crashes, higher functional classification roadways were generally associated with higher crash frequencies for people bicycling as shown in Table 27. Arterial roadways accounted for 55 percent of overall bicycle crashes as well as 57 percent of KSI crashes and 57 percent of injury crashes. Arterial roadways have the largest number of bicycle crashes on a per-mile basis with 4.891 crashes per mile followed by collector roadways with 3.378 crashes, and local roadways with 0.874 crashes per mile. Of all modes, bicycle crashes have the highest crash per mile calculation on collector streets. This is likely because more of the existing bikeway network is located on these streets.

Table 27: Bicyclist Crashes by Functional Classification, 2009-2018

Functional Classification	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	Miles of Street	Crashes per Mile
Arterial	207	55%	17	52%	190	55%	42	4.891
Collector	65	17%	4	17%	61	18%	19	3.378
Local Street	104	28%	9	31%	95	27%	119	0.874

In general, bicyclist and pedestrian crash distribution are quite similar in regard to crash frequency and severity and how they are related to roadway functional classification. Future study is recommended to better understand factors along collector and arterial roadways and how they might be related to bicycle crashes. Factors such as the number of travels lanes, bicycle facilities (with accurate installation dates), speed limit, and traffic volumes would be useful to include in a future study.

Vehicle Type Involved

Table 28 summarizes pedestrian crashes by the type of motor vehicle involved in the crash. The vast majority of pedestrian crashes and KSI crashes that occurred during the ten-year study period involved a passenger car accounting for 86 percent of overall crashes, followed by pickup or panel truck accounting for 8 percent of overall crashes.

Table 28: Pedestrian Crashes by Vehicle Type Involved in Crash, 2009-2018

Vehicle Type	Pedestrian Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Passenger Car	274	86%	35	90%	239	85%
Pickup or Panel Truck	26	8%	1	3%	25	9%
Unknown	14	4%	2	5%	4	4%
Truck or Truck Tractor	2	1%	0	0%	2	1%
Other Bus	2	1%	1	3%	1	0%
Emergency Vehicle	1	0%	0	0%	1	0%
Other Vehicle	1	0%	0	0%	1	0%

Table 29 summarizes bicyclist crashes by the type of motor vehicle involved in the crash. Like pedestrian crashes, passenger crash accounted for the largest share of overall crashes with 66 percent of crashes, followed by “Unknown” vehicle type with 21 percent, and pickup or panel truck with 8 percent of crashes.

Table 29: Bicyclist Crashes by Vehicle Type Involved in Crash, 2009-2018

Vehicle Type	Bicyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Passenger Car	250	66%	16	53%	234	68%
Solo Bike Crash	81	21%	9	30%	72	21%
Pickup or Panel Truck	30	8%	3	10%	27	8%
Pedestrian	4	1%	0	0%	4	1%
Truck or Truck Tractor	3	1%	0	0%	3	1%
Motorcycle/Scooter	3	1%	1	3%	2	1%
Other Bus	2	1%	1	3%	1	0%
Bicycle	1	0%	0	0%	1	0%
Passenger Car with Trailer	1	0%	0	0%	1	0%
School Bus	1	0%	0	0%	1	0%

Motorcycle/Motor Vehicle Crashes

This section explores citywide crash patterns and trends by evaluating automobile and motorcycle crashes, excluding crashes that involved a pedestrian or bicyclist.

Behaviors

Violations

The reported violation types for motorcycle crashes are summarized in Table 30. The most common violation type for motorcycle crashes included motorcyclist - unsafe speed accounting for 28 percent of all crashes, followed by driver - automobile right of way (18 percent), and driver - improper turning (8 percent). Motorcyclist - unsafe speed and driver - automobile right of way violation types accounted for the majority of KSI crashes with 24 percent and 14 percent respectively.

Table 30: Reported Violations, Motorcycle Crashes, 2009-2018

Party at Fault - Reported Violation	Motorcycle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Motorcyclist - Unsafe Speed	34	28%	5	24%	29	28%
Driver - Automobile Right of Way	22	18%	3	14%	19	19%
Driver - Improper Turning	10	8%	1	5%	9	9%
Driver - Unsafe Speed	9	7%	1	5%	8	8%
Motorcyclist - Improper Turning	8	7%	1	5%	7	7%
Motorcyclist - Improper Passing	7	6%	1	5%	6	6%
Motorcyclist - Automobile Right of Way	6	5%	2	10%	4	4%
Motorcyclist - Driving or Bicycling Under the Influence of Alcohol or Drug	4	3%	2	10%	2	2%
Unknown Mode - Unknown	3	2%	2	10%	1	1%
Unknown Mode - Other Than Driver	3	2%	0	0%	3	3%
Unknown Mode - Driving or Bicycling Under the Influence of Alcohol or Drug	2	2%	0	0%	2	2%
Driver - Unsafe Lane Change	2	2%	1	5%	1	1%
Motorcyclist - Traffic Signals and Signs	2	2%	1	5%	1	1%
Other[22]	11	9%	1	5%	10	10%

[22] Motorcycle crashes with less than 2 overall crashes have been grouped in the "Other" party at fault and reported violation.

Violation types for motor vehicle crashes are summarized in Table 31. The top three violations types for motor vehicle crashes were the same as motorcycle crashes with automobile right of way accounting for 26 percent of crashes, followed by driver - unsafe speed (25 percent), and driver - improper turning (14 percent). Driving under the influence of drugs or alcohol appears to be a safety issue in Alameda with 11 percent of all motor vehicle crashes and 13 percent of KSI crashes having occurred as a result of the motorist driving under the influence of drugs or alcohol.

Table 31: Reported Violations, Motor Vehicle Crashes, 2009-2018

Party at Fault and Reported Violation	Automobile Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Driver - Automobile Right of Way	262	26%	6	26%	256	26%
Driver - Unsafe Speed	256	25%	3	13%	253	26%
Driver - Improper Turning	138	14%	3	13%	135	14%
Driver - Driving Under the Influence of Alcohol or Drugs	113	11%	3	13%	110	11%
Driver - Traffic Signals and Signs	99	10%	0	0%	99	10%
Unknown Mode - Other Than Driver	20	2%	4	17%	16	2%
Driver - Unsafe Starting or Backing	20	2%	0	0%	20	2%
Unknown Mode - Unknown	16	2%	3	13%	13	1%
Driver - Wrong Side of the Road	11	1%	0	0%	11	1%
Unknown Mode - Traffic Signals and Signs	9	1%	0	0%	9	1%
Unknown Mode - Unsafe Speed	9	1%	0	0%	9	1%
Driver - Other Hazardous Violation	8	1%	0	0%	8	1%
Driver - Improper Passing	6	1%	0	0%	6	1%
Driver - Unknown	6	1%	1	4%	5	1%
Driver - Unsafe Lane Change	6	1%	0	0%	6	1%
Driver - Following Too Closely	6	1%	0	0%	6	1%
Other	23	2%	0	0%	23	2%

Movement Types

Table 32 summarizes the frequency and severity of motorcycle crashes by the movement preceding the collision of the first motor vehicle involved in the crash. The most common movement type was motorcyclist proceeding straight and motorist proceeding straight accounting for the largest share of crashes with 67 percent of all crashes and 52 percent of KSI crashes.

Table 32: Movement Preceding Collision, Motorcycle Crashes, 2009-2018

Movement Type	Motorcycle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Motorcyclist Proceeding Straight, Motorist Proceeding Straight	83	67%	11	52%	72	71%
Motorcyclist Stopped, Motorist Stopped	8	7%	1	5%	7	7%
Motorcyclist Passing Other Vehicle, Motorist Passing Other Vehicle	7	6%	0	0%	7	7%
Motorcyclist Making Left Turn, Motorist Making Left Turn	7	6%	3	14%	4	4%
Motorcyclist Making Right Turn, Motorist Making Right Turn	5	4%	0	0%	5	5%
Motorcyclist Slowing/Stopping, Motorist Slowing/Stopping	4	3%	1	5%	3	3%
Motorcyclist Entering Traffic, Motorist Entering Traffic	2	2%	1	5%	1	1%
Motorcyclist Other Unsafe Turning, Motorist Other Unsafe Turning	2	2%	1	5%	1	1%
Unknown	2	2%	2	10%	0	0%
Motorcyclist Changing Lanes, Motorist Changing Lanes	1	1%	0	0%	1	1%
Motorcyclist Other, Motorist Making Left Turn	1	1%	0	0%	1	1%
Motorcyclist Crossed Into Opposite Lane, Motorist Crossed Into Opposite Lane	1	1%	1	5%	0	0%

The reported motor vehicle crash types are summarized in Table 33. The most common motor vehicle crash types include broadside crashes (38 percent), rear end (31 percent), and sideswipe (10 percent). The most common crash types resulting in a KSI include broadside crashes (22 percent) followed by hit object[23] (22 percent). Unsurprising, rear end crashes had the second highest share of overall crashes, this crash type also had the second lowest number of KSI crashes, suggesting that rear end crashes do not frequently result in severe injuries.

[23] Hit object can refer to a motorist striking a light pole, a barrier, traffic signal, etc.

Table 33: Reported crash Type, Motor Vehicle Crashes, 2009-2018

Crash Type	Motor Vehicle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Broadside	382	38%	5	22%	377	38%
Rear End	308	31%	2	9%	306	31%
Sideswipe	97	10%	1	4%	96	10%
Hit Object	95	9%	5	22%	90	9%
Head-On	86	9%	3	13%	83	8%
Overturned	20	2%	1	4%	19	2%
Other	14	1%	3	13%	11	1%
Unknown	6	0%	3	13%	3	0%

Environmental Conditions

Lighting condition

Motorcycle crash frequency and severity by lighting condition is summarized in Table 34. Most motorcycle crashes occurred during daylight conditions (70 percent), KSI crashes (52 percent), and injury crashes (78 percent). Again, this is to be expected as most travel is done during daylight lighting conditions. The 30 percent of overall crashes and 48 percent of KSI crashes that occurred during dark lighting conditions is somewhat high when considering there are substantially fewer trips made during the evening compared to during the day. This suggests possible crash risk issues for motorcyclists traveling during dark lighting conditions.

Table 34: Motorcycle Crashes by Lighting Condition, 2009-2018

Lighting Condition	Motorcycle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Daylight	86	70%	11	52%	38	78%
Dark - Street Lights	31	25%	7	33%	10	20%
Dusk - Dawn	3	2%	1	5%	0	0%
Unknown	2	2%	2	10%	0	0%
Dark - No Street Lights	1	1%	0	0%	1	2%

The lighting conditions during motor vehicle crashes is summarized in Table 35. Most motor vehicle crashes occurred during daylight lighting conditions accounting for 68 percent of overall crashes, followed by dark – street light conditions (27 percent).

Table 35: Motor Vehicle Crashes by Lighting Condition, 2009-2018

Lighting Condition	Motor Vehicle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Daylight	683	68%	11	48%	672	68%
Dark - Street Lights	275	27%	8	35%	267	27%
Dusk - Dawn	36	4%	0	0%	36	4%
Dark - No Street Lights	8	1%	1	4%	2	0%
Unknown	5	0%	3	13%	7	1%
Dark - Street Lights Not Functioning	1	0%	0	0%	1	0%

Weather Condition

Weather conditions did not appear to have been a significant factor in motorcycle and motor vehicle crashes in Alameda. The vast majority of crashes occurred during clear weather conditions with 89 percent of motorcycle crashes and 80 percent of motor vehicle crashes occurring during clear weather conditions. Motorcycle crashes are summarized in Table 36 and motor vehicle crashes are summarized in Table 37.The same lack of significant factors related to traffic safety issues is true for roadway conditions (dry vs. wet roadway surface), with 96 percent of motorcycle crashes and 89 percent of motor vehicles crashes having occurred on dry roadway surfaces.

Table 36: Motorcycle Crashes by Weather Condition, 2009-2018

Weather Condition	Motorcycle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Clear	110	89%	19	90%	91	89%
Cloudy	7	6%	0	0%	7	7%
Raining	3	2%	0	0%	3	3%
Other	1	1%	0	0%	1	1%
Wind	0	0%	0	0%	0	0%
Unknown	2	2%	2	10%	0	0%

Table 37: Motor Vehicle Crashes by Weather Condition, 2009-2018

Weather Condition	Motor Vehicle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes
Clear	806	80%	16	70%	164	81%
Cloudy	142	14%	2	9%	25	12%
Raining	53	5%	2	9%	12	6%
Unknown	4	0%	3	13%	1	0%
Fog	2	0%	0	0%	1	0%
Wind	1	0%	0	0%	0	0%

Crash Location Type

Motorcycle crash frequency and severity by location type is summarized in Table 38 and automobile crashes are summarized in Table 39. For both motorcycles and automobiles, crashes occurred most often at intersections (with or without a traffic signal) accounting for 85 percent of motorcycle crashes and 89 percent of automobile crashes. Like bicycle and pedestrian crashes, these crashes occurred most frequently at unsignalized intersections with 66 percent of motorcycle crashes and 68 percent of motor vehicle crashes occurring at unsignalized locations. Additionally, crashes appear to be more severe at unsignalized intersections with the majority of KSI and injury crashes occurring at these locations.

Table 38: Motorcyclist Crashes by Location Type, 2009-2018

Location Type	Motorcyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	# of locations	Crashes per Location
Intersection with a Traffic Signal	23	19%	4	19%	5	10%	83	0.277
Intersection without a Traffic Signal	81	66%	12	57%	34	69%	1,203	0.067
Segment	19	15%	5	24%	10	20%	--	--

Table 39: Automobile Crashes by Location Type, 2009-2018

Location Type	Motor Vehicle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	# of locations	Crashes per Location
Intersection with a Traffic Signal	209	21%	4	17%	45	22%	83	2.518
Intersection without a Traffic Signal	683	68%	13	57%	128	63%	1,203	0.568
Segment	116	12%	6	26%	30	15%	--	--

Functional Classification

Crashes by functional classification for motorcycle crashes are summarized in Table 40 and motor vehicle crashes are summarized in Table 41. As expected, the majority of overall, KSI, and injury crashes occurred at arterial locations both motorcycle crashes (67 percent of all crashes) and motor vehicle crashes (63 percent of all crashes).

Table 40: Motorcyclist Crashes by Functional Classification, 2009-2018

Functional Classification	Motorcyclist Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	Miles of Street	Crashes per Mile
Arterial	82	67%	13	62%	33	67%	42	1.952
Collector	17	14%	4	19%	7	14%	19	0.895
Local Street	24	20%	4	19%	9	18%	119	0.202

Table 41: Motor Vehicle Crashes by Functional Classification, 2009-2018

Functional Classification	Motor Vehicle Crashes	% of Crashes	KSI Crashes	% of KSI Crashes	Injury Crashes	% of Injury Crashes	Miles of Street	Crashes per Mile
Arterial	635	63%	17	74%	129	64%	42	15.120
Collector	140	14%	2	9%	34	17%	19	7.368
Local Street	233	23%	4	17%	40	20%	119	1.874

High Injury Corridors

The development of high injury corridor (HIC) maps is often a key element of Vision Zero plans and efforts. This section summarizes the results of a sliding window analysis along the street network within the City of Alameda. The sliding window analysis was conducted separately for each mode and displayed in a series of maps (Figure 10 through Figure 13).

The HIC development process involves developing crash density estimates along street corridors throughout the city, weighted by crash severity, and then identifying the highest crash-density sections for each mode individually. HIC corridors are identified by applying a one-mile moving window aggregation to the street network in Alameda. The one-mile moving windows were created to form corridors using the roadway street name. In this approach, a virtual "window" is moved along each street, counting the number of crashes by severity and mode that occurred within each successive one-mile segment. Both intersection and segment crashes were included in this evaluation, as the focus is on overall corridor conditions

Crash Weighting

Cities that choose to include moderate or lesser injury crashes in the analysis sometimes weight them less than KSI crashes. This allows for their inclusion in the analysis but acknowledges that the key goal of Vision Zero is elimination of fatal and severe injury crashes, and therefore the more severe crashes should count for more in the analysis. It also acknowledges the reality that KSI crashes have a greater impact on the victim's family and acquaintances, as well as a greater cost to society.

The method selected for this analysis includes moderate injury crash types in addition to KSI crashes for pedestrian, bicyclist, motorcycle, and motor vehicle crashes and applies a weight for KSI crashes. Each KSI crash is assigned a weight of 3, with moderate injury crashes weighted at 1, and all other crashes excluded (or weighted at 0). Once the weights are established and applied to the crashes, the total number of crashes are aggregated along a corridor while incorporating the crash severity weighting. For instance, with KSI crashes weighted at three times moderate injury crashes, a corridor with two KSI crashes will have the same weighted total as a corridor with six moderate injury crashes.

Moderate injury crashes were included in this analysis to augment the relatively small dataset of KSI crashes and in response to research that has found a significant percentage of pedestrian and bicyclist injuries to be underreported and/or misclassified between injury levels. The HIC aims to help identify corridors that may warrant special attention. Identification of these streets helps a city prioritize investment in the areas where crash history demonstrates the most serious problems and easily communicate those priorities to the community.

Difference Between Countywide Active Transportation Plan HIC Methodology

The methodology used in this analysis differs slightly from the methodology used in the 2019 Alameda County Transportation Commission Countywide Active Transportation Plan (CATP) HIC.[24] The main differences between the two analyses are related to how the crash severity is weighted, the sliding window size, and the thresholds used to define the HIC corridors.

The crash weighting schema used in the CATP applied an equivalent property damage only performance measure to weight KSI crashes by 10, visual or complaint of pain crashes by 5, and property damage only (PDO) crashes by 1. The TIMS crash data used in this analysis does not include PDO crashes, therefore the weighting schema used in this analysis was adjusted accordingly (KSI = 3 and moderate injury = 1). Additionally, the CATP

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[24] https://www.alamedactc.org/wp-content/uploads/2019/06/RPT_CATP_Appendices_Part_2_20190625.pdf?x33781

used 5 years of crash data, while this analysis used 10 years of crash data. The decision to include 10 years of crash data in this analysis was to augment a relatively small dataset.

The CATP window size was set to one-fourth (1/4) of a mile with one-tenth (1/10) of a mile sliding increments, whereas the window size used in this analysis was set to one mile with one-tenth (1/10) of a mile sliding increments. The decision to increase the window size to one mile was to reduce the overall impact one particular intersection might have on the selection of HIC corridors, leading to a fragmented network that focuses short HIC segments at intersections, rather than along problematic corridors.

Lastly, the threshold used to determine which segments were included in the HIC was another difference between the two analyses. The CATP selected segments with the top 20 percent of the crash Equivalent Property Damage Only[25] scores within separate planning areas to be included in the HIC. The planning areas were determined by walking and bicycling to work commute shares. This analysis looked at natural breaks within the crash network data for each mode individually. The goal was to include window segments with a high weighted crash severity total while avoiding a fragmented HIC. The longer window size leads to a higher threshold and reduces the impact one particular intersection has on the overall HIC network.

Pedestrian High Injury Network

The results of the pedestrian HIC can be viewed in Figure 10. Otis Dr and Webster St have the highest concentrations of pedestrian crashes and severity. These streets serve as either critical thoroughfares in the City of Alameda, provide connections to other cities, or provide connections to key destinations such as parks, commercial/retail locations, and schools/universities.

Table 42: Pedestrian High Injury Network

Street Name	Miles
Otis Dr	2.2
Lincoln Av	1.7
Central Av	1.5
Shoreline Dr	1.5
Park St	1.4
Grand St	1.2
Oak St	1.1
Webster St	0.9
Total	**11.4**

[25] Equivalent Property Damage Only (EPDO) is a weighting scheme for crash severity. The CATP used a weighting of 1 for property damage only crashes, 5 for visual injury or complaint of pain crashes, and 10 for fatal or severe injury crashes.

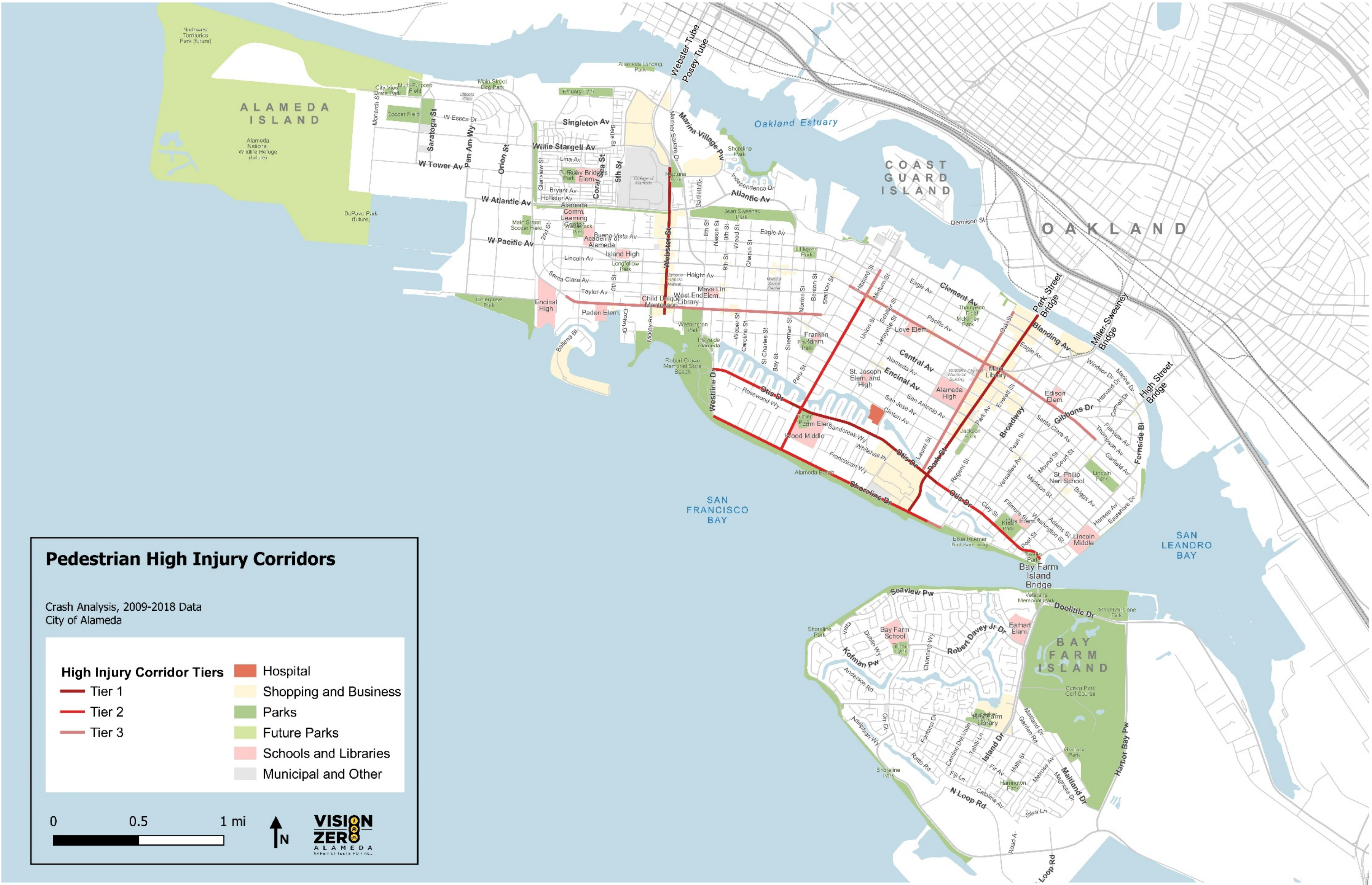

Figure 10: Pedestrian HIN

Bicyclist High Injury Network

The results of the bicyclist HIC can be viewed in Figure 11. Grand St and Park St have the highest concentrations of bicycle crashes and severe bicycle crashes. Both streets serve as key north-south routes for travel due to the limited number of streets that provide connections to the southwest area of the island. Park St in particular has a large number of key destinations such as retail and commercial properties along the corridor as well as connections schools and the Park St Bridge. Other corridors that have moderately high concentrations to bicycle crashes are located along streets that also accommodate cross-island travel such as Central Ave, Lincoln Ave, Santa Clara Ave, Clement Ave, and Webster Ave. Several of these HIC corridors have existing bicycle facilities, which likely contributes to higher volumes of bicyclists (and therefor higher levels of exposure) along these routes. Santa Clara Ave, Central Ave, Atlantic Ave, Grand St, and Fernside Blvd have existing bike lanes. Oak St, Park St, and Sherman St have marked shared lanes along at least part of the corridors.

Table 43: Bicycle High Injury Network

Street Name	Miles
Central Av	3.6
Santa Clara Av	2.9
Lincoln Av	1.9
Fernside Bl	1.5
Grand St	1.4
Park St	1.4
Pacific Av	1.3
Main St	1.3
Clement Av	1.2
Oak St	1.1
Sherman St	1.0
Webster St	0.9
Atlantic Av	0.8
Blanding Av	0.4
Total	**20.5**

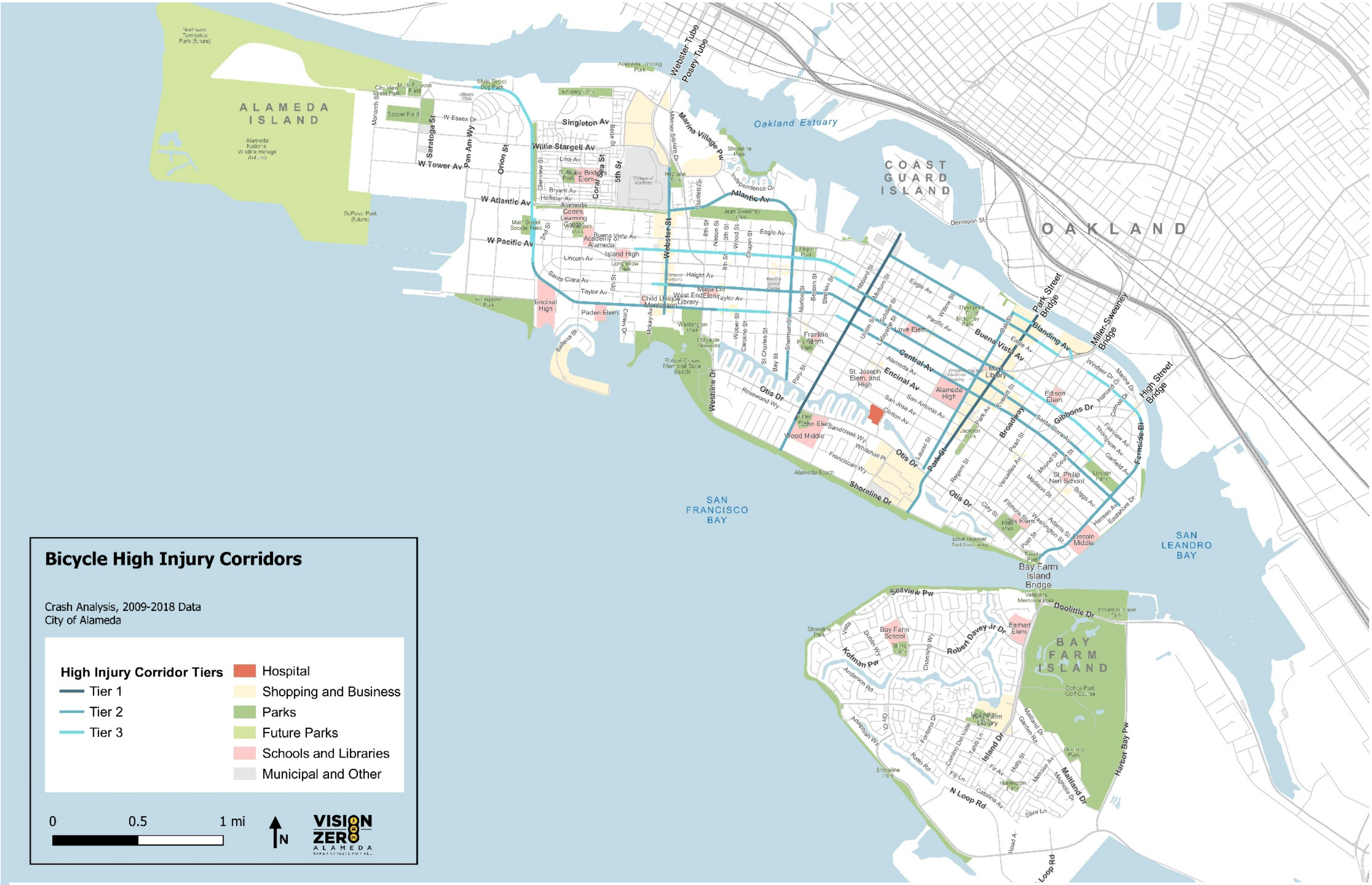

Figure 11: Bicyclist HIN

Motorcyclist High Injury Network

The results of the motorcycle HIC analysis can be viewed in Figure 12. Many of the streets with high concentrations of motorcycle crashes and injury severity are located along arterial roadways that serve as key cross-island routes and provide key connections to and from the Island such as the Webster and Posey Tube, Park St, and Broadway. Like the results displayed in the pedestrian and bicyclist HICs, motorcycle crashes tend to concentrate near areas with higher activity levels such as commercial and retail centers and along roads with higher traffic volumes.

Table 44: Motorcycle High Injury Network

Street Name	Miles
Central Av	3.3
Lincoln Av	1.2
Santa Clara Av	1.2
Versailles Av	1.2
Webster St	1.2
Main St	1.1
Broadway	1.1
Park St	1.1
Encinal Av	1.0
Webster Tube	0.8
Atlantic Av	0.8
Constitution Wy	0.8
Westline Dr	0.4
Total	**15.1**

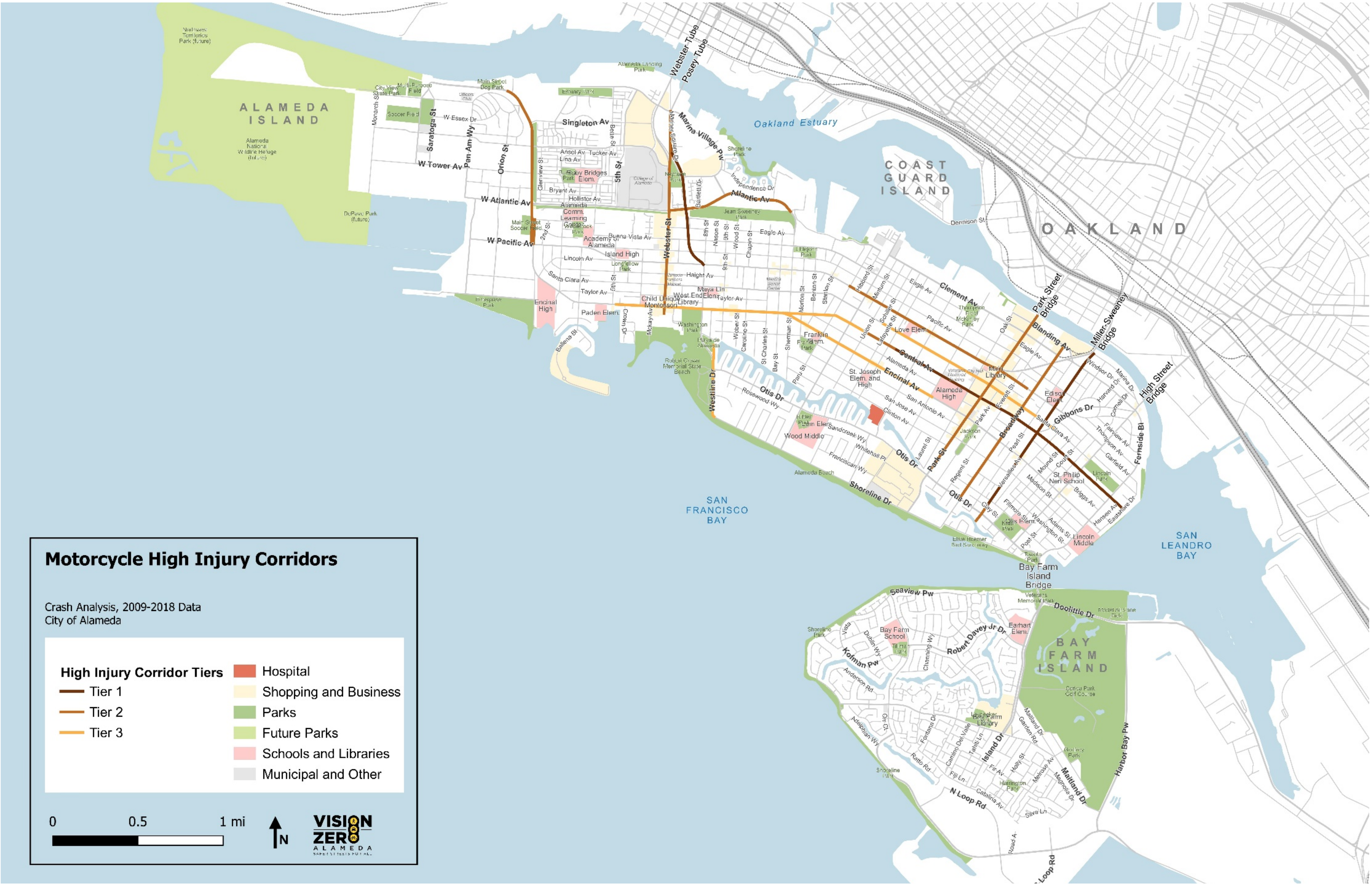

Figure 12: Motorcyclist HIN

Motor Vehicle High Injury Network

The results of the motor vehicle HIC analysis can be viewed in Figure 13. The corridors with the highest concentration of crashes are located along Main St and Midway Ave. The intersection of Midway Ave and Main St in particular has had numerous KSI crashes that may be a contributing factor as to why Midway Ave is included as a HIC corridor. Other corridors that have a high concentration of crashes include Lincoln Ave, Park St, Webster St, Central Ave Encinal Ave, Otis Dr, Broadway, Island Dr and Harbor Bay Pkwy. Like the other modes, corridors that provide cross-island connections and connections to commercial and retail location have higher concentrations of crashes.

Table 45: Motor Vehicle High Injury Network

Street Name	Miles
Encinal Av	1.6
Main St	1.6
Lincoln Av	1.5
Park St	1.2
Otis Dr	1.1
Central Av	1.0
W Midway Av	0.9
Willie Stargell Av	0.9
Webster St	0.9
Ralph Appezzato Memorial Pw	0.8
Total	**11.4**

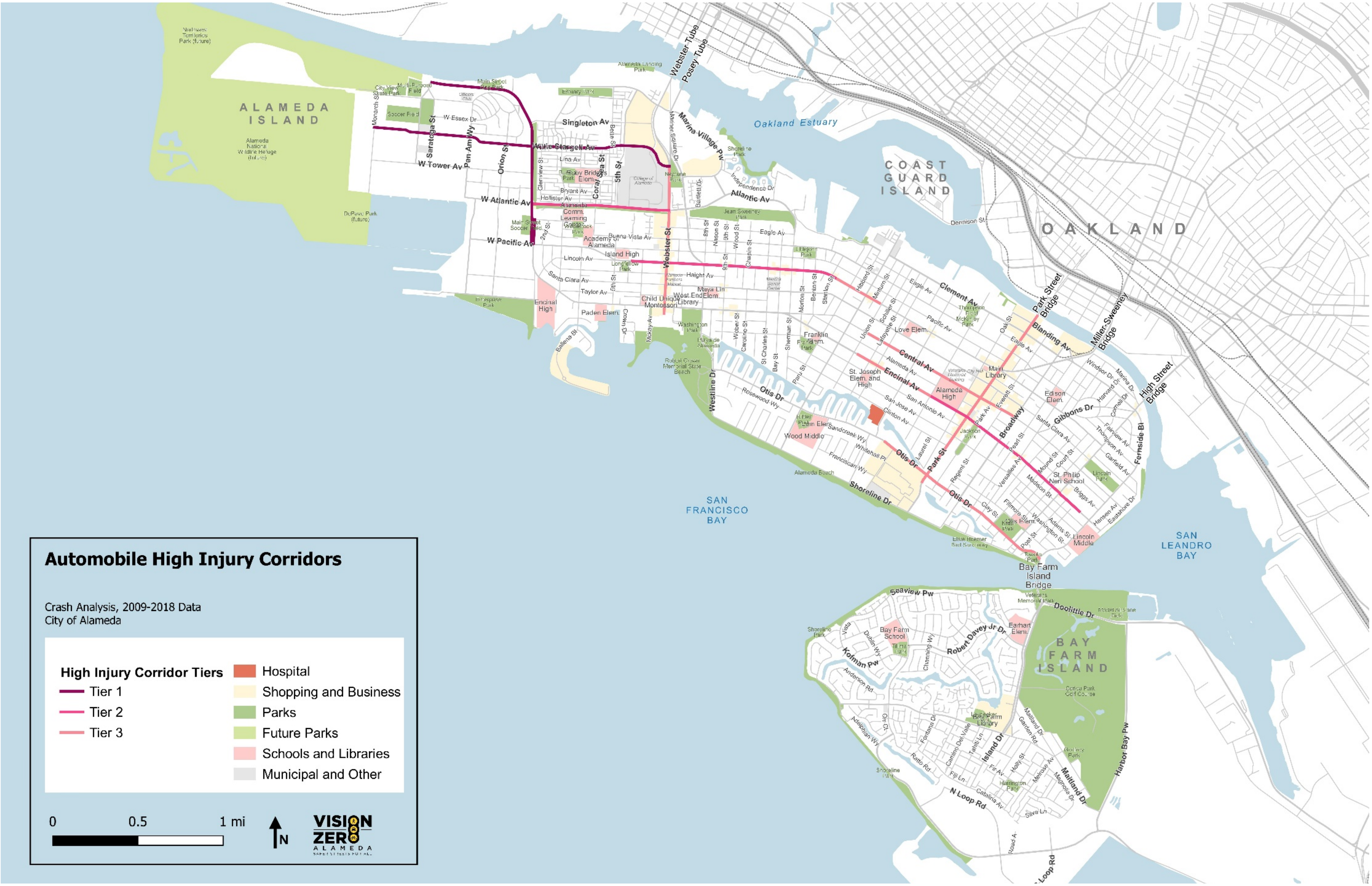

Figure 13: Motor Vehicle HIN

All-Mode High Injury Network

The results of the all-mode HIC analysis can be viewed in Figure 14. This map displays the aggregate weighted and scaled injury score of all modal HICs. Before aggregating each modal injury score, the scores for each HIC segment are proportionately transformed using a 0-5-point scale, with the lowest weighted injury score being a 0 and the highest being a 5. Next, each scaled modal injury score are then aggregated to create the all-mode aggregate injury score. Scaling the scores for each mode allows for combining the modal HIC while limiting the affect one mode might have on the overall all-mode HIC. For example, motor vehicle crashes represent the largest number of crashes and therefore have the highest injury weight throughout the network. If the raw (non-scaled) motor vehicle scores were combined with the raw bicycle scores, the bicycle scores will be muted and overshadowed by the motor vehicle crashes. Transforming (proportionate scaling) the score so that each mode carries the same weight makes it so that the safety priorities of every mode are made equal, without one mode overshadowing the others.[26]

The resulting all-mode HIC map highlight portions of the HIC where there are higher levels of crashes or priorities for all modes. Central Ave, Lincoln Ave, Park St, Webster St and Main St make up the highest tier. These locations were scored highly for the individual modal HICs, suggesting these are priority corridors for all modes.

[26] Segments of the all mode HIC that were comprised of only the motorcycle HIC were removed. While these segments alone are important in the motorcycle HIC, the number and severity of crashes are very low to be included in the all mode HIC and detract from the purpose of this analysis. These segments removed from the all mode HIC include Versailles Ave, Broadway, Constitutional Way, and short sections of Webster Dr, Encinal Ave, and Central Ave. Many of the crashes that caused these streets to be part of the motorcycle HIC are still captured in the all-modes HIC because they occurred at intersections with other modes' HIC streets.

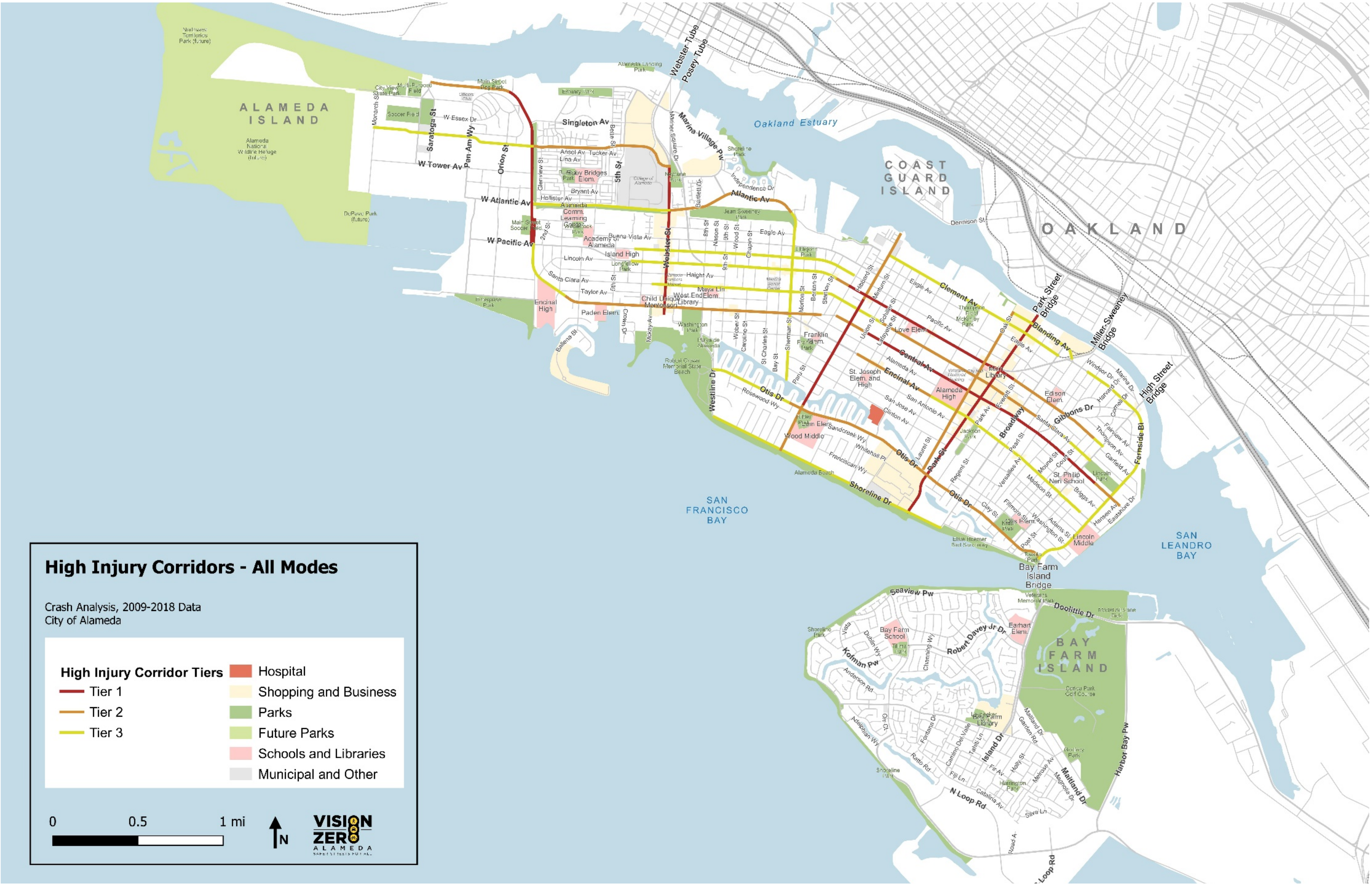

Figure 14: All Modes HIC

Conclusion

Recommendations

While this crash analysis presented in this report helped to move ahead the understanding of pedestrian, bicyclist, motorcycle, and motor vehicle safety issues, there are several recommendations for an improved understanding of crashes in Alameda both today and going forward.

- Several GIS datasets were not available during the time of this analysis that would help contextualize the crashes data and assist the City to draw more insight as to what factors are contributing to crashes. GIS datasets that included stops signs, number of travels lanes, and bicycle facilities (with accurate installation dates) would be useful to include in a future study.
- Continue to update the analysis on a two to three-year timeline to reflect the most up-to-date crash patterns and continue to work closely with the Alameda Police Department to update the database with fatal and serious injury crashes.
- Document installation dates and details on before and after characteristics by specific locations (intersections and segments) so that before conditions and crashes can be incorporated into future analyses.
- There are a high number of crashes coded with broad violations categories for both pedestrian and bicyclist crashes. The broad violation categories are an impediment to understanding and addressing pedestrian and bicyclist safety. Future efforts to make the crash reporting form more amenable to additional details will help the City have a better grasp on the crashes that occur and how to address them. These efforts will need to be made at the state-level to update the crash reporting forms.

These recommendations would help to develop a better understanding of crash patterns and possible factors that contribute to crashes. Additionally, these options could help the city develop a prioritization tool or process to continue pursuing safety Improvements for all roadway users with an eye towards eliminating fatal and serious injury crashes.

Definitions

KSI: Killed or Serious Injured

Injury severity definitions:

Fatal Injury (K): A fatal injury is any injury that results in death within 30 days after the motor vehicle crash in which the injury occurred. If the person did not die at the scene but died within 30 days of the motor vehicle crash in which the injury occurred, the injury classification should be changed from the attribute previously assigned to the attribute “Fatal Injury.”

Serious Injury (A): A suspected serious injury is any injury other than fatal which results in one or more of the following:

- Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood
- Broken or distorted extremity (arm or leg)
- Crush injuries
- Suspected skull, chest or abdominal injury other than bruises or minor lacerations
- Significant burns (second and third degree burns over 10% or more of the body)
- Unconsciousness when taken from the crash scene
- Paralysis

Injury (B): A minor injury is any injury that is evident at the scene of the crash, other than fatal or serious injuries. Examples include lump on the head, abrasions, bruises, minor lacerations (cuts on the skin surface with minimal bleeding and no exposure of deeper tissue/muscle).

Possible Injury (C): A possible injury is any injury reported or claimed which is not a fatal, suspected serious, or suspected minor injury. Examples include momentary loss of consciousness, claim of injury, limping, or complaint of pain or nausea. Possible injuries are those that are reported by the person or are indicated by their behavior, but no wounds or injuries are readily evident.

No Apparent Injury or Property Damage Only (O): No apparent injury is a situation where there is no reason to believe that the person received any bodily harm from the motor vehicle crash. There is no physical evidence of injury and the person does not report any change in normal function.

Source: National Highway Transportation Safety Administration. “Model Minimum Uniform Criteria (MMUCC) 5th Edition.” 2017.

Appendix A – Crashes by Month for Each Mode

Table 46: Crashes by Month, Pedestrians, 2009-2018

Month	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
January	38	12%	3	8%	35	12%
February	23	7%	0	0%	23	8%
March	28	9%	3	8%	25	9%
April	20	6%	3	8%	17	6%
May	21	7%	3	8%	18	6%
June	23	7%	4	10%	19	7%
July	21	7%	0	0%	21	7%
August	16	5%	4	10%	12	4%
September	24	8%	3	8%	21	7%
October	26	8%	3	8%	23	8%
November	40	13%	6	15%	34	12%
December	40	13%	7	18%	33	12%
unknown	0	0%	0	0%	0	0%
Total	**320**	**100%**	**39**	**100%**	**281**	**100%**

Table 47: Crashes by Month, Bicycle, 2009-2018

Month	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
January	33	9%	3	10%	30	9%
February	23	6%	0	0%	23	7%
March	28	7%	2	7%	26	8%
April	32	9%	1	3%	31	9%
May	34	9%	5	17%	29	8%
June	31	8%	4	13%	27	8%
July	29	8%	1	3%	28	8%
August	30	8%	2	7%	28	8%
September	46	12%	5	17%	41	12%
October	37	10%	2	7%	35	10%
November	31	8%	3	10%	28	8%
December	22	6%	2	7%	20	6%
unknown	0	0%	0	0%	0	0%
Total	**376**	**100%**	**30**	**100%**	**346**	**100%**

Table 48: Crashes by Month, Motorcycle, 2009-2018

Month	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
January	8	7%	2	10%	6	6%
February	10	8%	0	0%	10	10%
March	5	4%	0	0%	5	5%
April	12	10%	1	5%	11	11%
May	8	7%	2	10%	6	6%
June	10	8%	1	5%	9	9%
July	13	11%	2	10%	11	11%
August	13	11%	2	10%	11	11%
September	10	8%	2	10%	8	8%
October	9	7%	0	0%	9	9%
November	14	11%	5	24%	9	9%
December	9	7%	2	10%	7	7%
unknown	2	2%	2	10%	0	0%
Total	**123**	**100%**	**21**	**100%**	**102**	**100%**

Table 49: Crashes by Month, Motor Vehicle, 2009-2018

Month	# of Crashes	% of 10-Year Total Crashes	# of KSI Crashes	% of KSI Crashes	# of Injury Crashes	% of Injury Crashes
January	79	8%	0	0%	79	8%
February	65	6%	0	0%	65	7%
March	70	7%	3	13%	67	7%
April	75	7%	0	0%	75	8%
May	98	10%	3	13%	95	10%
June	81	8%	3	13%	78	8%
July	82	8%	2	9%	80	8%
August	87	9%	1	4%	86	9%
September	79	8%	2	9%	77	8%
October	98	10%	4	17%	94	10%
November	90	9%	3	13%	87	9%
December	104	10%	2	9%	102	10%
unknown	0	0%	0	0%	0	0%
Total	**1,008**	**100%**	**23**	**100%**	**985**	**100%**

Appendix B – Crashes by Functional Classification

Table 50: Crashes per Mile by Functional Classification

Traffic classification	Miles	Total	Pedestrian	Bicycle	Motorcycle	Motor Vehicle
Arterial	42	26.0	4.0	4.9	1.9	15.1
Collector	19	14.4	2.7	3.4	0.9	7.4
Local Street	119	3.9	0.8	0.9	0.2	1.9