APPENDIX C: TECHNICAL ANALYSIS METHODOLOGIES

Pedestrian Demand Methodology

To conduct the pedestrian demand evaluation, Toole Design Group applied the Alameda County-wide pedestrian volume models developed by Schneider, et al.[1] These models estimate weekly pedestrian crossing volumes at intersections based on surrounding population density, employment density, number of commercial properties, and proximity to regional transit. The paper establishes the relationships between these variables and pedestrian crossing volumes observed between April and June 2008 using Ordinary Least Squares regression. In other words, it identifies how to weight the predictor variables (e.g., population density, employment density) to most accurately estimate the pedestrian volumes. While these variables and the pedestrian volumes have changed since 2008, the relationships between them are not expected to have changed. Updating the predictor variables to reflect current conditions will yield up-to-date pedestrian volume estimates.

Three models are presented in the paper, which largely rely on the same input variables with slight variations. The inputs include populations, employment counts, commercial property counts, number of BART stations, number of bus stops, and percentage of the population under 18 years old. Three models were applied, and the resulting estimates were compared to identify the model best suited for use in the Plan.

1 Schneider, R., Arnold, L., & Ragland, D. (2009). Pilot model for estimating pedestrian intersection crossing volumes. Transportation Research Record: Journal of the Transportation Research Board, (2140), 13-26. Available online at https://cloudfront.escholarship.org/dist/prd/content/qt3nr8h66j/qt3nr8h66j.pdf

For this effort, the pedestrian models were applied to all street intersections in Berkeley using updated input datasets, such as recent population numbers from the Census. Using a previously developed model to estimate pedestrian volumes citywide carries with it some distinct advantages and disadvantages over alternative approaches. On one hand, this approach allows us to draw on previous research completed locally to understand the relationships between pedestrian volumes and surrounding characteristics without collecting updated pedestrian count data. On the other hand, although the predicted model integrates updated data and should reflect current conditions, it is impossible to validate results and assess the degree to which the modeled volumes agree with current conditions without updated count data.

The primary alternative approach considered was applying the Space Syntax model presented in the 2006 Pedestrian Plan. This model was also developed based on observed counts. However, unlike the Schneider, et al. models, it only predicts mid-day peak pedestrian volumes, and the input variables only include distance to BART stations, average daily traffic (ADT), and a network accessibility metric known as "Radius 6 spatial integration." While these variables were found to be significant predictors when the models were developed, they are not suitable predictor variables for updating the volume estimates to current conditions. Both proximity to BART stations and R6 spatial integration have not changed substantially since 2008 and are unlikely to change in the future. However, pedestrian volumes can change over time without these variables changing, such as through increases in population or employment levels. The ADT variable, which is the only one that might have changed substantially since 2008, has a negative relationship with pedestrian volume in the Space Syntax model. Considering that ADT has presumably stayed steady or increased over the past decade with increases in population density, applying this model would lead to the conclusion that pedestrian volumes have decreased on average, which is contradictory to the common finding in pedestrian behavior research that volumes are positive associated with population density.

DATA SOURCES AND CONSOLIDATION

All data needed for these pedestrian models were publicly accessible. **Table C-1** displays the data source and geometry for each variable, in addition to whether the data was needed for each of the three models. All relevant datasets were downloaded from appropriate sources and the statistics were summarized around intersections consistent with methods presented in the paper by Schneider, et al.

City of Berkeley Business License data and employment and enrollment data for UC Berkeley was used to calculate employment numbers in the proximity of each intersection. The City of Berkeley Business License data includes employee counts but does not include employment data for UC Berkeley. Considering that UC Berkeley is the city's largest employer and a major generator of pedestrian volumes, this omission is a critical gap.

UC Berkeley employment and enrollment data was acquired for the 2017-2018 academic year and proportionally allocated the values to UC Berkeley buildings downloaded from OpenStreetMap. To do this, the estimated volume of UC Berkeley buildings where staff are located within the City limits was calculated by multiplying the area of a building's footprint by the number of levels in a building. Of the 305 building footprints in the OpenStreetMap dataset, 211 (69 percent) did not have data on the number of levels in the building. In these instances, the project team assumed the number of levels to be four. The team decided to use four levels as the underlying assumption based on the teams' familiarity with the campus.

Person counts were then assigned to each building based on the ratio of the building's volume to the total volume for all buildings. University student enrollment numbers were included in this evaluation, despite not being explicitly included in the original model, because these trips fulfill a similar function as employees' trips to work and therefore can be expected to be similarly predictive of pedestrian volumes. Additionally, the assignment of values to campus buildings is imprecise for various reasons (e.g., different types of buildings have different densities of office space, classrooms, and laboratory space). However, the campus building assignments provide the best readily available approximate proxy for which areas of the UC Berkeley campus have higher levels of pedestrian attraction.

Pedestrian volumes were also assigned to road segments. Interpolating pedestrian volumes from intersections to segments is imprecise because it requires assumptions about which segments the crossing volumes correspond to. Accordingly, the segment volumes should be interpreted as relative activity levels rather than precise pedestrian volumes. To interpolate, intersection points were joined to the street segments spatially and summed to calculate the pedestrian volumes at each intersection along the segment. The pedestrian volumes for all intersections located on a street segment were summed to provide the total pedestrian street segment volume. These values were then assigned to each road segment in Berkeley, with a road segment being the length of a block or the length between two adjacent intersections.

TABLE C-1: INPUT VARIABLES FOR EACH MODEL

Input Variable	Model A	Model B	Model C	Data Source	Geometry
Population	X	X	X	2016 U.S. Census 5-year estimates	Census block
Employment	X	X		City of Berkeley Business License (updated 2018)	Point locations
				Open Street Map building footprints	Building polygon
				UC Berkeley employment and enrollment numbers for academic year 2017-2018	No geometry
Proximity to Commercial Properties	X	X	X	City of Berkeley Open Data (updated November 2017)	Parcel
Proximity to Regional Transit (BART stations)	X	X	X	Alameda County Public Works (updated 2018)	Point locations
Proximity to Bus Stops			X	Alameda County Public Works (updated 2018)	Point locations
Percent of Population Under 18	X			2016 U.S. Census 5-year estimates	Census block group

RESULTS

Figure C-1, **Figure C-2**, and **Figure C-3** display the intersection pedestrian volumes, and **Figure C-4**, **Figure C-5**, and **Figure C-6** display the interpolated road segment pedestrian activity levels. On the maps, the road segment volumes are displayed in Low to High bins due to the imprecise nature of interpolating intersections onto road segments. As indicated on the maps, high pedestrian volume intersections cluster around the perimeter of the UC Berkeley campus, in downtown Berkeley, and around the North Berkeley and Ashby BART stations.

North Berkeley BART Station

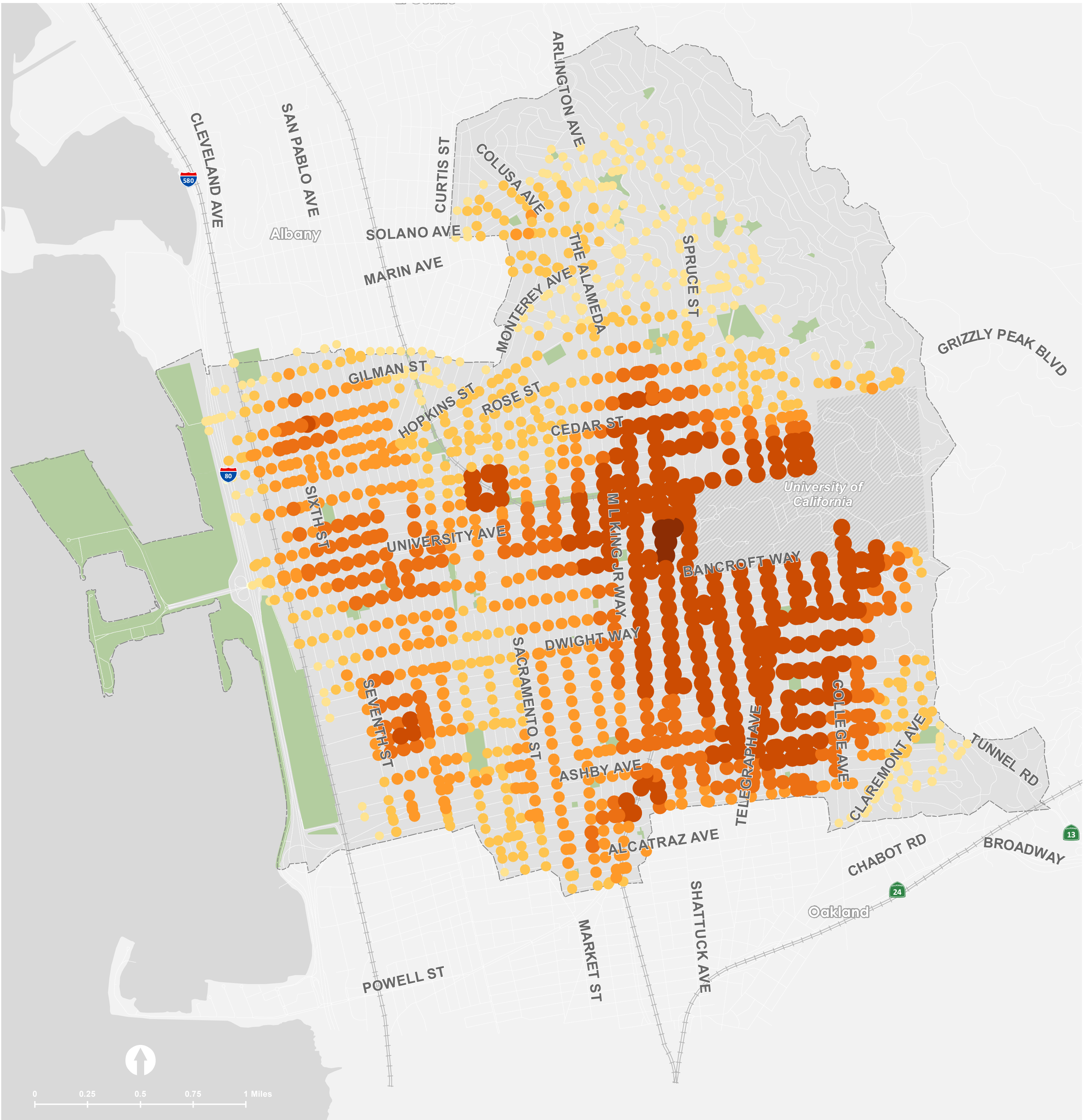
The predicted volumes around North Berkeley BART station seem to be higher than expected due to the station being classified as a "regional transit stop"; however, the surrounding land uses do not attract pedestrian activity. The low pedestrian volumes at the North Berkeley BART station are highlighted by the entry and exit data from the station. For example, in 2017, the average weekday entries and exits to the North Berkeley BART station were only 2,661, which was less than half of those for the Downtown Berkeley station (9,082). Additionally, in 2015, 45 percent of BART users departing on BART from North Berkeley reached the station by walking. Only 56 percent of people arriving at the North Berkeley BART station by BART left the station by walking. In comparison, 74 percent of riders leaving the Downtown Berkeley BART station reached the station by walking, and 90 percent of riders who arrived at the station by BART left the station by walking.[2] The project team recommends removing this station as a "regional transit stop" from the models since the station is located in a residential area and does not have as much pedestrian activity as the model results indicate.

2 Bay Area Rapid Transit. Station Profile Study. Accessed August 13, 2018. Available at: https://www.bart.gov/about/reports/profile

Negative Predicted Values

Because the original models were formulated as continuous variable models, rather than discrete count models, negative values are possible predicted values. For each model, some of the intersections in Berkeley have negative predicted values. While this may seem to call the model into question, this conveys that these locations have relatively low values for the variables that are positively associated with pedestrian volumes and are therefore places with very low predicted volumes. For example, Model A predicts a weekly pedestrian crossing volume of -1131 at the intersection of Wildcat Canyon Road and Park Hills Road. This is a result of the low population (approximately 2,540 people within a half mile), minimal employment and lack of commercial properties within a quarter mile, lack of regional transit stations in proximity, and a high proportion (21 percent) of the population being under the age of 18. Model A suggests that population, employment, commercial properties, and proximate regional transit stations are positively related to volumes, while the proportion of the population under 18 is substantially negatively associated with pedestrian volumes. Despite the fact that the resultant number is negative in this case, the fact that a low value was predicted for this site stands to reason – it is an intersection in the hills adjacent to Tilden Park with minimal pedestrian accommodations on the roadway. While people do walk at this location, the total number crossing through the intersection in one week is relatively low, so a negative result is fairly accurate. That said, there are no variables in the models to factor in recreational walking, such as adjacency to off-street trails. The predicted volumes for locations of this type are likely underestimates.

For ease of interpretation and communication, negative results are given a value of "0" on the corresponding maps. These locations can be seen as simply "low pedestrian volume" sites according to the model. As with all predictions from statistical models, the results presented here are estimates only and should not be interpreted as exact values.



- 5,001 - 10,000
- 10,001 - 15,000
- 15,001 - 20,000
- 20,001 - 100,000
- > 100,000
- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-1: MODEL A PEDESTRIAN VOLUMES AT INTERSECTIONS

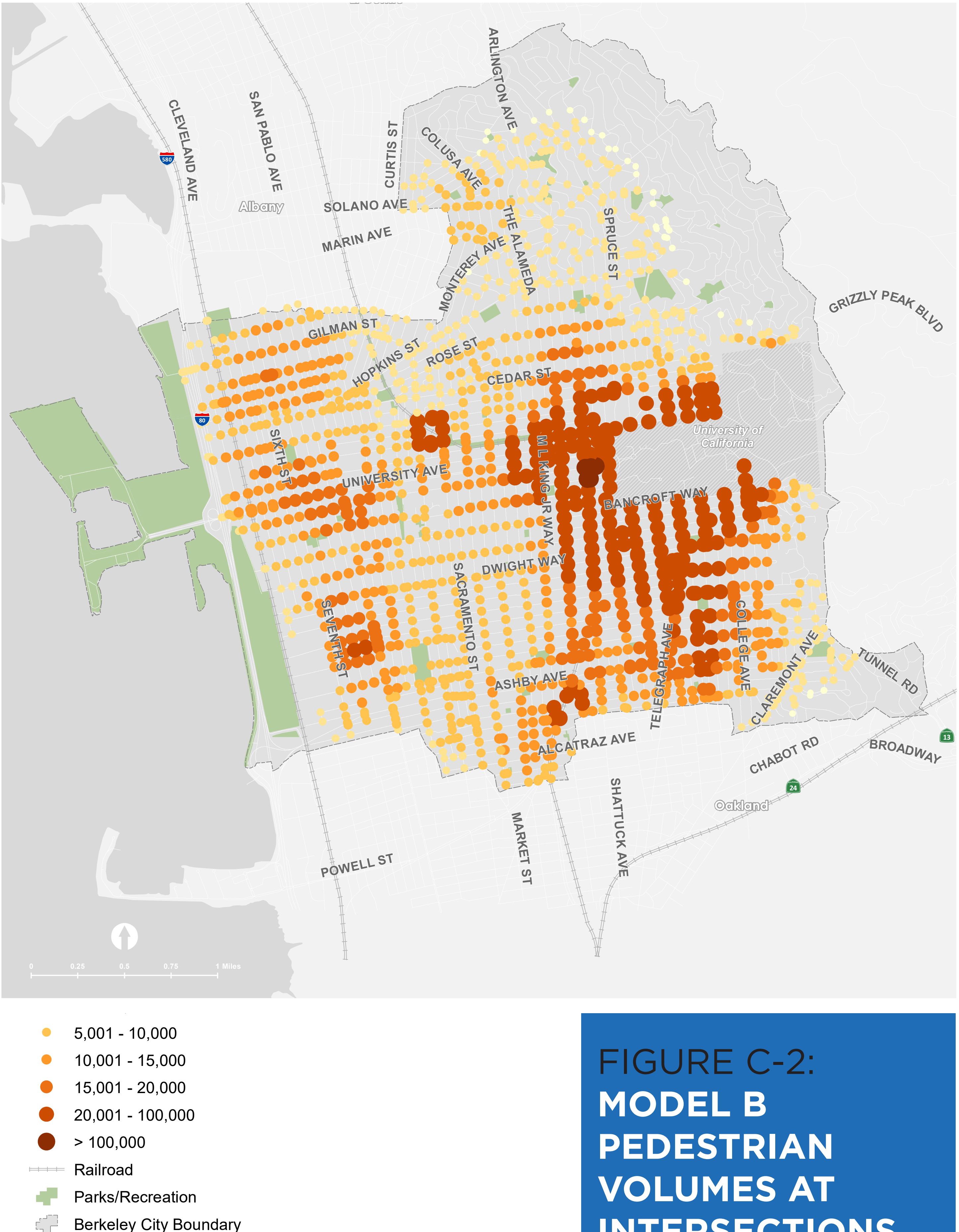
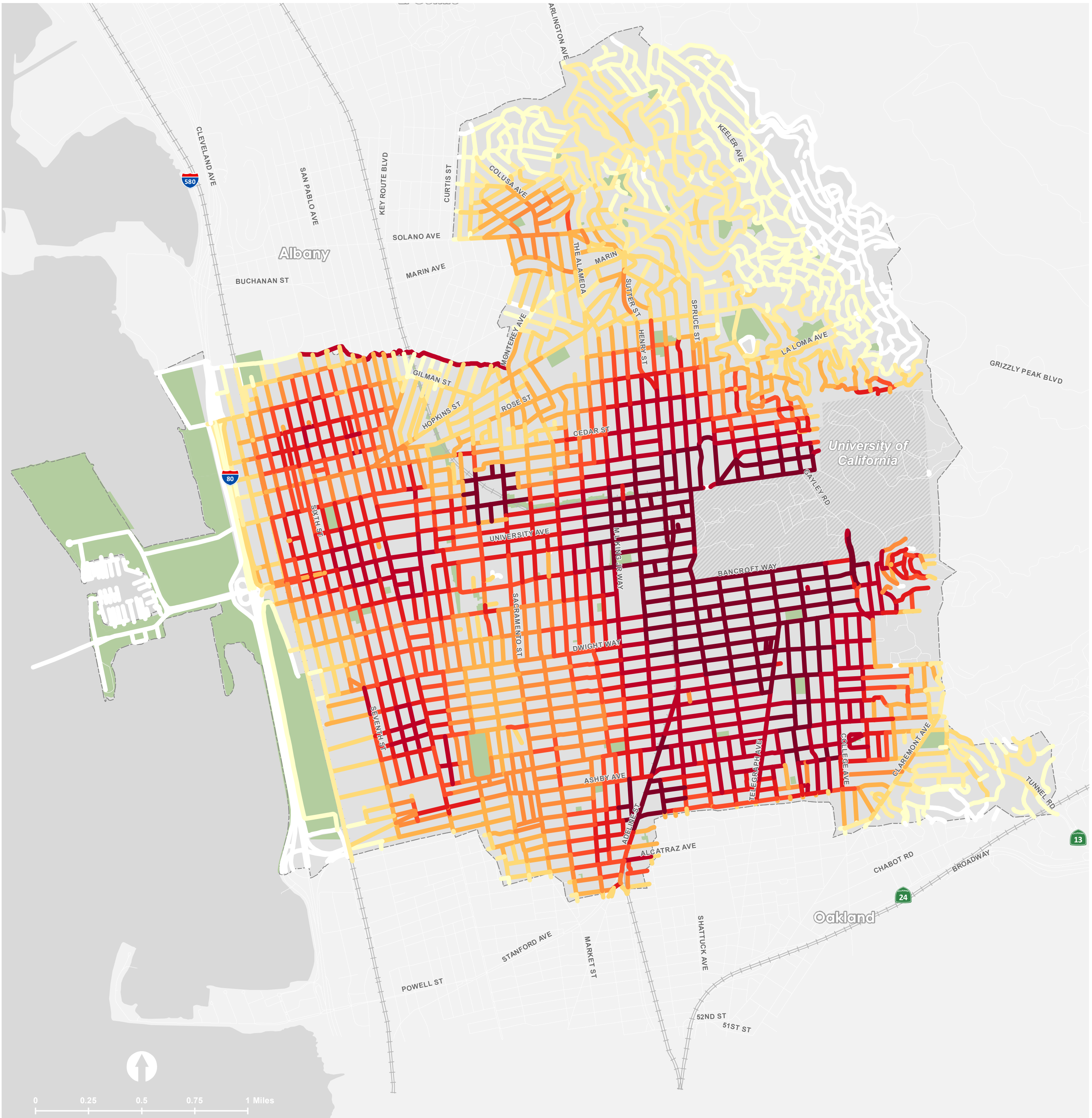


FIGURE C-2: **MODEL B PEDESTRIAN VOLUMES AT INTERSECTIONS**

251 - 5,000
5,001 - 10,000
10,001 - 15,000
15,001 - 20,000
20,001 - 100,000
Railroad
Parks/Recreation
Berkeley City Boundary

FIGURE C-3:
MODEL C PEDESTRIAN VOLUMES AT INTERSECTIONS

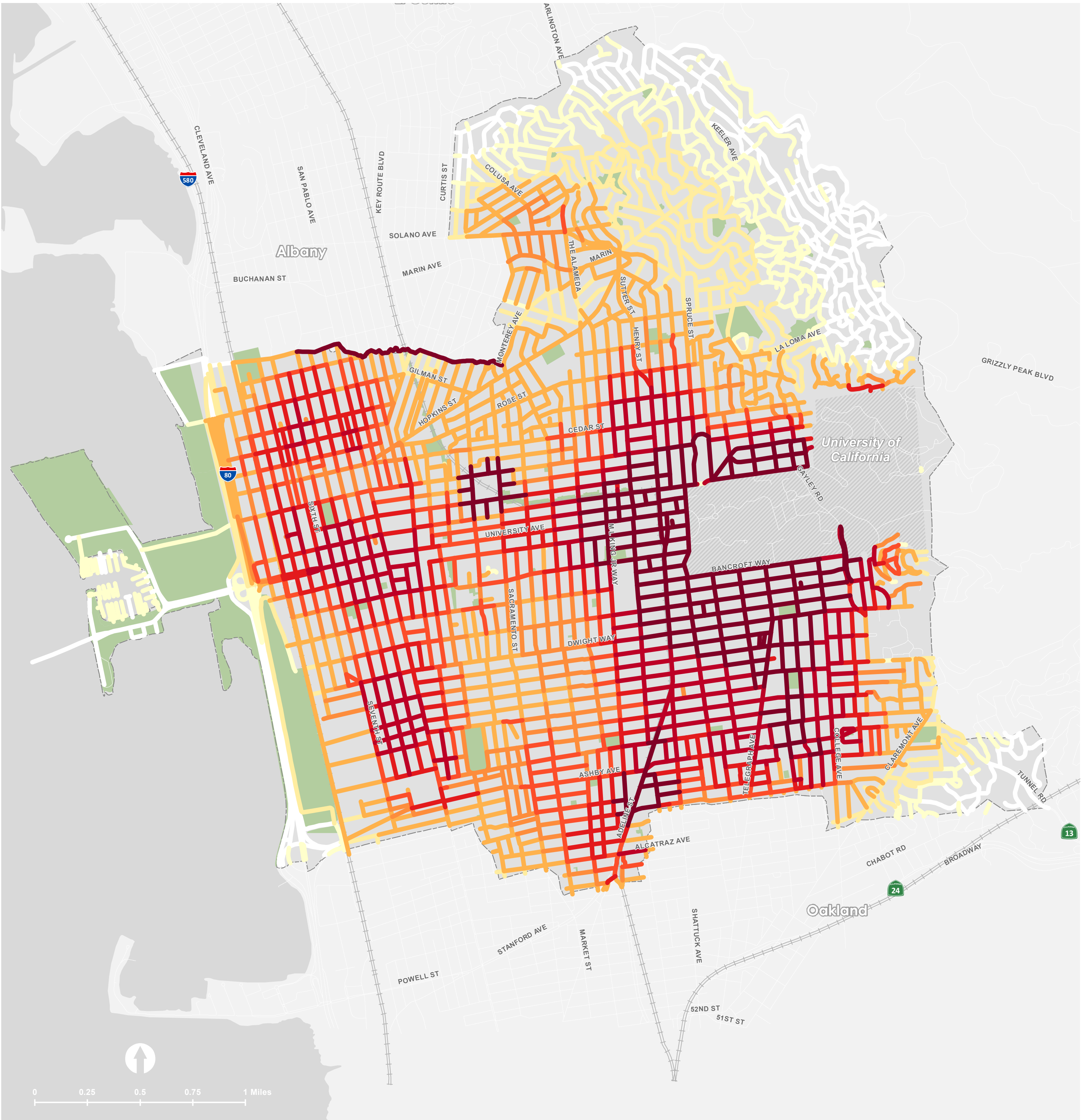


Estimated Weekly Pedestrian Volumes

- Top 10% Segment Demand
- Top 20% Segment Demand
- Top 30% Segment Demand
- Top 40% Segment Demand
- Top 50% Segment Demand
- Top 60% Segment Demand
- Top 70% Segment Demand
- Top 80% Segment Demand
- Top 90% Segment Demand
- All Segment Demand

- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-4: **MODEL A PEDESTRIAN VOLUMES ON ROAD SEGMENTS**

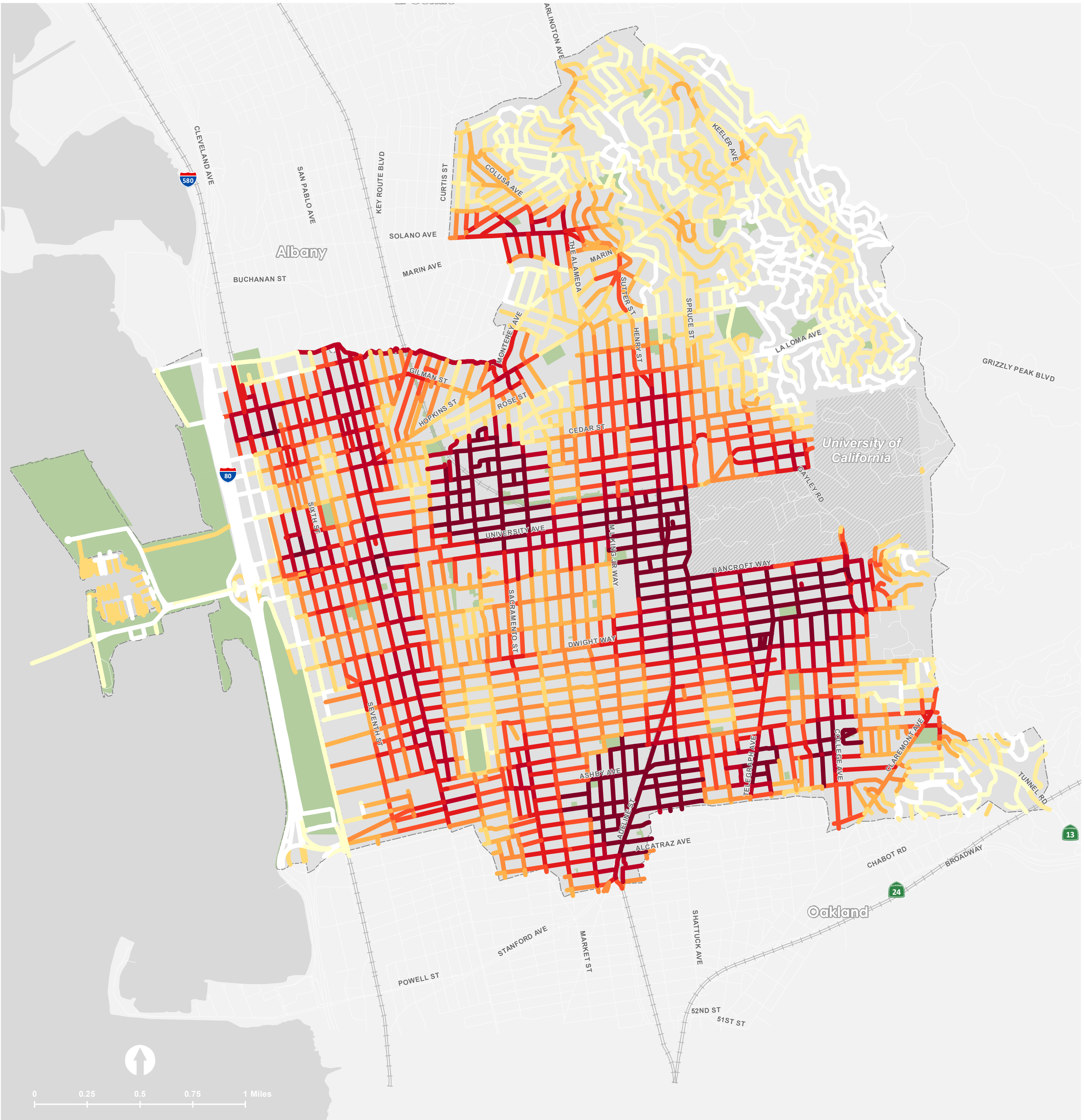


Estimated Weekly Pedestrian Volumes

- Top 10% Segment Demand
- Top 20% Segment Demand
- Top 30% Segment Demand
- Top 40% Segment Demand
- Top 50% Segment Demand
- Top 60% Segment Demand
- Top 80% Segment Demand
- Top 90% Segment Demand
- All Segment Demand

- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-5: **MODEL B PEDESTRIAN VOLUMES ON ROAD SEGMENTS**



Estimated Weekly Pedestrian Volumes

- Top 10% Segment Demand
- Top 20% Segment Demand
- Top 30% Segment Demand
- Top 40% Segment Demand
- Top 50% Segment Demand
- Top 60% Segment Demand
- Top 70% Segment Demand
- Top 80% Segment Demand
- Top 90% Segment Demand
- All Segment Demand

- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-6: **MODEL C PEDESTRIAN VOLUMES ON ROAD SEGMENTS**

Table C-2 through **Table C-4** demonstrate the top 20 intersections by estimated pedestrian crossing volume for each model. These are intended to both contextualize the results by showing which locations are predicted to have the highest crossing rates, and to show the relative consistency between models in terms of the ranking of high-volume locations.

TABLE C-2: TOP 20 MODEL A INTERSECTIONS WITH HIGH PEDESTRIAN VOLUME

Model A Rank	Street 1	Street 2	Model A Volume	Model B Volume	Model C Volume
1	Shattuck East	Addison ST	110,224	107,241	85,519
2	Shattuck West	Addison ST	108,895	105,055	87,776
3	Shattuck AV	Center ST	107,207	102,994	82,493
4	Shattuck AV	Allston WY	101,546	95,545	89,614
5	Adeline ST	Woolsey ST	74,720	70,303	51,191
6	Adeline ST	Essex ST	74,122	69,617	53,323
7	Emerson ST	Adeline ST	74,050	69,340	61,608
8	Woolsey ST	Martin Luther King Jr WY	73,852	69,542	52,835
9	Tremont ST	Essex ST	73,755	68,409	51,648
10	Tremont ST	Prince ST	73,613	68,256	46,423
11	Prince ST	Martin Luther King Jr WY	72,447	68,275	47,394
12	Sacramento ST	Delaware ST	70,193	64,555	47,285
13	Short ST	Delaware ST	69,990	64,147	44,909
14	Delaware ST	Acton ST	68,910	62,933	43,197
15	Sacramento ST	Francisco ST	67,195	61,726	46,346
16	Francisco ST	Acton St	66,690	60,853	42,137
17	Short ST	Virginia ST	64,965	59,606	44,658
18	Acton ST	Virginia ST	64,955	59,227	42,510
19	Virginia ST	Sacramento ST	64,853	59,713	45,583
20	Bowditch ST	Bancroft WY	60,281	62,196	14,300

TABLE C-3: TOP 20 MODEL B INTERSECTIONS WITH HIGH PEDESTRIAN VOLUME

Model B Rank	Street 1	Street 2	Model A Volume	Model B Volume	Model C Volume
1	Shattuck East	Addison ST	110,224	107,241	85,519
2	Shattuck West	Addison ST	108,895	105,055	87,776
3	Shattuck AV	Center ST	107,207	102,994	82,493
4	Shattuck AV	Allston WY	101,546	95,545	89,614
5	Adeline ST	Woolsey ST	74,720	70,303	51,191
6	Adeline ST	Essex ST	74,122	69,617	53,323
7	Woolsey ST	Martin Luther King Jr WY	73,852	69,542	52,835
8	Emerson ST	Adeline ST	74,050	69,340	61,608
9	Tremont ST	Essex ST	73,755	68,409	51,648
10	Prince ST	Martin Luther King Jr WAY	72,447	68,275	47,394
11	Tremont ST	Prince ST	73,613	68,256	46,423
12	Sacramento ST	Delaware ST	70,193	64,555	47,285
13	Short ST	Delaware ST	69,990	64,147	44,909
14	Delaware ST	Acton ST	68,910	62,933	43,197
15	Bowditch ST	Bancroft WY	60,281	62,196	14,300
16	Sacramento ST	Francisco ST	67,195	61,726	46,346
17	Francisco ST	Acton St	66,690	60,853	42,137
18	Virginia ST	Sacramento ST	64,853	59,713	45,583
19	Short ST	Virginia ST	64,965	59,606	44,658
20	Acton ST	Virginia ST	64,955	59,227	42,510

TABLE C-4: TOP 20 MODEL C INTERSECTIONS WITH HIGH PEDESTRIAN VOLUME

Model C Rank	Street 1	Street 2	Model A Volume	Model B Volume	Model C Volume
1	Shattuck AV	Allston WY	101,546	95,545	89,614
2	Shattuck West	Addison ST	108,895	105,055	87,776
3	Shattuck East	Addison ST	110,224	107,241	85,519
4	Shattuck AV	Bancroft WY	40,059	35,871	85,200
5	Shattuck AV	Center ST	107,207	102,994	82,493
6	Shattuck AV	Kittredge ST	43,449	39,507	81,043
7	University AV	Shattuck West	53,085	52,118	79,075
8	University AV	Shattuck East	50,523	49,334	77,764
9	Berkeley WY	Shattuck AV	48,972	47,191	74,914
10	University AV	Bonita AV	39,992	36,614	74,428
11	Shattuck AV	Durant AV	38,888	34,035	74,206
12	Harmon ST	Adeline ST	13,914	11,584	71,082
13	Henry ST	Berkeley WY	47,974	45,667	71,015
14	Kittredge ST	Fulton ST	44,045	40,412	70,323
15	Kittredge ST	Harold WY	41,626	37,329	69,226
16	University AV	Milvia ST	45,842	43,166	68,937
17	Newbury ST	Ashby AV	19,568	15,931	66,844
18	University AV	Sacramento ST	15,361	11,698	67,319
19	Bancroft WY	Fulton ST	38,414	33,805	65,732
20	Milvia ST	Addison ST	47,377	44,672	65,679

SUMMARY

In summary, using the pedestrian volume models developed by Schneider, et al., produced estimates at each intersection in the City of Berkeley solely using publicly accessible data. While the three models produced similar ranges of pedestrian volumes and rankings of top locations, there are also discrepancies in the overall patterns predicted by the three.

Despite the discrepancies, there are four intersections that appear in each models' top 20 intersections with highest pedestrian volumes. These locations are all in the downtown core of Berkeley, near the BART station (see **Table C-5**).

Since these models treated the pedestrian counts as a continuous variable, some predicted intersection volumes are negative. Model C had the highest number of negative values; because of this, the project team does not recommend using Model C. While Model A and Model B both produce logical results, the project team recommends that the City of Berkeley use results from Model B to inform the Plan. This recommendation is supported by Schenider et al's recommendation to use Model B because it has a good overall model fit, includes logical independent variables, and all variables are statistically significant at the 95 percent confidence interval.

If the City desires a more nuanced or accurate view of pedestrian volumes, the project team recommends conducting counts at representative locations in a variety of contexts throughout Berkeley to validate the model-predicted values, and potentially to develop a revised model. If a new model is developed, adjacency to trails would be an important variable to consider as the methodology does not account for facilities such as the Ohlone Greenway and West Street Path which are likely high demand areas. More accurate results could also be achieved with refined input variables, particularly for the employment numbers and locations for UC Berkeley. Since the current models rely on distributing employment numbers based on building volume, the specific distribution of the pedestrian activity around the campus could be misrepresented. However, the effects of this are not expected to be substantial relative to the precision of the model.

Despite the limitations associated with applying these models, the outputs are a reasonable prediction of pedestrian activity in Berkeley. The predicted pedestrian demand will be used to assist in prioritizing pedestrian projects and used to measure the level of pedestrian exposure at pedestrian-involved collision locations throughout Berkeley.

TABLE C-5: INTERSECTIONS IN EACH MODELS' TOP 20 INTERSECTIONS

Street 1	Street 2
Shattuck East	Addison ST
Shattuck West	Addison ST
Shattuck AV	Center ST
Shattuck AV	Center ST

Pedestrian Collisions

This analysis examines all recorded collisions involving a pedestrian in Berkeley. The Statewide Integrated Traffic Records System (SWITRS) database from the California Highway Patrol reported 1,071 collisions involving a pedestrian from 2008 to 2017 – the 10 most recent years with complete data. The majority of collisions took place at or within 250 feet of an intersection.

The California Office of Traffic Safety collects collision data for each city and county in California and ranks cities of similar sizes (based on population) along collision parameters. The most recent year of data is from 2015, where Berkeley had 119,997 residents. Of the 57 cities with 100,000 to 250,000 residents, Berkeley was:

- **First** in total collisions involving pedestrians (116 collisions)
- **First** in total collisions involving bicyclists (173 collisions)
- **Second** in total collisions involving pedestrians over the age of 65 (18 collisions)
- **Eighth** in total collisions that were speed related (218 collisions)

COLLISION HISTORY

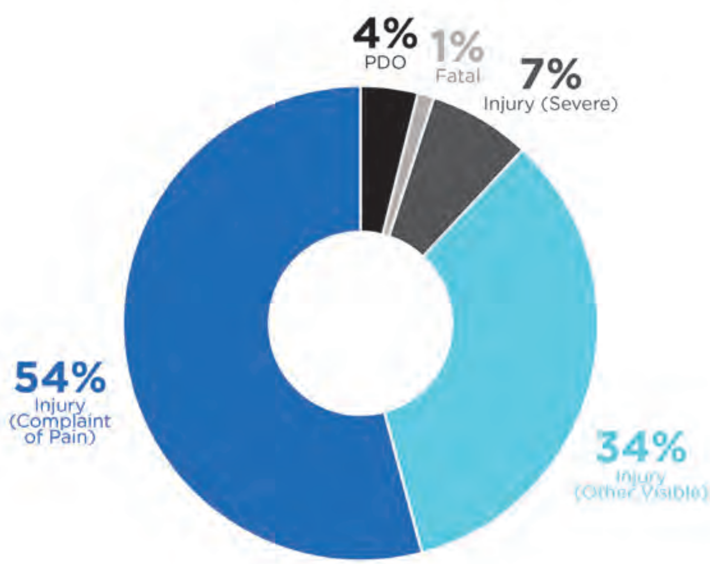
The SWITRS database reports the following outcomes for pedestrian-involved collisions, listed from most to least severe:

- **Fatal:** A pedestrian fatality from a collision
- **Injury (Severe):** Life-threatening or otherwise severe injury to a pedestrian
- **Injury (Other Visible):** Visible, non-severe pedestrian injury
- **Injury (Complaint of Pain):** No visible injury, but the pedestrian complains of pain
- **Property Damage Only:** No injuries from a collision

Of the 1,071 total collisions involving pedestrians in Berkeley between 2008 and 2017 (collisions involving pedestrians on Interstate 80 were excluded from this analysis), 10 were fatal and 79 led to a severe injury (see **Exhibit C-1**). These totals represent collisions that were reported to the police and likely undercounts the number of actual collisions involving a pedestrian in Berkeley. Similarly, the reported injuries from the collision are simply a police officer's account at the time of the collision; a reported injury could become more severe or chronic over time, which cannot be captured in an officer's point-in-time report. Collision records are updated if a pedestrian dies of complications from the collision.

Of the 1,071 total pedestrian collisions, 31 took place along a street segment (defined as more than 250 feet away from an intersection). Three of the 10 fatal collisions took place along a street segment: these included two collisions on University Avenue, a major east-west thoroughfare through Berkeley connecting the UC Berkeley campus, I-80, and the Berkeley Marina, and on Gilman Street (see **Table C-6**). One intersection – Adeline Street and Harmon Street, had two fatal collisions.

EXHIBIT C-1: PEDESTRIAN COLLISIONS IN BERKELEY, 2008-2017 USING CALTRANS INJURY COLLISION TYPES



Source: SWITRS 2008-2017

TABLE C-6: FATAL PEDESTRIAN COLLISIONS IN BERKELEY, 2008-2017

Collision Location	Collision Date
Warring Street/Derby Street Intersection	2/27/2009
Adeline Street/Harmon Street Intersection	4/29/2009
Adeline Street/Harmon Street Intersection	3/10/2010
San Pablo Avenue/Gilman Street Intersection	10/23/2010
Gilman Street and Frontage Road	11/26/2011
Tulare Avenue/Marin Avenue Intersection	1/30/2012
University Avenue on Overpass over Interstate 80	7/15/2013
Sacramento Street/Bancroft Way Intersection	4/4/2014
University Avenue Between Shattuck Avenue and Milvia Street	9/27/2016
Monterey Avenue/Hopkins Street Intersection	4/15/2017

Source: SWITRS 2008-2017

Five intersections in Berkeley have had 10 or more reported pedestrian collisions between 2008 and 2017 (see **Table C-7**). Three of the 10 fatal pedestrian collisions occurred at an intersection with a high number of overall pedestrian collisions – two occurred at Adeline Street/Harmon Street, and one occurred at San Pablo Avenue/Gilman Street. There were two severe injury collisions at these intersections – one at Spruce Street/Hearst Street, and one at Telegraph Avenue/Parker Avenue.

As shown in **Figure C-7**, the intersections in Berkeley with the highest number of collisions were generally located around downtown, south of the UC Berkeley campus, and along major arterials such as Ashby Avenue, San Pablo Avenue, Shattuck Avenue, and University Avenue.

The streets with the most pedestrian collisions are generally arterial streets with high vehicle volumes and streets that run through downtown or close to the UC Berkeley campus (see **Table C-8**). Shattuck Avenue, which meets all of the criteria, had 122 pedestrian collisions between 2008 and 2017. Ashby Avenue and San Pablo, both of which are state highways, had 88 pedestrians collisions each during this time period.

The majority of pedestrian collisions in Berkeley occur at intersections. For this table, intersection collisions are tallied for both streets at the intersection. A more thorough analysis of collisions by street segment can be found later in this appendix.

TABLE C-7: INTERSECTIONS BY TOTAL NUMBER OF PEDESTRIAN COLLISIONS, 2008-2017

Intersection	Number of Collisions
College Avenue and Ashby Avenue	13
Fulton Street and Bancroft Way	12
Adeline Street and Harmon Street	10
Dana Street and Channing Way	10
Oxford Street and Addison Street	10
Bowditch Street and Durant Avenue	9
Martin Luther King Jr Way and Ashby Avenue	9
San Pablo Avenue and University Avenue	9
Spruce Street and Hearst Avenue	9
Action Street and University Avenue	8
College Avenue and Bancroft Way	8
Dana Street and Bancroft Way	8
Le Roy Avenue and Hearst Avenue	8
San Pablo Avenue and Gilman Street	8
Telegraph Avenue and Parker Street	8

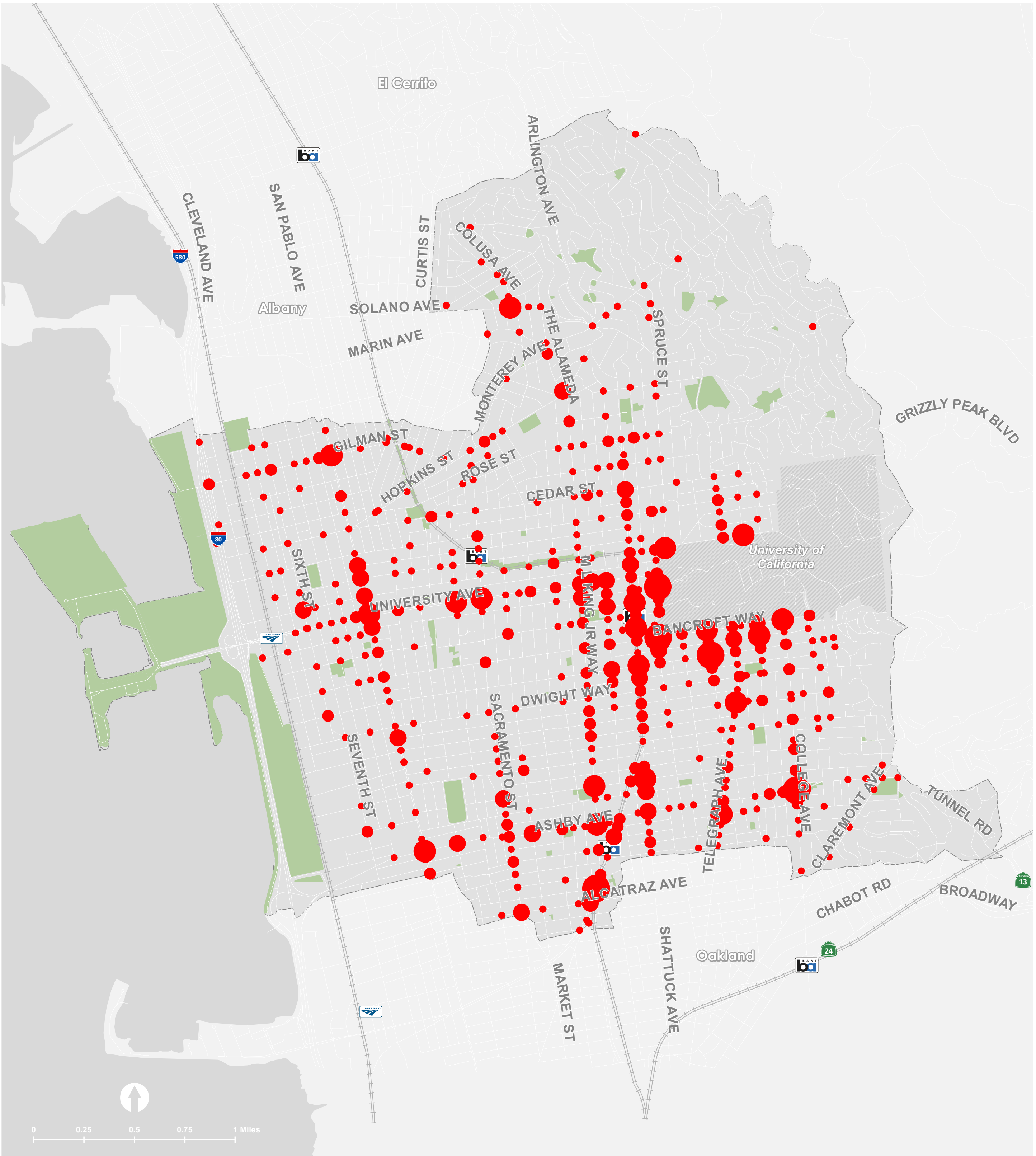
Source: SWITRS 2008-2017

TABLE C-8: STREETS BY TOTAL NUMBER OF PEDESTRIAN COLLISIONS, 2008-2017

Street	Number of Collisions
Shattuck Avenue	122
Ashby Avenue	88
San Pablo Avenue	88
Martin Luther King Jr Way	76
University Avenue	74
Bancroft Way	65
Sacramento Street	56
Telegraph Avenue	56
Channing Way	52
Hearst Avenue	51
College Avenue	48
Adeline Street	42
Addison Street	40
Milvia Street	36
Dwight Way	35

Source: SWITRS 2008-2017

FIGURE C-7: TOTAL COLLISIONS AT INTERSECTIONS MAP



Total Collisions at Intersections

- 1 - 2
- 3 - 4
- 5 - 6
- 7 - 9
- 10 - 13

- Amtrak Station
- BART Station
- Railroad
- Parks/Recreation
- Berkeley City Boundary

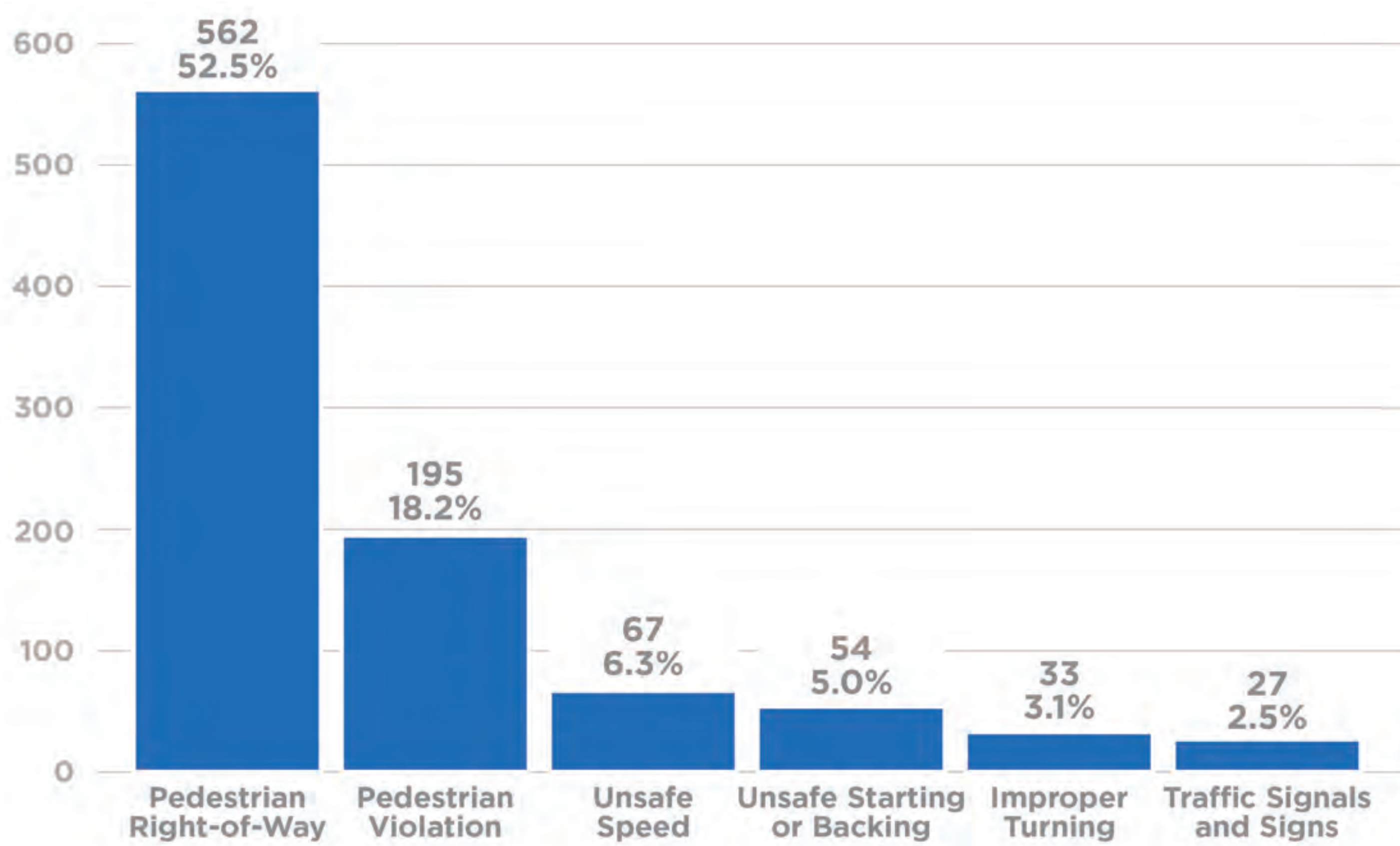
COLLISION CONTRIBUTING FACTORS

SWITRS provides several data points for each collision, including collision factor, pedestrian action, and driver action. The primary collision factor is the reporting officer's best judgment as to the primary contributing factor to the collision. This element represents an officer's opinion and is used to examine collision trends. **Exhibit C-2** shows the top six primary collision factors identified in pedestrian collisions in Berkeley from 2008 to 2017. Definitions of these collision factors are below:

- **Pedestrian Right-of-Way:** Driver or person walking fails to yield to and then collides with a vehicle, pedestrian or bicyclist already in an intersection.
- **Pedestrian Violation:** Pedestrian fails to yield the right-of-way to a vehicle when not in a marked crosswalk or unmarked crosswalk at an intersection.
- **Unsafe Speed:** Driver travels above the posted speed limit or at an unsafe speed for the existing roadway conditions.
- **Unsafe Starting or Backing:** Driver backs up a vehicle or enters traffic from a stopped or parked position that resulted in a collision with a person walking or other vehicle.
- **Improper Turning:** Driver makes a U-turn at an intersection without a four way stop that resulted in a collision with a person walking or other vehicle.
- **Traffic Signals and Signs:** Driver fails to stop at a stop sign and collides with a vehicle, pedestrian, or person on a bicycle.

The majority of pedestrian collisions in Berkeley occurred when a driver failed to yield the right of way to a pedestrian. Of the 10 fatal collisions, pedestrian violations were the collision factor for three collisions. Pedestrian right-of-way was the collision factor for two fatal collisions, and driving under the influence was the collision factor for one fatal collision. The other four fatal collisions did not state a primary collision factor.

EXHIBIT C-2: PRIMARY COLLISION FACTORS FOR PEDESTRIAN COLLISIONS IN BERKELEY FROM 2008 TO 2017



Source: SWITRS 2008-2017

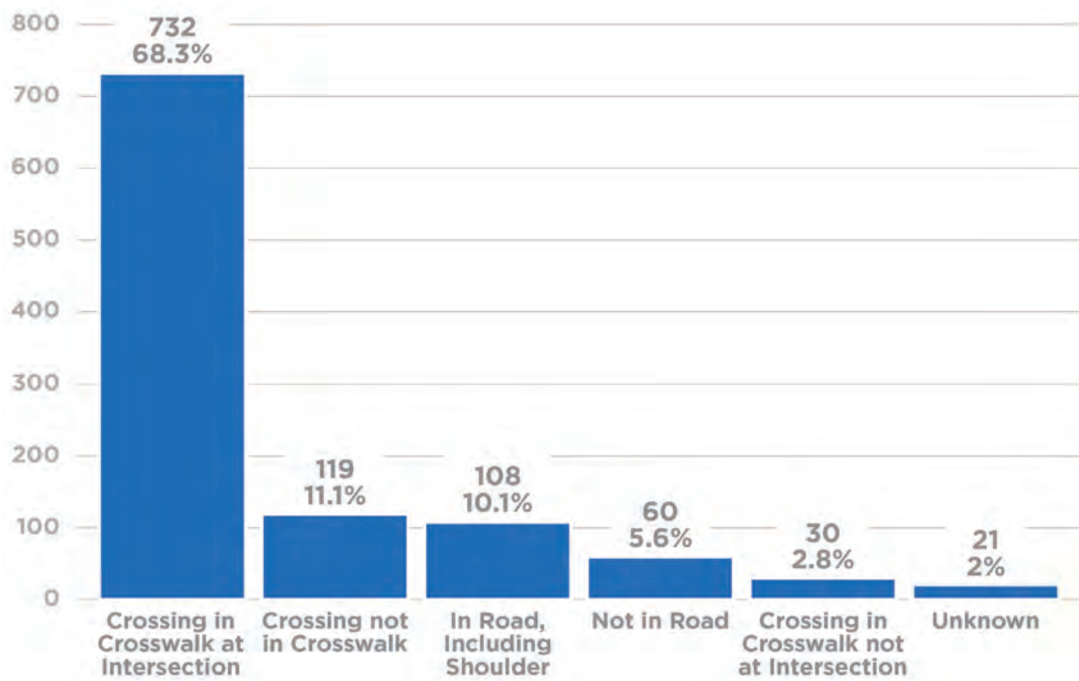
Nearly 70 percent of pedestrians involved in collisions were crossing the street at a crosswalk in an intersection at the time of the collision. Over 11 percent of pedestrians were crossing the street outside of the crosswalk, and 10 percent were in the road when they were hit. A small percentage of pedestrians were hit while crossing at a mid-block crossing. **Exhibit C-3** shows all pedestrian actions prior to the reported collision.

Of the 10 fatal collisions, six pedestrians were crossing in a crosswalk at an intersection, two were in the road, one were crossing not at a crosswalk, and one was crossing at a mid-block crosswalk.

Prior to the collision, the majority of drivers were either proceeding straight or making a left turn (see **Exhibit C-4**). Drivers were more than two times likelier to be making a left turn prior to colliding with a pedestrian than making a right turn. **Exhibit C-4** shows the top five driver actions from more than a dozen reported actions.

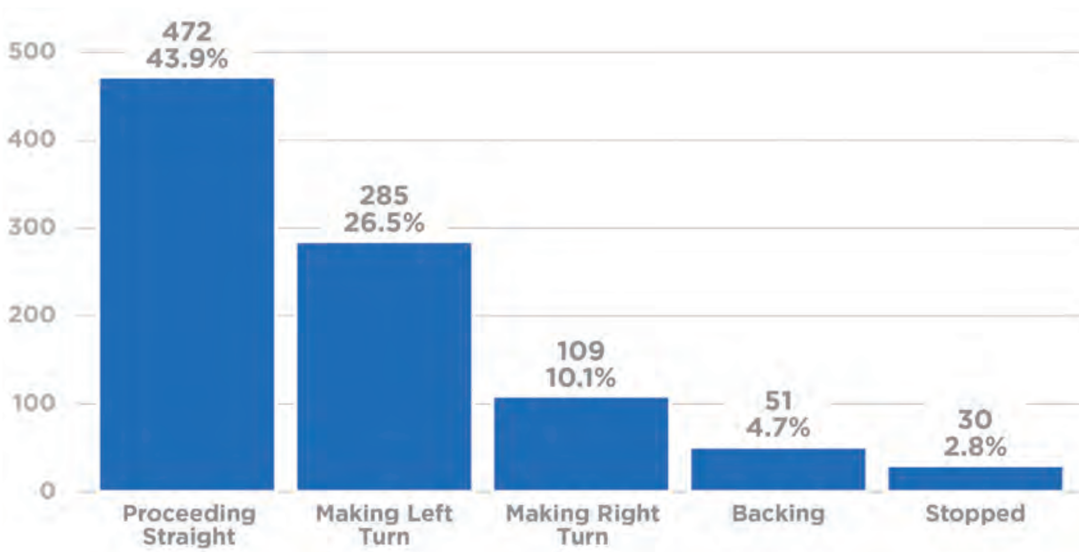
Of the 10 fatal collisions, drivers were proceeding straight for five of the collisions and making a left turn for three of the collisions. The driver action proceeding the collision was unknown for the other two fatal collisions.

EXHIBIT C-3: PEDESTRIAN ACTION PRIOR TO COLLISION



Source: SWITRS 2008-2017

EXHIBIT C-4: DRIVER ACTION PRIOR TO COLLISION



Source: SWITRS 2008-2017

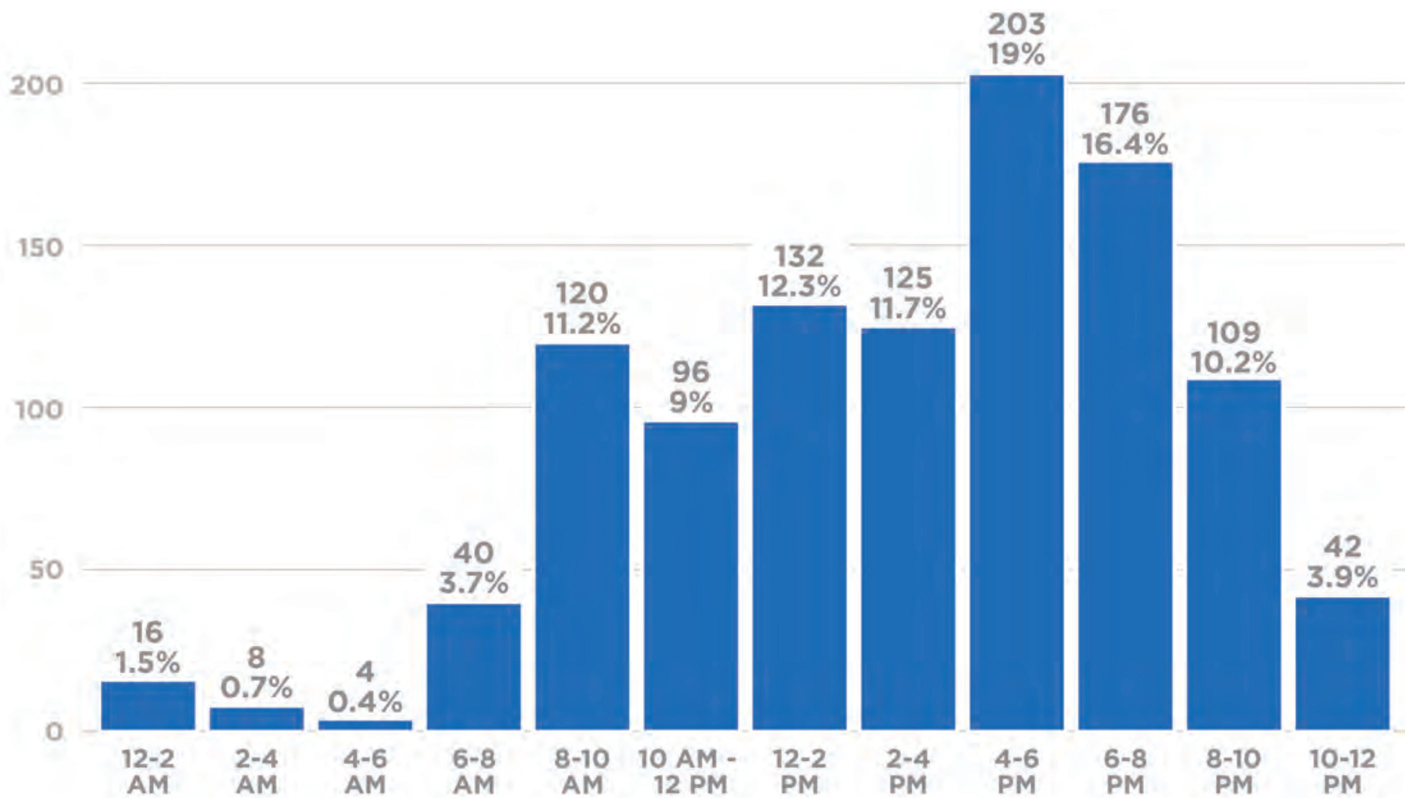
COLLISION OCCURRENCE

This section examines when pedestrian collisions took place by time of day, day of the week, and month.

Pedestrian collisions are more likely to take place in the afternoon than in the morning. **Exhibit C-5**, which categorizes collisions into two hour increments, shows that more than 35 percent of reported collisions in Berkeley between 2008 and 2017 took place between 4pm and 8pm, which captures the afternoon rush hour. The morning rush hour has fewer collisions – only 15 percent took place between 6am and 10am. 27 percent of reported collisions took place during the first 12 hours of the day.

Of the 10 fatal pedestrian collisions, seven took place between the hours of 6:30 PM and midnight, and one more took place at 5:10 AM. Only two collisions took place during year-round daylight hours: one at 12:23 PM and the other at 1:46 PM.

EXHIBIT C-5: PEDESTRIAN COLLISIONS BY TIME OF DAY



Source: SWITRS 2008-2017

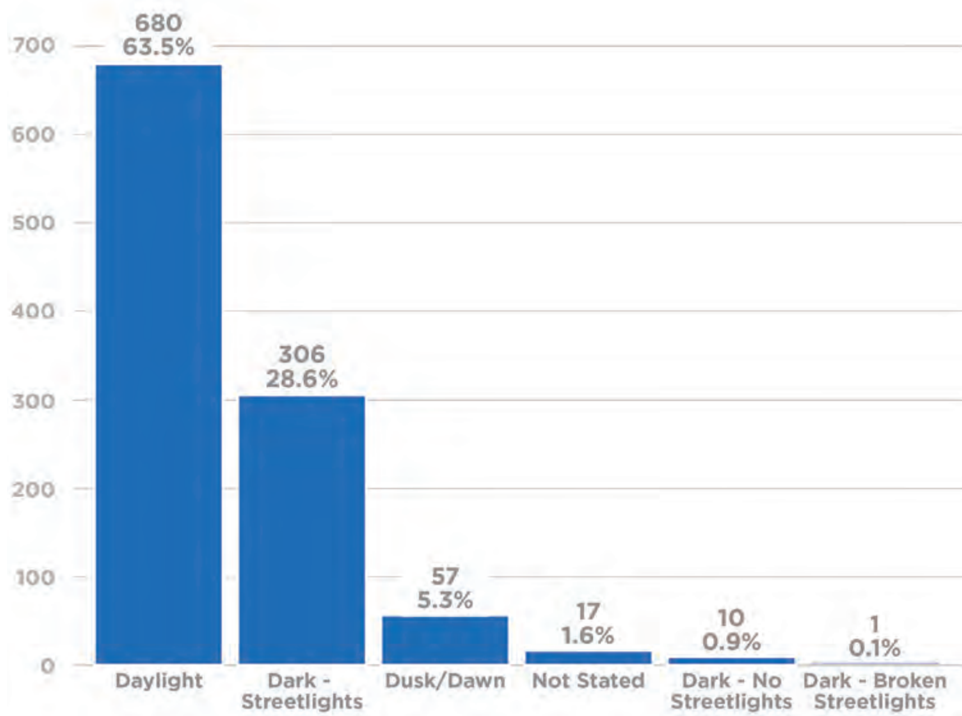
Nearly two-thirds of Berkeley's reported pedestrian collisions took place during the daylight hours (see **Exhibit C-6**). Overall, 11 of the 1,071 total pedestrian collisions between 2008 and 2017 took place on streets with no streetlights or on streets with broken streetlights.

Seven of the 10 fatal pedestrian collisions took place at night, on streets with streetlights. Two collisions took place during the day, and one did not state whether it was during the day or at night.

The most collisions take place on Tuesdays, Wednesdays, and Thursdays, with fewer collisions on Mondays and Fridays. This likely corresponds with the days where most people are at work. Both weekend days have the lowest number of collisions, representing just over 20 percent of all pedestrian collisions in Berkeley from 2008 to 2017.

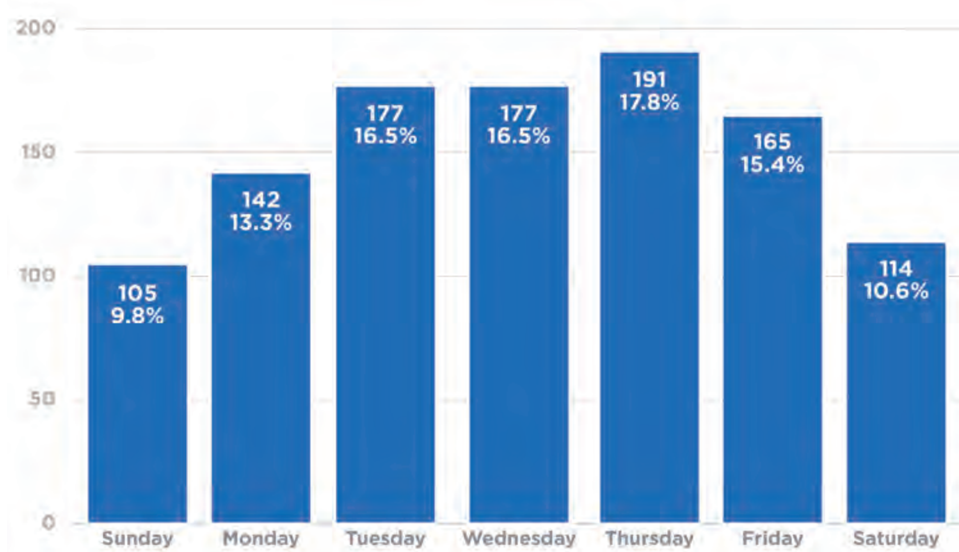
Of the 10 fatal pedestrian collisions, two occurred on a Monday, one occurred on a Tuesday, two occurred on a Wednesday, two occurred on a Friday, and three occurred on a Saturday.

EXHIBIT C-6: STREET LIGHTING CONDITIONS FOR BERKELEY'S PEDESTRIAN COLLISIONS



Source: SWITRS 2008-2017

EXHIBIT C-7: PEDESTRIAN COLLISIONS BY DAY OF THE WEEK

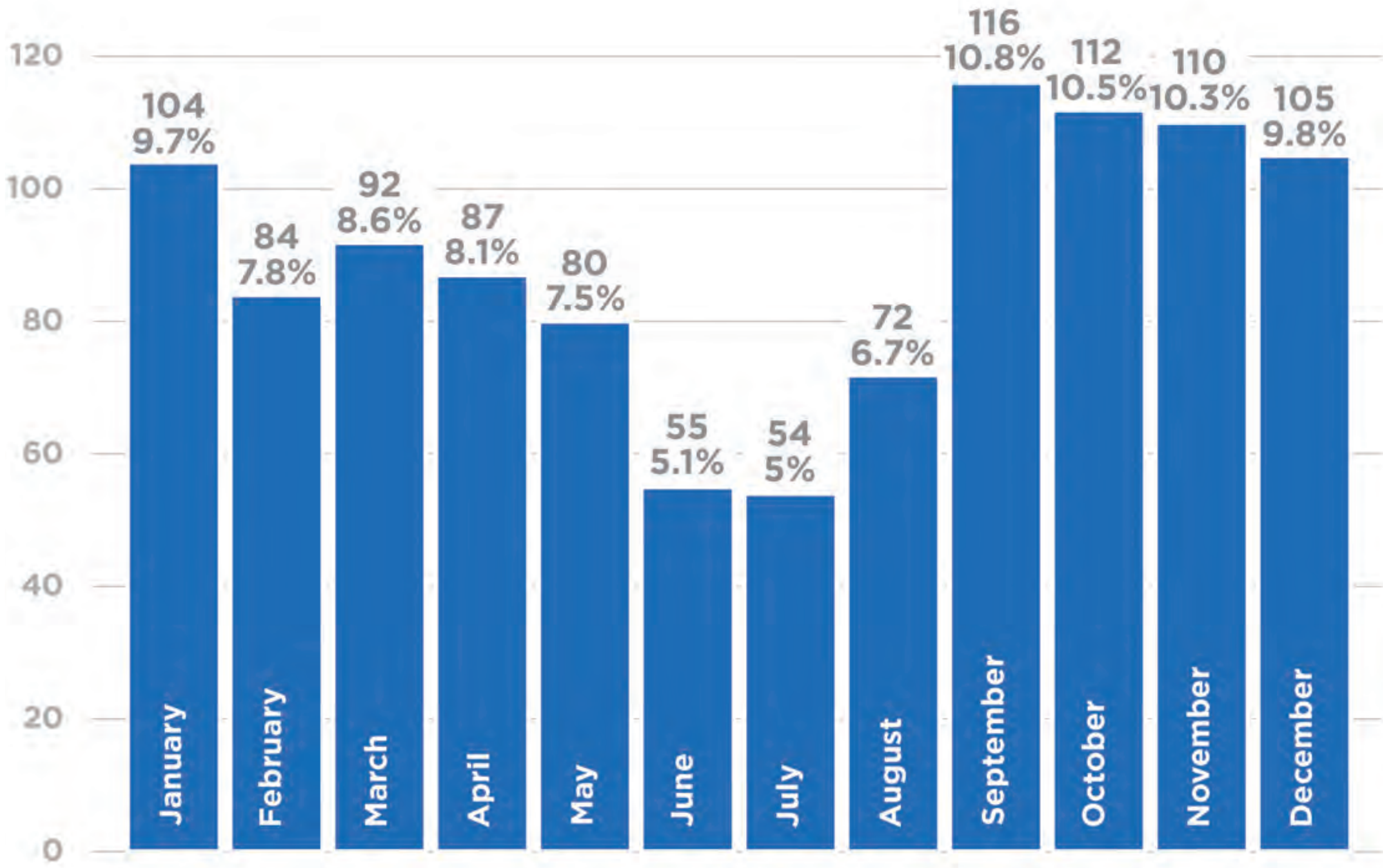


Source: SWITRS 2008-2017

There is a clear drop off in pedestrian collisions during June, July, and August, as **Exhibit C-8** shows. This could be due to two factors. First, these summer months have longer daylight hours, which improve visibility for pedestrians and drivers. Second, UC Berkeley runs many fewer summer classes during these months compared with the standard school year, so the number of people in Berkeley decreases.

There were three fatal pedestrian collisions in April. In January, February, March, July, September, October, and November, there was one fatal pedestrian collision each.

EXHIBIT C-8: PEDESTRIANS COLLISIONS BY MONTH



Source: SWITRS 2008-2017

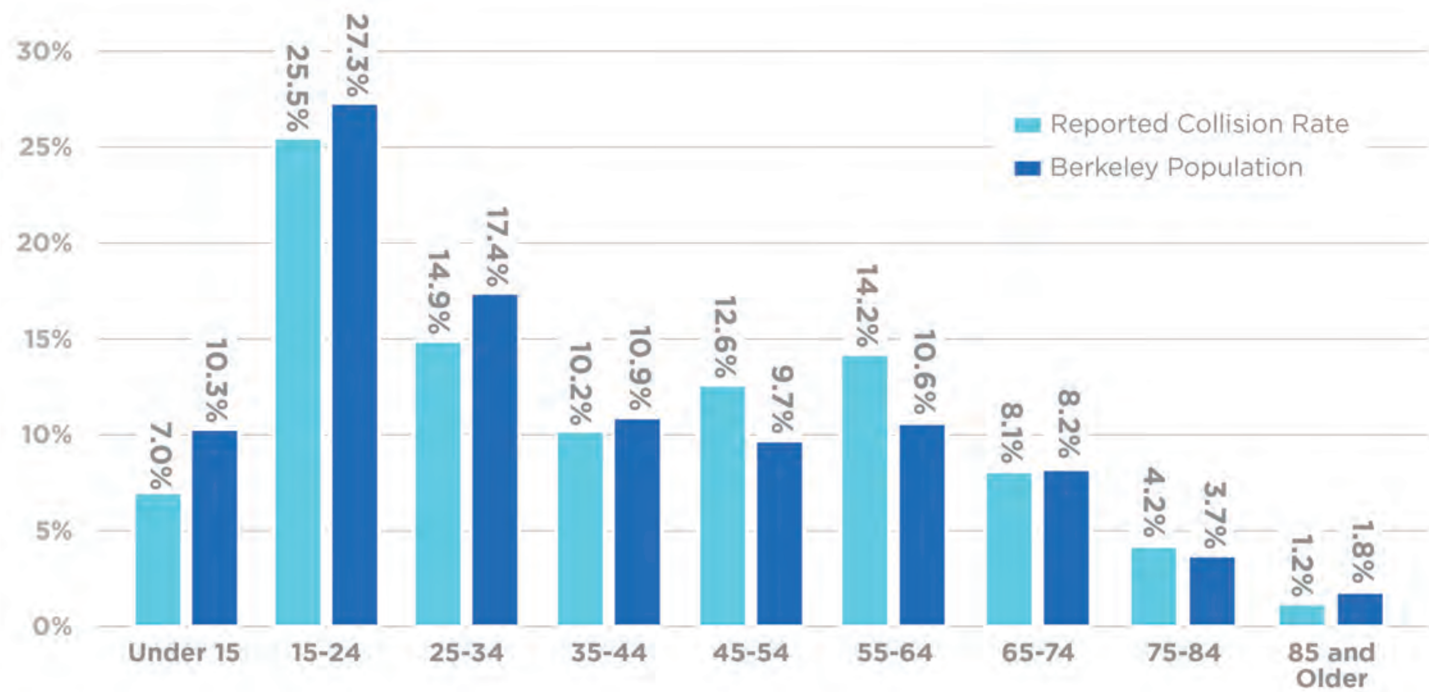
PEDESTRIAN CHARACTERISTICS

This section examines the demographic characteristics (age, race, gender) of the pedestrians involved in collisions with vehicles.

Berkeley residents between the ages of 45 and 64 represent 20 percent of the population, but they accounted for 27 percent of pedestrians in collisions in Berkeley between 2008 and 2017 (see **Exhibit C-9**). Conversely, children under 15 years of age accounted for 10 percent of Berkeley's population, and seven percent of pedestrians involved in collisions.

The ages of the pedestrians involved in fatal collisions in Berkeley from 2008 to 2017 range from five to 98. Four of the 10 pedestrians killed were between the ages of 46 and 57.

EXHIBIT C-9: AGE OF PEDESTRIANS INVOLVED IN PEDESTRIAN COLLISIONS



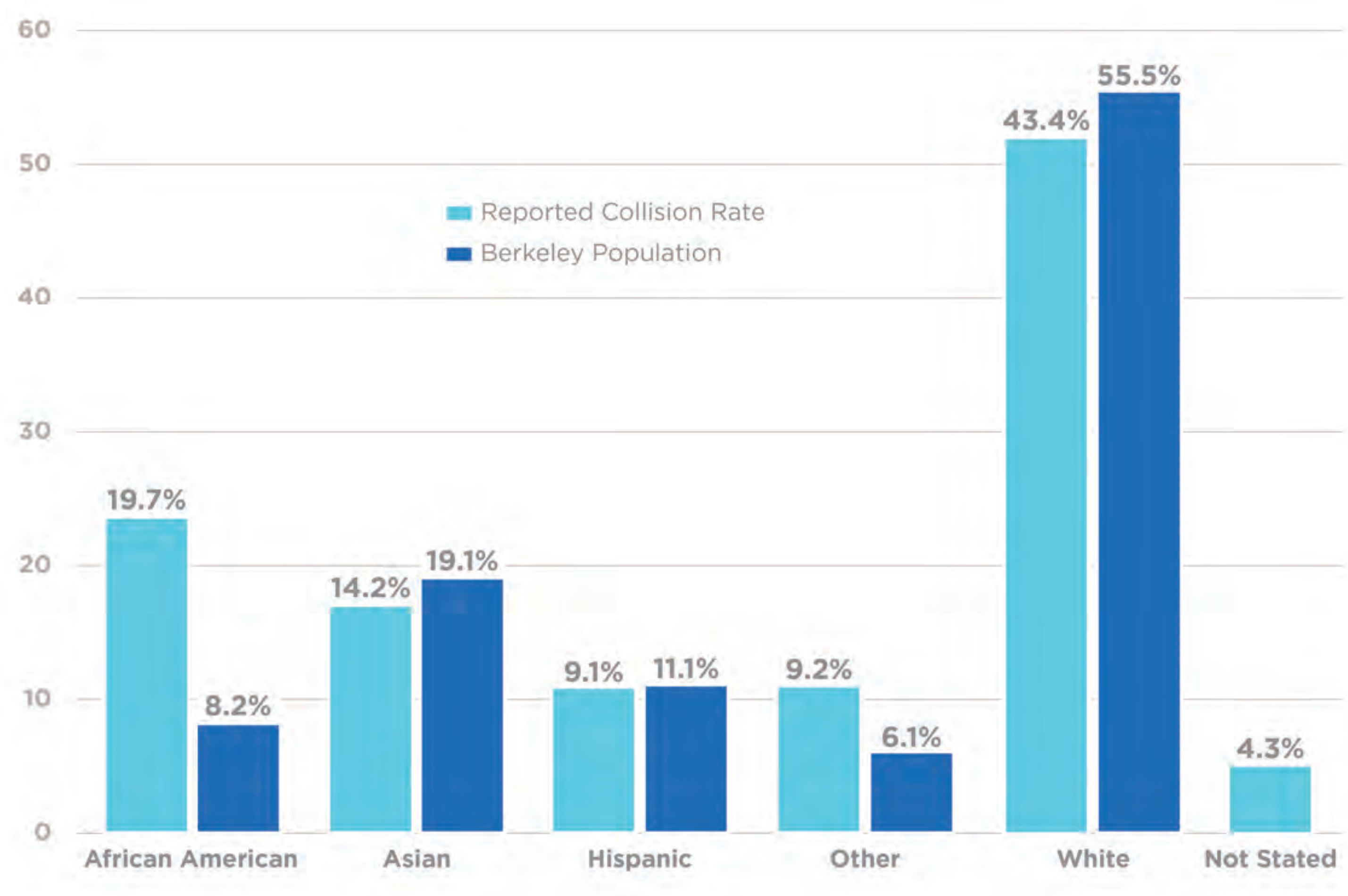
Source: SWITRS 2008-2017, 2012-2016 American Community Survey 5-Year Estimates

White residents, Hispanic residents, and Asian residents are all involved in collisions as pedestrians at rates below their population levels in Berkeley. African Americans, on the other hand, are overrepresented in pedestrian collisions. Over eight percent of residents are African American, but nearly 20 percent of pedestrians involved in pedestrian collisions in Berkeley from 2008 to 2017 were African American, a rate around two and a half times more likely than is expected from resident populations alone (see **Exhibit C-10**).

SWITRS race data only includes categories for African Americans, Asians, Hispanics, and Whites. Every other racial group as defined by the U.S. Census Bureau (American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, Two or more races) falls into a category labelled as "Other" In SWITRS. This collective group is also overrepresented as pedestrians involved in collisions when compared to their population levels in Berkeley.

Of the 10 fatal pedestrian collisions, four were White, three were African American, one was Other, and two were Not Stated.

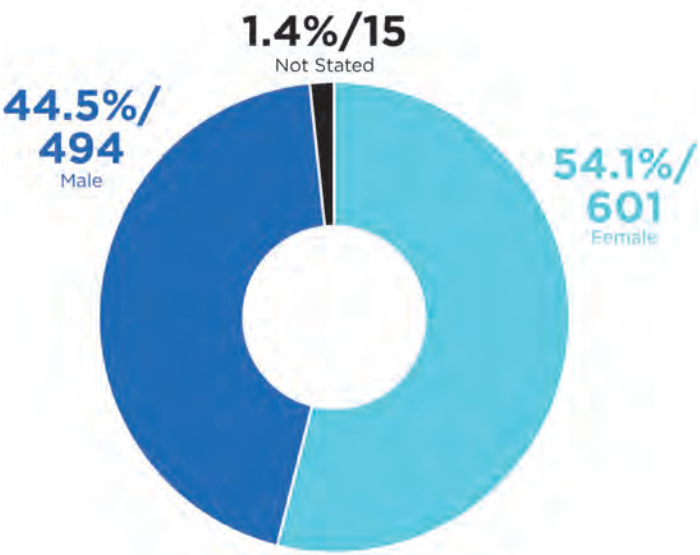
EXHIBIT C-10: RACE OF PEDESTRIANS INVOLVED IN PEDESTRIAN COLLISIONS



Source: SWITRS 2008-2017, 2012-2016 American Community Survey 5-Year Estimates

From 2008 to 2017, 54 percent of reported pedestrian collisions involved a female pedestrian, as **Exhibit C-11** shows. Of the 10 fatal pedestrian collisions, seven pedestrians were male, two were female, and one did not have a gender reported.

EXHIBIT C-11: GENDER OF PEDESTRIANS INVOLVED IN PEDESTRIAN COLLISIONS



Source: SWITRS 2008-2017

HIGH INJURY STREETS

This analysis identifies the High Injury Streets that have a higher incidence of severe and fatal collisions. The High Injury Streets are comprised of 14 percent of Berkeley's street miles and account for 93 percent of pedestrian fatalities and severe injuries.

An ArcGIS analysis was conducted to identify Berkeley's High Injury Streets. Fatal and Injury (Severe) collision types were included and weighted by severity. These collisions were georeferenced to Berkeley's street network and each street received a cumulative score based on the number and severity of collisions that took place. Street lengths were normalized to ensure that the high-injury analysis captured streets with higher densities of collisions. Then, streets that were more than 1.2 standard deviations away from the normalized mean were identified as a High Injury Street.

Berkeley's High Injury Streets are shown in **Figure C-8** along with the location of fatal and injury (severe) pedestrian collisions between 2008 and 2017.

Of the 89 fatal and severe injury pedestrian collisions in Berkeley from 2008 to 2017, 80 collisions (90 percent) occurred on a High Injury Street. All fatal pedestrian collisions from 2008 to 2017 are located on a High Injury Street. San Pablo Avenue and Ashby Avenue, the two state highways that run through Berkeley, are second and third for streets in Berkeley with the highest number of fatal or severe injury pedestrian collisions, behind Shattuck Avenue.

TABLE C-9: LOCATION OF FATAL OR SEVERE PEDESTRIAN INJURY COLLISIONS ON HIGH INJURY STREET IN BERKELEY, 2008-2017

Collision Location	Number of Fatal or Severe Collisions
Shattuck Avenue	12
Ashby Avenue	10
San Pablo Avenue	9
University Avenue	9
Sacramento Street	7
Adeline Street	5
Martin Luther King Jr Way	5
Telegraph Avenue	5
Cedar Street	4
Gilman Street	4
Haste Street	4

Source: SWITRS 2008-2017, Kittelson analysis

FIGURE C-8: BERKELEY HIGH INJURY STREETS MAP

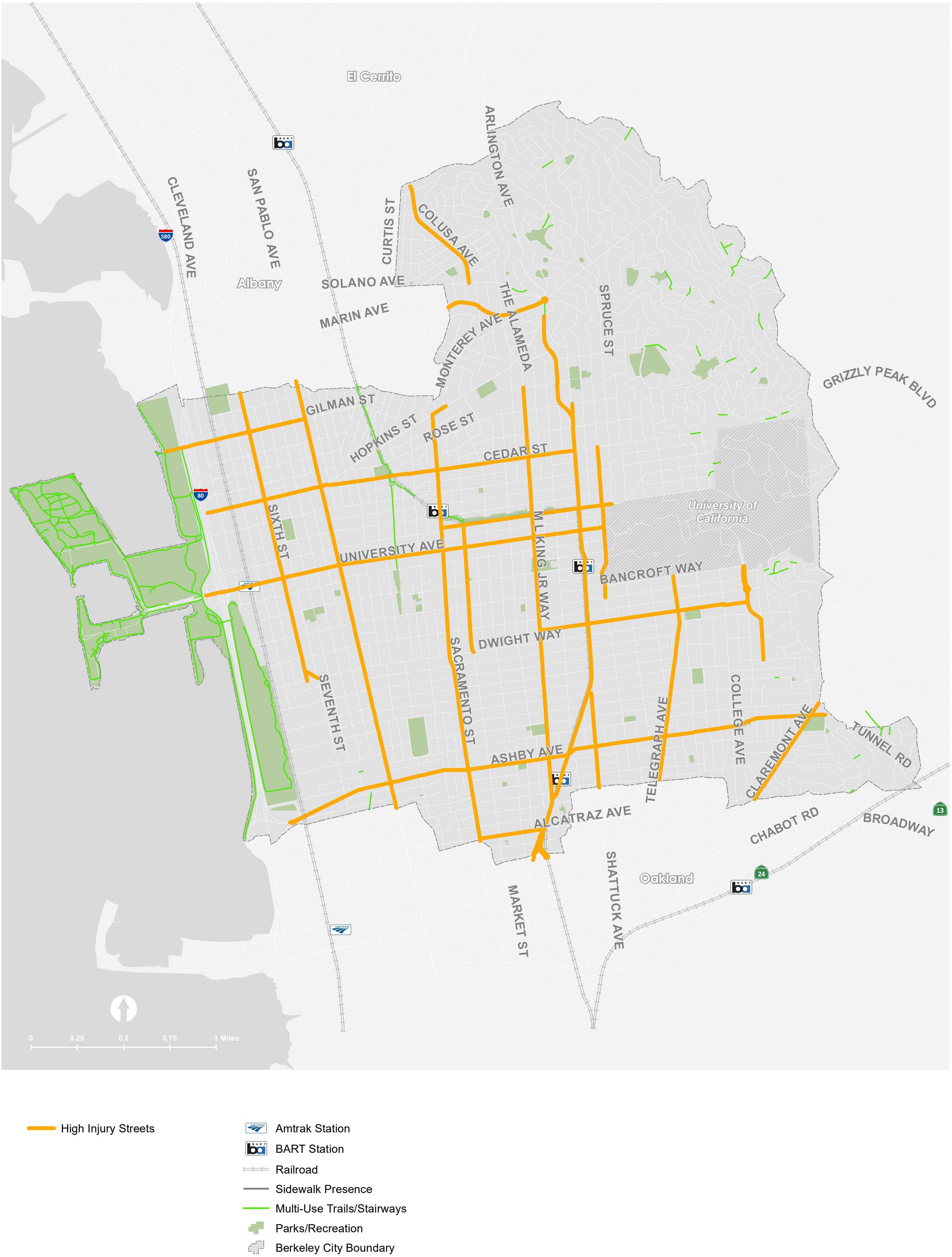


Table C-10 lists Berkeley's 27 High Injury Streets in alphabetical order, with their start and end points.

TABLE C-10: HIGH INJURY STREETS

High Injury Streets	Beginning Point	End Point
Adeline Street	Shattuck Avenue	Southern City Limits
Alcatraz Avenue	Sacramento Street	Adeline Street
Ashby Avenue	Interstate 80	Tunnel Road
California Street	Hearst Avenue	Dwight Way
Cedar Street	Sixth Street	Shattuck Avenue
Claremont Avenue	Eastern City Limits	Southern City Limits
Dwight Crescent	6th Street	Dwight Way
Fulton Street	Kittredge Street	Durant Avenue
Gilman Street	Berkeley Waterfront	San Pablo Avenue
Haste Street	Martin Luther King Jr Way	Piedmont Avenue
Hearst Avenue	Sacramento Street	Spruce Street
Henry Street	Eunice Street	Rose Street
Hopkins Street	Sacramento Street	Monterey Avenue
Marin Avenue	Western City Limits	Marin Circle
Martin Luther King Jr Way	Berryman Street	Southern City Limits
Oxford Street	Cedar Street	Kittredge Street
Piedmont Avenue	Bancroft Way	Warring Street
Sacramento Street	Hopkins Street	Southern City Limits
San Pablo Avenue	Northern City Limits	Southern City Limits
Shattuck Avenue	Rose Street	Southern City Limits
Shattuck Place	Rose Street	Shattuck Avenue
Sixth Street	Gilman Street	Dwight Way
Sutter Street	El Dorado Avenue	Eunice Street
Telegraph Avenue	Bancroft Way	Southern City Limits
University Avenue	I-80 Frontage Road	Oxford Street
Warring Street	Piedmont Avenue	Derby Street

Source: SWITRS 2008-2017

Table C-11 lists every fatal and severe injury collision in Berkeley from 2008 to 2017. The Adeline Street/ Harmon Street intersection is the lone intersection with multiple fatal pedestrian collisions. There are eight additional intersections with more than one severe injury pedestrian collisions. However, most fatal and severe injury collisions took place at an intersection that only had one such reported collision over the 10-year period.

TABLE C-11: FATAL AND SEVERE INJURY COLLISION LOCATIONS, 2008-2017

Collision Location	Total Fatal/Severe Injury Collisions	Fatal Collisions	Severe Injury Collisions	High Injury Street?
Adeline Street and Harmon Street	2	2	0	Yes
Frontage Road and University Street	2	0	2	Yes
Telegraph Avenue and Ashby Avenue	2	0	2	Yes
Shattuck Avenue and Berkeley Way	2	0	2	Yes
Sixth Street and Gilman Street	2	0	2	Yes
Adeline Street and Fairview Street	2	0	2	Yes
Shattuck Avenue and Channing Way	2	0	2	Yes
Adeline Street and Alcatraz Avenue	2	0	2	Yes
Sacramento Street and Ashby Avenue	2	0	2	Yes
Monterey Avenue and Hopkins Street	1	1	0	Yes
Interstate 80 Overpass and University Street	1	1	0	Yes
Frontage Road and Gilman Street	1	1	0	Yes
Shattuck Avenue and University Avenue	1	1	0	Yes
Sacramento Street and Bancroft Way	1	1	0	Yes
San Pablo Avenue and Gilman Street	1	1	0	Yes
Tulare Avenue and Marin Avenue	1	1	0	Yes
Warring Street and Derby Street	1	1	0	Yes
Warring Street and Parker Street	1	0	1	Yes
Prospect Street and Hillside Avenue	1	0	1	No
Colusa Avenue and Vincente Avenue	1	0	1	No
Colusa Avenue and Catalina Avenue	1	0	1	No
Colusa Avenue and Marin Avenue	1	0	1	Yes
Telegraph Avenue and Parker Avenue	1	0	1	Yes
Bowditch Street and Channing Way	1	0	1	No
Hillegass Avenue and Ashby Avenue	1	0	1	Yes
Piedmont Avenue and Bancroft Way	1	0	1	Yes
Piedmont Avenue and Haste Street	1	0	1	Yes
Piedmont Avenue and Forest Street	1	0	1	No
Eton Avenue and Claremont Avenue	1	0	1	Yes
McGee Avenue and University Avenue	1	0	1	Yes
Grant Street and Hearst Avenue	1	0	1	Yes
Martin Luther King Jr Way and Berryman Street	1	0	1	Yes
Bonita Avenue and Cedar Street	1	0	1	Yes
Bonita Avenue and University Street	1	0	1	Yes
Henry Street and Eunice Street	1	0	1	Yes
Shattuck Avenue and Rose Street	1	0	1	Yes
Shattuck Avenue and Vine Street	1	0	1	Yes
Spruce Street and Hearst Avenue	1	0	1	Yes
Fourth Street and Delaware Street	1	0	1	No

Collision Location	Total Fatal/Severe Injury Collisions	Fatal Collisions	Severe Injury Collisions	High Injury Street?
Ohlone Greenway and Cedar Street	1	0	1	Yes
Eighth Street and Camelia Street	1	0	1	No
San Pablo Avenue and Page Street	1	0	1	Yes
San Pablo Avenue and Jones Street	1	0	1	Yes
San Pablo Avenue and Cedar Street	1	0	1	Yes
Tenth Street and University Avenue	1	0	1	Yes
Chestnut Street and Cedar Street	1	0	1	Yes
Sacramento Street and University Avenue	1	0	1	Yes
California Street and Allston Way	1	0	1	Yes
California Street and Ward Street	1	0	1	No
Ellis Street and Ashby Avenue	1	0	1	Yes
Martin Luther King Jr Way and Addison Street	1	0	1	Yes
Martin Luther King Jr Way and Bancroft Way	1	0	1	Yes
Milvia Street and University Avenue	1	0	1	Yes
Milvia Street and Haste Street	1	0	1	Yes
Shattuck Avenue and Center Street	1	0	1	Yes
Shattuck Avenue and Kittredge Street	1	0	1	Yes
Shattuck Avenue and Bancroft Way	1	0	1	Yes
Shattuck Avenue and Durant Avenue	1	0	1	Yes
Shattuck Avenue and Blake Street	1	0	1	Yes
Shattuck Avenue and Oregon Street	1	0	1	Yes
Oxford Street and Allston Way	1	0	1	Yes
Fulton Street and Durant Avenue	1	0	1	Yes
Fulton Street and Ashby Avenue	1	0	1	Yes
Deakin Street and Ashby Avenue	1	0	1	Yes
Dana Street and Haste Street	1	0	1	Yes
Telegraph Avenue and Haste Street	1	0	1	Yes
Telegraph Avenue and Blake Street	1	0	1	Yes
Sixth Street and Channing Way	1	0	1	Yes
Eighth Street and Addison Street	1	0	1	No
San Pablo Avenue and Allston Way	1	0	1	Yes
San Pablo Avenue and Bancroft Way	1	0	1	Yes
San Pablo Avenue and Carleton Street	1	0	1	Yes
San Pablo Avenue and Ashby Avenue	1	0	1	Yes
San Pablo Avenue and Haskell Street	1	0	1	Yes
Mabel Street and Ashby Avenue	1	0	1	Yes
Sacramento Street and Oregon Street	1	0	1	Yes
Sacramento Street and Russel Street	1	0	1	Yes
Sacremento Street and Woolsey Street	1	0	1	Yes
Total	**89**	**10**	**79**	**-**

Source: SWITRS 2008-2017, Kittelson & Associates, Inc. analysis

Pedestrian Exposure

Figure C-9 shows the estimated pedestrian collision rate at intersections in Berkeley per one million entering pedestrians based on model pedestrian volumes.

The pedestrian demand models use inputs that reflect real life activity, but the models themselves represent hypothetical pedestrian demand in Berkeley. In other words, they show what we should expect pedestrian demand to look like in Berkeley without using pedestrian counts. These tables represent a model where pedestrians are expected to go in Berkeley and may not accurately depict existing demand.

According to the pedestrian demand estimates, the areas with the highest number of collisions are generally located in major destination areas in Berkeley. The intersection collision rate – defined as the number of collisions at an intersection from 2008 to 2017 SWITRS data divided by estimated pedestrian demand volumes – has been normalized at collisions per one million entering pedestrians. This approach scores all locations on the same scale, and it controls for the number of pedestrians at all locations.

COLLISIONS AND PEDESTRIAN DEMAND

With pedestrian demand estimates from the Pedestrian Demand section, we can analyze intersections based on estimated pedestrian demand volumes. **Table C-12** shows the intersections in Berkeley with the highest collision rate per one million entering pedestrians (**Figure C-9** maps the collision rate for all intersections that had a recorded collision in Berkeley from 2008 to 2017).

Because collisions at intersections take place at a specific location while street segments are along a set length, this makes comparing collision rates challenging. Given that so few collisions took place on street segments, these have been excluded from the estimated pedestrian demand model analysis. The number of collisions does not correlate with the collision rate. In fact, many areas in Berkeley with the highest estimated pedestrian demand have some of the lowest estimated pedestrian collision rates. These include areas downtown and south of the UC Berkeley campus. **Table C-12** shows that a mix of low-pedestrian intersections in the Berkeley Hills and some intersections with a higher number of pedestrians collisions make up the intersections with the highest estimated collision rates in Berkeley. The Euclid Avenue and Marin Avenue intersection has a collision rate that is more than double any other intersection in Berkeley.

TABLE C-12: COLLISION RATES AT ALL INTERSECTIONS BY ONE MILLION ENTERING PEDESTRIANS

Intersections	Number of Collisions	Collisions Per 1 Million Entering Pedestrians
Euclid Avenue and Marin Avenue	1	**19.8**
Monterey Avenue and Sonoma Avenue	1	**8.7**
College Avenue and Alcatraz Avenue	1	**6.5**
The Alameda and Hopkins Street	5	**4.3**
Spruce Street and Marin Avenue	1	**2.8**
Spruce Street and Santa Barbara Road	1	**2.6**
Spruce Street and San Benito Road	1	**2.4**
The Alameda and Monterey Avenue	4	**2.3**
Monterey Avenue and Hopkins Street	4	**1.9**
Oxford Street and Marin Avenue	1	**1.9**
Sacramento Street and Alcatraz Avenue	5	**1.9**
Shattuck Avenue and Marin Street	1	**1.8**
College Avenue and Ashby Avenue	13	**1.8**
Colusa Avenue and Solano Avenue	7	**1.7**
Spruce Street and Eunice Street	2	**1.7**
Adeline Street and Harmon Street	10	**1.7**
San Pablo Avenue and Ashby Avenue	7	**1.6**
Eastshore Highway and Gilman Street	3	**1.6**
Claremont Avenue and Ashby Avenue	2	**1.6**

Source: SWITRS 2008-2017, Kittelson & Associates, Inc./Toole Design Group analysis

FIGURE C-9: MAP OF COLLISIONS PER 1 MILLION ENTERING PEDESTRIANS AT TIER 1, TIER 2, TIER 3 INTERSECTIONS

In general, the intersections with high collision rates based on estimated pedestrian demand are located along San Pablo Avenue and the northern and southern edges of Berkeley (see **Figure C-9**): Marin Avenue, Gilman Street, and Ashby Avenue all have numerous intersections that are among the highest 20 percent of intersections by collision rate. Conversely, downtown and the neighborhoods to the south of UC Berkeley have numerous intersections that are among the lowest 20 percent of intersections by collision rate. This makes sense – intersections with fewer pedestrians where collisions occur will have a higher collision rate, and based on the estimated pedestrian demand model, the northern and southern edges of Berkeley are not areas with particularly high pedestrian demand.

Prioritization Framework

This section details a prioritization framework to identify locations for pedestrian improvements as part of the Berkeley Pedestrian Plan. The prioritization criteria are intended to align with the Plan's goals, which include the following:

- Reduce pedestrian fatalities and severe injuries to zero by 2028
- Achieve equity and extend transportation choices to all
- Improve public health and the environment

Following the methodology from NCHRP 803: ActiveTrans Priority Tool (APT), this memo will follow the APT's scoping phase:

- Select Factors: create a shared set of community values around pedestrian travel
- Select Variables and Assess Data: identify ways to measure factors using available data
- Establish Factor Weights: assign values to the selected factors

SELECTING FACTORS

The evaluation process is informed by the framework from NCHRP Report 803[3], the result of a national research effort. The APT methodology was based on an extensive review of existing prioritization processes being used by agencies across the country at the state, regional, and local levels. It uses a standard set of terms and definitions to describe the different steps in the process. The following definitions apply within the APT:

- Factors are the categories used to express community or agency values considered in the prioritization process and contain groups of variables with similar characteristics.
- Variables (or evaluation criteria) are characteristics of roadways, households, neighborhood areas, and other features that can be measured and organized under each factor.
- Weights are the numbers used to indicate the relative importance of different factors based on community or agency values. Weights are applied to factors, not to variables (which are often more technical in nature).
    - » As a result, factors with multiple variables will see the impact of each variable reduced. This prioritization has focused on minimizing the number of variables per factor as a result.
- Scaling is the process of making two variables comparable to one another (e.g., number of crashes vs. population density.)

The prioritization factors and criteria, summarized in **Table C-13** and detailed in the following sections, are informed by NCHRP Report 803, by the Plan's overall vision and goals referenced above, and from discussions and feedback that we have heard from the project team. The prioritization criteria will only

3 http://www.pedbikeinfo.org/pdf/PlanDesign_Tools_APT_Guidebook.pdf

TABLE C-13: PRIORITIZATION FACTORS AND CRITERIA

Factor	Criteria	Notes
Safety	Concentration of fatal and severe crashes	Captures locations with a high concentration of pedestrian fatalities, injuries, and collisions, as a noted City priority.
Equity	Locations in historically underserved neighborhoods	Uses historic redlining maps with adjustments based on most recent (2010) Census data, current property values, and locations of community centers that serve historically redlined areas.
Connectivity	Pedestrian Demand: Land uses attracting most pedestrian trips including BART and Amtrak stations (High Demand Intersections)	Uses pedestrian demand model to identify where pedestrians are walking. Top 30% of intersections will be used, with each top 10% intersection group by demand receiving a different weight.
	Transit Access: Proximity to major bus lines	Uses distance of 0.25-mile from major AC Transit corridors. These corridors are defined as AC Transit Major Corridors.
Existing Plan	Carried over from 2010 Pedestrian Master Plan	Recognizes existing work from the 2010 Berkeley Pedestrian Master Plan.

be applied to the High Injury Streets.

Safety

Safety is a top goal for the City of Berkeley and eliminating all pedestrian fatalities and severe injury collisions by 2028 is one of the three goals of the Plan. Therefore, the location on the City's high-injury

TABLE C-14: SAFETY FACTOR

Criterion	Concentration of Fatal and Severe Collisions
Data Needs	The spatial files representing the high-injury streets have already been conducted as a part of Existing Conditions and Needs Analysis process.
Methodology	The purpose of this methodology was to identify areas with high concentrations of collisions. Kittelson assigned a safety score to each block group based on the amount of high injury streets passing through or bordering the block group. Since some Census block groups only contained small segments of the high injury streets, while others were completely bounded by the high injury streets, the prioritization safety score took into account the estimated area of roadway within or bordering each block group.
Scoring	The City's high injury streets were split into 0.1-mile segments, and each segment received a percentile value on a 0-100 scale
Limitations	This analysis considered collisions that have been reported to the California Statewide Integrated Traffic Records System (SWITRS). Collisions that do not result in injury, fatality, or over a sufficient amount of property or vehicle damage are not required to be reported in California and would not necessarily be recorded in the data. As a result, not all pedestrian collisions are represented in this data and the quality of collision data is limited by the amount of detail provided by the person completing the collision report form. In addition, the reported injuries from a collision represent the extent of the injury at the time of the collision. They do not include injuries that may have resulted in a more serious injury a later date. Therefore, this data likely underreports the number of severe and moderate injury collisions. Vehicle, pedestrian and bicycle count data is not consistently and completely available; therefore, pedestrian or bicycle exposure could not be accounted for in developing this criterion.

streets has been identified as the criterion for this factor.

Equity

Equity has been a stated goal for the City of Berkeley throughout the Plan process. The performance measure attached to the equity goal for the plan is to make 70 percent of pedestrian-related investments

TABLE C-15: EQUITY FACTOR

Criterion	Location in Historically Underserved Areas
Data Needs	The equity factor will focus on historically redlined communities within Berkeley, based on federal Home Owners' Loan Corporation (HOLC) redlining maps, with adjustments from 2010 Census data, current property values, and locations of community centers that serve historically redlined communities. The City of Berkeley has provided a shapefile with the portions of the city that will be the basis for the equity analysis.
Methodology	The equity analysis considers three factors: racial and ethnic composition by race, property values (as found on Zillow), and presence of community and cultural centers. The racial and ethic composition element incorporates historically redlined neighborhoods. Within these areas, areas consisting entirely of homes with values greater than $750,000 were omitted. Finally, the area between Shattuck Avenue and Adeline Street, while not historically redlined, was included given the presence of many community centers that serve historically redlined areas.
Scoring	The equity layer will be joined to the 0.1-mile street segments. Segments inside or bordering the equity area will receive a score of 1, and all street segments outside of the equity area will receive a score of 0.
Limitations	The purpose of using the equity factor is to capture historically redlined areas that have experienced decades of underinvestment. The methodology is intended to pinpoint locations where targeted groups reside and place these areas in a higher priority bucket. The methodology relies on a mix of data sources, including racial and ethnic demographic data, home values, and land use information. While recognizing that many students at UC Berkeley may be low-income, these students typically represent a more transient population and also may not come from low-income families; the choice to look at historically redlined areas took this variable into account.

within historically underserved areas by 2028.

Connectivity

The connectivity factor is the first factor that incorporates two separate criteria. First, the Existing Conditions and Needs Analysis of the Plan included a demand model showing where pedestrians are expected to be within Berkeley and thus, where connectivity is likely most important. Second, the proximity to major bus stops shows where walking access is important for transit connectivity.

TABLE C-16: CONNECTIVITY FACTOR

Criterion	Pedestrian Demand and Transit Access
Data Needs	**Pedestrian Demand**: The spatial files produced with the pedestrian demand model, and a list of locations of major AC Transit stops in the City. **Transit Access**: AC Transit major transit routes within city limits. These routes are Line 6, Line 12, Line 18, Line 51B, Line 72, and Line F.
Methodology	**Pedestrian Demand**: An overall pedestrian demand model score will be assigned to each block group that adds all intersections within a block group. Since block groups vary in geographic size (and the amount of intersections inside each block group), the model scores will be normalized for the purposes of comparison. **Transit Access**: For transit, the methodology will use the distance from the centroid of each block group to the quarter-mile buffer (rather than straight-line distance) around one of the six major AC Transit bus lines outlined above. The quarter-mile buffer will also extend beyond Berkeley city limits if the bus line crosses outside of the city. Block groups that fall within the quarter-mile buffer will receive an elevated score, and block groups with more than one major bus line will receive an even higher score based on the number of quarter-mile buffers inside that block group. This will represent the added importance of being close to multiple major bus lines.
Scoring	**Pedestrian Demand**: The top 30% high demand intersections in Berkeley will be identified and weighed as follows: • Top 10%: 1.00 • Top 10-20%: 0.66 • Top 20-30%: 0.33 These weighted intersections will then be joined to the closest 0.1-mile segment. **Transit Access**: Scoring will be as follows for block groups: • No major transit lines: 0 • One major transit line: 1 • Two major transit lines: 2 (and so on)
Limitations	**Pedestrian Demand**: The pedestrian demand model reflects estimated or hypothetical demand based on land use inputs. It is an approximation of real pedestrian demand. Using the model with this factor to estimate connectivity provides a data-rich look at connectivity by Census block group, but it is not actual demand. **Transit Access**: The 0.25-mile walkshed for connectivity to major bus lines does not take average daily traffic or crossing access of roads into consideration.

Carryover from 2010 Pedestrian Master Plan

Much work has already been done to identify pedestrian projects in Berkeley. The 2010 Pedestrian Master Plan identified a list of recommended projects, and locations of projects carried over from this plan are

TABLE C-17: EXISTING PLANS FACTOR

Criterion	Carried Over From the 2010 Pedestrian Master Plan
Data Needs	Spatial representation of projects within the 2010 Pedestrian Master Plan that have not yet been constructed.
Methodology	Census block groups will be flagged with an indicator variable (1="yes", 0="no") if a project has been proposed there as a result of a previous planning effort.
Scoring	An identified project will be joined to each 0.1-mile segment that contains that project. Segments with more than one project will receive more weight in the prioritization framework.
Limitations	The identified projects in the 2010 Pedestrian Master Plan reflect the needs at that specific point in time and do not reflect demographic changes and trends in the city over the last decade. These projects also may not reflect the safety, equity, and health goals outlined in the Vision and Goals document for this Pedestrian Plan.

included within the prioritization framework.

APPLYING THE WEIGHTS

This section revisits the framework with a few weightings. There are four weighting options in the table below. The first option provides equal weights to all four factors (with the 25 percent to Connectivity split between the pedestrian demand model and bus stop portions of the factor). The second and third options reflect higher weights for Safety and Equity, respectively. The final option, which is the City's preference, elevates Safety and Equity to 30 percent and weighs Connectivity and Carryover from 2010 Pedestrian Master Plan at 20 percent. Within Connectivity, the 13.5 percent for pedestrian demand and 6.5 percent for transit access represents applying two-thirds of the Connectivity weight to pedestrian demand and one-third to transit access, at the request of the City.

Figures C-10 through **C-15** map the prioritization outputs by unique factor: safety, equity, connectivity

TABLE C-18: FACTOR WEIGHING FOR PRIORITIZATION

Factor	Criteria	Equal Weights	Goal: Safety	Goal: Equity	Goals: Safety & Equity
Safety	Concentration of fatal & severe crashes	25%	34%	22%	**30%**
Equity	Locations in historically underserved neighborhoods	25%	22%	34%	**30%**
Connectivity	Pedestrian Demand: Land uses attracting most pedestrian trips including BART and Amtrak stations (High Demand Intersections)	12.5%	11%	11%	**13.5%**
	Transit Access: Proximity to major bus stops	12.5%	11%	11%	**6.5%**
Existing Plans	Carried over from 2010 Pedestrian Master Plan	25%	22%	22%	**20%**

FIGURE C-10: PRIORITIZATION INPUT: SAFETY

Safety

- Top 20% of Roadway Segments
- Top 40% of Roadway Segments
- Top 60% of Roadway Segments
- Top 80% of Roadway Segments
- All Roadway Segments

- Amtrak Station
- BART Station
- Railroad
- Parks/Recreation
- Berkeley City Boundary

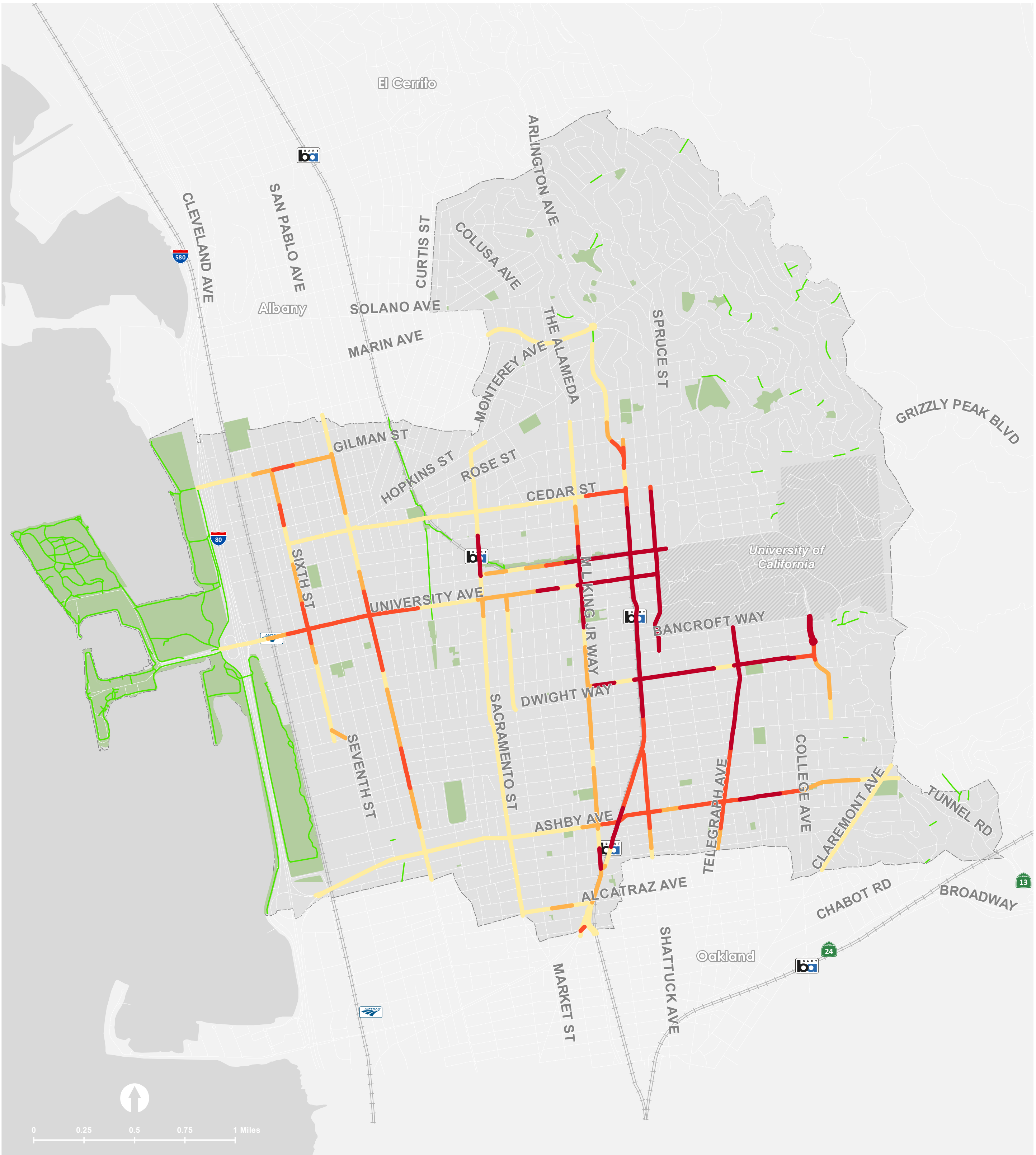
FIGURE C-11: PRIORITIZATION INPUT: EQUITY

Equity

- Within historically underserved area
- Outside historically underserved area

- Amtrak Station
- BART Station
- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-12: PRIORITIZATION INPUT: CONNECTIVITY – PEDESTRIAN DEMAND



Model Pedestrian Demand

- Roadway Segments Near Top 10% High-Demand Intersection
- Roadway Segment Near Top 20% High-Demand Intersection
- Roadway Segment Near Top 30% High-Demand Intersection
- Roadway Segments Not Near Top 30% High-Demand Intersections

- Amtrak Station
- BART Station
- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-13: PRIORITIZATION INPUT: CONNECTIVITY – AC TRANSIT MAJOR CORRIDORS

Access to AC Transit Major Corridors

- Connects with 2 AC Transit Major Corridors
- Connects with 1 AC Transit Major Corridor
- Does Not Connect with Any AC Transit Major Corridors

- Amtrak Station
- BART Station
- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-14: PRIORITIZATION INPUT: EXISTING PROJECT

Existing High-Priority Project

- Connects to Existing Plan
- Does Not Connect to Existing Plan

- Amtrak Station
- BART Station
- Railroad
- Parks/Recreation
- Berkeley City Boundary

FIGURE C-15: PEDESTRIAN PRIORITIZATION SCREENING MAP