Title
Safe Routes to Transit Program Evaluation Final Report

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Safe Routes to Transit
Program Evaluation

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Contents

List of Tables and Figures

Tables

Figures

Executive Summary

Overview
Safe Routes to Transit (SR2T) was initiated in 2004 with the adoption of the San Francisco Bay Area's Regional Measure 2 which established a $1 increase in Bay Area bridge tolls. The intended purpose of this funding was to support various transportation projects within the region in order to reduce congestion along the seven state-owned toll bridge corridors. Consistent with this purpose, the SR2T Program was awarded $20 million to fund enhancements to increase walking and cycling to regional transit stations.

SR2T funds were used for the following improvements, among others: ssecure bicycle storage at transit stations; safety enhancements for pedestrian and bicycle station access to transit stations/stops; removal of pedestrian/bicycle barriers near transit stations; and system-wide transit enhancements to accommodate bicyclists or pedestrians**.**

MTC collaborated with Fehr & Peers and the UC Berkeley Safe Transportation Research and Education Center (SafeTREC) to oversee the assessment of the SR2T program on mode share, perceived traffic safety, traffic behaviors and perceived air quality. Additional data was collected to obtain economic feedback on spending behavior as related to mode choice. Transit stations were chosen based on key variables associated with travel behavior and mode choice, such as population density, employment density, and the percentage of households living beneath the poverty line. The transit stations included in the before and after study were the Balboa Park, Bay Fair, Civic Center, Glen Park, Lafayette, and Pittsburg BART stations, as well as the Palo Alto Transit station. Fremont and Rockridge BART stations were the control sites.

Methodology
Baseline data was collected in the fall of 2011 and follow-up in the falls of 2012 and 2013. Data included postcard surveys that were completed by transit users and intercept surveys that were conducted by trained field workers. Postcard surveys captured basic information about travel done by the participant on the journey from home to the entrance of the BART station (e.g., home location, intermediate stop location(s), travel time by mode, out-of-pocket costs). Intercept surveys included the same questions as the postcard survey and additionally inquired about the user's perceptions of pedestrian and bicycle safety and air quality, and about awareness of changes to the roadway environment in the area around the station. In addition to the surveys, intersection observations were conducted to record driver, pedestrian, and bicyclist travel behavior at each site. Behavior observations were conducted at intersections or street segments. Data collectors observed all pedestrians, bicyclists, and drivers who approached the intersection.

Results
Surveys: The data suggest that the streetscape and roadway improvements made through the SR2T program positively influenced the propensity to walk, bicycle, and take the bus to transit stations as reported through surveys. Of note is the fact that mode shift to walking and bicycling did occur. When averaging responses among the treatment sites, results show that walking increased just over 3%, compared to control sites. Bicycling also increased 3% at treatment sites, although it also increased at control sites, indicating a general societal shift. Further, driving

decreased 2.5% at treatment sites. For the sake of comparison, data from the American Community Survey indicate that walking and bicycling in the Bay Area only increased 0.06% from 2011 to 2012, suggesting that this project may have made a substantial impact in its targeted areas. If carried through to the overall commute trends in the Bay Area, the project's 3% increase in active modes and 2.5% decrease in driving would translate to 3,780 additional walk and bike trips and 37,524 fewer driving trips. Perceived air quality, in general, improved in the post- period. When asked about traffic risk, an indicator of safety, bicyclists more than pedestrians reported feeling safer on the road, with 10% of the bicyclists, on average, feeling safer after the improvements.

Observations: Several behaviors associated with crashes improved in the treatments areas around where improvements were installed. Specifically, pedestrian jaywalking decreased significantly across treatment sites. In general, bicycling and walking was safer in the post period and more likely to occur in urban areas than suburban areas. Additionally, bicyclists, pedestrians, and drivers all tended to follow the law significantly in the post period more in urban areas than in suburban areas.

Conclusions and Recommendations

Key highlights from this research include:

- Walking and bicycling, whether as the sole access mode to transit or as part of a multi-modal trip to access the various stations, increased from the pre- to the post-period at the treatment sites.
- Those who travel to transit stations by foot, bike, or bus routinely reported lower transportation costs than those who drove.
- Perceived traffic risk decreased significantly among cyclists and drivers. Research suggests that decreased perceptions of traffic risk may encourage bicycling, and that a positive change in drivers' perceptions may result from enhanced pedestrian and bicycle infrastructure.
- Perceived air pollution decreased among all groups at the sites, a finding that may result from and contribute to increased walking and bicycling.
- Generally, walking and bicycling were observed to improve at treatment sites.
- Overall, the percentage of pedestrians, drivers, and cyclists behaving illegally was low at all sites. However, illegal behaviors were more likely to occur at suburban than urban sites.
- Also of interest to active transportation and transit planning are economic indicators. Those surveyed whose main mode was walking were much more likely to make stops for food and drink on the way to transit. Bicyclists and pedestrians were over-represented among those who stopped for food or drink on the way to the transit station, whereas those driving to the stations were much less likely to stop for anything but childcare along the way. Improvements that enhance walkability and bikability may therefore result in indirect economic benefits to the surrounding areas.

Future research is needed to better understand the factors leading to significant increase in bus usage observed and how walking and bicycling interact with such factors, in addition to research about how improvements affect perceived risk and behavior.

The SR2T program funds improvements to support walking and bicycling to transit in an effort to improve air quality, increase active transportation, decrease congestion and improve safety. This program seeks to reverse decades long, automobile-dominant commute trends. It is through this lens that results from this analysis should be interpreted. Given the promising movement toward active transportation and use of transit, support for programs like SR2T should be given strong consideration, support and funding.

Overview

As of 2011, nearly 80% of working Americans drove to work (US Census Bureau Public Information Office, 2013). This is a nearly 20% increase in the last 50 years. Although driving provides a convenient and relatively safe way of commuting to work, traffic congestion increases, risk to non-motorized road users increases, and transit use decreases as a result. Subsequently, this dependence on motor vehicles causes damage to the environment, air quality, and health. By improving the safety and convenience of walking and biking to public transit, the Safe Routes to Transit Program (SR2T) encourages commuters to leave their cars at home and actively commute to transit. In doing so, SR2T intends to increase the number of and enhance traffic safety for bicyclists and pedestrians accessing regional transit stations in the Bay Area, improve air quality, and decrease congestion.

Background on Safe Routes to Transit

SR2T was initiated in 2004 with the adoption of the San Francisco Bay Area's Regional Measure 2 (RM2) which established a $1 increase in Bay Area bridge tolls. The intended purpose of this funding mechanism was to support various transportation projects within the region in order to reduce congestion along the seven state-owned toll bridge corridors. Specifically, RM2 established the Regional Traffic Relief Plan and identified specific transit operating assistance and capital projects and programs eligible to receive RM2 funding. Consistent with this purpose, the SR2T Program was awarded $20 million to focus on enhancements that will facilitate walking and cycling to regional transit stations. The local advocacy organizations TransForm and the East Bay Bicycle Coalition were responsible for administering these funds.

The Regional Traffic Relief Plan explains that project improvements must either provide direct access to regional transit or that a "transit service associated with the project has to connect with, cross, or provide the same geographic connection as a state-owned Bay Area bridge" (TransForm, 2014). Regional Transit was defined as transit that serviced inter-county trips. In reference to this SR2T evaluation, these associated transit services included Caltrain, Muni, Bay Area Regional Transit (BART), AC Transit, and other public transportation services.

SR2T funds may be used for the following improvement types, among others:

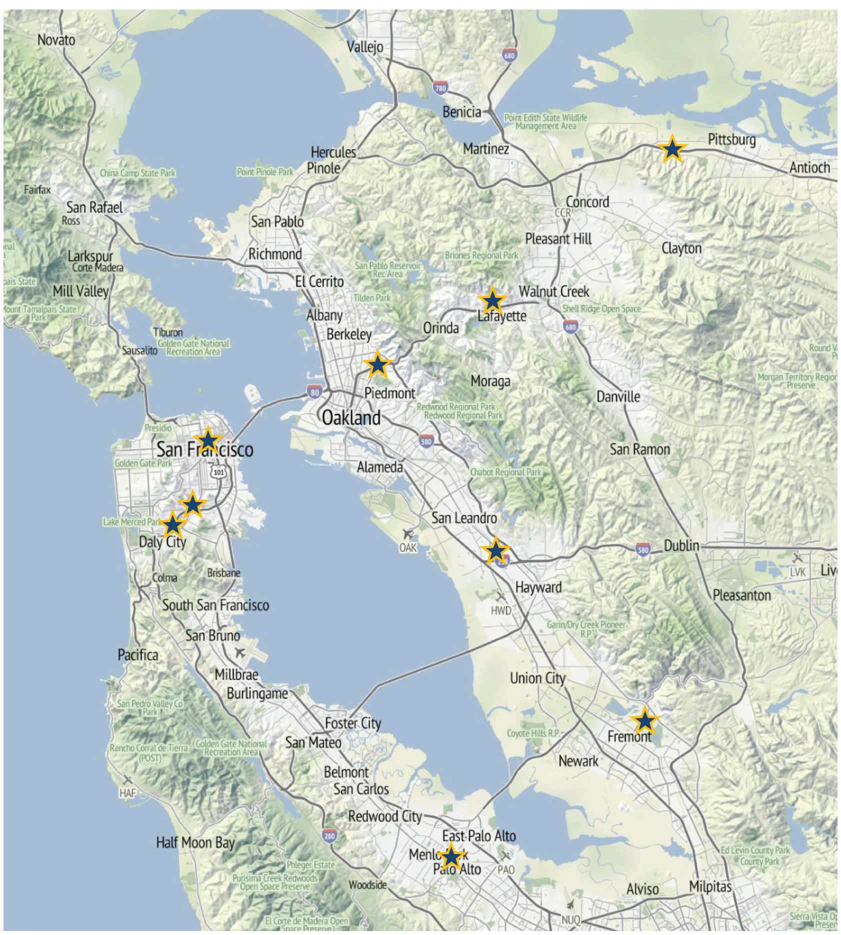
- Secure bicycle storage at transit stations/stops/pods
- Safety enhancements for pedestrian and bicycle station access to transit stations/stops/pods
- Removal of pedestrian/bicycle barriers near transit stations
- System-wide transit enhancements to accommodate bicyclists or pedestrians.

SR2T Evaluation

While there are no legislated calls for evaluating the effectiveness of the SR2T Program, MTC allocated funding to support the evaluation of the effectiveness of this program. Of particular concern was the ability of these capital and planning projects to shift travel from single-occupant vehicles to non-motorized modes for the transit access trip and to increase the safety of pedestrians and bicyclists.

MTC collaborated with Fehr & Peers and the UC Berkeley Safe Transportation Research and Education Center (SafeTREC) to oversee the assessment of the SR2T program on mode share, perceived traffic safety, and air quality. Transit stations were chosen based on key variables associated with travel behavior and mode choice, such as population density, employment density, and the percentage of households living beneath the poverty line. The likelihood of the improvements at each site being completed by the post phase was also taken into account. The transit stations initially chosen for the study included the following BART stations receiving improvements: Balboa Park, Bay Fair, Civic Center, Glen Park, Lafayette, Pittsburg, Richmond, and San Leandro (see Figure 1). The Palo Alto Caltrain station and the San Rafael transit station were also chosen as "treatment" stations, while the Fremont and Rockridge BART stations were selected as "controls" (i.e., they did not receive any SR2T improvements). Due to the improvements not being completed on time for post-phase data collection, data for Richmond, San Leandro, and the San Rafael stations were not included in this report.

Figure 1. Map of Transit Locations in the Bay Area



Map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under CC BY SA.

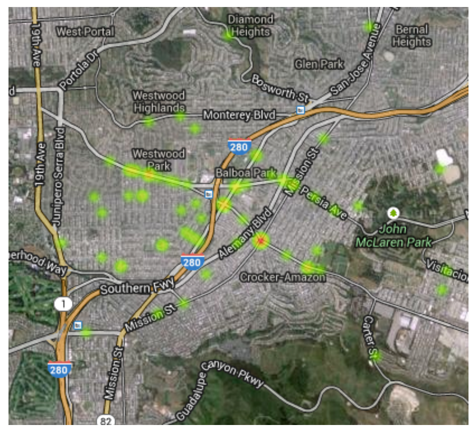
Fehr & Peers, the prime contractor, subcontracted with SafeTREC to design and conduct the evaluation, and consulted with SafeTREC throughout the process. Baseline data was collected in the fall of 2011 and follow-up data in the falls of 2012 and 2013. Data included postcard surveys that were completed by transit users and intercept surveys that were conducted by trained field workers. In addition to the surveys, intersection observations were conducted to record driver, pedestrian, and bicyclist travel behavior at each site.

The Project Sites: Background and Other Relevant Information

This section provides information on each of the project sites for which pre and post data was gathered, along with maps of the stations' catchment areas as reflected in all survey responses. A summary of this information is found in Table 1.

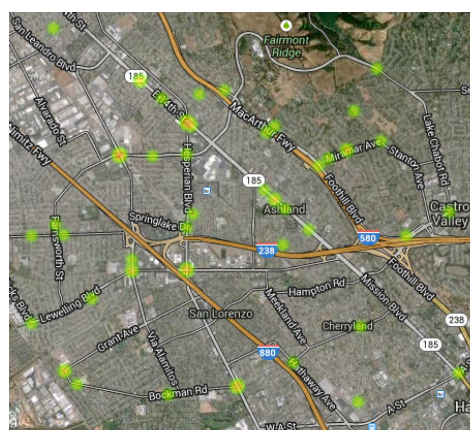
<u>Treatment sites</u>

Balboa Park BART Station, San Francisco, California:



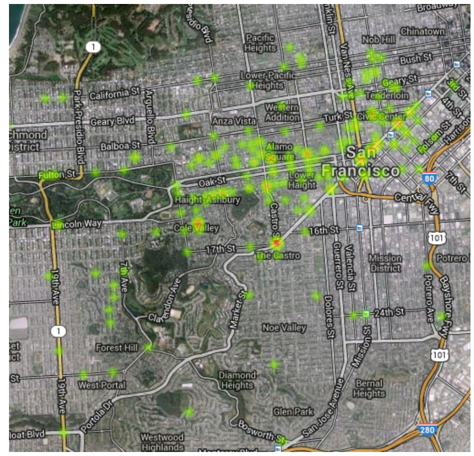
Opened for service in 1973, Balboa Park station is situated between Ocean Avenue and Geneva Avenue in the center of a small San Francisco neighborhood. Data from a 2008 BART report on system users indicates that 76% of Balboa Park's daily 15,567 riders either walked or used public transit to get to the station, and 82% of them used BART five or more days a week (Corey, Canapary & Galanis Research, 2008). Levels of household income were lower than the other San Francisco stations, however, with nearly a quarter of users reporting household incomes between $25,000 and $49,999. Also worth noting: although no parking is provided by the station, 7% of home commuters still drove alone to the station.

Bay Fair BART Station, San Leandro, California:



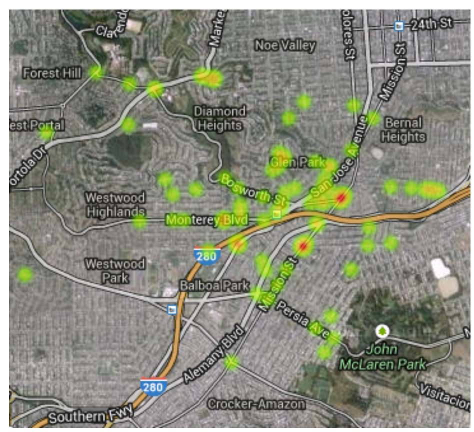
Opened for service in 1972, this BART station is positioned directly across the Bay Fair Center in the San Leandro neighborhood of Bay Fair. The area is densely populated in comparison to the rest of the city: 9,452 people per square mile live in the Bay Fair area, while there are 6,557 people per square mile in San Leandro in general. The 2008 BART study on ridership found that approximately 5,728 riders used this station on an average weekday. Of these 5,728 people, 4,476 (78%) were traveling to the station from home, and nearly 80% of these home commuters used BART five or more days a week (Corey, Canapary & Galanis Research, 2008). This finding corresponded with the average age and most prominent reason people traveled to the Bay Fair station. Nearly 80% used the station to commute to work, and, likely because free parking is available, 52% drove alone. In addition, 84% of riders were between the ages of 25 and 64 years of age.

Civic Center BART Station, San Francisco, California:



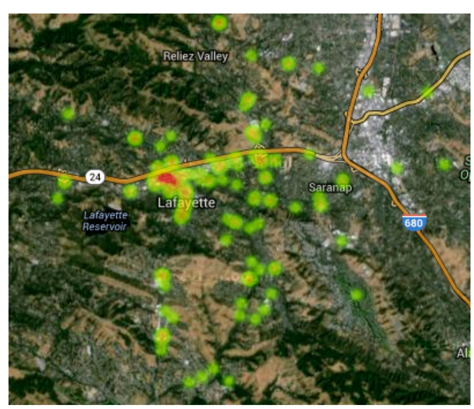
Opened for service in 1973, the Civic Center station is located in the heart of San Francisco near San Francisco's City Hall, War Memorial Opera House, public library, and symphony hall. The station was opened in 1973 and was estimated to serve 22,229 riders a day in 2008 (Corey, Canapary & Galanis Research, 2008). Unlike other BART stations, only 4,394 (less than 20%) of these travelers were traveling from home. 59% of these home origin riders used BART as a means to commute to work, and 16% used the station in order to commute to school. Due to its location and lack of parking, only 1% of home origin riders drove alone to the station. Subsequently, 45% used public transit and 43% walked in order to get to the station. In contrast to this, 71% of non-home origin commuters walked to the station and 74% used BART as a means to commute to work. Also noteworthy, while 71% of these commuters had a car available to them, 71% utilized BART five or more days a week.

Glen Park BART Station, San Francisco, California:



Opened for service in 1973, this station is located at Diamond and Bosworth Streets, in the center of the Glen Park neighborhood. There are only 55 parking spots available ($2 daily for a maximum of 5 hours) to serve the approximately 8,032 riders that enter the station each day (Corey, Canapary & Galanis Research, 2008). This limited parking, in combination with the density of the surrounding area, contributed to 49% of home commuters walking and 21% using other forms of public transit in order to access the station. Although 68% of home origin riders had a car available to them, 73% still used BART five or more days a week. Socio-economic data indicated that 25% of riders reported household incomes of $150,000 or more.

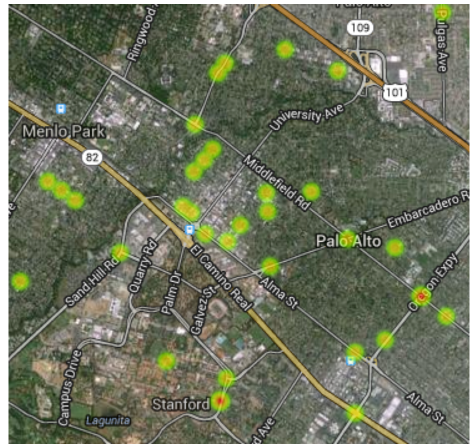
Lafayette BART Station, Lafayette, California:



The Lafayette BART station is located in the suburban city of Lafayette, an affluent city in central Contra Costa County, and opened in 1973. In 2010, almost 85% of the population was Caucasian, 9% was Asian, 6% Hispanic and less than 1% were African American, Native American, Pacific Islander (City of Lafayette, 2012). According to the 2008 BART study, the demographics of BART riders reflected this background. 78% of riders were Caucasian, 13% were Asian, 6% were Hispanic, and

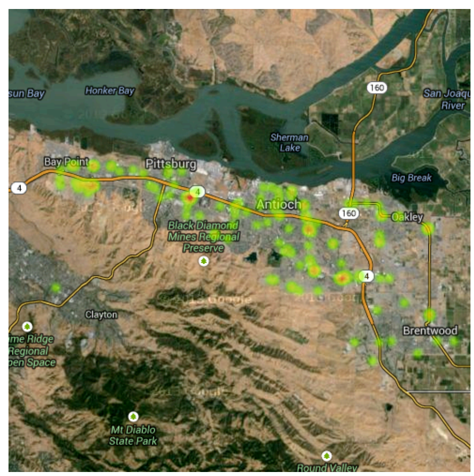
1% were Black as of 2008, and nearly half of home commuters reported household income levels of $150,000 or over (Corey, Canapary & Galanis Research, 2008). Only 1% of home commuters used public transit to get to the station, and 68% drove alone.

Palo Alto Caltrain Station, Palo Alto, California:



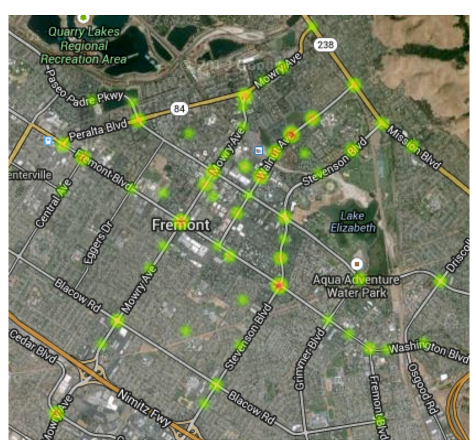
Caltrain has been providing commuter services to the Bay Area for nearly 150 years. The Palo Alto station, in particular, serves Santa Clara and San Mateo Counties and has been identified by MTC as one of the region's transportation hubs. Located on the west side of downtown Palo Alto, this station also serves the most bicyclists of all the cities within the Caltrain system and is considered to be the second most-used station. Consequently, the station has more bike racks than the other Caltrain stations, and has additional amenities including bike lockers and a bike station. The station was renovated in 2005 to accommodate 10 bus and shuttle lanes, and in 2009 the northernmost pedestrian underpass was made ADA-compliant, lighting was improved, and platforms were lengthened (San Mateo County Transit District, 2014).

Pittsburg BART Station, Pittsburg, California:



The Pittsburg BART station is located in the city of Pittsburg, a relatively small city with a population of 61,000 people in the eastern part of Contra Costa County. BART was extended to Pittsburg in the 1990s, with this station opening in 1996. As the north-eastern terminal for BART, this station mainly caters to commuters from Pittsburg, Antioch, Oakley, and Brentwood. According to the 2008 BART ridership study, approximately 5,106 riders entered the station on an average weekday—around 4,728 (93%) of whom were traveling from home (Corey, Canapary & Galanis Research, 2008). Due to a combination of the surrounding suburban environment, accessible free auto parking, and few bicycle parking spaces, 48% of these home commuters traveled to the station by driving alone, while only 1% biked to the station. In terms of trip purpose, 82% used BART as a means to get to work. With regard to racial diversity, an even distribution of Caucasian, Black/African American, Asian, and Hispanic riders was found.

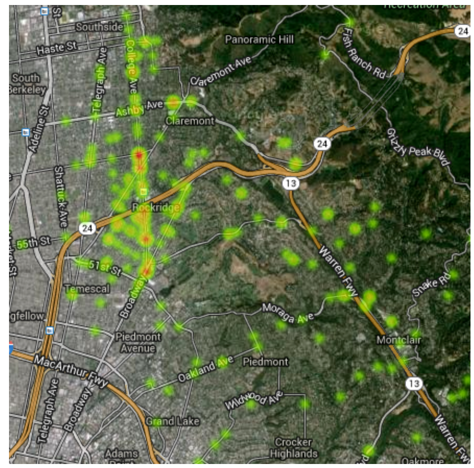
<u>Control sites</u>



Fremont BART Station, Fremont, California:

The Fremont Station is the southernmost station within the BART system. Located on Walnut Avenue in Fremont, this station served approximately 7,294 riders a day (74% of whom were coming from home) in 2008 (Corey, Canapary & Galanis Research, 2008). Although 25% of home origin riders had household incomes above $150,000, 21% of travelers coming from locations other than home stated that their income was below $25,000. A majority of those commuting from home identified Fremont, San Jose, Newark, or Milpitas as their city of origin. Also interesting to note: while 50% of home commuters drove alone to the station, only 8% of non-home commuters did. These non-home origin commuters tended to favor walking (32%) and using public transit (36%) as alternatives to travel to the station.

Rockridge BART Station, Oakland, California:
The Rockridge Station is located in the Rockridge neighborhood and commercial district on the edge of Berkeley and Oakland. According to the 2008 BART study, approximately 4,842 riders entered the station on an average weekday (Corey, Canapary & Galanis Research, 2008). Nearly 29% of these riders were coming from other locations besides their homes. Only 43% of the non-home-origin riders reported having used BART to commute to work. Additionally, 20% reported having a household income of less than $25,000. In contrast, 74% of home-origin riders had used BART to commute to work, and 37% reported household incomes of greater than $150,000.



Basic site information for each station is distilled in Table 1.

Table 1. Basic Site Information for Each Transit Station

Name of Station	Location	Setting (Population)	Type of Motorized Transit Available at Site	SR2T Project ID
Treatment Sites				
Balboa Park	San Francisco, California	Urban/ Neighborhood (789,172)	BART and Muni	20.26, 20.31
Bay Fair	San Leandro, California	Urban/ Shopping Center (84,950)	BART and AC Transit	20.32
Civic Center	San Francisco, California	Urban/ City (789,172)	BART, Muni, and Golden Gate Transit	
Glen Park	San Francisco, California	Urban/ Neighborhood (789,172)	BART and Muni	20.35
Lafayette	Lafayette, California	Suburban/Small Town (23,769)	BART and County Connection busing	20.23
Palo Alto Transit Center	Palo Alto, California	Urban/City (62,486)	Caltrain, SamTrans, Shuttles, and VTA Light Rail	20.41
Pittsburg/ Bay Point	Pittsburg, California	Urban/Neighborhood	BART, Tri-Delta	20.21, 20.23

		(61,723)	Transit, and Delta Breeze busing	
Control Sites				
Fremont	Fremont, California	Suburban/ Neighborhood (214,089)	BART, AC Transit, and VTA	None (control site)
Rockridge	Oakland, California	Urban/ Neighborhood and Shopping Center (390,724)	BART and Bus	None (control site)

*Statistics for this table were given by the 2010 Bay Area census ("Bay Area Census -- Cities," 2010), BART ("Station List | bart.gov," 2014), and Caltrain (San Mateo County Transit District, 2014).

Table 2 describes the improvements made at each station.

Table 2. Summary of Infrastructural Improvements Made to Each Station

Name of Station	Improvements Made
Treatment Sites	
Balboa Park	• At the BART Station- Geneva Transit Plaza, expanded bicycle and pedestrian BART entrance, enhanced Muni LRV terminal boarding areas, and new Westside Walkway Plaza • Mission Street and Geneva Avenue Improvements: Bus bulbs, curb extensions, crosswalk restriping, landscaping, transit shelters with NextBus display, elimination of free right-turn, left-turn pockets on Mission Street. • In general: Intersection crosswalk improvements, Ocean Avenue signalized pedestrian crossing, I-280 off-ramp improvements, Muni light-rail station improvements, Geneva Avenue & Howth Street improvements, Ocean Avenue and northbound I-280 on-ramp improvements, Geneva Avenue and Northbound I-280 Ramp improvements, Geneva Avenue and San Jose Avenue improvements
Bay Fair	• Pedestrian bridge including lighting, pathway treatments, and wayfinding signage • Pedestrian underpass including lighting, wayfinding signage, and bicycle lockers • AC transit Intermodal Facility including lighting, wayfinding signage, and removal of bus wind screens • Thornally Drive sharrows and wayfinding signage for bicyclists
Civic Center	• Market Street Safety Calming Zone improvements
Glen Park	• Class II bicycle lanes • Class III bicycle routes • Alemany Boulevard and Lyell Street intersection improvements • I-280 on/off ramp improvements • Removal of parking and reduction of lane widths on Bosworth Street
Lafayette	• 24 electronic bicycle lockers
Palo Alto	• Electronic bicycle-sharing system with bicycles and pods
Pittsburg/ Bay Point	• Bus shelters and benches on Bailey Road • Reconstructed and landscaped medians on Bailey Road • Widening Bailey Road to accommodate Class II bicycle facilities • Lighting and landscaping fixtures along the De Anza Trail • Bailey Road intersection improvements • 8 electronic bicycle lockers
Control Sites	
Fremont	The Fremont BART station functioned as the control for this study. No improvements were made at this site as part of the SR2T study.

Rockridge	The Rockridge BART station functioned as the control for this study. No improvements were made at this site as part of the SR2T study.

The Built Environment, Active Commuting, and Health: A Review of the Literature

The Safe Routes to Transit (SR2T) program focuses on a setting that is emerging as a nexus of transportation and urban planning, health, traffic engineering, and safety: public transit. Used every day by millions to complete life's daily tasks, public transportation is a medium by which communities can directly address congestion and pollution, and indirectly address issues of chronic disease, obesity, stress, and traffic safety. By improving the infrastructure along street segments and at intersections around transit stations, this program aims to promote active and safe commuting to public transit, and to reduce stress and decrease carbon emissions. This literature review covers the relationships among the built environment, active travel, physical activity, traffic safety, and other health outcomes.

The Built Environment's Influence on Human Health

According to the Centers for Disease Control, only 20.6% Americans in 2011 met the Physical Activity Guidelines for aerobic and muscle-strengthening physical activity (Centers for Disease Control and Prevention, 2011). Worse yet, in 2012 more than one-third of the U.S.'s adult population (34.9%) was considered obese (Centers for Disease and Control, 2012)—a trend that has been steadily worsening. In response to these grim statistics, researchers and health professionals have studied the connection between the built environment and health, finding that the way communities are designed can seriously influence whether and how often people walk and bicycle, in addition to attendant health benefits or challenges (Frumkin, Frank, & Jackson, 2004). Health in these circumstances was measured in many ways, including physical fitness, safety from injury (particularly traffic injury), and pulmonary and cardiac health.

For example, in their meta-analysis of transportation research, Koren and Butler (2006) found that the built environment powerfully influences the ability and desire to choose to walk or bike, and consequently human and environmental health more broadly. Through studying the interactions among transportation, land use, and life style, they concluded that changes in a community due to the built environment inevitably affect transportation behavior and health. For instance, while cars undeniably provide benefits in terms of privacy and convenience, urban sprawl has encouraged a dependence on automobile use that has led to increased air and noise pollution, reduced physical activity, and heightened commuter stress. Neighborhoods are built farther and farther from commercial districts, and schools are built centrally outside of neighborhoods. These patterns, and the behavior that they encourage, have ultimately led to direct consequences on our health, such as increased rates of cancer, obesity, and asthma. Because of current urban design trends like these, Koren and Butler concluded that the quality of human and environmental health were affected not only by the built environment's direct stressors, but also by the stressors derived from the built environment's promoted behavior.

Several researchers have suggested that active transportation may be a way to increase daily physical activity and slow or reverse the growth of the obesity epidemic. For example, Dannenburg and Besser (2005) proposed the commute to work as an opportunity to encourage physical activity and combat chronic obesity. Their results suggested that by promoting public transit and active commuting to public transit, a greater proportion of Americans can not only reduce traffic congestion and their carbon footprint, but also meet the CDC's physical activity requirements. Hamer and Chida's (2008) study on the association between commuting, physical activity, and cardiovascular risk supported this claim. Their research found that a combination of walking and cycling to work led to an overall 11% reduction in cardiovascular risk.

Unfortunately, the case for active transportation is complicated by the resultant increased exposure to vehicle emissions that "may lead to infections, lung cancer, chronic lung diseases, headaches, dry eyes, nasal congestion, nausea, and fatigue" (American Lung Association, 2014). Congestion only exacerbates the impact of vehicles on health by exposing motorists and pedestrians to greater concentrations of particulate matter for extended periods of time (Bigazzi, Figliozzi, & Clifton, 2013). This may be particularly acute for bicyclists: research on air pollutant exposure in traditional bicycle lanes and separated cycle tracks found that bicyclists were more likely to inhale greater levels of particulate matter in a bicycle lane adjacent to vehicular traffic than in a more separate cycle track (Kendrick et al., 2011). This finding was attributed to the increased distance cycle tracks provided from motorized traffic. Despite these findings, the research team concluded that the potential health benefits of active commuting outweigh this risk—although they encouraged an examination of the built environment's influence when promoting walking and cycling.

Built Environment and Travel Behavior

Related research has looked specifically at the built environment and travel behavior. In their interviews of transit station users, Park and Kang (2008a) found that, in general, built environment variables had lower explanatory power than travel and socio-economic variables in determining travel behavior. They consequently suggested that land use changes be measured on a micro-level basis; e.g., by looking at traffic calming features, pedestrian and bicycle crossing features, bicycle lanes and signage, etc. By doing so, the effects of the built environment on travel behavior may be more evident—particularly for those who travel by foot or bicycle. Similarly, Ragland et al (2014a) recommended evaluating built-environment improvements at the micro-level in a recent evaluation of the California Safe Routes to School Program.

Cervero's (1995)research on transit in the Bay Area corroborated these findings. While he found that the quality of transit services was the most influential aspect concerning the walk to transit, built environment features such as large-sized parking lots, low levels of land use mixes, and low surrounding residential densities were correlated most strongly with driving to BART. In a later study, Cervero (2001) again examined the San Francisco Bay Area's built environment and compared it to the pedestrian-oriented designs of Montgomery County, Maryland. While mixed-use settings with minimal obstructions were the most conducive to walking in the Bay Area, Cervero also found that sidewalk provisions and street dimensions significantly influenced whether one walked or drove to transit in Maryland. This finding suggested that a combination of macro- and other, less commonly-considered micro-level improvements may substantially influence the decision to walk and bicycle to transit.

Several other key factors have been identified as influencing travel mode choice, including land use density, land use mix, the number of nearby destinations, the distance to transit, and urban design features such as street tree alignment and parking lot placement. Cervero and Kockleman (1997) found that a combination of compact, diverse, and pedestrian-oriented improvements to neighborhoods could considerably influence how Americans travel. Ewing and Cervero (2001) attained further evidence that mode choice is mostly influenced by local land-use patterns. For example, shorter trip lengths were found in communities with central locations, fine land-use mixes, grid-like street networks, and activity centers.

With regard to mode choice and transit use, proximity and connectivity were key qualities for promoting walking or bicycling to stations, with one-half mile being a generally-accepted limit for how far someone is likely to walk to access a transit station (Schlossberg & Brown, 2004). According to Schlossberg and Brown's work, the connectivity of the area, heavily influenced by the street network design and presence of intersections, paths, and walkable zones, impacted the walkability. Marshall and Garrick (2010) similarly found that increased intersection density and street connectivity positively influenced walking, biking, and transit use.

A few studies have looked specifically at bicycling. Multiple studies have documented a preference among bicyclists and pedestrians for roadways with bicycle-specific facilities such as physically-separated or painted bicycle lanes (Dill & McNeil, 2013; Sanders, 2013; Winters & Teschke, 2010) Research has also found that, as important as infrastructure is, a holistic approach to encouraging active transport is even more powerful. For example, in their research on several BART stations, Cervero et al (2012) suggested that people will bicycle to transit if on-site infrastructure such as secure bicycle parking was installed at transit stations, and bicycle-friendly paths and roadways leading to the station were improved and increased. Similarly, in their review of the literature, Pucher, Dill, and Handy (2010) found that increases in bicycle use depended on a multitude of interventions, including infrastructure provision and pro-bicycle programs, supportive land use planning, and restrictions on car use. Although there were moderate positive associations between individual interventions and bicycling levels, comprehensive packages of interventions proved to have the biggest impact, significantly increasing bicycle trips and the share of people bicycling. These findings suggested that in order for specific improvements to be the most effective, they need to be coupled with complementary developments.

Demographic characteristics have been found to influence mode choice, as well. When studying passengers' travel patterns to BART, Loutzenheiser (1997)found that urban design and station area characteristics were secondary influences. Instead, individual qualities such as gender, car availability, income levels, and distance were more significant influences on one's choice to walk. Park and Kang (2008b) also found that car ownership and distance were important predictors of driving to transit in the Bay Area. However, gender was found to have differential effects: while males were more likely to bicycle to transit, there was no gender difference between those who walked.

The Built Environment and Safety

It is well established that greater exposure to motor vehicles (e.g., through higher vehicle volumes) negatively impacts pedestrian and bicyclist safety. In the Bay Area, 92 pedestrians were killed and nearly 2400 were injured in 2011 alone (MTC, 2008).

In response to this conflict, several research studies have examined countermeasures to improve pedestrian and bicyclist safety. Zegeer, Stewart, et al. (2002) found that in high volume, multi-lane street environments, raised medians, traffic signals that included pedestrian signals, and speed reduction were key additions to crosswalk markings that could improve crossing safety. Schneider et al (2010) examined the built environment's influence on pedestrian safety by identifying specific characteristics of intersections that may lead to more vehicle-pedestrian collisions. Utilizing detailed pedestrian crash data and pedestrian volume estimates from 81 intersections in Alameda County, the team found that intersections with right turn only lanes, more commercial properties, more nearby non-residential driveways, and more children under the age of 18 were more likely to experience collisions. The team identified medians as an important element to decrease pedestrian collisions and promote safety.

Research has also found that increasing bicycling and pedestrian levels alone can prove to enhance safety. Examining data at the city and county level, Jacobsen (2003) found that the likelihood of an individual person being injured by a motorist was inversely proportionate to the amount of people walking and cycling. This finding was seen across communities of varying sizes and intersections. Because cyclists and pedestrians do not behave significantly more carefully while traveling in larger groups, Jacobsen determined that the overall decrease in risk was due to motorists becoming more aware of and cautious around pedestrians and cyclists when they are more commonly seen in a community. Quite simply, there was safety in numbers.

Pucher and Dijkstra (2003) conducted a comparative study on safe walking and cycling in the Netherlands, Germany, and United States. Using data on traffic-related fatalities from 1975 to 2001 and injury rates for pedestrians and cyclists in 2000, the researchers found that American pedestrians and cyclists experienced much higher traffic risk per kilometer and trip traveled. In fact, American pedestrians were 23 times more likely and American bicyclists 12 times more likely to be killed than car occupants. The authors recommended auto-free zones, lower speed limits, pedestrian refuge islands, and limited, more expensive parking as strategies to promote more and safer active transportation.

The Success of Safe Routes to School Programs

Because the Safe Routes to Transit program is based off of the successes of the Safe Routes to School program (SRTS), it is relevant to discuss the impact this program has had on child commuting behaviors. First established in California in 1999, the goals of SRTS are to remove the barriers that hinder children from walking and bicycling safely to school and to encourage active commuting as a means to promote better health.

Evaluation research has found that safe routes to school programs have had a positive effect on safety (Ragland et al., 2014). Upon evaluating 75 California schools that had received funds from the program, Ragland et al. found that pedestrian safety improved significantly near where countermeasures were installed. Schools that were studied had implemented a variety of infrastructure improvements, including sidewalks, traffic signals, an intersection warning system, flashing beacons, pedestrian countdown signal heads, speed humps, and speed warning signs. These improvements also led to an increase in the probability of a child walking to school within this improvement zone, demonstrating how these infrastructural changes can potentially cause mode shifts.

In another SRTS evaluation, Boarnet et al. (2005) examined neighborhoods around nine schools in California for changes in trip-making before and after construction of infrastructural improvements. Data collection focused on counts of pedestrians during a 45-minute peak school trip period in the morning and afternoon in the vicinity of schools. Pedestrian improvement projects included sidewalk construction, traffic control installation, and intersection crossing improvements. In eight of nine schools, the number of observed walking trips increased, between 12% and 850%. In addition to the numbers of pedestrians and walking trips, observers also noted where pedestrians were walking within the roadway right-of-way. There were distinct changes in the locations where students were walking, with students shifting walking from the travel lane or shoulder to walking along a sidewalk.

Summary

The literature reviewed here demonstrates the interconnection between human health, physical activity, and the built environment. It is in light of this evidence that the MTC Safe Routes to Transit program was designed and implemented, with the aim of providing safer and more attractive routes to transit for those walking and bicycling. The following sections describe the SR2T effort and findings.

Methodology

Fehr & Peers collaborated with SafeTREC to develop an evaluation plan and the appropriate data collection tools for use in the field by the transit station sites. The evaluation team's tasks were to train, schedule, and supervise all data collection, database development, and data entry.

Prior to the fall 2011 baseline data collection, the evaluation team compiled an evaluation proposal for the sites that explained the purpose and importance of evaluation both for program planning and examining program effectiveness. The proposal contained timelines for data collection, recommended protocols for each of the data collection methods, suggestions for where data collection should be conducted as well as estimates for the total cost of data collection. A copy of the proposal can be found in Appendix A.

To support the analyses concerning the effects of constructed SR2T projects on pedestrian and bicycling safety, walking, and bicycling, a majority of the data collection effort was focused at the transit station or within the transit station buffer areas. Although the SR2T Program also includes goals related to reducing traffic congestion and improving air quality, it was determined that effects in these areas could largely be captured by changes in mode shares at transit stations.

All transit sites were required to have baseline data collected before program activities began at the station (typically prior to the fall of 2011) and again in the spring of 2012, after construction had finished. Data was collected at several other stations (Pittsburg, Fremont, Bay Fair, Balboa Park, Glen Park, and Palo Alto) in the fall of 2013 as well. Except for Fremont (a control site), this was due to construction not being completed by the fall of 2012 when post data was initially collected.

Student data collectors were hired to assist in the data collection. To promote consistency, SafeTREC organized and led the training for all students, and one supervising employee from SafeTREC monitored the students in the field. All appropriate data collectors received human subjects clearance. Additionally, permission was secured from the BART leadership before surveying commenced at the BART stations. A copy of the permission letter can be found in Appendix B.

Before and After Surveying Techniques

The study design was a before-after analysis using treatment and control sites. This study design conformed as closely as possible to a "natural experiment" in which the treatment site received an intervention and the control site did not, thereby allowing the researcher to investigate causality between the intervention and the variable of interest. Such a study design allowed for the best possible understanding of how the SR2T capital projects affected travel behavior and safety.

The SR2T project construction schedules were examined in order to determine the feasibility of conducting before-after analyses within the timeframe of the consultant's contract with MTC, which runs from fall 2010 through spring 2013. The consultant team collected SR2T applications submitted on behalf of various agencies to TransForm and reviewed them for construction start and end dates. When this information was not readily available, email inquiries were sent to each SR2T applicant project manager to request verification of the construction start and end dates.

Data Collection Instruments

Surveys

Surveys were distributed on fair-weather weekdays (Tuesday, Wednesday, or Thursday) between 6 and 11 a.m. They were offered in English, Spanish and Mandarin. Data collectors did not distribute surveys to or continue to interact with customers who refused the survey, and avoided getting in the way of customer movements. Data collectors aimed to collect a minimum of 150 postcard surveys and 60 full-page surveys at each station. The data collector who distributed postcard surveys was instructed to assist with full-page surveys after reaching his or her 150-survey minimum. This meant that the postcard surveys were mostly distributed from 6 a.m. to approximately 9 a.m. Responses from people who made transfers at the station were disregarded because they did not access the system at the station.

Postcard Surveys

Postcard surveys captured basic information about travel done by the participant on his or her journey from home to the entrance of the BART station (e.g., home location, all intermediate stop location(s), travel time by mode, out-of-pocket costs). This form was intended to be completed in one minute by a typical respondent, and should not have required additional explanation.

Postcard surveys were offered to as many customers as possible who were waiting for trains on the BART platform. The data collector started distributing surveys on one side of the platform immediately after a train departed the station on that side of the platform. He or she started at one end of the platform and moved towards the opposite end of the platform. The data collector stopped distributing surveys two to three minutes before the next train arrived on that side of the platform. At that point, the data collector retrieved the completed surveys from all survey participants directly. All survey distribution and collection were contained within the BART station area.

Intercept Surveys

Intercept Surveys included the same questions about the participant's journey to the BART station as the postcard survey. Additional information about the user's perceptions of pedestrian and bicycle safety, perceptions of air quality, and awareness of changes to the roadway environment (e.g., pedestrian and bicycle facilities, traffic calming treatments, intersection characteristics, signs) in the area around the station was also sought. This form was designed for data collectors to record answers from respondents directly on the form. It was intended to be completed in three minutes by a typical respondent.

Intercept surveys were offered to as many customers as possible who were waiting for the train on the BART platform. The data collector began inviting people to participate in the survey immediately after a train departed the station on that side of the platform. He or she invited the first person who arrived on the platform after a train departed to participate in the survey. After completing the survey with one participant, the data collector then invited the first person that he or she saw on the side of the platform that had a longer wait time until the next train to participate. The data collector reversed directions when reaching the end of the platform. If two or more people were traveling in a group, only one person from the group was surveyed.

The combination of postcard and intercept surveys was used to maximize survey size in recognition of the fact that opportunities to intercept people on their way to a destination in a time-sensitive manner (e.g., through needing to catch a BART train) would be limited. The intercept surveys inquired about a range of travel behaviors related to active transportation to transit. The postcards provided a much larger sample size with demographic and basic trip information that could then be matched with and extrapolated to the more detailed information from the intercept surveys to give an idea about the larger population of BART users.

Observations

Pedestrian, bicyclist, and driver behaviors were observed for two hours on a fair-weather weekday before and after projects were implemented. The two-hour observation period was during the late afternoon (4 p.m. to 6 p.m.), and every 15-minute segment was marked on the data collection sheet. Depending on the project, observations were made either at an intersection, ramp, or street segment location. To see where observations were conducted at each site, please view the site maps in Appendix C.

For pedestrian and bicyclist observations, the observation team attempted to record age, gender, other personal characteristics, and positioning on the roadway. Pedestrians with disabilities, including people using assistive devices or limping, were also noted. Due to the general speed and volume of cars, only driver actions (i.e., not age or gender) were recorded. The specific behaviors recorded at each location type are discussed below.

Intersection and Ramp Behaviors
Behavior observation sheets were used to document specific pedestrian, bicyclist, and driver actions at each study intersection or ramp. Data collectors observed all pedestrians, bicyclists, and drivers who approached the intersection, unless each type of user approached more than once per 30 seconds. For high-frequency situations, data collectors randomized their selection process by choosing to observe every fifth or tenth user who approached from the adjacent intersection after the last observation was completed. Data collectors observed each subject and marked all behaviors they observed for that person at the intersection. Three different data collectors were used at each intersection—one each for pedestrians, bicyclists, and drivers. Note that some behaviors depended on whether the intersection was controlled by a stop sign or traffic signal, or whether the bicyclist or automobile driver was turning.

- Pedestrian behaviors included: crossing on green or yellow light, still crossing street when light turned red, stopping and waiting at red light, jaywalking against red light, looking both ways before entering crosswalk, entering crosswalk without looking, running or hurrying to avoid approaching vehicles, texting or talking on cell phone or other communication device.

- Bicyclist behaviors included: entering on green or yellow light, stopping at red light, running red light, turning right on red, stopping/slowing at stop sign, running stop sign, riding the wrong way (i.e., against the flow of traffic) on the street/sidewalk, texting or talking on cell phone or other communication device, holding something in hand (e.g., cup, bag, or cell phone not in use, etc.).
- Driver behaviors included: passing crossing because has right-of-way, yielding to let pedestrian cross, not yielding to pedestrian or cyclist, speeding past pedestrian crossing, honking at pedestrian, slowing abruptly or skidding to yield to pedestrian, running red light, running stop sign, encroaching over crosswalk line or bicycle box, using cell phone or other communication device.

Roadway Segment Behaviors
Similar to the protocol for intersections, behavior observation sheets were used to document specific pedestrian, bicyclist, and driver behaviors at each study roadway segment. Data collectors observed all pedestrians, all bicyclists, and all drivers who approached the midpoint of the roadway segment from one direction on either side of the street, unless each type of user approached more than once per 30 seconds. For higher-frequency situations, data collectors used the same randomization process as with intersections. Data collectors observed each subject and marked all behaviors they observed for that person as they traveled along the segment. As with intersections, each user type was assigned one data collector.

- Bicyclist behaviors included: normal riding, riding in door zone (i.e., within 3 feet of parked cars), riding in front of traffic and slowing automobiles down, bicycling erratically (i.e., not maintaining a relatively straight line of travel or swerving in and out of traffic), riding the wrong way (i.e., against the flow of traffic) on the street/sidewalk, texting or talking on cell phone or other communication device, holding something in hand (e.g., cup, bag, or cell phone not in use, etc.).
- Driver behaviors included: Passing too close to bicyclist (i.e., within 3 feet), passing far enough from bicyclist, speeding on street segment with bicyclist present, honking at bicyclist, driving erratically (i.e., not maintaining a relatively straight line of travel, swerving in and out of traffic, or slowing/speeding up unexpectedly), using cell phone or other communication device.
- Pedestrian behaviors included: Walking with adjacent traffic, walking against adjacent traffic, running, and using cell phone or other device.

A copy of the survey and observation forms can be found in Appendices D and E, respectively.

Statistical Methodology

To determine the statistical significance of the effect of the treatments on the sites, the research team used the technique known as "difference in difference". Difference in difference measures the "effect of the treatment on the treated" (Goulding, 2011)by calculating the mean values for each group and determining whether the treated group followed a different trajectory than the untreated group in the post-treatment period. A significant result implies that the change in the variable of interest (e.g., behavior) at the treatment sites was significantly different than the change in the variable of interest at the control sites. All statistical tests were performed using Stata 12.

Defining Suburban and Urban

The research team also examined the results by whether the sites were located in urban or suburban areas. The team designated sites in San Francisco, Oakland, and Palo Alto (due to its downtown location) as “urban”, while the other sites were designated as “suburban.” Depending on the specific variable, the statistical significance of a relationship to urban/suburban status was examined through chi-square analyses or t-tests.

Results

This section presents findings from analyses of the survey and observation data.

Surveys
This section presents findings about the survey population, including demographic characteristics, travel behavior and costs, and perceptions of traffic safety and air pollution at the various sites. Comparisons were made between the pre and post data collection periods at the treatment and control sites, as well as between the urban and suburban areas. Where changes at particular sites were notable, their significance was tested individually.

Mode Share
Mode shares of respondents while traveling to the BART or Caltrain station were examined in two different ways. The first was total mode shares, measuring the share of all respondents who reported more than 5 minutes traveling on each access mode (see Figure 11). These mode shares added up horizontally to more than 100% due to the multimodal nature of respondents' trips. The second was main mode shares—the access mode for which each respondent reported the greatest amount of time spent (see Figure 12).

Walking increased slightly as a mode at treatment sites, and increased 3.1% when measured as difference-in-difference. As a main mode, walking decreased slightly at treatment sites, though still increased 1% when measured as difference in difference. The increase in mode share and decrease in main mode share at treatment sites can be interpreted as an increase in multi-modal trips. Walking for more than 5 minutes occurred in more access trips in the post period, but the increases in main mode occurred for those traveling by bike and bus. These observations suggest that Safe Routes to Transit may have increased walking in a way that is complementary to other sustainable transportation modes. Buses in particular increased substantially as a mode and main mode, though the changes and difference-in-difference were not statistically significant with the limited sample sizes of this study. While it is difficult to draw direct causal links, increases in bus mode and main mode shares may have been supported by the pedestrian safety improvements around treatment sites, since most people get to and from buses by walking.

Biking increased between 3.1% and 3.8% at both treatment and control sites, when measured either by mode or main mode, with all changes being statistically significant ($p \leq 0.05$). The changes in bike mode share at both treatment and control sites were similar in magnitude, so the difference-in-difference metric is insignificant. However, it is important to note that Fremont, one of the two control stations, also had bike facility improvements during the study period, although they were not funded by Safe Routes to Transit. The other control station, Rockridge, is in an urban neighborhood with relatively good bicycling infrastructure. In this context, it is more reliable to consider differences between the pre to post time periods, rather than difference-in-difference between treatment and control sites. Bicycling was the mode with the greatest gains in both mode share and main mode share from the pre to the post periods, and the increases were slightly higher at treatment sites.

Increases in alternative transportation modes were matched by decreases in driving, both as a mode and main mode at treatment and control sites. This is promising, since it suggests that alternative modes, especially biking, substituted for driving. Furthermore, decreases in driving were stronger at treatment sites, such that driving to treatment sites decreased 2.5% as a mode share and 1.7% as a main mode share when measured as difference-in-difference. It is notable that these changes were observed over a time period during which the economy in the Bay Area was generally improving, which could be expected to encourage automobile use. The reductions in driving and the greater magnitude of that reduction at treatment sites are in line with the mode shift and air quality goals of the Safe Routes to Transit program.

Figure 11. Change in Mode Share among the Survey Population

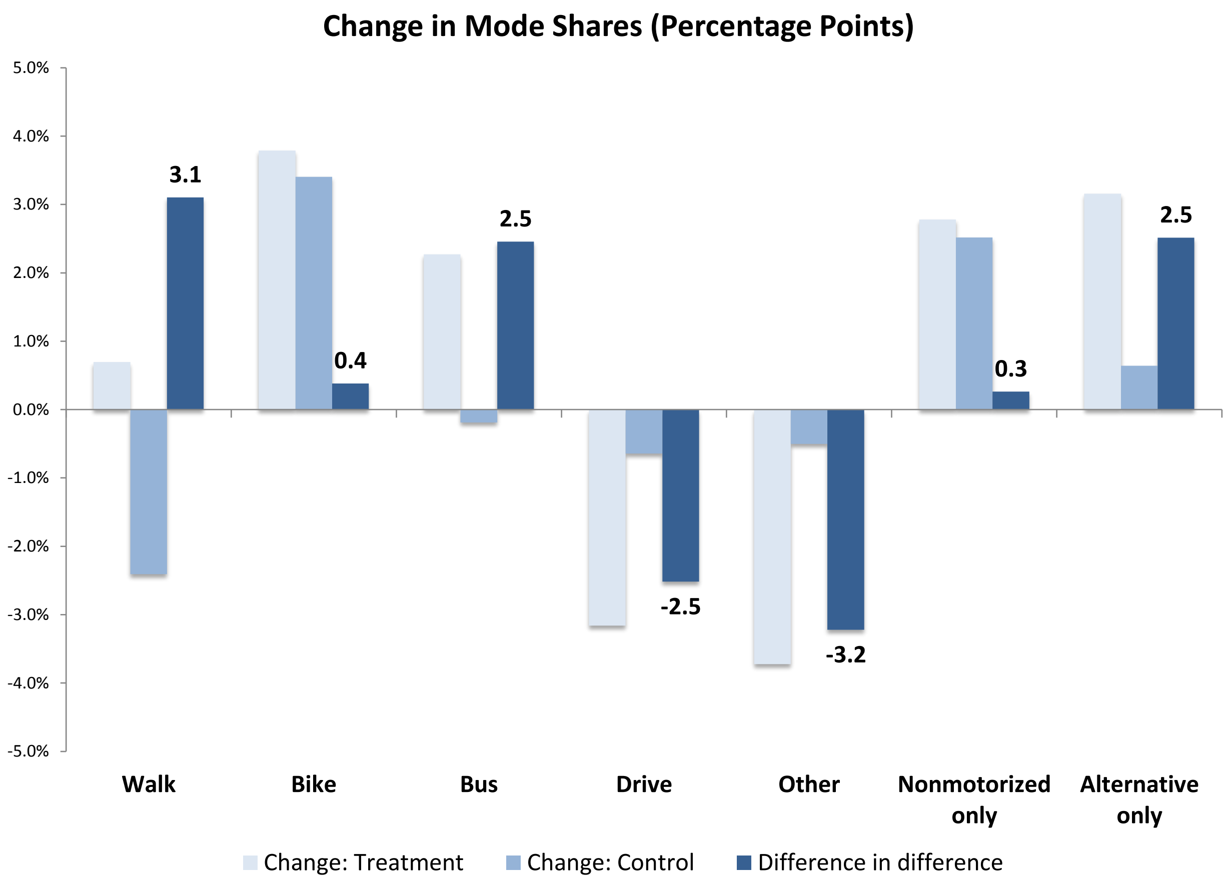
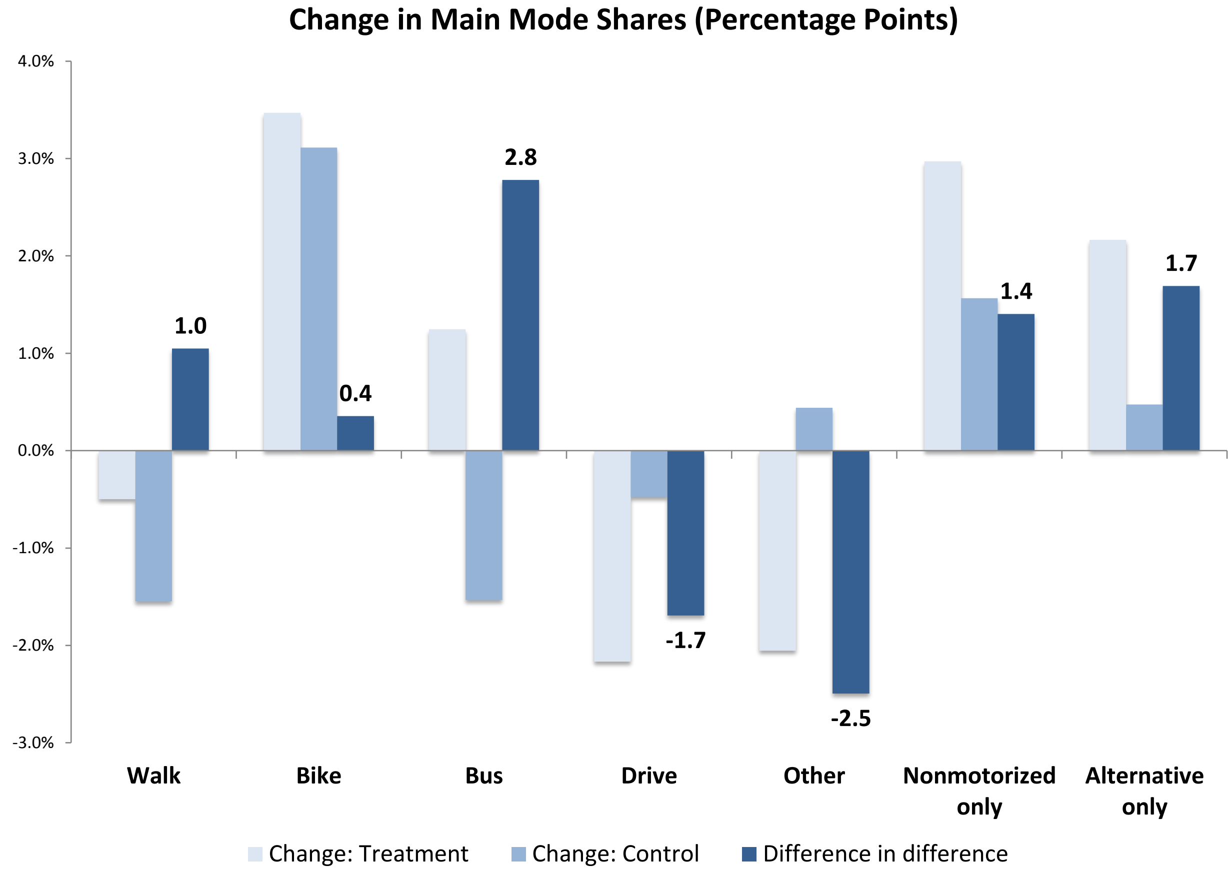


Figure 12. Change in Main Mode Share among the Survey Population



In order to understand the challenges and opportunities to shifting access trips towards walking and biking among transit riders, main mode shares were also examined by a variety of demographic and household characteristics (see Table 3). These data were combined across all sites and both time periods. The data indicate that men were slightly more likely to walk, although this difference was not statistically significant (p=0.2792). The greatest difference by gender was in bike mode share, with biking having a 7.2% main mode share for men and 2.4% for women. This difference is highly statistically significant (p<0.0001). However, both women and men saw substantial increases in bike main mode share, with women's bike main mode increasing from 1.6% to 3.1% (p=0.1108) and men's bike main mode share increasing from 4.8% to 9.1% (p=0.0070).

When examined by age group, walking has at least a 25% main mode share until the highest age group (65+ years old). Biking followed similar trends to walking in that younger patrons are more likely to use it as a mode. Interestingly, biking did not drop off substantially until the 55+ year old age groups. This suggests that the segments of the population that will take advantage of bicycling improvements are broader than might be expected, with bicycling still having a relatively high main mode share of 5% even in the 45-54 year old age range among respondents. Meanwhile, driving did not reach a majority of main mode share until the 45-54 age group.

Among the oldest group (patrons aged 65 and older), there was a much higher rate of driving and the lowest likelihood of using any non-motorized or alternative mode.

Households that had one adult were the most likely household type to have respondents report a main mode of walking, and households with either 1 or 4+ adults were the most likely to report bicycling as a main mode. This is likely due to correlations with age, since non-family households are more likely to walk and these types of households are the most likely to be young, non-family households. In contrast, an increasing number of children in a household was correlated with lower rates of walking as a main mode and increased rates of driving as a main mode, suggesting that having dependent children may make driving more attractive. In general, this relationship held true at the station level, varying from Rockridge where the walking main mode share was 3.1% higher for households without children, to Palo Alto where the same difference was 11.0%. The only exceptions were Fremont, where non-family households only had a 0.1% higher main mode share for walking, and Lafayette, where the walking main mode share was 3.0% lower for households without children. However, the difference at Lafayette was not statistically significant (p=0.5493). The relationship between children and commute mode may be different in Lafayette since this site is both highly affluent and suburban. Fremont is also a relatively wealthy and suburban station area.

Automobile ownership was a strong predictor of non-motorized and alternative mode use. While 43.5% and 7.4% of respondents in car-free households had a main mode of walking and biking, respectively, those figures were dramatically lower among two-car households (24.1% and 2.8%, respectively). Meanwhile, from car-free to single-car households, driving as a main mode doubled (from 16.0% to 31.9%), and from single-car to two-car households it nearly doubled again (to 61.9%). Thus, while there is evidence presented in this report that pedestrian and bicycle safety improvements do encourage walking and bicycling, these findings indicate that broader strategies around auto ownership will likely be necessary to widely affect mode shift to more sustainable modes.

Table 3. Main Mode Share by Demographics of the Survey Population

	Obs. (n=)	Walk (%)	Bike (%)	Bus (%)	Drive (%)	Other (%)	Non-motorized modes (%)	Alternative modes (%)
Gender								
Male	1,092	31.4	7.2	15.8	41.8	3.8	38.6	58.2
Female	1,170	29.3	2.4	15.4	50.3	2.6	31.7	49.7
Age Group								
18-24	351	30.5	2.6	26.8	38.7	1.4	33.0	61.3
25-34	674	33.2	6.7	15.4	40.5	4.2	39.9	59.5
35-44	514	31.9	5.8	10.9	47.7	3.7	37.7	52.3
45-54	362	26.2	5.0	13.3	52.8	2.8	31.2	47.2
55-64	233	27.9	1.3	14.2	53.2	3.4	29.2	46.8
65+	67	20.9	0.0	9.0	68.7	1.5	20.9	31.3
Number of Adults in Household								
1	501	36.9	5.2	19.4	35.5	3.0	42.1	64.5
2	1,163	29.1	4.9	10.7	51.4	3.9	34.0	48.6
3	266	22.6	2.6	20.7	52.6	1.5	25.2	47.4
4+	202	22.8	6.9	21.8	46.0	2.5	29.7	54.0
Number of Children in Household								
0	1,621	32.0	4.8	17.6	42.2	3.5	36.8	57.8
1	359	28.1	5.0	11.4	52.9	2.5	33.1	47.1
2	283	24.7	6.0	8.1	58.0	3.2	30.7	42.0
3+	82	24.4	3.7	23.2	48.8	0.0	28.0	51.2
Number of Automobiles in Household								
0	444	43.5	7.4	28.8	16.0	4.3	50.9	84.0
1	680	38.7	6.3	18.7	31.9	4.4	45.0	68.1
2	756	24.1	2.8	9.3	61.9	2.0	26.9	38.1
3+	463	15.3	3.9	9.3	69.3	2.2	19.2	30.7

Note:
Mode shares sum horizontally to 100%.
Non-motorized modes are walk and bike. Alternative modes are walk, bike, bus, and other.

<u>Additional Demographic Analyses</u>

The gender and age demographics of respondents in the pre and post periods were examined to test for possible sampling bias. Chi-squared tests of the gender of respondents across time periods showed that differences in gender composition of the sample were not significant overall (see Table 4). Gender differences between the two time periods were also not significant within the treatment and control groups or among urban and suburban stations.

Table 4. Gender Differences between the Data Periods and Site Categories

	Overall		Treatment Sites	
Gender	Pre (%)	Post (%)	Pre (%)	Post (%)
Female	53.6	50.7	53.0	51.1
Male	46.5	49.3	47.0	48.9
Obs (n=)	1,113	1,364	757	978
Chi-squared test		p = 0.152		p = 0.445

Note: The Chi-squared tests compare the gender shares across pre and post periods.

Table 5 shows the results of Chi-squared tests of the age groups of respondents across time periods. The differences in age composition of the sample across time periods were significant at the 5% level, both overall and within treatment sites (p=0.042 and p=0.047 respectively), but the magnitude of these differences was small. The greatest difference in the share of any age group between the pre and post periods was less than 5%. Thus, while the differences were significant, they were not large in magnitude, and are unlikely to have biased results substantially. Furthermore, we might expect to have seen some of the shifts we observed because of improvements around stations leading to increased biking and walking. At treatment sites and overall, the shares of those under age 35 increased, which could be partially attributed to increases in the number of bicyclists, who are disproportionately younger. The data do not appear to be subject to substantial sampling bias. Further station-level demographic data is presented in Appendix F.

Table 5. Age Differences between the Data Periods and Site Categories

	Overall		Treatment Sites	
Age Group	Pre (%)	Post (%)	Pre (%)	Post (%)
18-24	14.9	17.1	15.1	18.6
25-34	29.5	32.0	28.8	29.2
35-44	23.9	22.2	22.6	21.4
45-54	18.8	14.8	19.6	14.9
55+	13.0	14.0	13.9	15.9
Obs (n=)	1,090	1,317	740	939
Chi-squared test		p = 0.042		p = 0.047

Notes:
The 55-64 and 65+ age groups were consolidated due to the low number of observations in the 65+ age group.
The Chi-squared tests compare the age group shares across pre and post periods.

Economic Implications

While the primary goals of the Safe Routes to Transit program focus on safety, health, and sustainability effects from mode shift and improved air quality, there are also secondary economic benefits from encouraging walking and bicycling. Table 6 presents data across both the pre and post time periods, comparing the main mode shares among groups with different behavior with regard to stopping on the way to the transit station at which they filled out the survey. It is useful to compare mode shares within each group to the overall main mode shares to understand whether a mode is over- or under-represented within each group.

Those whose main mode was driving were slightly over-represented among those who made no stops, and under-represented among those who made any stop at all. Drivers were particularly under-represented regarding stopping for food and drink (33.3% compared to their overall mode share of 46.0%). The only type of stop for which drivers were over-represented was childcare, with 68.4% of those who stopped for childcare having a main mode of driving. This is consistent with patterns seen in the demographics section of this report with respect to main mode choice of households with children.

By contrast, those with a main mode of walking were much more likely to make stops on the way to transit. They were over-represented both in making any stop at all (37.1% compared to an overall mode share of 30.3%), and among those who stopped for food and drink (42.1%), which is a type of stop with direct neighborhood economic benefit. Interestingly, while respondents with a main mode of bicycling were slightly under-represented within the group of those who made any stop at all, they were over-represented among those who stopped for food and drink (6.3% compared to overall mode share of 4.9%). In general, all users of sustainable access modes (walk, bike, and bus) were more likely than drivers to generate local economic activity through stops for food and drink on the way to transit stations.

Table 6. Main Mode Shares by Whether Stopped and Type of Stop

Type of Stop	Walk (%)	Bike (%)	Bus (%)	Drive (%)	Non-motorized modes (%)	Alternative modes (%)
Overall Main Mode Shares	30.3	4.9	15.7	46.0	35.2	54.0
Made no stops	28.5	5.3	15.3	47.5	33.8	52.5
Made any stop	37.1	3.5	17.1	40.0	40.6	60.0
Stopped for food/drink	42.1	6.3	16.4	33.3	48.4	66.7
Stopped for childcare	18.4	0.0	10.5	68.4	18.4	31.6

Notes:
Mode shares sum horizontally to 100% with category "other" not presented here.
"Non-motorized modes" include walk and bike. "Alternative modes" include walk, bike, bus, and other.

In addition to economic benefits accruing to local businesses, the survey data indicated that those who used sustainable transit modes also saved money on personal transportation expenditures. Respondents reported their expenditures on parking fees, bus/Muni fares, and tolls. Notably, these total costs did not include the marginal per-trip cost of gasoline for drivers (difficult to estimate for a single trip), nor the fixed costs of auto ownership, such as insurance and car payments. Even ignoring these marginal and fixed costs of auto ownership, average total costs were lower for those who did not drive than those who did ($1.46 versus $1.65), with non-driving costs dominated by bus fares. This difference was not quite significant at the 10% level (p=0.111 with a conservative two-tailed t-test), though it is important to keep in mind that the difference would be greater and therefore almost certainly significant if fuel costs could be reliably recorded as well.[1]

Average total costs were even lower for those with a main mode of walking ($1.02) or bicycling ($0.83), with the differences in average cost compared to drivers being highly significant (p=0.0004 and p=0.0208, respectively). Those with main modes of walking and biking were also most likely to have no transportation expenses on their access trip: 77% of those with a main mode of walking and 84% of those with a main mode of bicycling reported no costs at all.

Perceptions of Traffic Risk

Perceptions of traffic risk were measured on a 5-point Likert scale, with higher scores indicating a greater level of concern while walking, biking, or driving to the station. As such, decreases indicate improvements in perceptions. Table 7 shows improvements in perceptions of traffic risk for all three modes when measured as difference-in-difference. In this case, pedestrians reported the least improvement in risk perceptions among the modes. Improvements in bicycling perceptions of safety were the strongest, with levels of concern decreasing 0.8 Likert scale points overall and 1.2 Likert scale points at urban stations when measured as difference-in-difference. The changes in bicycling perceptions were significant at the 10% level (p=0.059) when measured as difference-in-difference overall, as well as difference-in-difference at suburban sites (p=0.083). Seeing improvements in perceptions of traffic risk is a promising finding, as these perceptions factor into mode choice. These perceptual changes (based on actual on-the-ground improvements funded by the Safe Routes to Transit program) support mode shift to walking and biking.

Table 7. Average Perceptions of Traffic Risk, Levels and Change

	While Walking			While Biking			While Driving		
	Overall	Urban	Suburban	Overall	Urban	Suburban	Overall	Urban	Suburban
Control	0.3	-0.1	0.4	0.6	1.1	0.7	0.4	0.7 *	0.1
Treatment	0.1	0.2	-0.1	-0.2	-0.1	-0.3	-0.1	0.0	-0.2
Difference in Difference	-0.2	0.3	-0.5	-0.8 *	-1.2	-1.0 *	-0.5	-0.8 *	-0.2

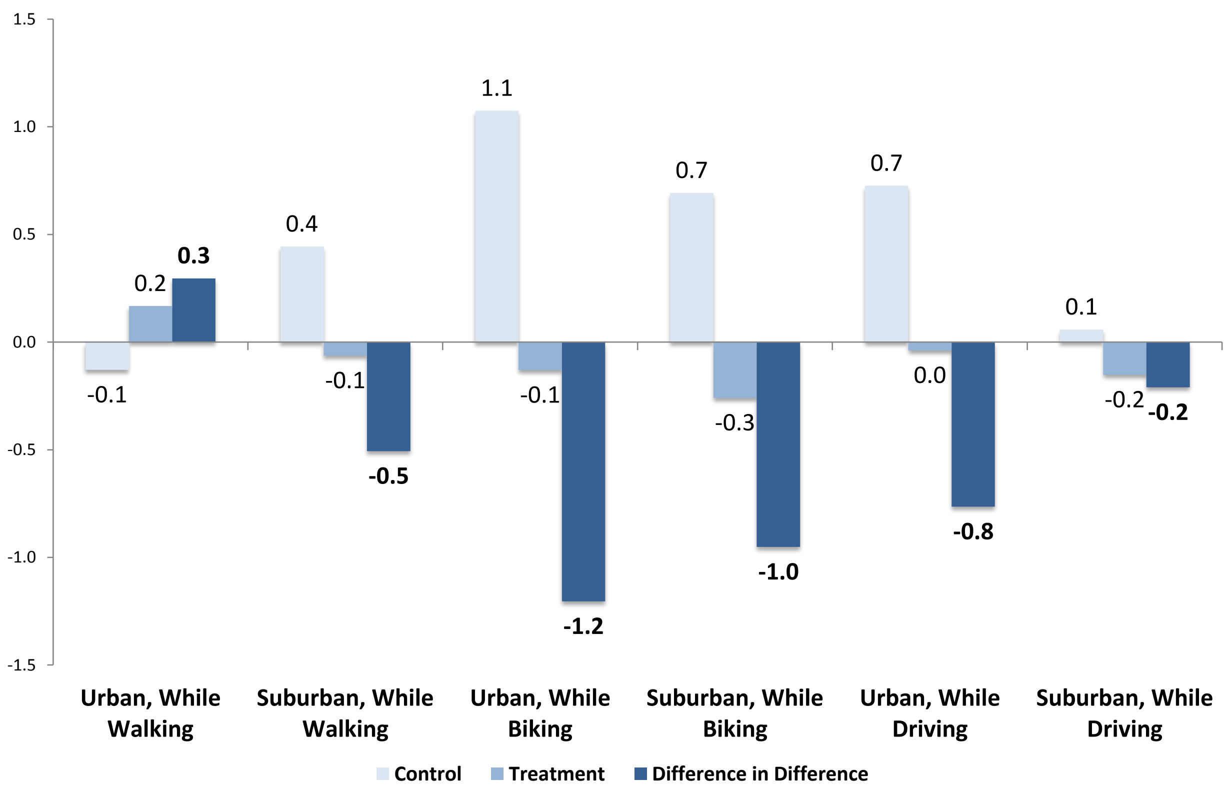
Notes:
Numbers reported are changes in average scores on a 5-point Likert scale; higher scores indicate more concern. Statistical tests are two-tailed t-tests. Significance levels indicated by the following: * $p \leq 0.10$

Interestingly, Figure 13 shows that traffic risk perceptions while driving to the station also improved significantly at the 10% level when measured as difference-in-difference at urban sites (p=0.078). This finding is consistent with research showing that drivers welcome pedestrian and bicycle improvements and the increased predictability they bring, particularly in urban areas where there are more likely to be multiple types of road users in constrained space (Sanders &

[1] The conservative two-tailed t-test used tests the hypothesis that the costs between the two groups (those who did not drive and those who did) are not equal. A less conservative one-tailed t-test would instead test the stronger hypothesis that those who did not drive spent *less* than those who did drive. This second test would find the difference between the two groups significant at the 10% level (p=0.055).

Cooper, 2012; Sanders, 2013). The data certainly do not show evidence that bicycle and pedestrian improvements make drivers feel less safe.

Figure 13. Changes in Average Perceptions of Traffic Risk, by Location Type (Average Likert Scores; Lower = Less Concerned)



When perceptions of traffic risk were analyzed by geography and gender, the data revealed notable differences. Table 8 shows the percentage of respondents who indicated they were concerned about traffic risk while traveling to the station (defined as a 4 or 5 on the 5-point Likert scale), as well as whether the change from the pre to post period was significant. In general, women were more concerned about safety while walking to the station. Interestingly, women's safety concerns while biking to stations decreased significantly from the pre to post time periods, while men's increased. There was also substantial heterogeneity among perceptions at the station level (data located in Appendix F), although small sample sizes at the site level should temper any conclusions drawn from the data.

Table 8. Percentage of Respondents who Feel Unsafe while Traveling to the Station

Demographic	While Walking		While Biking			While Driving	
	Pre (%)	Post (%)	Pre (%)	Post (%)		Pre (%)	Post (%)
Urban	12.3	18.1	28.0	28.4		15.7	19.0
Suburban	16.1	13.4	20.3	19.5		23.6	17.4
Female	19.5	17.6	34.9	19.7	**	22.8	16.9
Male	8.2	14.7	15.7	28.6	**	14.3	19.0
	Pre (n=)	Post (n=)	Pre (n=)	Post (n=)		Pre (n=)	Post (n=)
Urban	122	116	107	81		127	121
Suburban	62	97	59	77		72	115
Female	87	102	83	76		101	124
Male	97	102	83	77		98	100

Notes:
Percentages represent the share of respondents who reported a 4 or 5 on a 5-point Likert scale; higher scores indicate more concern about traffic risk.
Statistical tests are two-tailed t-tests. Significance levels indicated by the following: * $p \leq 0.10$; ** $p \leq 0.05$

While respondents in urban areas expressed traffic safety concerns about bicycling, this did not necessarily mean they were then choosing not to bicycle. Bike main mode share was 16% among urban respondents who expressed safety concerns about bicycling. Similarly for walking, 44% of those who expressed concerns about safety while walking to the station still chose walking as their main mode. This is in contrast to what was observed in suburban areas, where no one bicycled among those who expressed safety concerns, and only 29% of those expressing concerns about walking chose it as a primary mode. Being concerned about safety for any of the three modes is linked to higher rates of driving at the suburban stations. However, it also appears that those who bicycle may be more likely to express safety concerns about bicycling simply because they are more familiar with the experience of biking in cities with incomplete bicycle infrastructure. This finding could be clarified through future research on the relationship between perceptions of traffic risk and mode choice.

Additionally, all survey respondents were invited to report their perceptions of traffic risk on all three modes. As such, it is difficult to reliably interpret perceptions of traffic risk. This is particularly the case for bicycling, since this data includes perceptions of both bicyclists and non-bicyclists, even though only 4.8% and 8.2% of the responses collected about perceptions of traffic risk while biking in the pre and post periods, respectively, were by respondents who reported bicycling on their access trip to the station. Furthermore, among those who did not bicycle to the station on the day they were surveyed, it was unclear how many were occasional or leisure bicyclists, versus non-cyclists, as this information was not sought via the survey. Further research and a larger sample size would be necessary to better understand how improvements such as those funded by Safe Routes to Transit influence perceptions of traffic risk differently among various categories of bicyclists and non-bicyclists.

<u>Perceptions of Air Pollution</u>

Similarly to perceptions of traffic risk, perceptions of pollution were measured on a 5-point Likert scale, with higher scores indicating a greater level of concern while walking, biking, or driving to the station. As such, decreases indicate improvements in perceptions of pollution. Perceptions of pollution may not correlate perfectly with actual air quality around stations, but still offer some insights into perceived air quality and how it may affect willingness to walk or bike. Table 9 shows the change in average Likert scores of air pollution. When measured as difference-in-difference, perceptions of air pollution improved relatively substantially for all modes at treatment stations (about half a point overall for each access mode). These changes were significant at the 10% level overall for biking and at urban stations for driving. The decrease in concern about air pollution while walking to treatment sites was also statistically significant at the 10% level (p=0.0809), and the decrease in concern while biking to suburban treatment stations was both highly significant and substantial in magnitude (change of -0.7, p=0.0139). These improvements in perceptions of air pollution are promising, especially given that in general the public seems to be increasingly concerned and aware about the health and environmental impacts of air pollution.

Table 9. Average Perceptions of Air Pollution, Levels and Change

	While Walking			While Biking			While Driving		
	Overall	Urban	Suburban	Overall	Urban	Suburban	Overall	Urban	Suburban
Control	0.2	0.0	0.2	0.4	0.8 *	0.0	0.4	0.9 **	-0.1
Treatment	-0.3 *	-0.2	-0.4	-0.2	0.1	-0.7 **	0.0	0.2	-0.4
Difference in Difference	-0.5	-0.2	-0.6	-0.6 *	-0.7	-0.7	-0.4	-0.8 *	-0.3

Notes:
Numbers reported are changes in average scores on a 5-point Likert scale; higher scores indicate more concern.
Statistical tests are two-tailed t-tests. Significance levels indicated by the following: * $p \leq 0.10$; ** $p \leq 0.05$

Figure 14 and Table 10 show that perceptions of pollution varied substantially between urban and suburban stations. Perceptions of pollution while walking were approximately twice as high at suburban stations, with similar patterns observed in the pre-improvement time period for respondents while walking and biking to stations. This is likely due to the presence of arterials with high volumes of traffic at most suburban stations. Interestingly, concerns were higher at urban stations while biking and driving in the post-improvement time period. Unlike perceptions of safety, perceptions of pollution did not appear to vary strongly based on gender. As with perceptions of traffic risk, there was substantial heterogeneity among perceptions of pollution at the station level (data located in Appendix F), although small sample sizes at the site level should temper any conclusions drawn from the data.

Figure 14. Changes in Average Perceptions of Air Pollution, by Location Type (Average Likert Scores; Lower = Less Concerned)

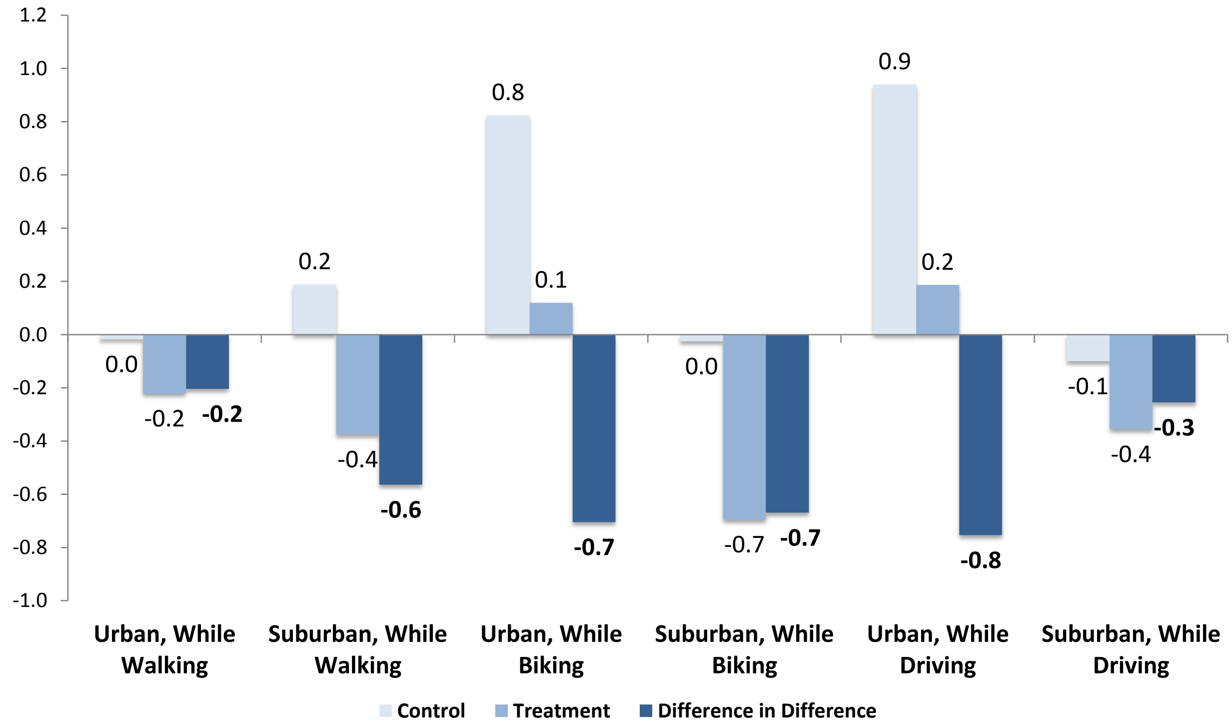


Table 10. Percentage of Respondents Concerned about Air Pollution while Traveling to the Station

Demographic	While Walking		While Biking		While Driving	
	Pre (%)	Post (%)	Pre (%)	Post (%)	Pre (%)	Post (%)
Urban	8.2	10.3	10.9	19.8 *	12.2	24.8 **
Suburban	21.4	18.6	22.2	14.8	28.8	19.5
Female	11.4	13.9	15.8	16.3	18.7	20.5
Male	13.8	15.4	13.9	19.8	17.8	25.5
	Pre (n=)	Post (n=)	Pre (n=)	Post (n=)	Pre (n=)	Post (n=)
Urban	110	116	101	101	115	121
Suburban	56	97	54	88	66	113
Female	79	101	76	92	91	117
Male	87	104	79	91	90	106

Notes:
Percentages represent the share of respondents who reported a 4 or 5 on a 5-point Likert scale; higher scores indicate more concern about air pollution.
Statistical tests are two-tailed t-tests. Significance levels indicated by the following: * $p \leq 0.10$; ** $p \leq 0.05$

Additionally, as with traffic risk, all survey respondents were invited to report their perceptions of air pollution on all three modes, regardless of their access mode to the station. Among the responses collected about perceptions of air pollution while biking, only 5.2% in the pre period and 6.3% in the post period were by respondents who reported bicycling on their access trip to the station. Further research and a larger sample size would be necessary to better understand how improvements such as those funded by Safe Routes to Transit influence perceptions of air pollution among active bicyclists in particular.

Observations

This section presents findings about observed driver, pedestrian, and cyclist behaviors at the various study sites. The specific behaviors and characteristics observed for each group of roadway users are those that could be reasonably expected to have been affected by this project, based on prior findings from the literature and best practices in the professional realm. In keeping with the difference-in-difference approach, all changes at treatment and control sites were evaluated in aggregate where applicable. Additional evaluation of urban versus suburban areas is also presented. Where changes at particular sites were notable, their significance was tested individually. The observational data are presented here as percentages, as the study team did not conduct comprehensive counts at each site.

Pedestrian Behaviors

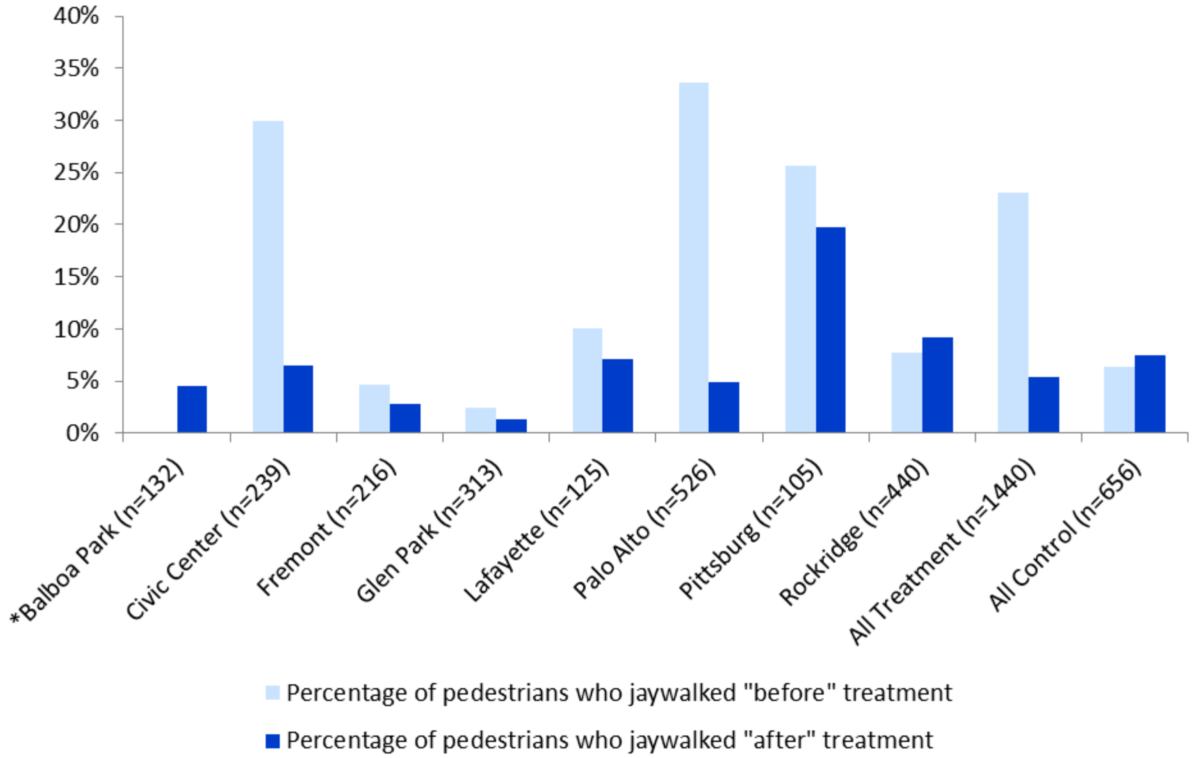
The observation team looked for a variety of pedestrian behaviors at each site, as can be seen on the data collection forms in Appendix E. These behaviors included both crossing behaviors (e.g., pedestrian crossing against the signal, crossing when the light turned red, looking before crossing, running or hurrying while crossing, and crossing outside of the crosswalk) and general characteristics (e.g., gender and use of cell phone). This section elaborates on the percentages of pedestrians behaving in various ways, whether those behaviors increased between the "before" and "after" periods, and whether the difference-in-difference was significant.

<u>Pedestrian crossing behaviors</u>

One of the behaviors examined at each site with a traffic signal was whether the pedestrian "jaywalked", or crossed against the signal. This behavior is important to investigate for several reasons. First, crossing across the signal is hazardous, as drivers are not expecting the pedestrian to do so, and may therefore not be looking for the behavior or be prepared to slow down quickly enough to avoid a collision. Crossing against the signal has been positively associated with long signal delays for pedestrians (Yagil, 2000), but may also signify that pedestrians feel unsafe in the area, either from a personal security standpoint or from car traffic. Lack of perceived safety may also influence pedestrians to walk quickly or run, affecting safety by itself. By making pedestrian improvements in the area, one would hope and expect that this behavior would decline.

Figure 15 shows that pedestrian jaywalking decreased significantly ($p \leq 0.000$) at treatment sites as compared to control sites (where there was actually a small increase in jaywalking). The difference remained highly significant even when Balboa Park was excluded (due to a lack of "before" data) and when Palo Alto and Lafayette (the two sites without pedestrian improvements) were excluded from the analysis. This finding suggests that the site improvements may have positively influenced pedestrian behavior.

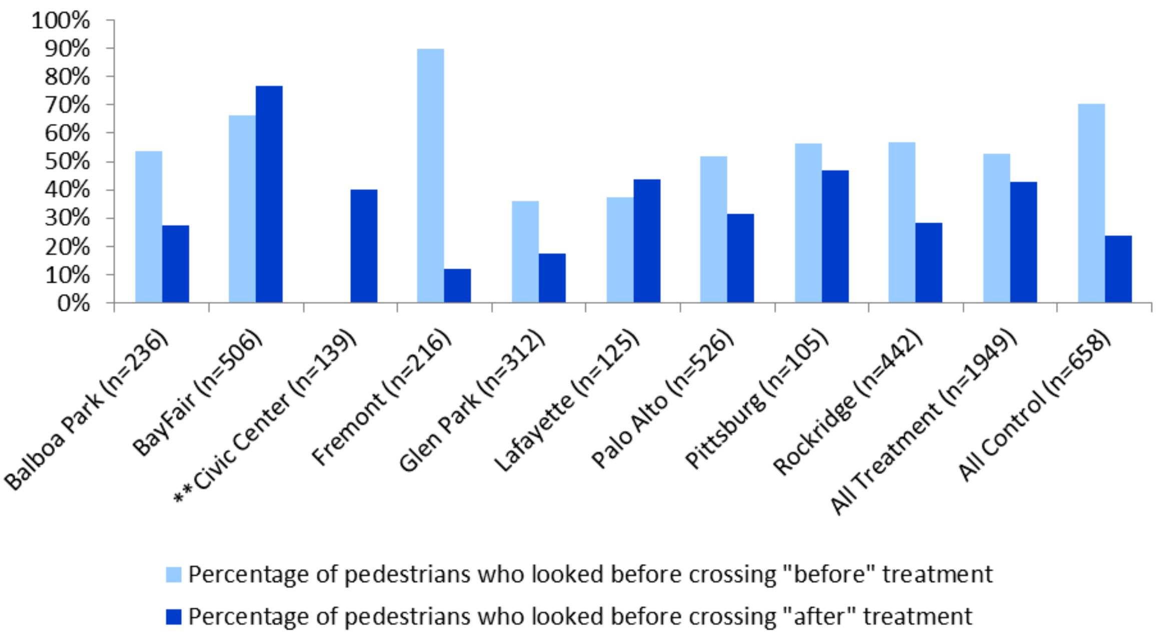
Figure 15. Pedestrian Jaywalking Behavior across Sites



*Note: Jaywalking was not recorded at Balboa Park in the "before" period

The observation team also recorded pedestrians who looked for cars before crossing the street. This behavior is again associated with safety, as looking for cars shows that the pedestrian is aware of the potential danger of crossing the street. A high rate of *not* looking may actually indicate that pedestrians feel safe crossing the street in the area, although it would be preferable that they continue to look for cars regardless of how safe they feel. As Figure 16 shows, there was a reduction in looking at both the treatment and control sites, although the reduction at the control sites was significantly greater ($p \leq 0.000$) than the reduction at the treatment sites—likely heavily influenced by the dramatic reduction in looking behavior at Fremont. It is possible that the pedestrian improvements at the Fremont intersection (conducted apart from this project, as Fremont was a control site) contributed to pedestrians feeling safer than before and therefore not looking as much, but additional research is needed to better understand this finding. The difference between the treatment and control sites remained highly significant even when Civic Center was excluded (due to a lack of "before" data), and when Palo Alto and Lafayette (the two sites without pedestrian improvements) were excluded from the analysis.

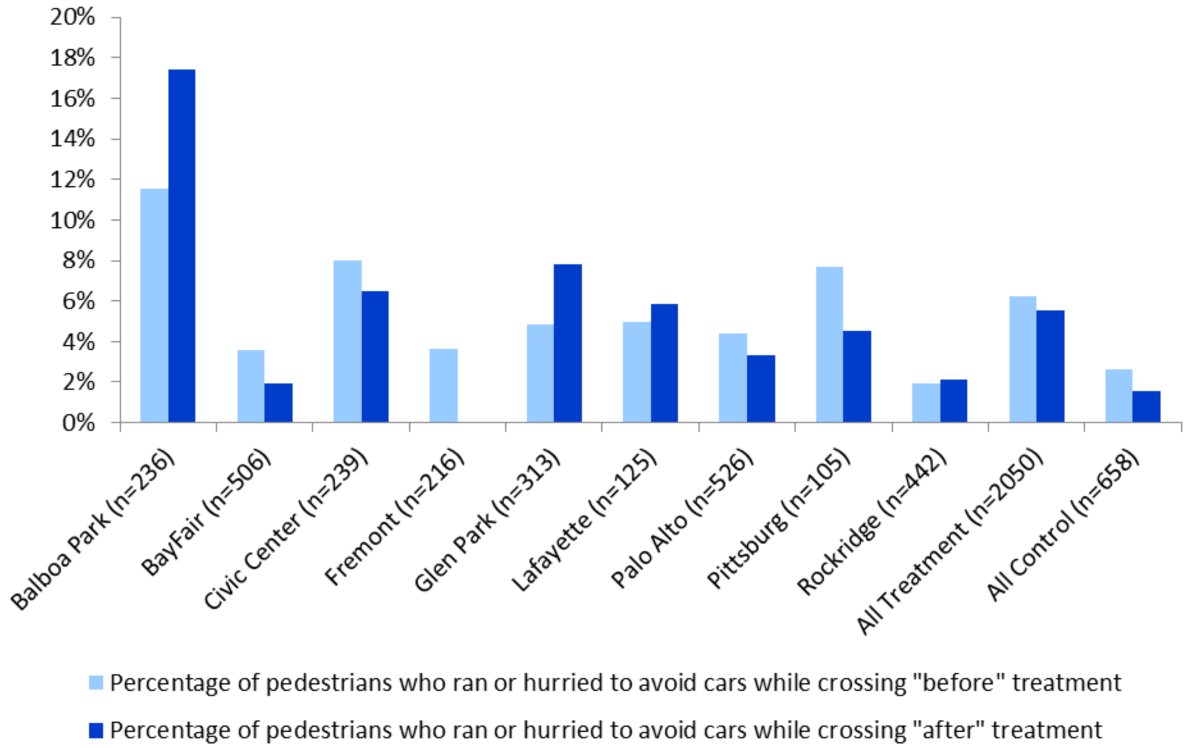
Figure 16. Pedestrian Looking Behavior before Crossing



*Note: Looking behavior not recorded at Civic Center in the "before" period

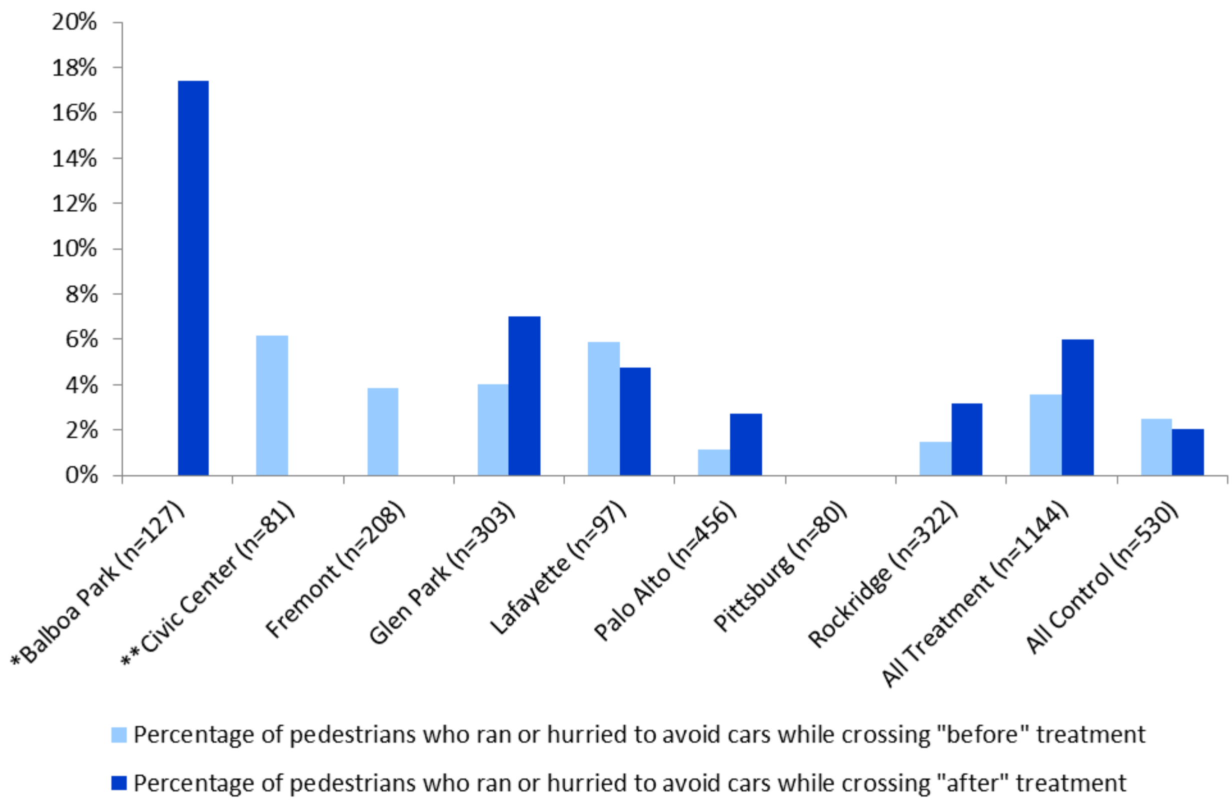
The percentage of pedestrians running or hurrying while crossing the street was also recorded. This behavior is often associated with pedestrians feeling unsafe crossing the street, and can therefore be an indicator of perceived traffic safety. The data in Figure 17 show that the percentage of pedestrians running or hurrying declined slightly at both treatment and control sites. While there was no statistical difference (p=0.831) between the decline at the two types of sites, it is a positive sign that the behavior was relatively uncommon overall.

Figure 17. Percentage of Pedestrians Running or Hurrying while Crossing



When data about running or hurrying is examined by whether the pedestrian has right of way, this behavior was seen to increase somewhat at treatment sites, but decrease at control sites, as shown in Figure 18. It is important to understand this nuance of the data, as it effectively controls for the possibility that people are running or hurrying to avoid drivers or bicyclists when they have crossed during another road user's right-of-way. Despite the difference in the two types of sites, their statistical difference remained insignificant (p=0.126)—likely due in part to the overall very low percentages of pedestrians running or hurrying. Additionally, when Balboa Park and Civic Center were removed from the analysis (due to a lack of "before" and "after" data, respectively), the difference was even more clearly insignificant (p=0.301). The difference remained insignificant (p=0.190) after excluding Lafayette and Palo Alto (the two sites without pedestrian improvements), as well.

Figure 18. Percentage of Pedestrians Running or Hurrying when Had Right-of-Way

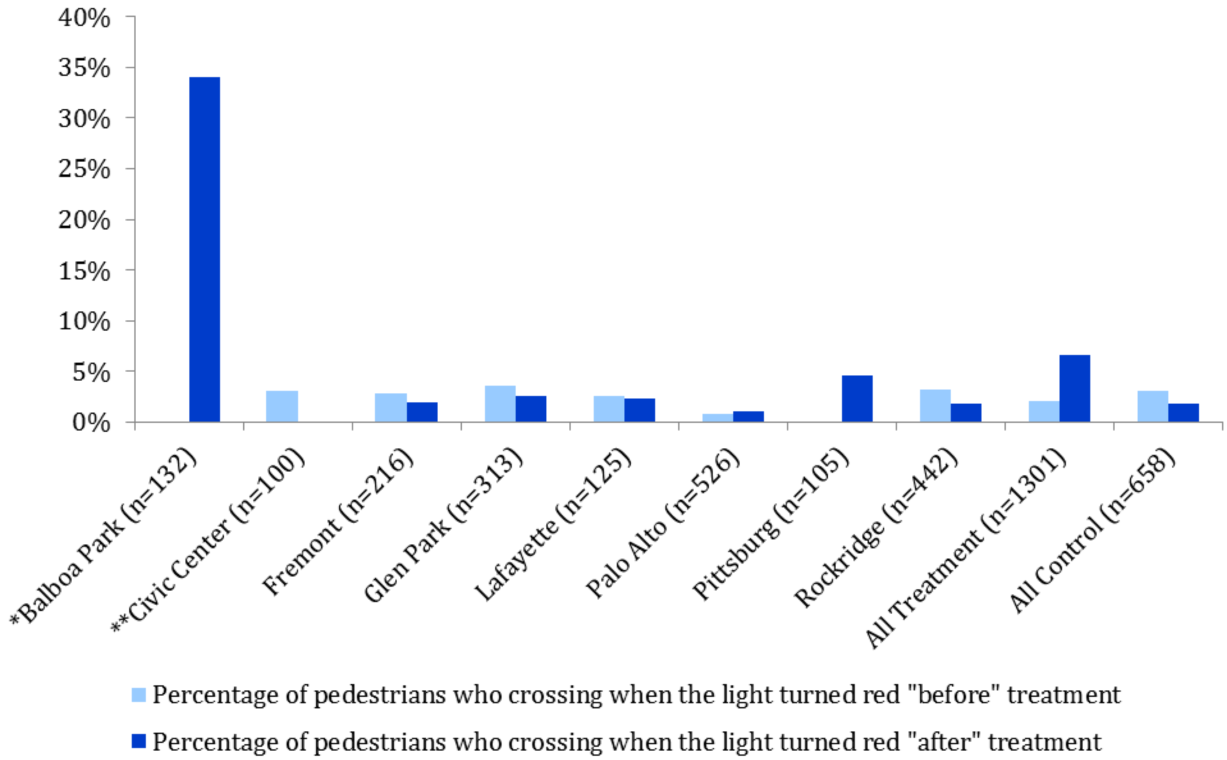


Note: Asterisks indicate the following:
*Right of way not recorded at Balboa Park in the "before" period
**Right of way not recorded at Civic Center in the "after" period

Figure 19 displays the percentage of pedestrians crossing when the light turned red. This behavior differs from that of crossing against the signal because it indicates pedestrians who began crossing when the light was green or yellow, but did not make it across the intersection in time. A high prevalence of this behavior may indicate that the signal is not long enough to accommodate most crossing pedestrians. However, it is also possible that this behavior reflects a general disregard for crossing laws.

Note that most sites showed a slight decline in the percentage, but the overall average was an increase due to the "after" data from Balboa Park (where "before" data was not recorded). Excluding Balboa Park from the statistical calculations, there was no significant difference (p=0.324) between the treatment and control sites regarding the change in the percentage of pedestrians crossing when the light turned red.

Figure 19. Percentage of Pedestrians Crossing when the Light Turns Red

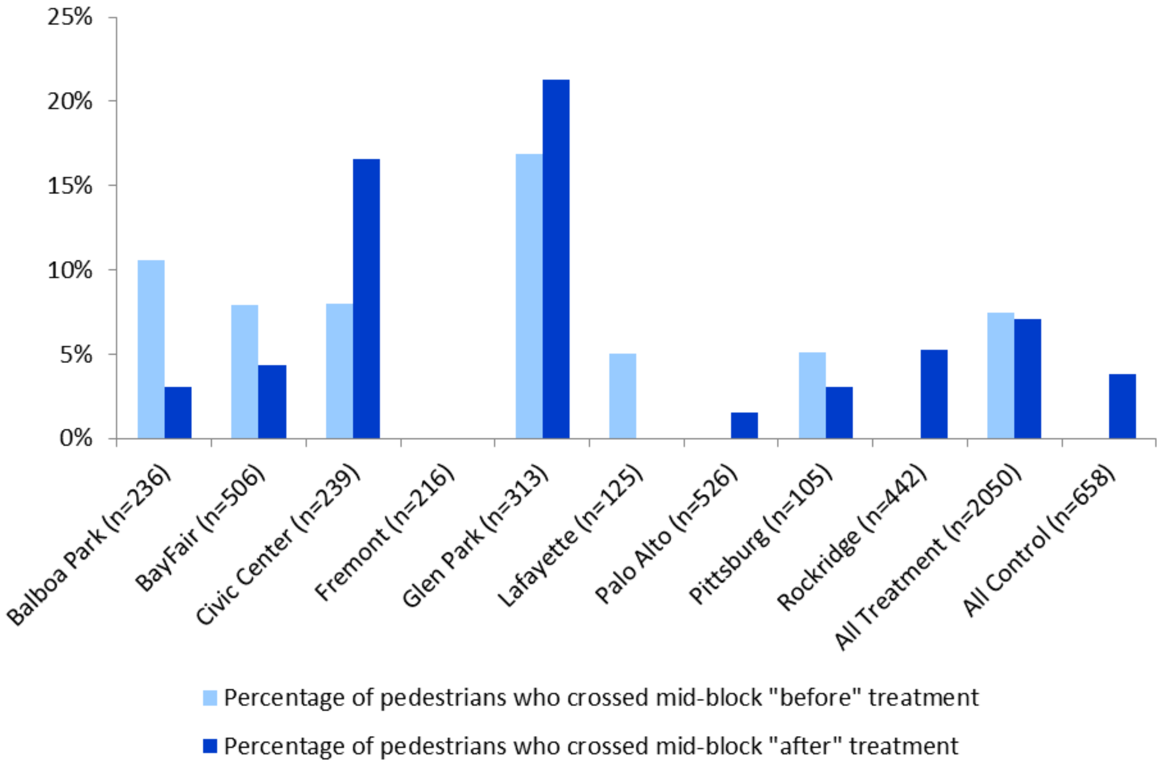


Note: Asterisks indicate the following:
*Right of way not recorded at Balboa Park in the "before" period
**Right of way not recorded at Civic Center in the "after" period

The observers also recorded the percentage of pedestrians crossing more than three feet outside of the crosswalk, a behavior that can be associated with increased risk and can even lead to pedestrians being cited in the case of a collision. While not always the case, this behavior often occurs in areas with long distances between signals that encourage pedestrians to cross the street at more convenient locations, such as midblock.

As Figure 20 shows, there was a large range between the sites for the prevalence of this behavior. No pedestrians were observed crossing outside of the crosswalk at Fremont, whereas approximately 20% of pedestrians did so at Glen Park. Overall, the change in crossing behavior between the pre and post periods was significantly different between the treatment and control sites (p=0.008), with a slight decrease in crossings outside the crosswalk at the treatment sites and an increase at the control sites. When Lafayette and Palo Alto (the two sites without pedestrian improvements) were excluded from the analysis, the difference became only marginally significant (p=0.063). On average, the percentage was low for both types of sites; however, additional research investigating the increases at Civic Center and Glen Park could clarify why they experienced an increase in spite of pedestrian improvements.

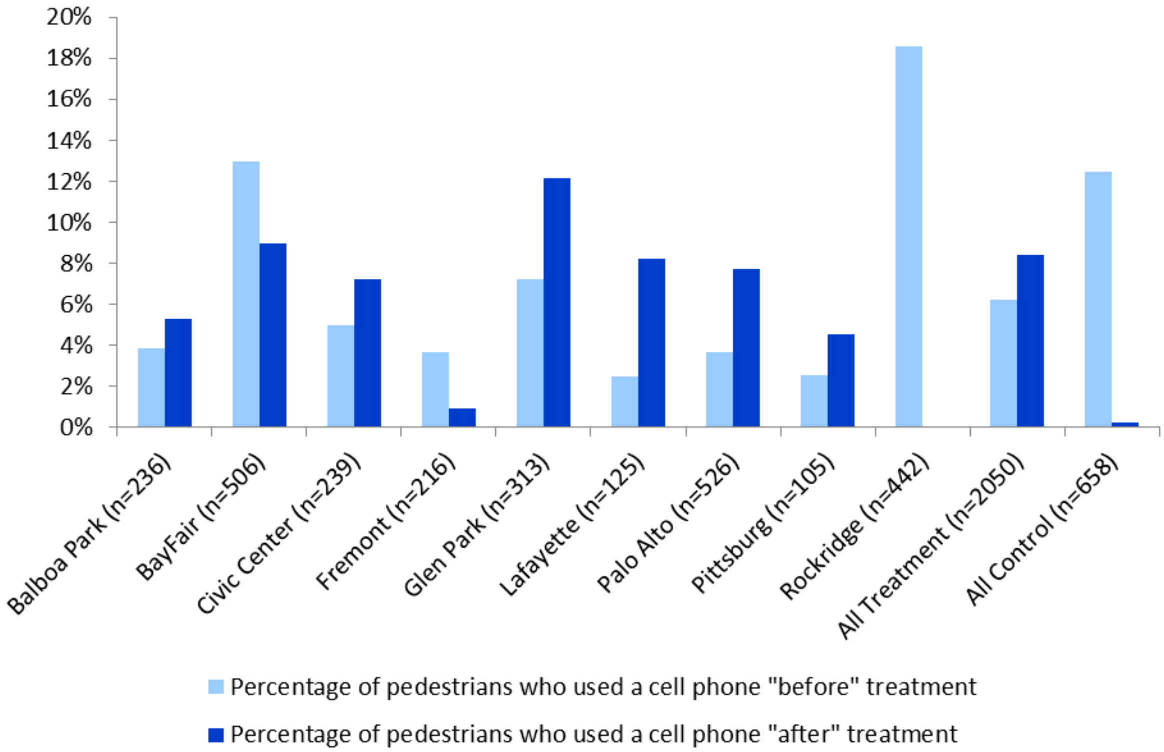
Figure 20. Percentage of Pedestrians Crossing Outside of the Crosswalk



General pedestrian statistics

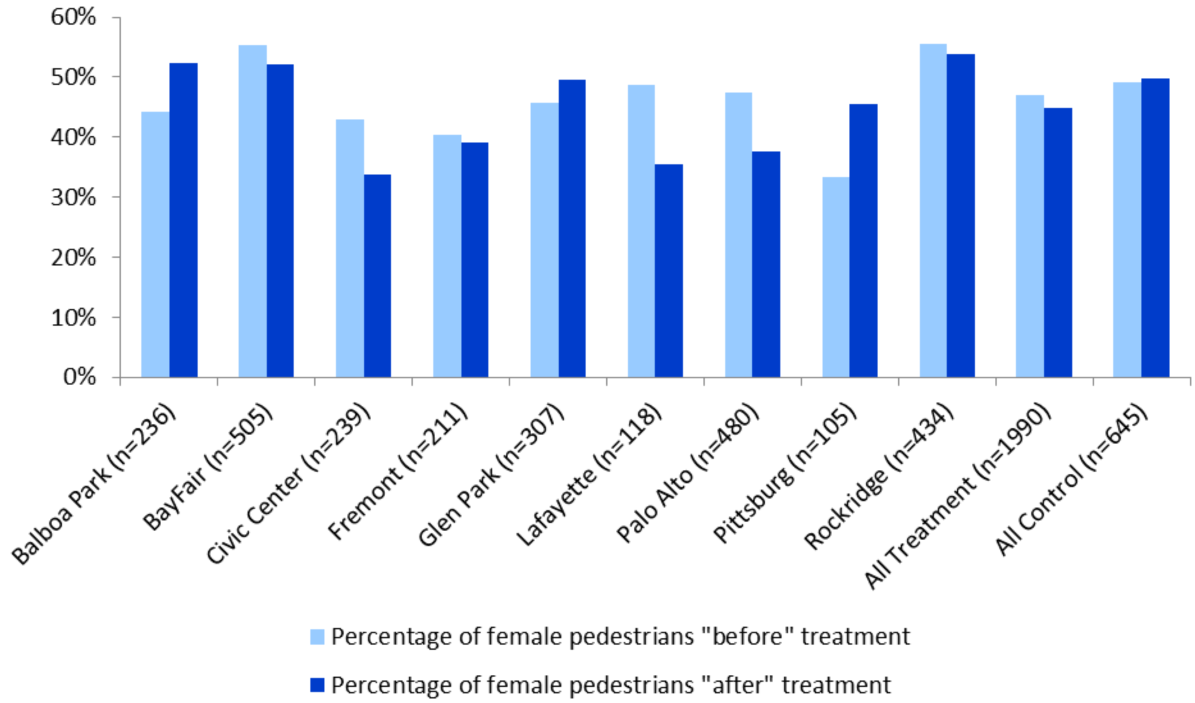
The researchers also observed pedestrians' gender and the percentage that used cell phones at the various sites. A general increase in the involvement of "distracted pedestrians" in collisions (particularly as they interact with distracted drivers) necessitates a better understanding of the prevalence of cell phone usage while crossing the street. Figure 21 shows that cell phone usage increased at treatment sites, but decreased at control sites, due in large part to a steep decrease at Rockridge. The difference between the treatment and control sites was highly statistically significant ($p \leq 0.000$), again likely driven by the decrease at Rockridge. The decrease remained highly significant even when sites without pedestrian improvements (i.e., Lafayette and Palo Alto) were removed from the analysis.

Figure 21. Pedestrian Cell Phone Usage across Sites



The distribution of males and females from the "before" and "after" periods varied across the sites, as Figure 22 demonstrates. Stations with a gender balance heavily in favor of males might indicate issues with personal security or traffic safety, two issues which tend to be more salient for females. However, none of these sites indicated a significant imbalance. Overall, there was no significant difference (p=0.557) in the change in gender distribution between the treatment and control sites.

Figure 22. Pedestrian Gender across Sites



Bicyclist Behaviors

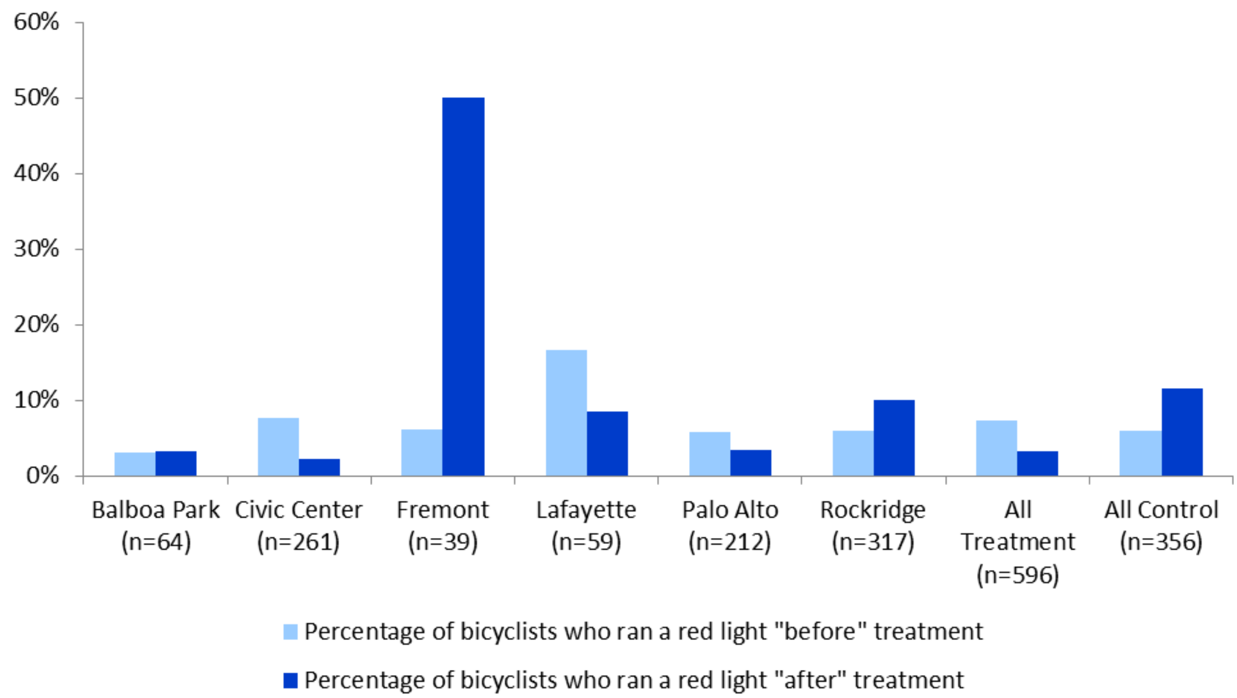
The observation teams also recorded multiple bicyclist behaviors and characteristics during the data collection periods. Traffic behaviors included whether bicyclists ran red lights, rode the "wrong way" (i.e., against traffic) on streets, and rode on sidewalks. Bicyclist characteristics included gender and whether they wore helmets or used cellphones.

<u>Traffic behaviors among cyclists</u>

The first traffic behavior examined was that of bicyclists running red lights. As with pedestrians crossing across the signal, this behavior is dangerous in that it may place bicyclists in conflict with oncoming motorists who are not expecting them, or who expect the bicyclists to yield. Red light running may also jeopardize pedestrians crossing in crosswalks. Frequent red light running may signify a traffic signal that is not responsive to cyclists' presence and/or results in a long delay for cyclists. A high prevalence of red light running may also indicate that bicyclists feel unsafe in the area and want to move through it as quickly as possible. While these explanations do not excuse red light running, it is important to understand the particular issues at play at intersections so as to promote safe behavior.

As Figure 23 indicates, only a minority of cyclists were observed running red lights at every location, with the exception of Fremont, which had a 50% rate of red-light-running in the "after" period. It should be noted that the sample size for Fremont in the "after" period was very small—only six cyclists, so the 50% rate only represents three cyclists running a red light. Even so, the difference in red light running between the treatment and control sites was statistically significant (p=0.003), with treatment sites showing a decrease in the behavior, while both control sites experienced an increase. When the analysis was run after excluding sites where there were no street improvements for bicyclists (Lafayette and Palo Alto), the difference between treatment and control sites remained significant at the 95% level (p=0.016). A chi-squared test also found a significant (p=0.010) difference between the propensity to run a red light in urban versus suburban areas in the "after" period, a not unsurprising finding given the long signal cycles that are often found in suburban areas.

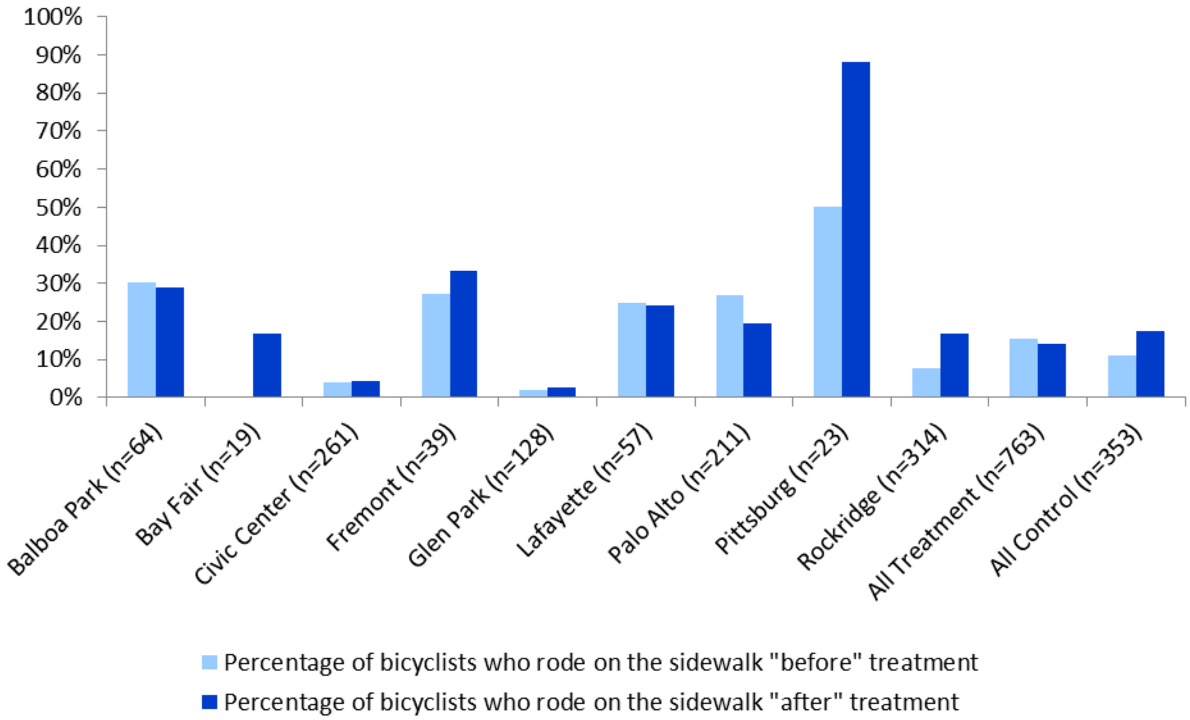
Figure 23. Bicyclist Red Light Running Behavior



The observation team also recorded the percentage of bicyclists riding on sidewalks, as shown in Figure 24. Although sidewalk riding is against many city ordinances in the Bay Area, it is often done in areas where bicyclists do not feel safe riding on the roadway. Note that in some places, such as Balboa Park and Lafayette, the percentages in the "before" and "after" periods remained stable. In contrast, there was a fairly large increase in sidewalk riding at Bay Fair and Pittsburg between the two periods, although it should be noted that the sample size for both sites is small (approximately 20 observations per site). The finding at Pittsburg is counter to what the project hoped to accomplish through the installation of bicycle lanes at the site, but is not altogether surprising given what prior research has found about strong preferences for physically-separated bicycle facilities on major roadways like those surrounding the Pittsburg BART station (Sanders, 2013; Winters & Teschke, 2010).

The variation between treatment sites on average was not significantly different (p=0.109) than the variation between control sites. However, a chi-square analysis revealed a highly significant ($p \leq 0.000$) correlation between the propensity to bicycle on the sidewalk in suburban versus urban areas in the "after" period. This finding is not unexpected given the types of roadways (e.g., wide, multi-lane, with high speed limits) typically found in suburban areas.

Figure 24. Percentage of Bicyclists Riding on the Sidewalk



The observation team also recorded the number of bicyclists riding the “wrong way” (i.e., against traffic) on the street—data that was only consistently gathered in the “after” period. Wrong-way riding is dangerous for the same reason that so many of the other behaviors observed here are dangerous—it is an unexpected behavior that may impair a motorist’s ability to avoid a collision. No research has comprehensively investigated wrong-way riding, although it has been associated with bicyclists’ (unfortunately mistaken) perceptions that it is actually safer than riding with traffic (Sanders, 2013). Additionally, the installation of bicycle facilities has been associated with a decrease in such behavior (San Francisco Department of Parking & Traffic & Alta Planning + Design, 2004).

There was clear variation among sites in the rates of wrong way riding, with approximately one-third of cyclists riding the wrong way at Fremont and Pittsburg, in contrast to 10% at Palo Alto and less than 5% at the other sites. It should be noted again that the small sample sizes at Fremont and Pittsburg meant that 2-3 cyclists could create a fairly large percentage of those riding the wrong way. A chi-square analysis of the data indicated that bicyclists were significantly ($p \leq 0.000$) more likely to bicycle the wrong way on the roadway in suburban areas than in urban areas. This finding may be associated with the perceptions of safety discussed above, although additional research is needed to fully understand this finding.

<u>General bicyclist statistics</u>

As using a cell phone can lead to distraction and increased risk, the research team also observed whether cyclists used a cell phone while riding during the “after” period (data on cell phone usage was not gathered for the "before" period). Cell phone usage among cyclists was rare, with only a handful of cyclists observed using a cell phone, and only at three of the nine sites. Additionally, chi-square tests revealed no significant difference (p=0.624) between cell phone usage at treatment versus control sites, or urban versus suburban sites.

Figure 25 shows the gender split across sites. While there was a slight decline in the percentage of female cyclists in the "after" period, the difference-in-difference analysis indicates no significant difference (p=0.782) in the changes recorded at the treatment versus control sites. A chi-squared analysis also suggested no significant difference (p=0.395) in gender split between urban and suburban areas in the "after" period. While the percentage of female cyclists observed dropped to zero in the "after" period for both Pittsburg and Fremont, it should be noted that the number of females at both sites was also very small in the "before" period (n=1 and n=4, respectively). Additionally, both of these sites had very small "after" sample sizes overall (n=17 and n=6, respectively). While this may indicate a systematic discomfort or inconvenience for female cyclists at these two locations, additional research is needed before broad conclusions can be drawn about gender and cycling at these two sites.

Figure 25. Bicyclist Gender across Sites

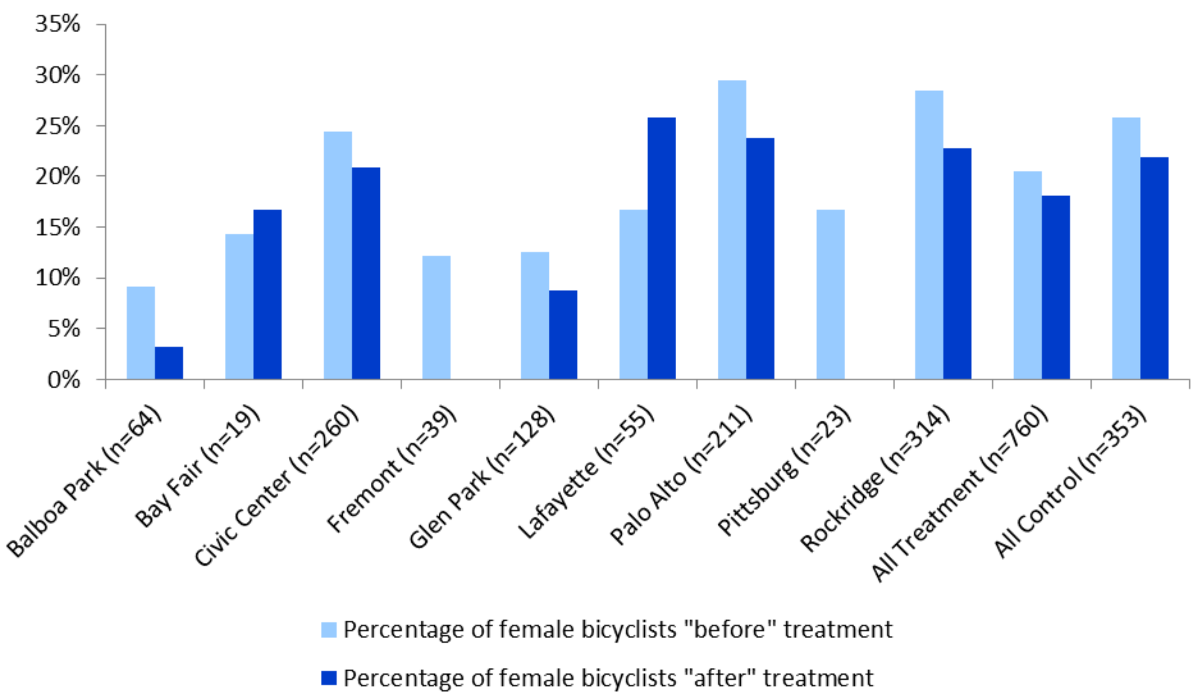
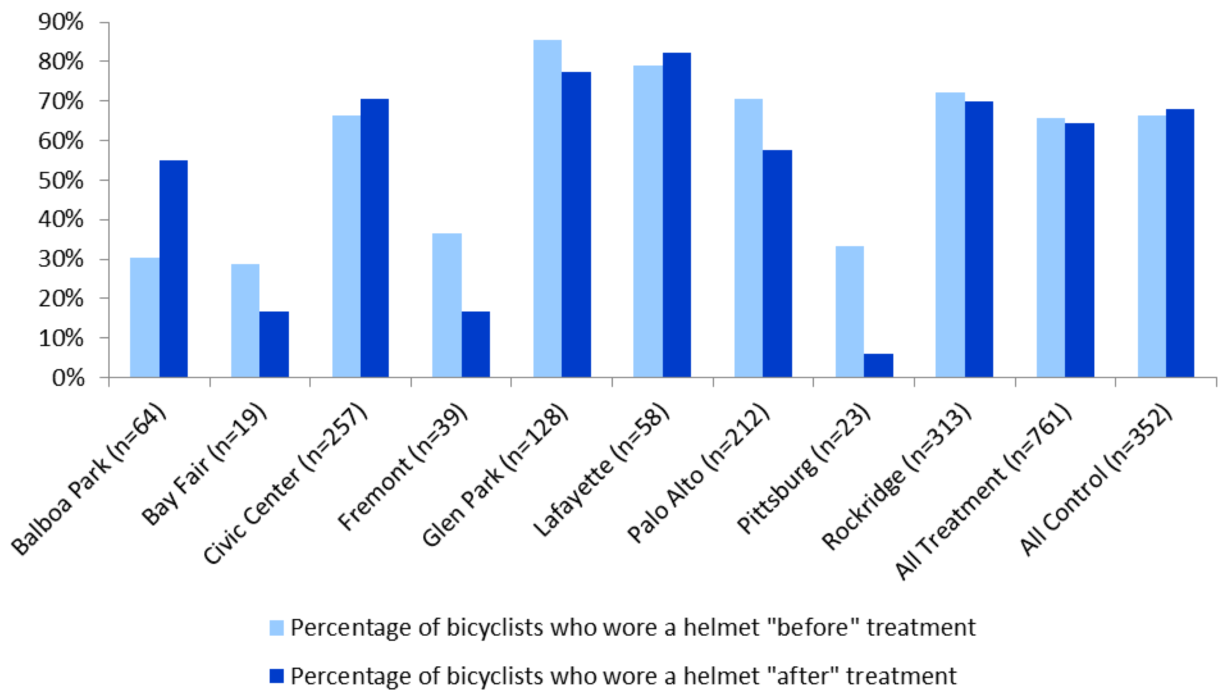


Figure 26 displays helmet usage at the different sites. While not mandatory for adult cyclists in California, research has generally found that the usage of a helmet can decrease the risk of head trauma in the event of a fall or collision (Attewell, Glase, & McFadden, 2001; Lee, Schofer, & Koppelman, 2005; Thompson, Rivara, & Thompson, 1999). The difference-in-difference analysis indicated no significant difference (p=0.611) between the treatment and control sites regarding the change between the "before" and "after" periods. However, a chi-square analysis suggested that urban cyclists were significantly ($p \leq 0.001$) more likely to wear a helmet in the "after" period than cyclists in suburban areas. This was likely driven in part by the large decrease in the percentage of cyclists using helmets at Pittsburg and Fremont. While the decreases for these two sites were based on small samples and therefore do not represent large numbers of cyclists, future research may help to clarify whether these observations captured a trend or an aberration in helmet usage patterns at these sites.

Figure 26. Bicyclist Helmet Usage across Sites

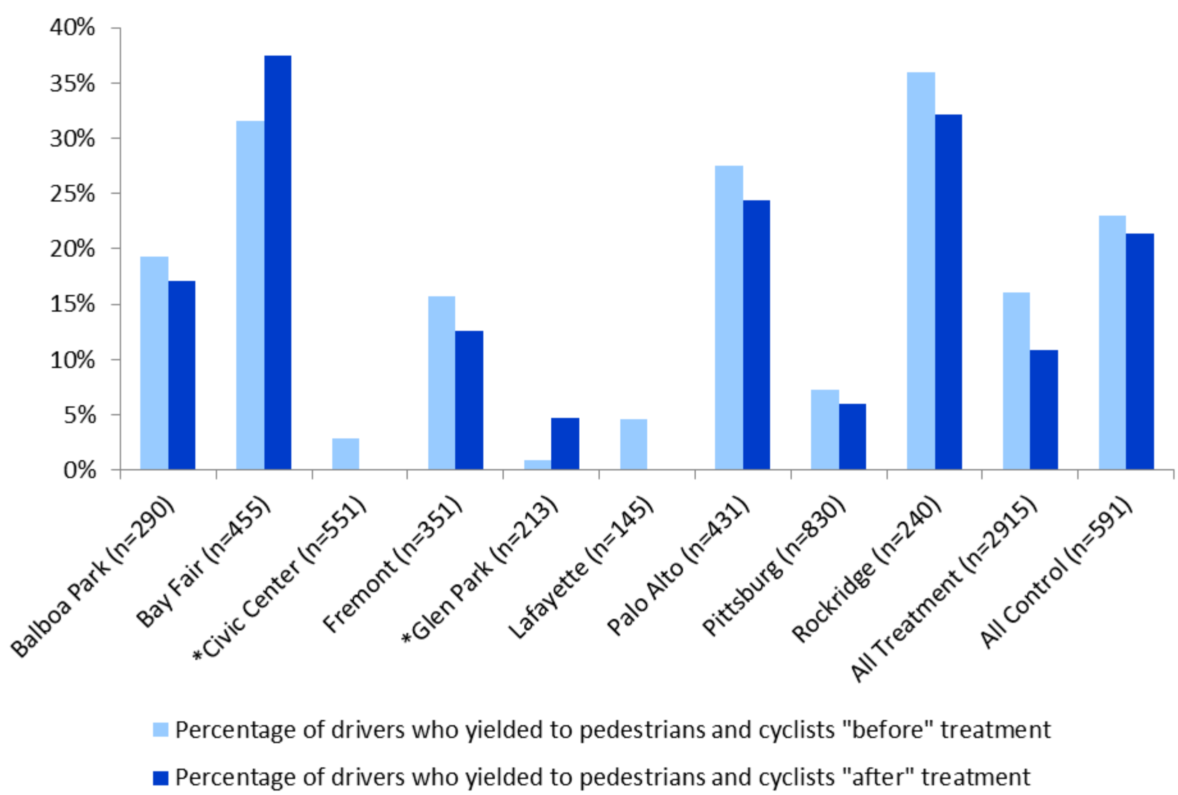


When helmet usage was analyzed according to gender, a chi-squared analysis indicated that female cyclists were significantly (p=0.003) more likely to wear helmets than males in the "after" period, although there was no significant difference (p=0.751) related to gender in the "before" period.

Driver Behaviors
Driver behavior was also observed and recorded for the study. Observations included whether drivers yielded to pedestrian and cyclists, ran red lights, sped past pedestrians and cyclists, slowed abruptly or skidded to a stop near intersections, encroached in crosswalks, or used cellphones.

Figure 27 shows the percentage of drivers who yielded to pedestrians and cyclists at the various sites. Because driver yielding affects both actual and perceived safety for pedestrians and bicyclists, it is important to understand this behavior and how it may have changed after site improvements. The data indicate that there was a small decline in driver yielding among both treatment and control sites, although the difference-in-difference analysis indicated no significant difference (p=0.517) between the declines of the two groups. A Chi-squared analysis suggested that drivers in urban areas were significantly ($p \leq 0.000$) more likely to yield to pedestrians than those in suburban areas, likely due in part to the greater numbers of pedestrians in urban areas. Due to the data collection process, it is not entirely clear whether these findings represent the percentage of drivers who yielded overall (i.e., out of the entire universe of drivers, whether or not they had the opportunity to yield), or just those drivers who should have yielded and did so. Future research should specifically look at the difference between these two populations to contribute a fuller understanding of how patterns in driver yielding affect pedestrian and bicyclist safety.

Figure 27. Driver Yielding Behavior toward Pedestrians and Bicyclists



*Note: Driver yielding at Civic Center and Glen Park pertained to bicyclists, rather than pedestrians.

The propensity of drivers to run red lights was also observed. A high percentage of drivers running red lights leads not only to greater risk for all roadway users, but also degrades the sense of safety pedestrians, cyclists, and other drivers feel in the area. Figure 28 shows that red light running decreased at both treatment and control sites. The decrease was marginally significantly (p=0.095) larger at control sites, although it should be noted that fewer drivers ran red lights at the treatment sites in either period than at the control sites. A chi-square analysis revealed that drivers were significantly ($p \leq 0.000$) more likely to run a red light at a suburban site than an urban one. This is not particularly surprising, given how many more potential conflicts exist at urban intersections and the resultant greater risk of a collision when running a light.

The single site that experienced a significant (p=0.015) change in driver red light running from the "before" and "after" data collection periods was Palo Alto, where the percentage decreased from 13% to 6%.

Figure 28. Red Light Running Behavior among Drivers

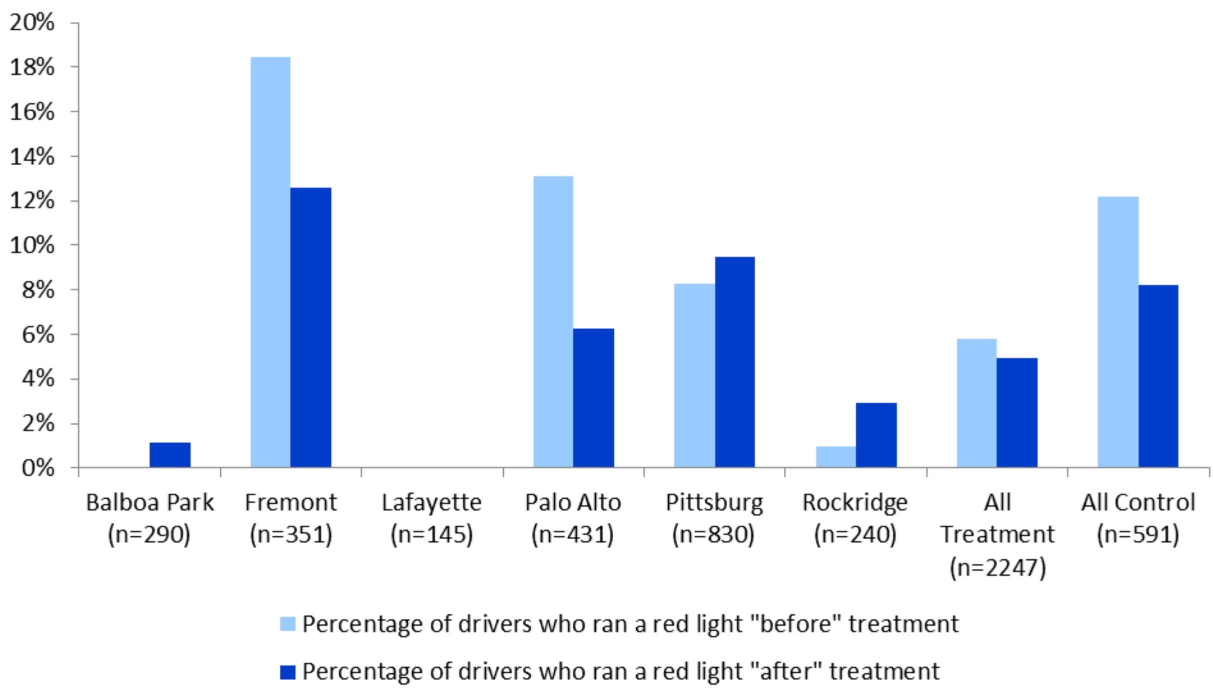
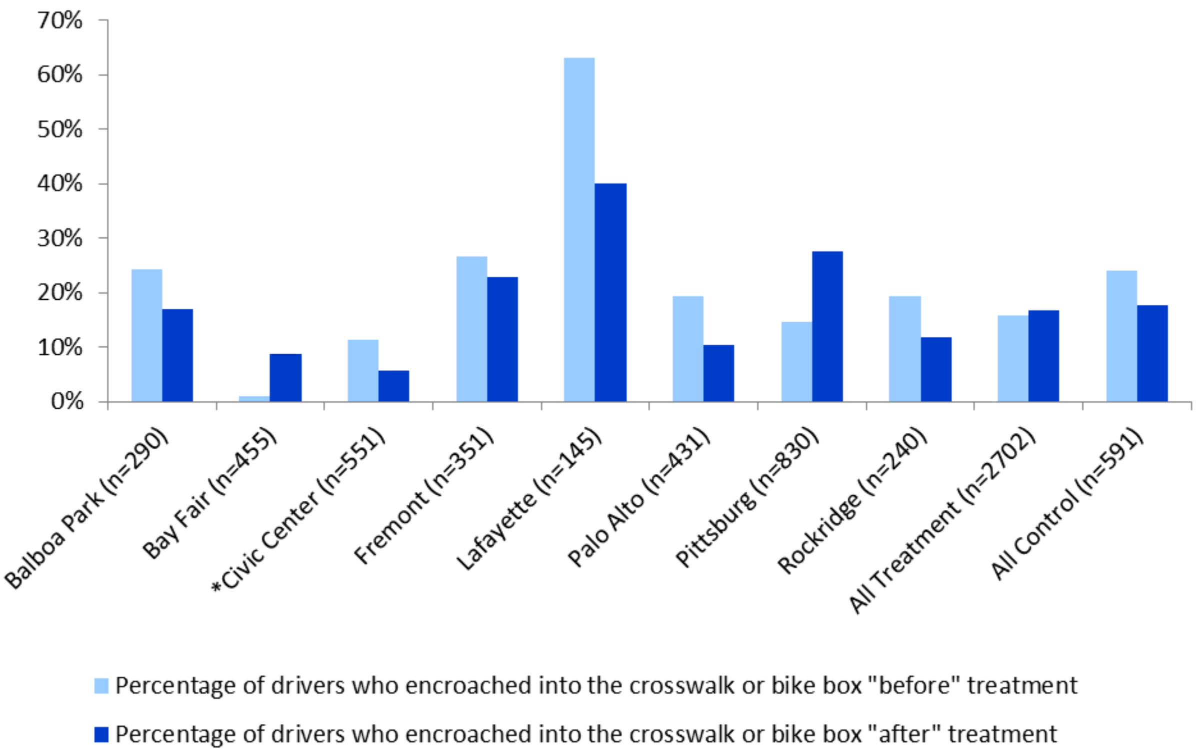


Figure 29 displays the percentage of drivers who encroached into the crosswalk and bicycle box (Civic Center only) at the various sites. Encroachment into the crosswalk and bicycle box can be perceived as threatening to the pedestrians and cyclists using the space, and may have an impact on crash risk if the driver encroaches and hits someone in the space. The difference-in-difference analysis indicated a significant (p=0.049) difference between the changes in encroachment at treatment versus control sites, with control sites experiencing a decline, while treatment sites experienced a minimal increase. It should be noted that fewer drivers were observed encroaching in either period at treatment sites than at control sites. Additionally, driver encroachment was significantly ($p \leq 0.000$) more likely in suburban areas than in urban areas in the "after" period, which likely again reflects in part the higher numbers of pedestrians in urban areas, and resulting greater need to yield.

There were also significant changes at individual sites. Driver encroachment decreased significantly at Lafayette (p=0.006) and Palo Alto (p=0.008), and marginally significantly at Rockridge (p=0.097). In contrast, encroachment increased significantly ($p \leq 0.000$) at Pittsburg and Bay Fair.

Figure 29. Driver Encroachment in the Crosswalk and Bike Box



*Note: Encroachment at Civic Center pertained to the bike box, rather than the crosswalk.

Figure 30 displays the observations of driver yielding behavior with regard to abrupt slowing or skidding to a stop at the various sites. This behavior may be associated with driver speeding, and degrades the sense of safety and comfort that pedestrians and cyclists experience—particularly when crossing the street. The data show that the percentage of drivers slowing abruptly or skidding to a stop was low overall, and declined even further at both treatment and control sites. A difference-in-difference analysis indicated no significant difference (p=0.211) in the changes between the two groups of sites. There was also no significant difference (p=0.217) between the rates of abrupt stopping or skidding at urban and suburban sites in the "after" period. In terms of individual sites, driver slowing or skidding decreased significantly at Glen Park (p=0.005), Civic Center (p=0.017), and marginally significantly at Lafayette (p=0.088). These decreases may reflect effects of the pedestrian and bicyclist improvements at the sites.

Figure 30. Driver Slowing and Skidding Behavior

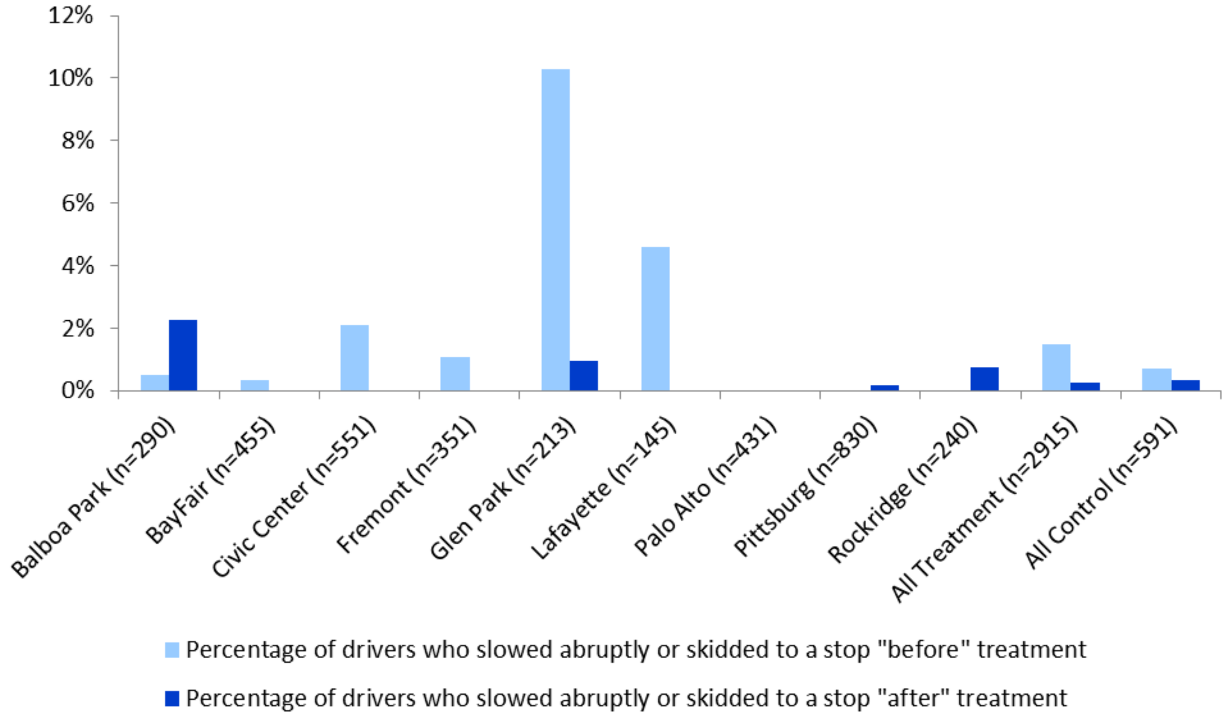
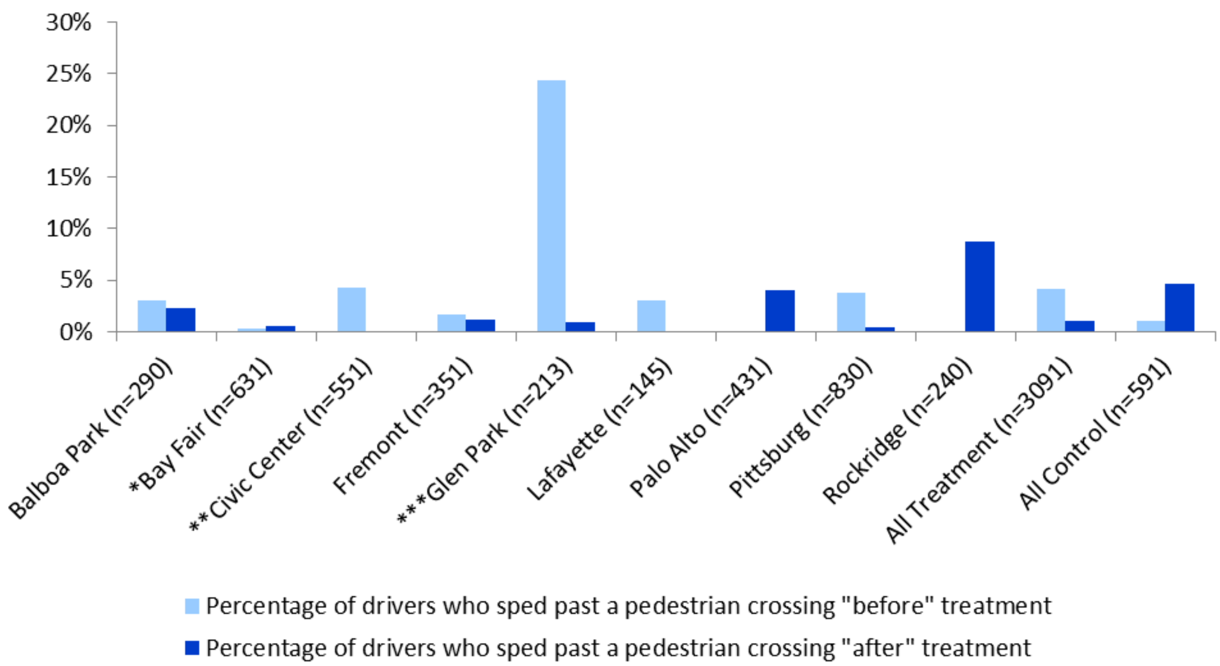


Figure 31 displays the percentage of drivers who sped past pedestrians or cyclists (noted by various asterisks) at each site. The difference-in-difference analysis indicated that the decline in speeding at treatment sites was highly statistically significant ($p \leq 0.000$) compared to the increase in speeding at control sites. A chi-squared analysis suggested that drivers were significantly ($p \leq 0.000$) more likely to speed in urban areas than suburban ones in the "after" period, although these results seem heavily influenced by the small sample sizes of speeding drivers, as less than 3% of drivers sped in the urban areas. The data show a significant ($p \leq 0.000$) *decrease* in speeding at both Glen Park and Civic Center, which may be related to the pedestrian and bicyclist improvements at the sites. In contrast, speeding was found to significantly *increase* at Palo Alto (p=0.009) and Rockridge (p=0.001).

Figure 31. Driver Speeding Behavior

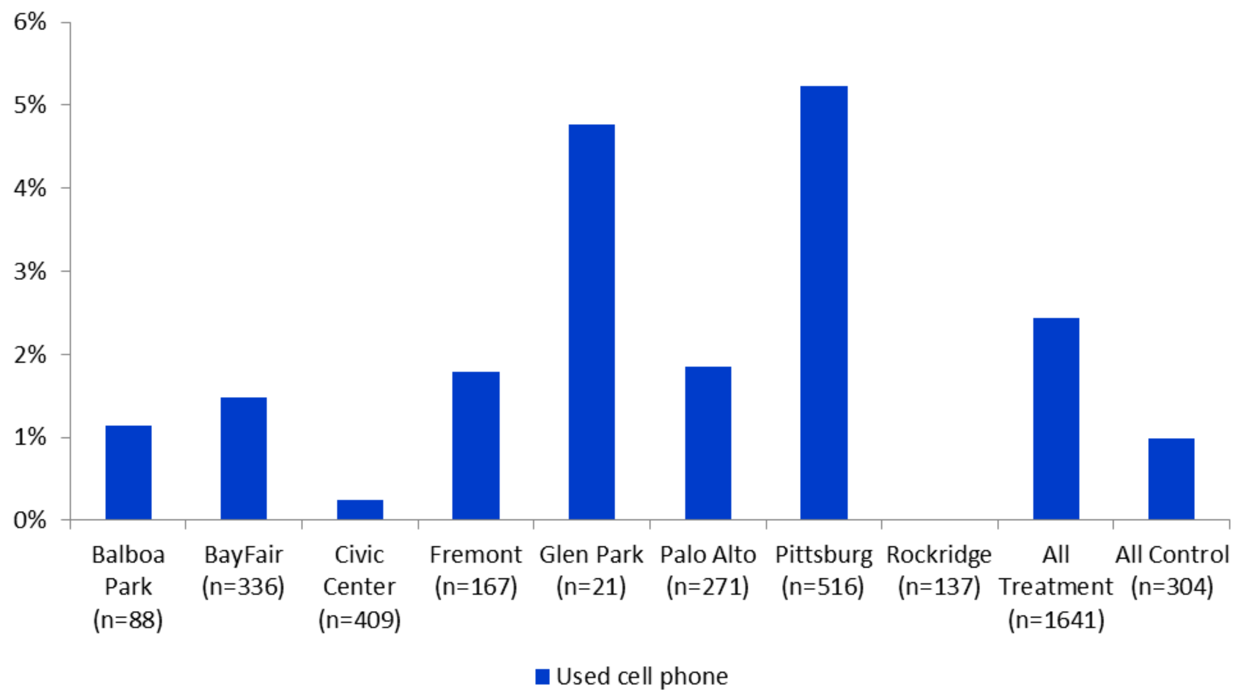


Note: Asterisks indicate the following:
* Driver sped past cyclist on roadway segment
** Driver sped through intersection
*** Driver sped past cyclist crossing the ramp

Figure 32 displays the percentage of drivers who used cell phones in the “after” period (data on cell phone usage was not gathered for the “before” period). The data suggest that only a small portion of the drivers used a cell phone at any of the sites. However, observing cell phone usage in moving vehicles is notoriously difficult to do, and it is likely that these numbers underrepresent the percentage of drivers using cell phones.

Chi-squared analyses indicated that drivers at the treatment sites were no more likely to use their cell phones than those at the control sites, but that suburban drivers were significantly more likely ($p \leq 0.000$) to do so.

Figure 32. Driver Cell Phone Usage in "After" Period



Limitations of the Data

The findings discussed in the previous section suggest that the improvements made through the Safe Routes to Transit program did affect pedestrian, bicyclist, and driver behavior and mode choice. It is important to note that this program occurred along with other streetscape and roadway improvements specific to each city but unrelated to the SR2T program, as well as within the context of a national and statewide conversation about the importance of active transport and larger trends of increased bicycling. For these reasons, it is impossible to give complete credit to SR2T for changes observed. With this said, multiple research studies have found that improvements like those made through the SR2T program can influence mode choice and behavior. The data presented here do suggest that the SR2T program can be credited, at least in part, for the improvements in behavior, shifts in access mode, and perceptions of air quality and traffic safety.

With regard to data collection, as with any field research, there were some limitations. First, given the scope of the project, we required the participation of many student data collectors over a 2.5 year period. While there was consistency in the training team and protocol, without the resources to maximize consistency among field researchers, there could be differences in interpretations of traffic behavior. Second, having a large cadre of intercept surveyors could have resulted in subtly different samples across stations and time periods.

The Sum of the Parts: Conclusions and Recommendations

The data suggest that the streetscape and roadway improvements made through the Safe Routes to Transit (SR2T) program positively influenced the propensity to walk, bicycle, and take the bus to transit stations. This study occurred in the context of other regional efforts to encourage active transport as well as general societal trends toward reduced driving and increased bicycling, and does not claim that the SR2T program is responsible for all of the observed changes. Nevertheless, the fact that the treatment sites routinely showed shifts toward walking, bicycling, and bus use, as well as improvements in both the safety-related behaviors measured and the perceptions of safety and air pollution, suggests that the SR2T program did, on its own, contribute to the shifts observed.

In particular, the data indicate the following:

- Walking and bicycling, whether as the sole access mode to transit or as part of a multi-modal trip to access the various stations, generally increased from the pre to the post period at the treatment sites.
- Specifically, average responses from the treatment sites indicate that walking increased just over 3%, compared to control sites. Bicycling also increased 3% at treatment sites, although it also increased at control sites, indicating a general societal shift. For the sake of comparison, data from the American Community Survey indicate that walking and bicycling in the Bay Area only increased 0.06% from 2011 to 2012, suggesting that this project may have made a substantial impact in its targeted areas. Furthermore, if carried through to the overall commute trends in the Bay Area, the project's 3% increase in active modes would translate to 3,780 additional walk and bike trips.
- The data also show an average 2.5% decrease in driving among the treatment sites. If carried through to the overall commute trends in the Bay Area, the project's 2.5% decrease in driving would translate to 37,524 fewer driving trips, which could have a substantial impact on congestion and air quality.
- Those who travel to transit stations by foot, bike, or bus routinely reported lower transportation costs than those who drove.
- Perceived traffic risk decreased significantly among cyclists and drivers. Research suggests that decreased perceptions of traffic risk may encourage bicycling, and that a change in drivers' perceptions may result from realized benefits of enhanced pedestrian and bicycle infrastructure.
- Perceived air pollution decreased among all groups at the sites, a finding that may result from and contribute to increased walking and bicycling.
- Generally, bicycling and walking behavior was safer in the post period and more likely to occur in urban areas than suburban areas. Additionally, bicyclists, pedestrians, and drivers all tended to follow the law significantly more in urban areas than in suburban areas in the post period.
- Overall, the percentage of pedestrians, drivers, and cyclists behaving illegally was low at all sites. However, illegal behaviors were more likely to occur at suburban than urban sites.
- Bicyclists and pedestrians were over-represented among those who stopped for food or drink on the way to the transit station, whereas those driving to the stations were much less likely to stop for anything but childcare along the way. Improvements that enhance

walkability and bikability may therefore result in secondary economic benefits to the surrounding areas.

The data also indicate areas for future research, including the need to:

- Look at how certain improvements affect perceived risk and behavior; e.g., whether pedestrians use cell phones more because they feel safer, and whether there is an objective impact on actual traffic risk when this occurs.
- Observe pedestrian, bicyclist, and motorist behaviors at a larger, more representative sample of sites so that it is possible to estimate the frequency of particular behaviors across a broader geographic area.
- Compare specific behaviors to reported crash data. With a larger sample of behavior observations, it may be possible to identify specific behaviors that are the best indicators of pedestrian, bicyclist, and motorist crash risk.
- Develop a detailed database that includes built and natural environment characteristics as well as behaviors observed at many sites. This could be used to identify specific roadway design and other features associated with particular behaviors.
- Observe sites before and after specific engineering, education, and enforcement treatments are made to determine if the treatments are effective at changing particular behaviors.
- Conduct additional research on bicyclist behavior to obtain a better sample size. Future research would be helpful in understanding how various improvements affect mode shift to bicycling and perception of safety among current and potential cyclists.
- Explore the factors leading to significant increase in bus usage observed and how walking and bicycling interact with such factors.

In terms of expectations from programs like SR2T, this program funded improvements to support walking and bicycling to transit in an effort to improve air quality, increase active transportation, decrease congestion and improve safety. This program seeks to reverse decades-long, automobile-dominant commute and travel trends. It is through this lens that results from this analysis should be interpreted. Given the promising movement toward active transportation and use of transit, support for programs like SR2T should be given strong consideration, support, and funding.

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Appendices

- Appendix A – Proposal and Evaluation Plan
- Appendix B - Station maps used for conducting observations
- Appendix C - BART permission letters
- Appendix D - Intercept and postcard surveys
- Appendix E - Data collection (observation) forms
- Appendix F - Additional survey findings

Metropolitan Transportation Commission
Safe Routes to Transit Program Evaluation Plan

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December 2010

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TRANSPORTATION CONSULTANTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

The purpose of this report is to present a proposed methodology for evaluating the effectiveness of the Metropolitan Transportation Commission's (MTC) Safe Routes to Transit (SR2T) Program. This program was initiated in 2004 with the adoption of the San Francisco Bay Area's Regional Measure 2 (RM2). The intended purpose of this funding mechanism is to support various transportation projects within the region in order to reduce congestion along the seven state-owned toll bridge corridors. Specifically, RM2 establishes the Regional Traffic Relief Plan and identifies specific transit operating assistance and capital projects and programs eligible to receive RM2 funding. Consistent with this purpose, the SR2T Program focuses upon enhancements that will facilitate walking and cycling to regional transit stations.

To date, approximately $12 million over three funding cycles have been awarded to 30 capital and planning projects. **Table 1** provides a description of each project including the agency sponsor, project name, and award amount for the funding cycles in 2005, 2007, and 2009, respectively. The overall budget is approximately $20 million and is be expected to cover two more cycles in 2011 and 2013. Two Bay Area non-profit organizations – TransForm and the East Bay Bicycle Coalition – are administering the SR2T Program. **Figure 1** displays the SR2T project locations within the Bay Area region.

Table 1: Funded Safe Routes to Transit Projects (2005 through 2009)

SR2T Cycle	Project Sponsors	Project	Capital or Planning Project	Award Amount
2009	SF MTA, BART	Balboa Park Station Connections Project Phase II	Capital	$722,000
	BART	Bay Fair BART Safety and Security Improvement Project	Capital	$196,000
	City of Berkeley	Berkeley/AC Transit Pedestrian and Bicycle Access Improvements	Capital	$498,820
	City of San Leandro, BART	Downtown San Leandro BART Pedestrian and Bicycle Access Project	Capital	$750,000
	SF MTA	Glen Park Area Bicycle Project	Capital	$168,000
	City of Santa Rosa	Highway 101 Bicycle/Pedestrian Overcrossing	Planning	$100,000
	City of Oakland	MacArthur Station Bicycle Access Project Phase II	Capital	$242,500
	SF MTA, SF Dept. of Public Works, SF Planning Dept.	Market St. Multi-Modal Transportation Improvements Study	Planning	$200,000
	Richmond Community Redevelopment Agency	Nevin Avenue Bicycle/Pedestrian Improvements	Capital	$750,000
	VTA, City of San Jose, City of Mountain View, City of Palo Alto	VTA Pilot Bike Sharing Implementation	Capital	$500,000
	West Contra Costa Advisory Committee, and multiple agencies	West Contra Costa/Albany Transit Wayfinding Plan	Planning	$69,000
2007	City of Pittsburg; Contra Costa County	Bailey Road Transit Access Improvement Project	Capital	$650,000
	San Francisco MTA; BART	Balboa Park Ocean Avenue Pedestrian/Bicycle Connections	Plan	$181,280
	BART	BART Electronic Bicycle Locker Gap Closure Project	Capital	$200,000

Table 1: Funded Safe Routes to Transit Projects (2005 through 2009)

SR2T Cycle	Project Sponsors	Project	Capital or Planning Project	Award Amount
	BART; City of San Leandro	Bay Fair BART Station Area Improvement Plan	Plan	$100,000
	Contra Costa County; BART	Contra Costa Centre/Pleasant Hill BART Shortcut Path and Wayfinding Project	Capital	$300,000
	San Francisco MTA; SF Department of Public Works	Mission & Geneva Pedestrian Improvements	Capital	$940,500
	City of San Rafael	Puerto Suello Hill Path to San Rafael Transit Center Connector Project	Capital	$600,000
	City of Richmond; City of El Cerrito	Richmond/Ohlone Greenway Gap Closure-Class I Access to Transit	Plan	$200,000
	City of Berkeley, BART	Safe Routes to Ed Roberts Campus/Ashby BART	Capital	$325,000
	San Francisco MTA	24th St. & Mission BART Station Area Access Improvements	Capital	$450,000
2005	AC Transit	AC Transit TransBay Expanded Bike Access	Capital	$180,000
	AC Transit	AC Transit Bicycle Parking Plan	Plan	$100,000
	BART	BART C2 Rail Car Reconfiguration Project	Capital	$581,000
	City of Albany Community Development Department	El Cerrito/Albany Ohlone Greenway Safety Project	Capital	$807,000
	City of Berkeley	Downtown Berkeley BART Bikestation	Capital	$496,784
	City of Fairfield	Union Avenue/Suisun Train Station Enhancement Program	Capital	$300,000
	City of Oakland CEDA Redevelopment	MacArthur Transit Hub Streetscape Improvement Project Phase II	Capital	$398,800
	City of Oakland Public Works Department	MacArthur BART Station Bicycle Access Project Phase I	Plan	$30,000
	San Francisco Department of Parking & Traffic	Improved Bicycle Access to 16th Street BART Station	Capital	$195,000
	San Francisco Municipal Railway	Balboa Park Station Intermodal Connections	Plan	$200,000
	San Francisco Municipal Railway	Market Street Safety Zone Calming	Capital	$600,000
	Valley Transportation Authority	Santa Clara Transit Center-Pedestrian/Bike Crossing	Plan	$50,000

SR2T funds may be used for the following improvement types:

- Secure bicycle storage at transit stations/stops/pods
- Safety enhancements for pedestrian and bicycle station access to transit stations/stops/pods
- Removal of pedestrian/bicycle barriers near transit stations
- System-wide transit enhancements to accommodate bicyclists or pedestrians

The intended outcomes of the SR2T Program are to increase the number of bicyclists and pedestrians accessing regional transit stations in the Bay Area, to enhance safety for bicyclists and pedestrians accessing regional transit stations, to improve air quality, and to decrease congestion.

While there are no legislated calls for evaluating the effectiveness of the SR2T Program, MTC has allocated funding to support the evaluation of the effectiveness of this program. Of particular concern is the ability of these capital and planning projects to shift travel from single-occupant vehicules to non-motorized modes for the transit access trip and to increase the safety of pedestrians and bicyclists.

The purpose of this report therefore is to present a Program Evaluation Plan including a description of the SR2T projects funded to date, a proposed methodology for assessing program effectiveness, potential data sources, and approaches to the data collection efforts.

After the Introduction section, this memorandum is divided into the following five sections:

- **Chapter 2 – Literature Review** presents a brief review of recent research related to built environment and travel behavior relationships, as well as research on Safe Route to School Program evaluation methodologies and findings.
- **Chapter 3 – Analysis Approach** describes a proposed before-after analysis approach with test and control sites, as well as an analysis approach for those SR2T sites where an after-only analysis is feasible.
- **Chapter 4 – SR2T Project Improvement Types** presents information on the number, type, and location of sites considered for evaluation.
- **Chapter 5 – Data Collection, Sources and Costs** discusses proposed data to be collected, data collection tools, and estimated costs for primary data collection.
- **Chapter 6 – Next Steps** provides an overview of research to be conducted over the coming 15 months.

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SR2T PROJECT LOCATIONS
FIGURE 1

2.0 LITERATURE REVIEW

[TO BE COMPLETED]

Several sources of academic and professional literature were reviewed in preparation for developing the SR2T Program Evaluation Plan. Essential questions posed by this effort rely upon an understanding of built environment–travel behavior relationships. This topic has been widely addressed in academic and professional literatures in recent decades.

The purpose of this literature review is to examine the most recent efforts focused on built environment-travel behavior relationships, and more specifically, to examine a subset of this literature related to Safe Routes to Schools (SRTS) program evaluation. In the following sections, state-of-the-art built environment – travel behavior literature is reviewed, including research designs and findings, followed by a summary of those studies that have focused specifically on developing an understanding of the effects of infrastructure changes on children's trip making behaviors to school.

BUILT ENVIRONMENT AND TRAVEL BEHAVIOR

The SR2T Program Evaluation is tasked with measuring how pedestrian and bicycle infrastructure improvements influence mode shifts from automobile to walking and cycling for the regional transit access trip. The program evaluation, in other words, is not focused on how the macro-level changes in the built environment, such as land use densification, land use mix, and roadway network patterns influence travel behavior. A major focus of the built environment–travel behavior literature to date has been on these macro-level influences on travel behavior.

At the macro level, several key factors have been identified as influencing travel mode choice, including land use density, land use mix, urban design, the number of nearby destinations, and the distance to transit (Cervero and Kockelman, 1997; Ewing and Cervero, 2001; Ewing, Greenwald and Zhang, 2009). This research focuses on the degree to which the design of the roadway environment affects travel mode choice. Specifically, this research examines whether infrastructure improvements intended to improve walking and cycling environments, i.e. slowing vehicular speeds, reducing vehicular capacity, increasing visibility of the pedestrian at key points of conflicts, etc. lead to increases in walking and cycling trips along these roadways.

Ewing and Cervero (2010) provide a recent and comprehensive look at this literature and will be used here to summarize the most current understanding of the direction and magnitude of relationships between individual built environment and travel behavior factors.

[review methods and findings]

ASSESSING THE MOBILITY IMPACTS OF SAFE ROUTES TO SCHOOL PROGRAMS

The Safe Routes to School Program has provided a unique funding source with direct impacts on the walking and cycling environments near schools. The evaluation requirements associated with receipt of funding has generated a fair amount of assessments of the effectiveness of these programs, especially in the realm of shifting vehicular modes for the journey to school to walking and bicycling. The agency requirement to perform effectiveness analyses has led to rigorous research efforts by public health, urban planning and traffic engineering academics. Two key studies are of particular focus as background for the current study; Boarnet et. al. (2003) and Cooper et. al. (date)

Walking/Bicycle Rates

Boarnet et. al. (2003) is attributed with performing the most in-depth study of changes in travel behavior associated with implementation of SRTS projects. In the Boarnet et al (2003) study, neighborhoods around nine schools in California were assessed for changes in trip-making before and after construction of infrastructure improvement projects. Data collection focused on counts of pedestrians during a 45-minute peak school trip period in the morning and afternoon in the vicinity of schools. Pedestrian improvement projects included sidewalk construction, traffic control installation or intersection crossing improvements. In eight of nine schools, the number of observed walking trips increased, between 12% and 850%. One of nine schools saw a decrease (-29%) in walking trips from before to after construction of an intersection crossing improvement project.

In addition to the numbers of pedestrians, observers also noted where pedestrians were walking within the roadway right-of-way. There were distinct changes in the locations where students were walking within the roadway right-of-way, with students shifting walking from the travel lane or shoulder, to walking along a sidewalk. This shift supports the idea that the SR2S improvements increased safety for school children walking to school.

The final data type evaluated in the Boarnet (2003) study is parental perceptions of changes in walking/biking rates from before to after the improvement projects. 1,244 surveys were collected from parents who report increases between 3% and 29% in walking after construction of improvement projects for students whose travel route passes along the location where the improvement was made.

Safety

Orenstein et al (2007)

3.0 ANALYSIS APPROACH

STUDY DESIGN

The proposed study design is a before-after analysis using test and control sites. **Figure 2** illustrates this approach using pedestrian safety as a hypothetical evaluation variable.

This study design conforms as closely as possible to a "natural experiment" whereby the test site receives an intervention and the control site does not, thereby allowing the researcher to establish causality between the intervention and the variable of interest – in the case of Figure 2, pedestrian safety. Such a study design allows for the best possible understanding of how the SR2T capital and planning projects affect travel behavior and safety.

SR2T PROJECT LOCATIONS AND CONSTRUCTION SCHEDULES

The SR2T project construction schedules were examined in order to determine the feasibility of conducting before-after analyses within the timeframe of the consultant's contract with MTC, which runs from Fall 2010 through Spring 2013.

The consultant team collected SR2T applications submitted on behalf of various agencies to TransForm and reviewed them for construction start and end dates. When this information was not readily available, email inquiries were sent to each SR2T applicant project manager to request verification of the construction start and end dates.

Tables 2 and **3** display the results of the SR2T project construction schedule assessment. Overall, it was determined that 10 SR2T projects have a construction start and end date that enables a before-after analysis, while 11 SR2T projects have a construction start and end that date that supports an "after-only" analysis. **Figure 3** presents the SR2T project locations and distinguishes those sites where before-after analysis is feasible given the expected SR2T project construction schedule, as well as those sites where "after-only" analysis will be performed.

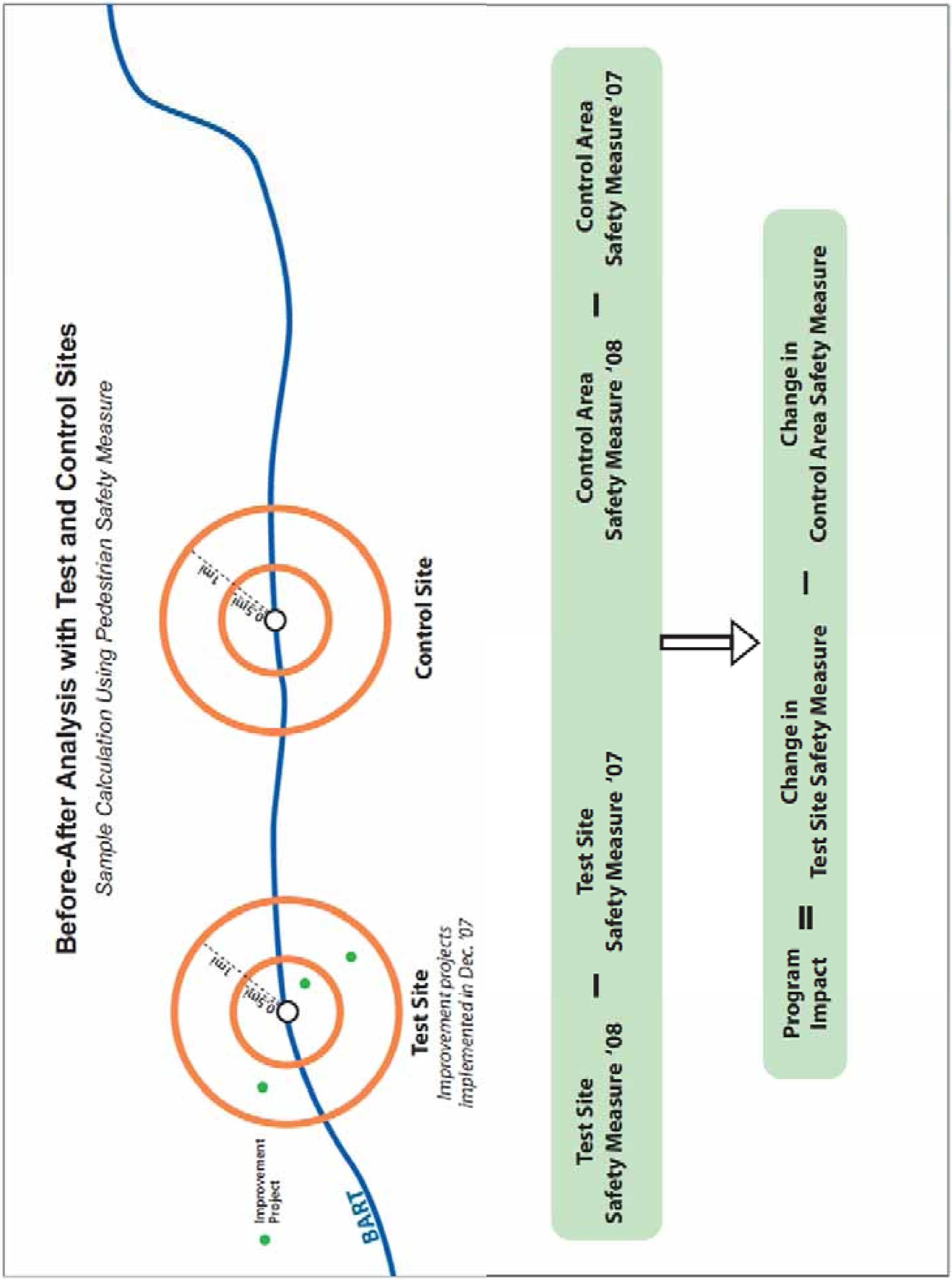

FIGURE 2 - PROPOSED STUDY DESIGN
MTC SR2T PROGRAM EVALUATION

Table 2: Start and End Dates for SR2T Projects with Before-After Analysis Opportunity

Project Sponsor	SR2T Project ID	Durat-ion	County	MTC SR2T Program Evaluation 31 Month Duration and Individual SR2T Project Construction Start and End Dates																														
				2010				2011													2012													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
City of Pittsburg	20.21	3/ 2011- 6/ 2012	Contra Costa																															
Bay Area Rapid Transit	20.23	3/ 2011- TBD	Multi-county																															
San Francisco Municipal Transport. Agency	20.26	6/ 2011- 4/ 2012	San Franc.																															
City of San Rafael	20.27	3/ 2011 – 7/2011	Marin																															
Bay Area Rapid Transit	20.32	6/ 2011- 10/ 2011	Alam.																															
City of Berkeley	20.33	12/2011- 12/ 2012	Alam.																															
City of San Leandro	20.34	9/2011- 12/2012	Alam.																															
San Francisco Municipal Transport. Agency	20.35	12/2010-9/ 2011	San Franc.																															

Table 2: Start and End Dates for SR2T Projects with Before-After Analysis Opportunity

Project Sponsor	SR2T Project ID	Durat-ion	County	MTC SR2T Program Evaluation 31 Month Duration and Individual SR2T Project Construction Start and End Dates																														
				2010				2011													2012													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Richmond Comm. Develop. Corp.	20.39	7/2011-1/2012	Contra Costa																															
Santa Clara Valley Transport. Authority	20.41	end date Spring 2011	Santa Clara																															

Table 3: Start and End Dates for SR2T Projects with After-Only Analysis Opportunity

Project Sponsor	SR2T Project ID	Duration	County	MTC SR2T Program Evaluation 31 Month Duration and Individual SR2T Project Construction Start and End Dates																														
				2010				2011													2011													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
BART	20.4	12/2007 -7/2010	Alam.																															
City of Oakland	20.5	1/2008-5/2009	Alam.																															
City of Fairfield	20.6	7/2008-10/2009	Solano																															
City of Albany	20.7	2007-2008	Contra Costa																															
San Francisco Department of Parking and Traffic/MTA	20.12	12/2010 - 12/2010	San Franc.																															
San Francisco Municipal Transport. Agency	20.13	11/2008 -3/2011	San Franc.																															
BART	20.15	1/2010-6/2010	Alam.																															
City of Berkeley	20.29	9/ 2008-1/2011	Alam.																															
San Francisco Municipal Transport. Agency	20.30	1/ 2010-6/2011	San Franc.																															

Table 3: Start and End Dates for SR2T Projects with After-Only Analysis Opportunity

Project Sponsor	SR2T Project ID	Duration	County	MTC SR2T Program Evaluation 31 Month Duration and Individual SR2T Project Construction Start and End Dates																														
				2010				2011													2011													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
San Francisco Municipal Transport. Agency	20.31	11/2010 - 12/2012	San Franc.																															
City of Oakland	20.37	7 2010-11/2011	Alam																															

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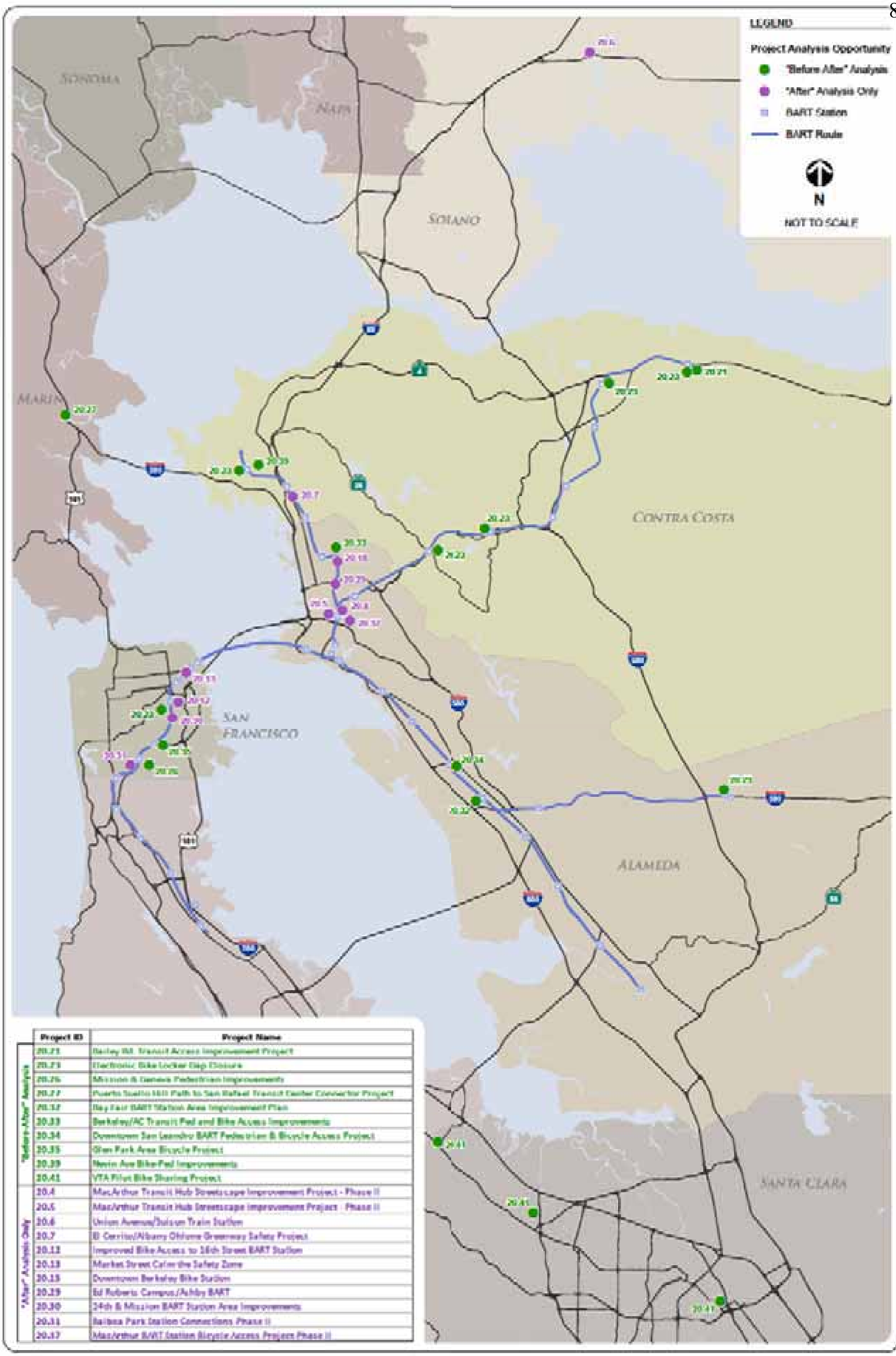

	Project ID	Project Name
"Before-After" Analysis	20.21	Bailey Rd. Transit Access Improvement Project
	20.23	Electronic Bike Locker Gap Closure
	20.26	Mission & Geneva Pedestrian Improvements
	20.27	Puerto Suello Hill Path to San Rafael Transit Center Connector Project
	20.32	Bay Fair BART Station Area Improvement Plan
	20.33	Berkeley/AC Transit Ped and Bike Access Improvements
	20.34	Downtown San Leandro BART Pedestrian & Bicycle Access Project
	20.35	Glen Park Area Bicycle Project
	20.39	Nevin Ave Bike-Ped Improvements
	20.41	VTA Pilot Bike Sharing Project
"After" Analysis Only	20.4	MacArthur Transit Hub Streetscape Improvement Project - Phase II
	20.5	MacArthur Transit Hub Streetscape Improvement Project - Phase II
	20.6	Union Avenue/Suisun Train Station
	20.7	El Cerrito/Albany Ohlone Greenway Safety Project
	20.12	Improved Bike Access to 16th Street BART Station
	20.13	Market Street Calm the Safety Zone
	20.15	Downtown Berkeley Bike Station
	20.29	Ed Roberts Campus/Ashby BART
	20.30	24th & Mission BART Station Area Improvements
	20.31	Balboa Park Station Connections Phase II
	20.37	MacArthur BART Station Bicycle Access Project Phase II

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SR2T PROJECT LOCATIONS AND ANALYSIS OPPORTUNITY
FIGURE 3

ESTABLISHING TEST AND CONTROL SITES

Establishing valid test and control study sites is an important methodological issue for the success of this study. The initial approach will be to establish a fairly small scale study area around test and control sites using a one-half mile street network buffer around regional transit stations that are the focus of the various SR2T projects A majority of the data collection effort will be focused at the transit station or within the transit station buffer areas.

Test site areas will require matching control site areas where no infrastructure improvement project has been implemented. The test and control site areas will be matched based upon several key variables typically associated with travel behavior and specifically with mode choice, such as population density, employment density, and percent of families in poverty. In addition, the test and control areas can be matched based upon levels of daily transit ridership at each of the stations where the SR2T projects are focused.

Test and control site areas should match on *either* population or employment density (corresponding to either trip origin or destination) *and* transit ridership or income (propensity to use transit). **Table 4** lists the variables to be use for matching test and control site areas.

Table 4: Variables for Matching Test and Control Sites

Variable	Units
Transit Ridership	Daily Ons/Offs by Station
Population Density	2000 Population per Acre within Half-Mile Street Network Buffer
Employment Density	2000 Employment per Acre within Half-Mile Street Network Buffer
Percent Households in Poverty	2000 Poverty Households / Total Households within Half-Mile Street Network Buffer

Figure 4 through **Figure 13** display the 23 regional transit stations that the focus of the "before-after" SR2T projects, along with the half-mile street network buffer. In addition, these figures levels of population, employment, and percent households in poverty for each half-mile test site buffer area.

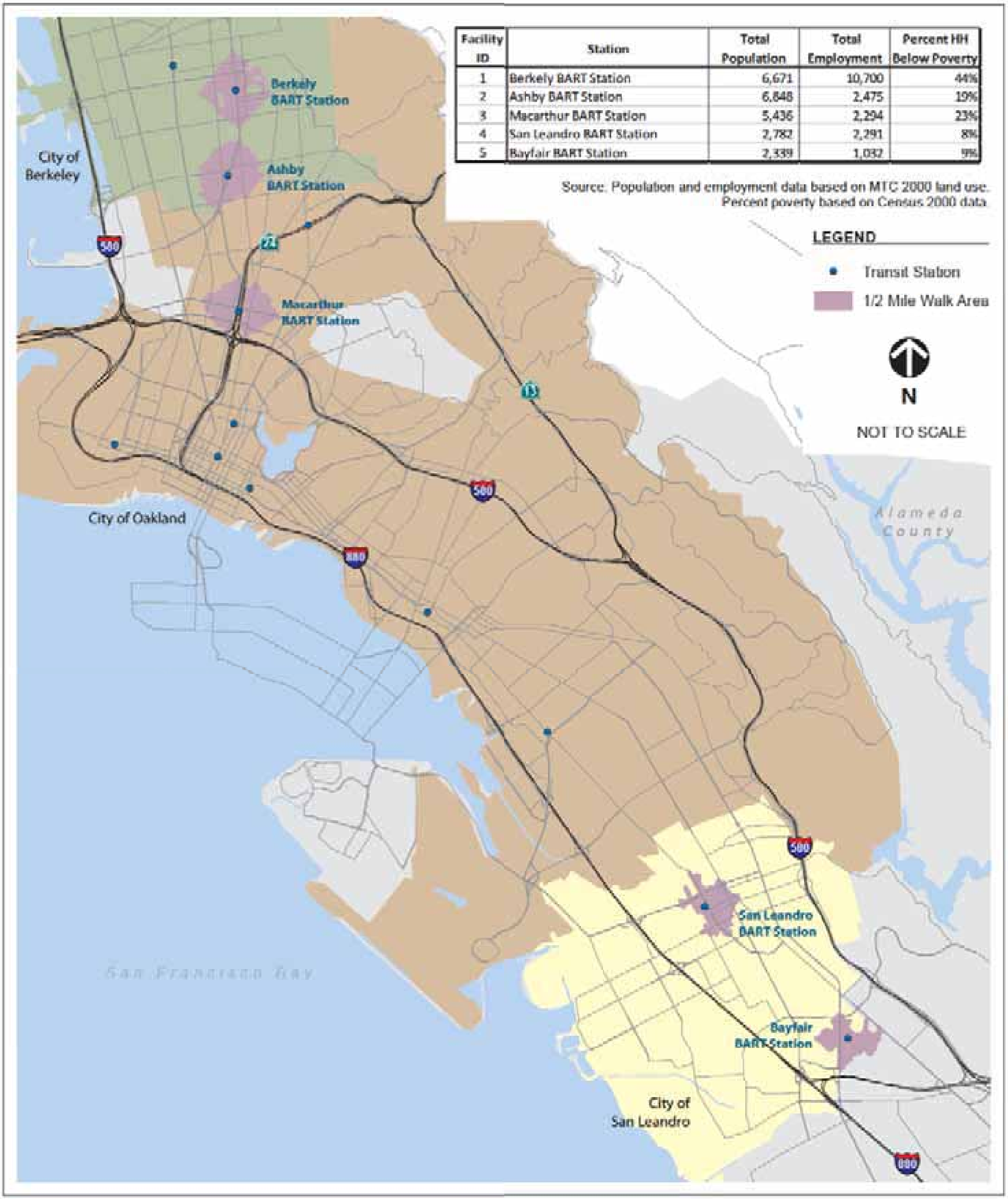
In the event that adequately matching control sites cannot be found, countywide controls may be utilized to the extent possible. For example, changes in countywide pedestrian and bicycle crashes might be used as a comparison with test site changes in pedestrian and bicycle crashes. Likewise, countywide changes in the level of walk and bicycle commute trips from the American Community Survey might be used as a comparison with test site changes in pedestrian and bicycle counts.

Table 5 summarizes the level of population, employment and households in poverty within a half-mile street network buffer for each of the transit stations that are the focus of SR2T projects in the Bay Area.

The information displayed in Figures 4 through 13, as well as in Table 5, will be used to support the identification of the adequate control areas, which will also be based upon half-mile street network buffers near regional transit stations that have not experienced any pedestrian or bicycle improvements.

Table 5: Transit Ridership, Population, Employment and Poverty Within a Half-Mile of Before-After Transit Station Test Sites

Transit Station ID	Transit Station	Daily On/Offs	Total Population	Total Employment	Percent HH Below Poverty
1	Berkeley BART Station		6,671	10,700	44%
2	Ashby BART Station		6,848	2,475	19%
3	MacArthur BART Station		5,436	2,294	23%
4	San Leandro BART Station		2,782	2,291	8%
5	Bayfair BART Station		2,339	1,032	9%
6	Pittsburg/Bay Point BART Station		691	37	13%
7	Richmond BART Station		6,437	1,877	25%
8	El Cerrito Del Norte BART Station		3,177	1,037	11%
9	El Cerrito BART Plaza Station		3,258	1,892	8%
10	Powell BART Station		21,300	71,849	28%
11	16th Street Mission BART Station		18,204	12,158	17%
12	24th Street Mission BART Station		20,246	4,767	15%
13	Glen Park BART Station		7,756	948	8%
14	Balboa Park BART Station		9,826	2,063	9%
15	San Rafael Transit Center		1,420	2,022	16%
16	Suisun/Fairfield Station		89	157	21%
18	San Jose Dridon Caltrain Station		2,001	2,773	8%
19	Palo Alto Caltrain Station		1,273	2,809	8%
20	Downtown Mountain View Caltrain Station		1,790	2,706	8%
21	Orinda BART Station		230	54	2%
22	Dublin/Pleasanton BART Station		298	418	2%
23	Lafayette BART Station		363	120	5%
24	Concord Martinez BART Station		1,716	162	6%



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
1	Berkely BART Station	6,671	10,700	44%
2	Ashby BART Station	6,848	2,475	19%
3	Macarthur BART Station	5,436	2,294	23%
4	San Leandro BART Station	2,782	2,291	8%
5	Bayfair BART Station	2,339	1,032	9%

Source: Population and employment data based on MTC 2000 land use. Percent poverty based on Census 2000 data.

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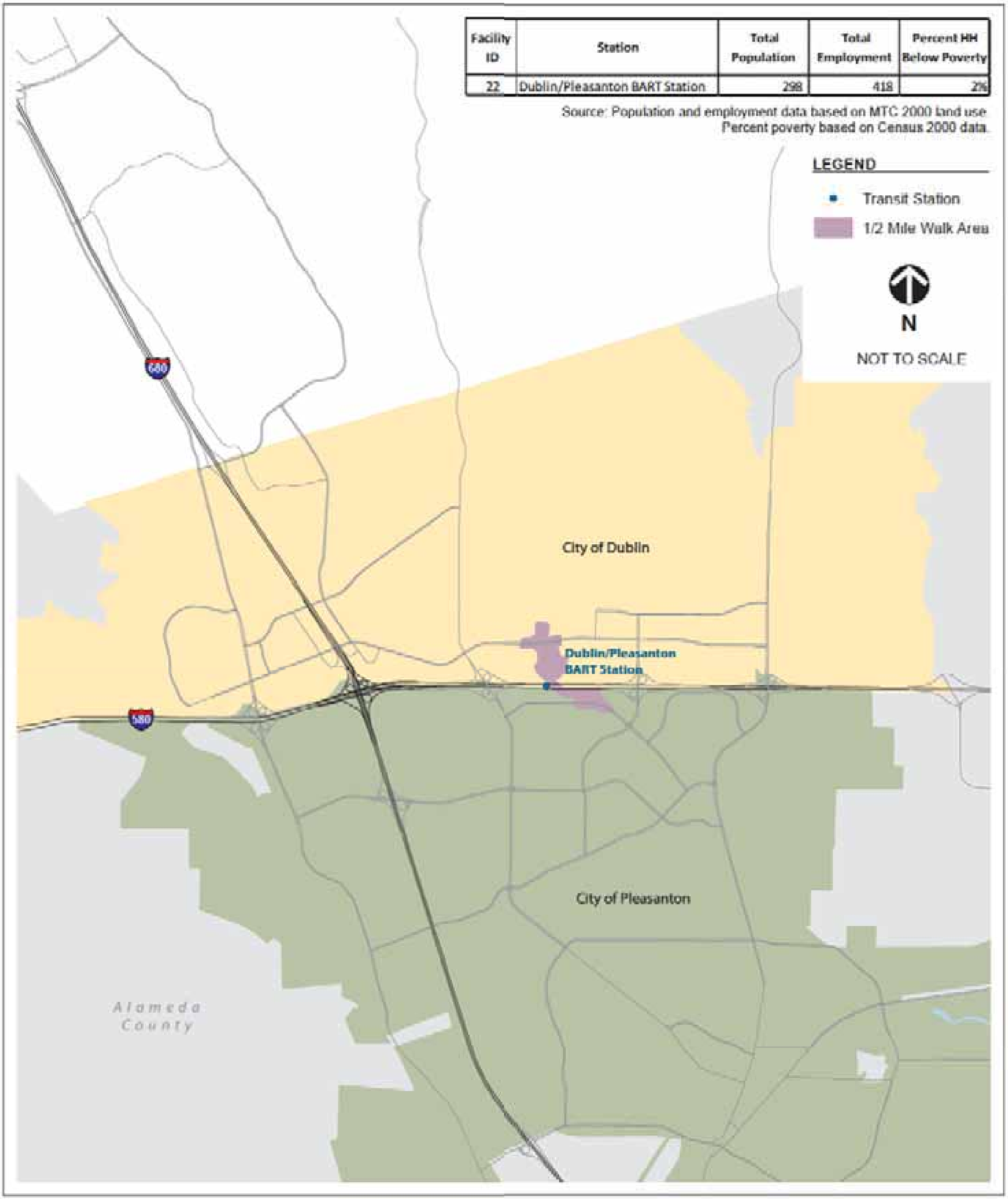
ALAMEDA COUNTY (WEST) POPULATION AND EMPLOYMENT CHARACTERISTICS WITHIN 1/2 MILE

FIGURE 4

Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
22	Dublin/Pleasanton BART Station	298	418	2%

Source: Population and employment data based on MTC 2000 land use.
Percent poverty based on Census 2000 data.



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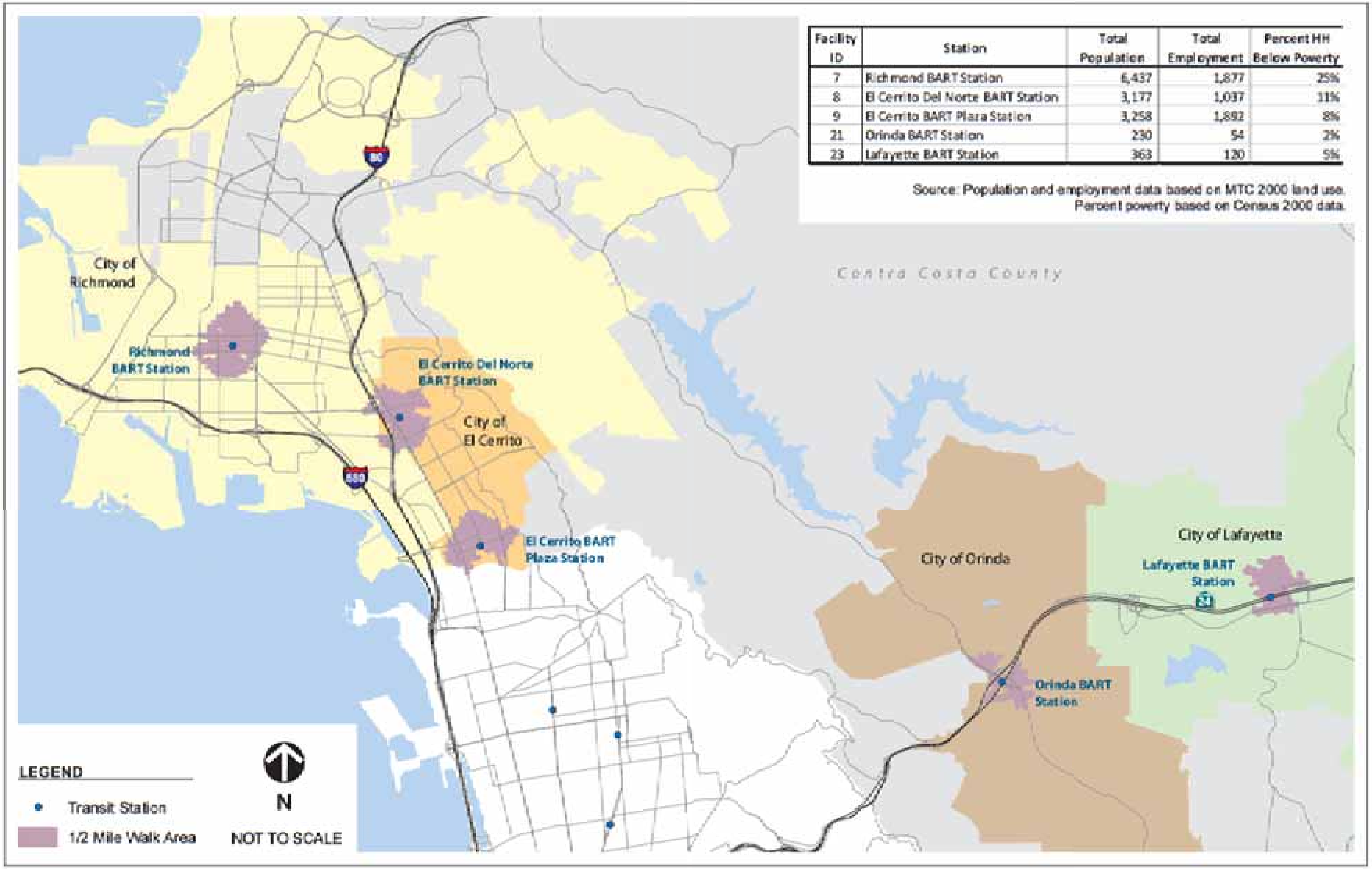
ALAMEDA COUNTY (EAST) POPULATION AND EMPLOYMENT CHARACTERISTICS WITHIN 1/2 MILE

FIGURE 5



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
7	Richmond BART Station	6,437	1,877	25%
8	El Cerrito Del Norte BART Station	3,177	1,037	11%
9	El Cerrito BART Plaza Station	3,258	1,892	8%
21	Orinda BART Station	230	54	2%
23	Lafayette BART Station	363	120	5%

Source: Population and employment data based on MTC 2000 land use.
Percent poverty based on Census 2000 data.

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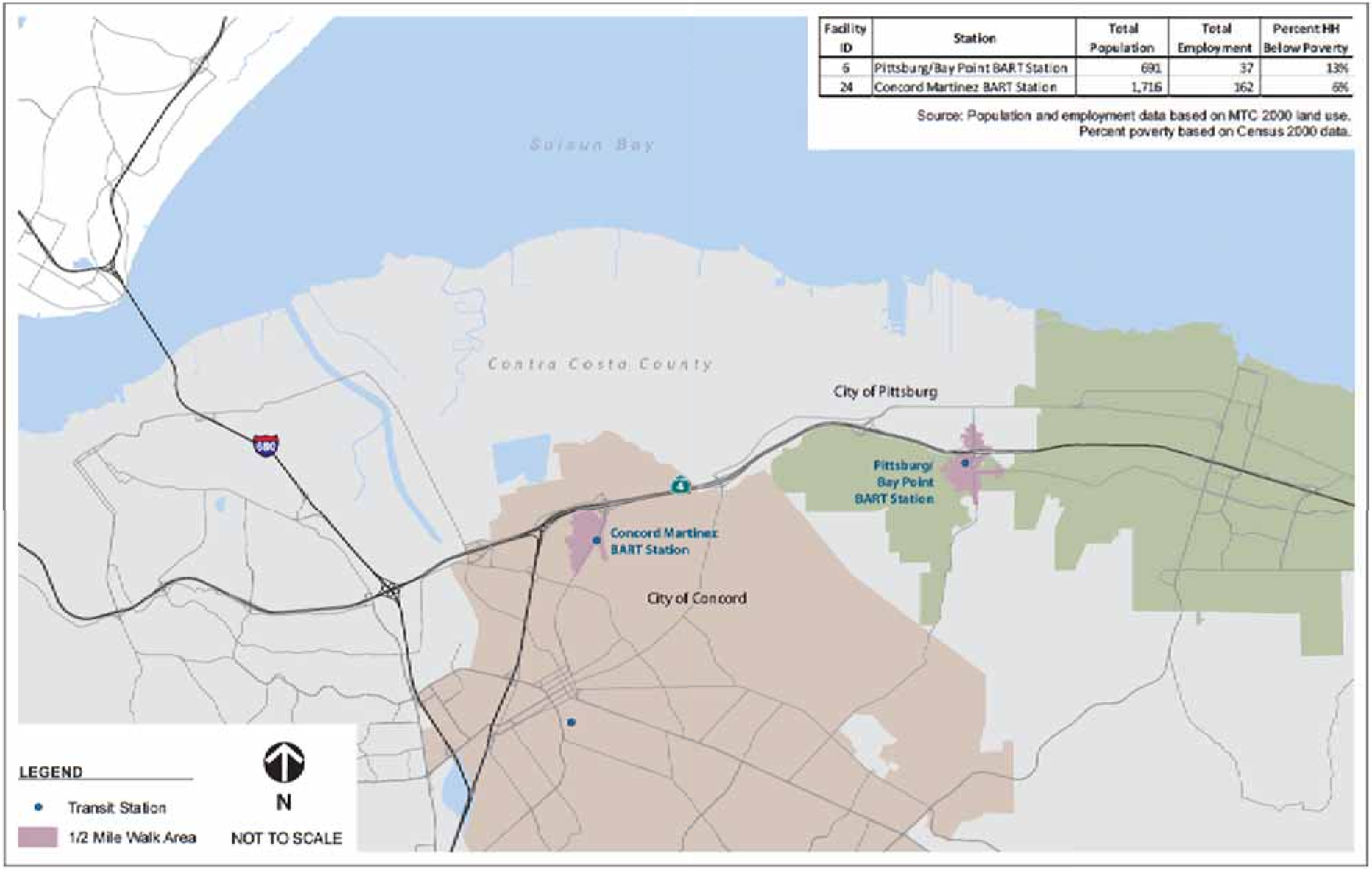
CONTRA COSTA COUNTY (EAST)
POPULATION AND EMPLOYMENT CHARACTERISTICS WITHIN 1/2 MILE
FIGURE 6



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
6	Pittsburg/Bay Point BART Station	691	37	13%
24	Concord Martinez BART Station	1,716	162	6%

Source: Population and employment data based on MTC 2000 land use. Percent poverty based on Census 2000 data.

FEHR & PEERS TRANSPORTATION CONSULTANTS SafeTREC

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CONTRA COSTA COUNTY (WEST)
POPULATION AND EMPLOYMENT CHARACTERISTICS
WITHIN 1/2 MILE
FIGURE 7

Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
15	San Rafael Transit Center	1,420	2,022	16%

Source: Population and employment data based on MTC 2000 land use.
Percent poverty based on Census 2000 data.

FEHR & PEERS TRANSPORTATION CONSULTANTS SafeTREC

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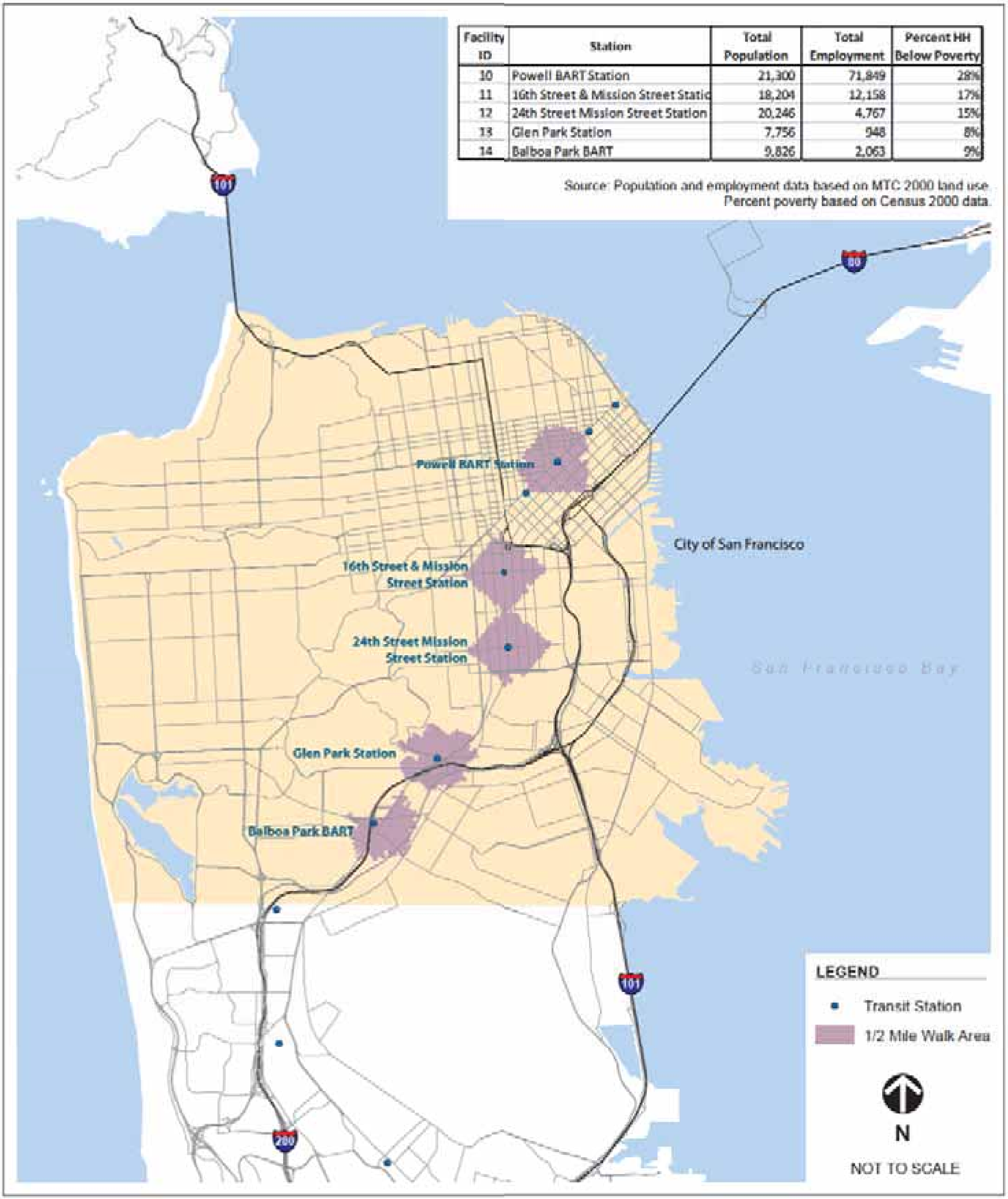
MARIN COUNTY
POPULATION AND EMPLOYMENT
CHARACTERISTICS
WITHIN 1/2 MILE
FIGURE 8



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
10	Powell BART Station	21,300	71,849	28%
11	16th Street & Mission Street Static	18,204	12,158	17%
12	24th Street Mission Street Station	20,246	4,767	15%
13	Glen Park Station	7,756	948	8%
14	Balboa Park BART	9,826	2,063	9%

Source: Population and employment data based on MTC 2000 land use. Percent poverty based on Census 2000 data.

FEHR & PEERS TRANSPORTATION CONSULTANTS SafeTREC

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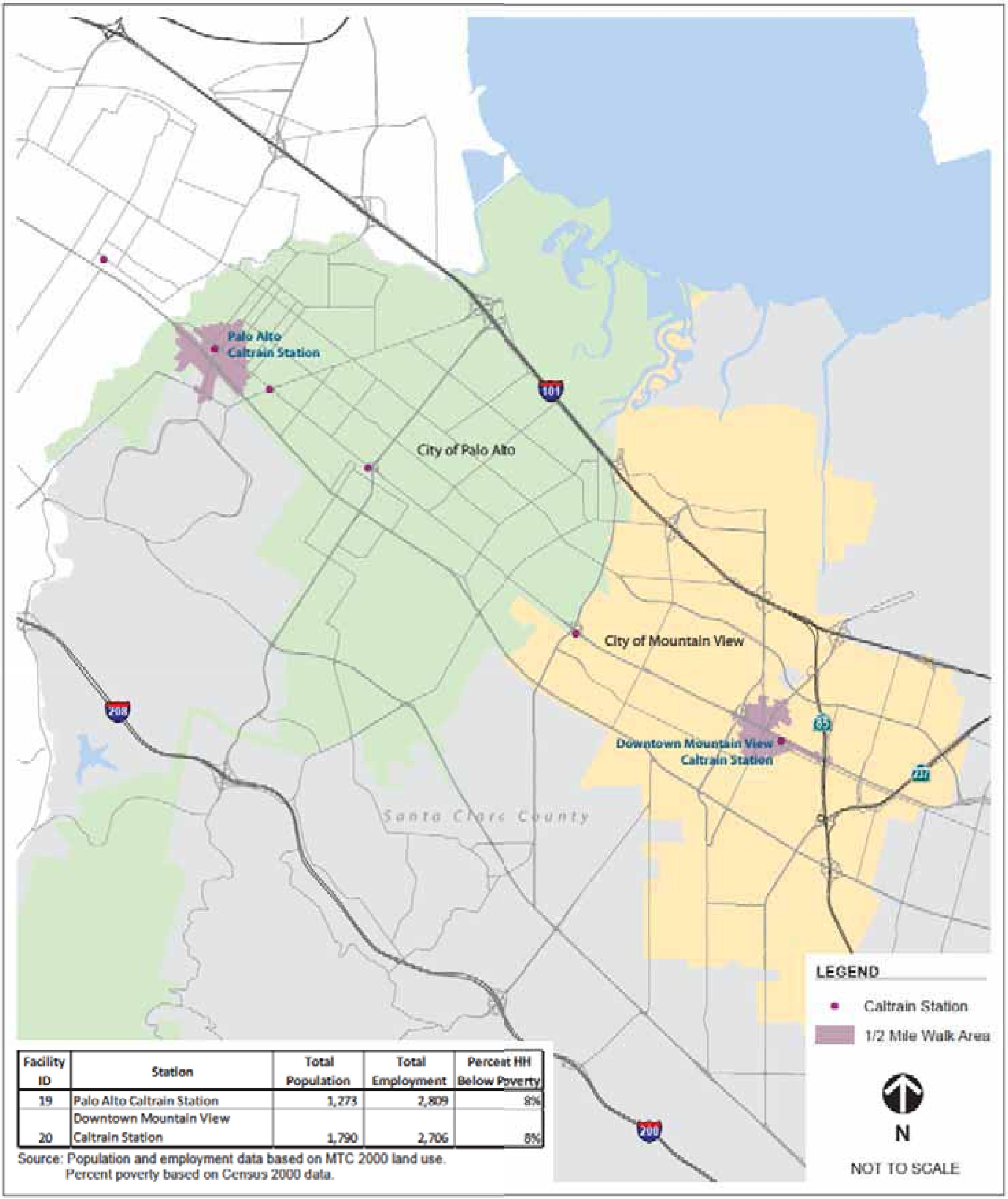
SAN FRANCISCO COUNTY POPULATION AND EMPLOYMENT CHARACTERISITICS WITHIN 1/2 MILE

FIGURE 9



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
19	Palo Alto Caltrain Station	1,273	2,809	8%
20	Downtown Mountain View Caltrain Station	1,790	2,706	8%

Source: Population and employment data based on MTC 2000 land use.
Percent poverty based on Census 2000 data.

FEHR & PEERS TRANSPORTATION CONSULTANTS SafeTREC

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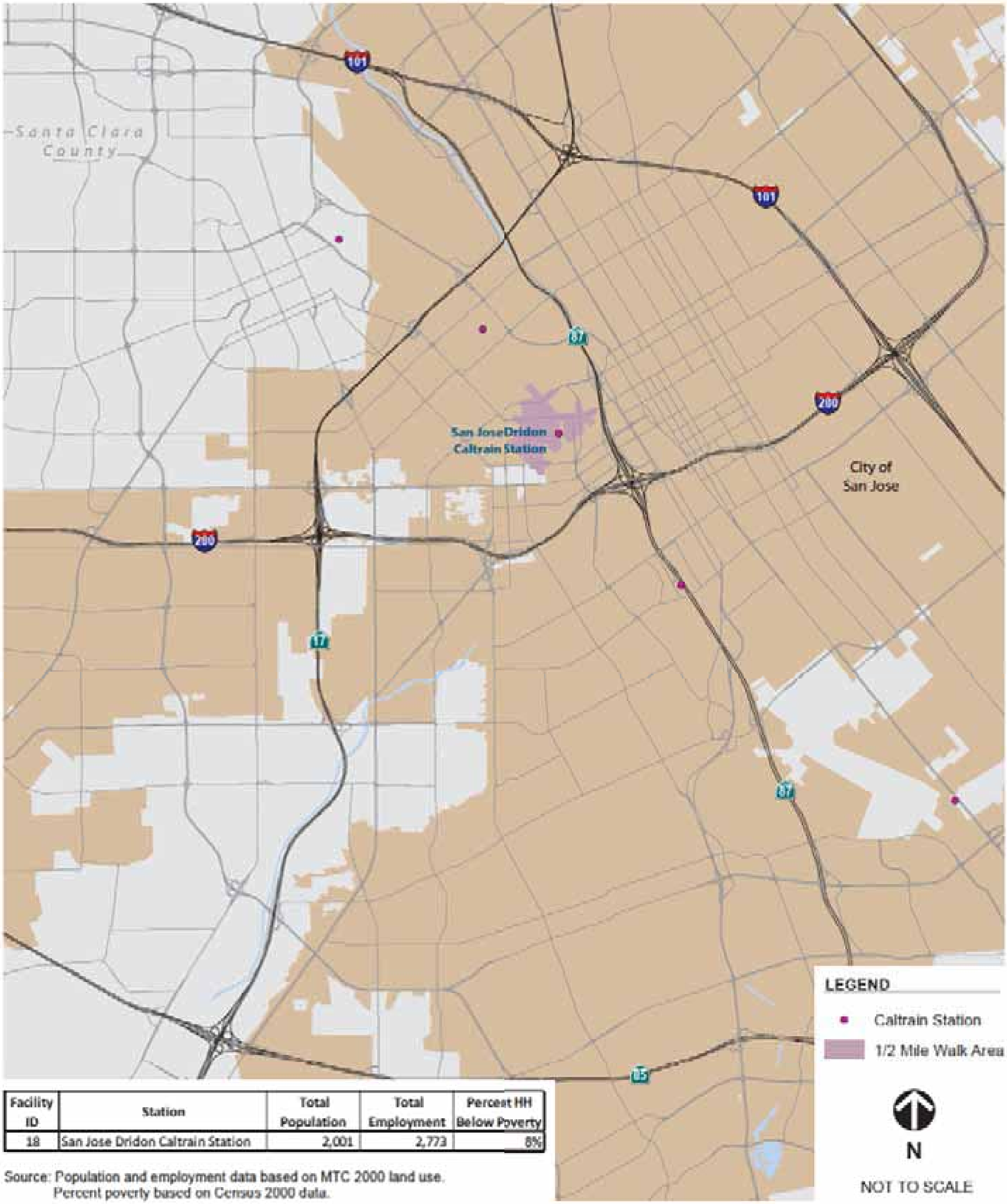
SANTA CLARA COUNTY (NORTH) POPULATION AND EMPLOYMENT CHARACTERISITICS WITHIN 1/2 MILE

FIGURE 10



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
18	San Jose Dridon Caltrain Station	2,001	2,773	8%

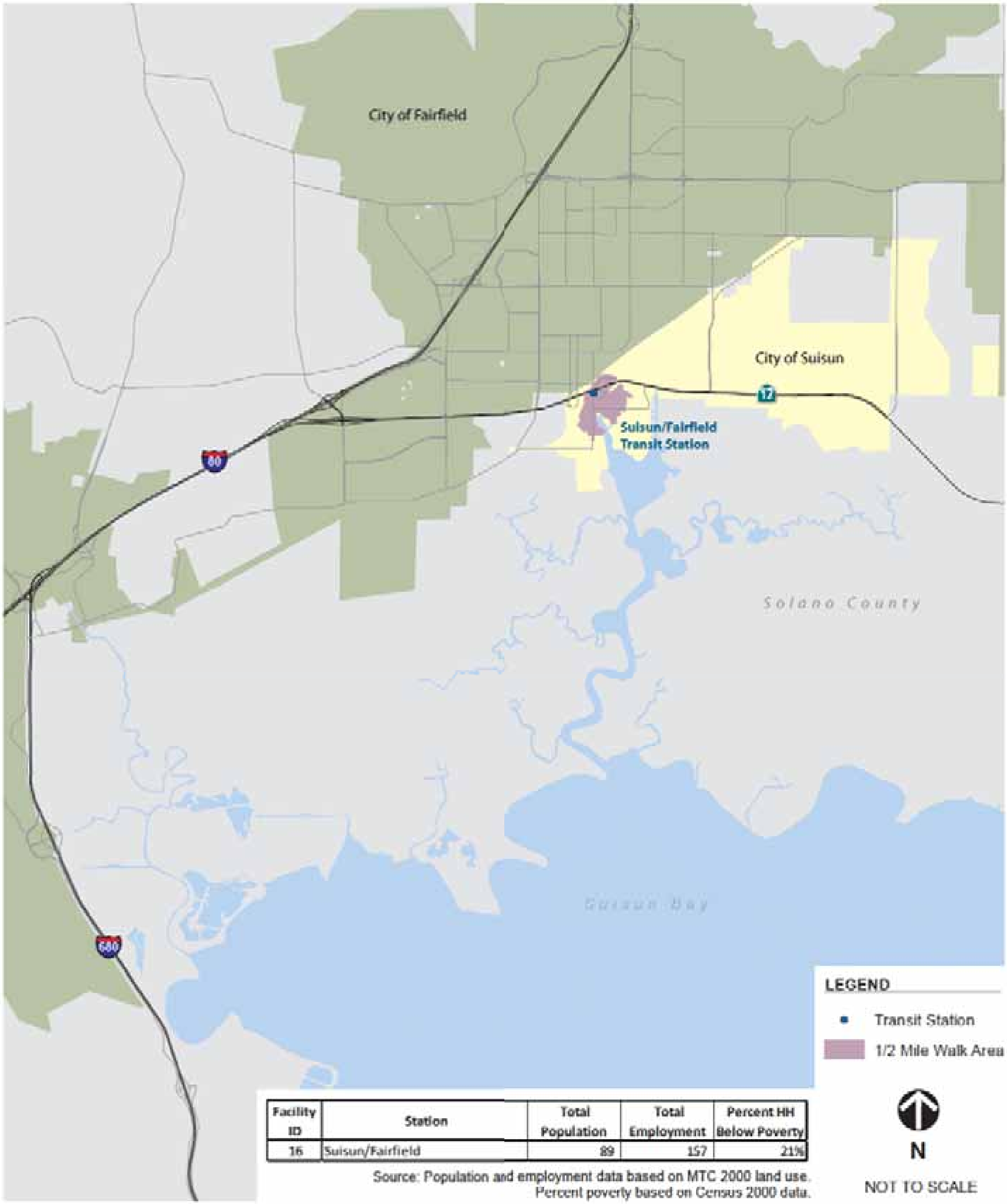
Source: Population and employment data based on MTC 2000 land use.
Percent poverty based on Census 2000 data.

FEHR & PEERS
TRANSPORTATION CONSULTANTS
SafeTREC

N:\2010Projects\SD_Projects\SD10_0018\Graphics\GIS\MXD\SantaClara_Summary_2.mxd

SANTA CLARA COUNTY (SOUTH) POPULATION AND EMPLOYMENT CHARACTERISITICS WITHIN 1/2 MILE

FIGURE 11



Facility ID	Station	Total Population	Total Employment	Percent HH Below Poverty
16	Suisun/Fairfield	89	157	21%

Source: Population and employment data based on MTC 2000 land use.
Percent poverty based on Census 2000 data.

FEHR & PEERS TRANSPORTATION CONSULTANTS SafeTREC

N:\2010Projects\SD_Projects\SD10_0018\Graphics\GIS\MXD\Solano_Summary.mxd

SOLANO COUNTY POPULATION AND EMPLOYMENT CHARACTERISTICS WITHIN 1/2 MILE

FIGURE 12

4.0 SR2T PROJECT IMPROVEMENT TYPES

Figure 14 through **Figure 30** display aerial overviews of each SR2T project location, the relevant regional transit station, and the proposed improvement types.

Table 6 summarizes the 23 regional transit station locations where SR2T projects will be constructed along with a description of the key improvement types anticipated. The Transit Station ID in Table 6 corresponds to the Facility ID in Figures 14 through 30.

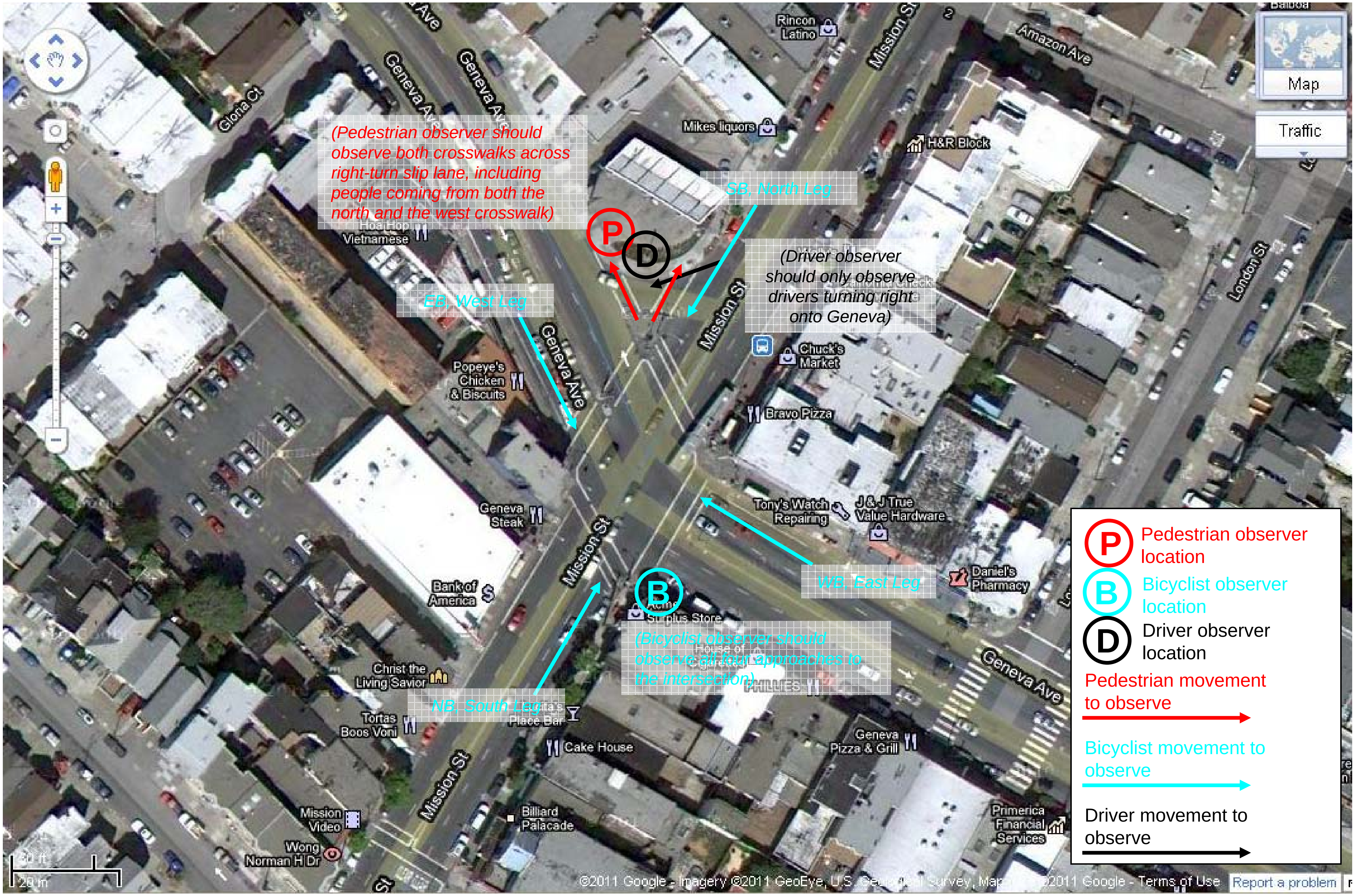
Table 6: Proposed SR2T Project Improvement Types by Transit Station

Transit Station ID	Transit Station	SR2T Project	Project Components
1	Berkeley BART Station	20.15, 20.33	• Shattuck Avenue & Vine Street – Bicycle Oasis – Relocate news racks and install benches and planters – Advance stop bars on all approaches – Install "Turning Traffic Must Yield to Pedestrians" signage • Colusa Avenue & Solano Avenue – Curb extensions – Bus bulb – Relocate light and signal poles – High-visibility crosswalks – Advance Stop bars – Bus Shelter – Bicycle oasis • Berkeley Bike Station on concourse or above-ground storefront
2	Ashby BART Station	20.29	• 12 electronic BART bicycle lockers • Wayfinding signage within ¼ mile radius • Adeline Street enhanced mid-block crossing • Improved staircase, ramp, and multi-use pathway with pedestrian-scale lighting and landscaping • Staircase and elevator providing vertical access
3	MacArthur BART Station	20.4, 20.5, 20.37	• Class II bicycle facilities • Class III bicycle facilities • Pedestrian-scale street lighting • Bicycle storage • Wayfinding signage • 40th Street intersection improvements • BART station entrance signal and crosswalk
4	San Leandro BART Station	20.34	• Relocation of existing pedestrian railroad crossing • Multi-use path from relocated crossing to station fare gate • Bicycle/pedestrian public paseo between Alvarado Street and Martinez Street • Bicycle lockers

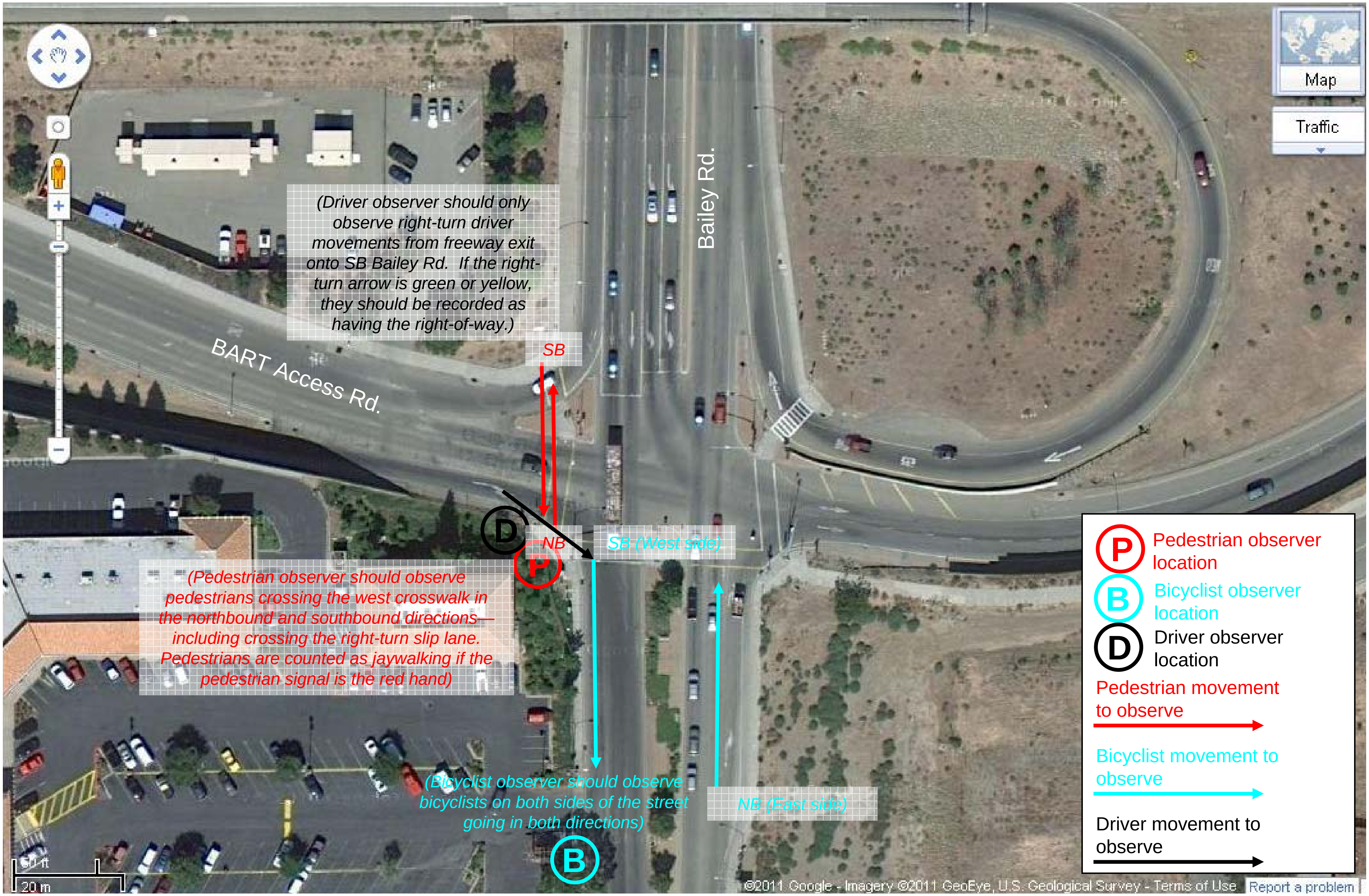
Table 6: Proposed SR2T Project Improvement Types by Transit Station

Transit Station ID	Transit Station	SR2T Project	Project Components
			• West Juana Street intersection improvements • Narrowing of West Juana Street and widening of sidewalk
5	Bayfair BART Station	20.32	• Pedestrian bridge including lighting, pathway treatments, and wayfinding signage • Pedestrian underpass including lighting, wayfinding signage, and bike lockers • AC Transit Intermodal Facility including lighting, wayfinding signage, and removal of bus wind screens • Thornally Drive sharrows and wayfinding signage for bicyclists
6	Pittsburg/Bay Point BART Station	20.21, 20.23	• Bus shelters and benches on Bailey Road • Reconstruct and landscape Bailey Road medians • Widen Bailey Road to accommodate Class II bike facilities • Lighting and landscaping installation along De Anza trail • Bailey Road Intersection improvements • 8 electronic bicycle lockers
7	Richmond BART Station	20.23, 20.39	• Reconstruction of eastern BART station entrance • Stairway, elevator, and pedestrian plaza facilitating access to BART • Nevin Avenue street improvements • 8 electronic bicycle lockers
8	El Cerrito Del Norte BART Station	20.7	• Video surveillance • Pedestrian-scale lighting • Pedestrian call boxes along Ohlone Greenway
9	El Cerrito BART Plaza Station	20.7	• Video surveillance • Landscaped median at Moeser Lane and Ohlone Greenway • Pedestrian call boxes along Ohlone Greenway • Intersection realignment at Masonic Avenue & Portland Avenue and Masonic Avenue & Washington Avenue
10	Powell BART Station	20.13	• Safety zone improvements including signage, enhanced striping, colorized pavement, bike boxes, and other unspecified improvements
11	16th Street Mission BART Station	20.12	• Class II bicycle facilities
12	24th Street Mission BART Station	20.3	• Sidewalk widening on Valencia Street • ADA curb ramps • Wayfinding signage in BART Plazas • Curb extensions • Signal and curb ramp upgrades • Pedestrian countdown signals

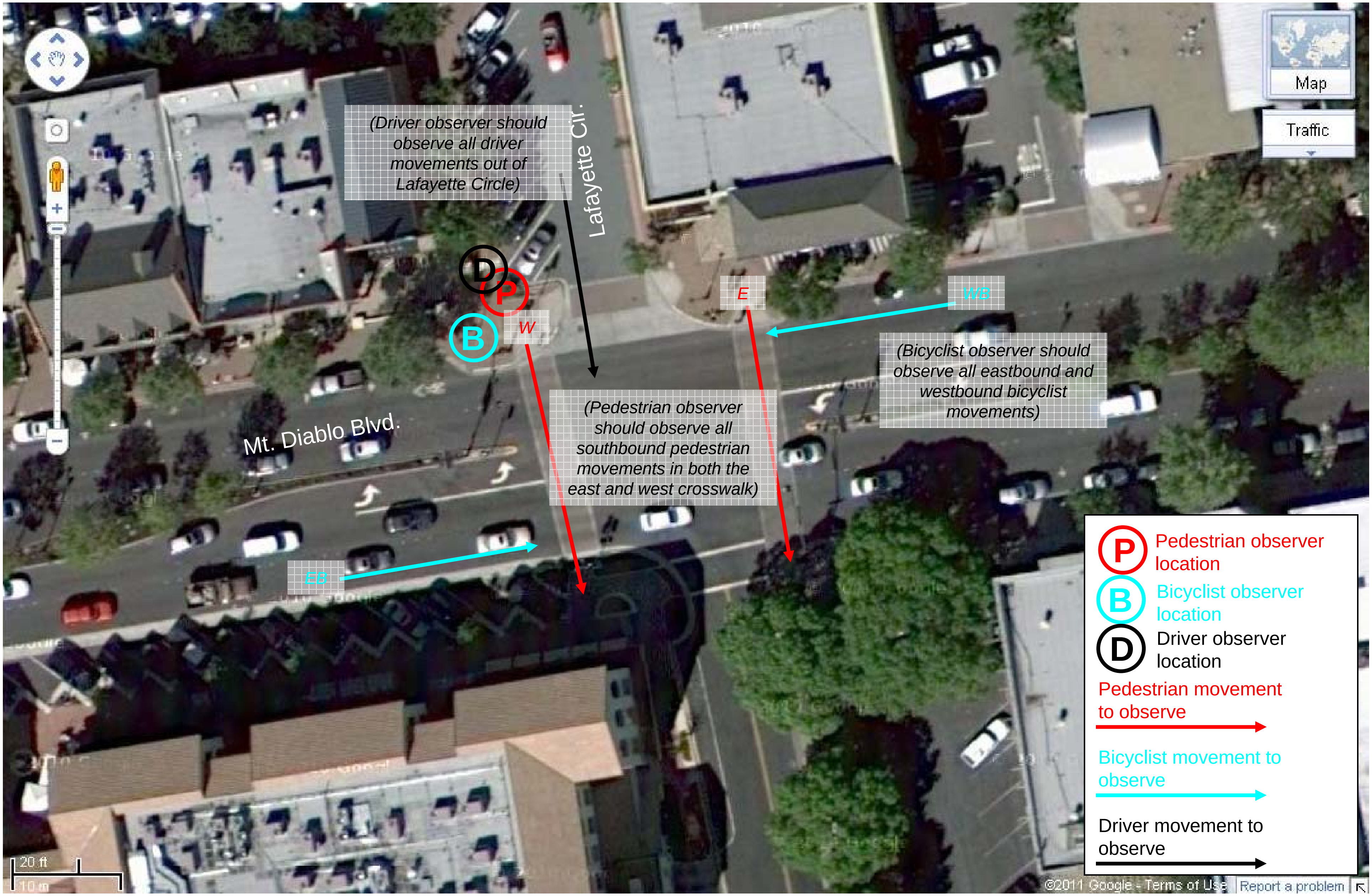
Balboa Park: Geneva Ave. & Mission St.



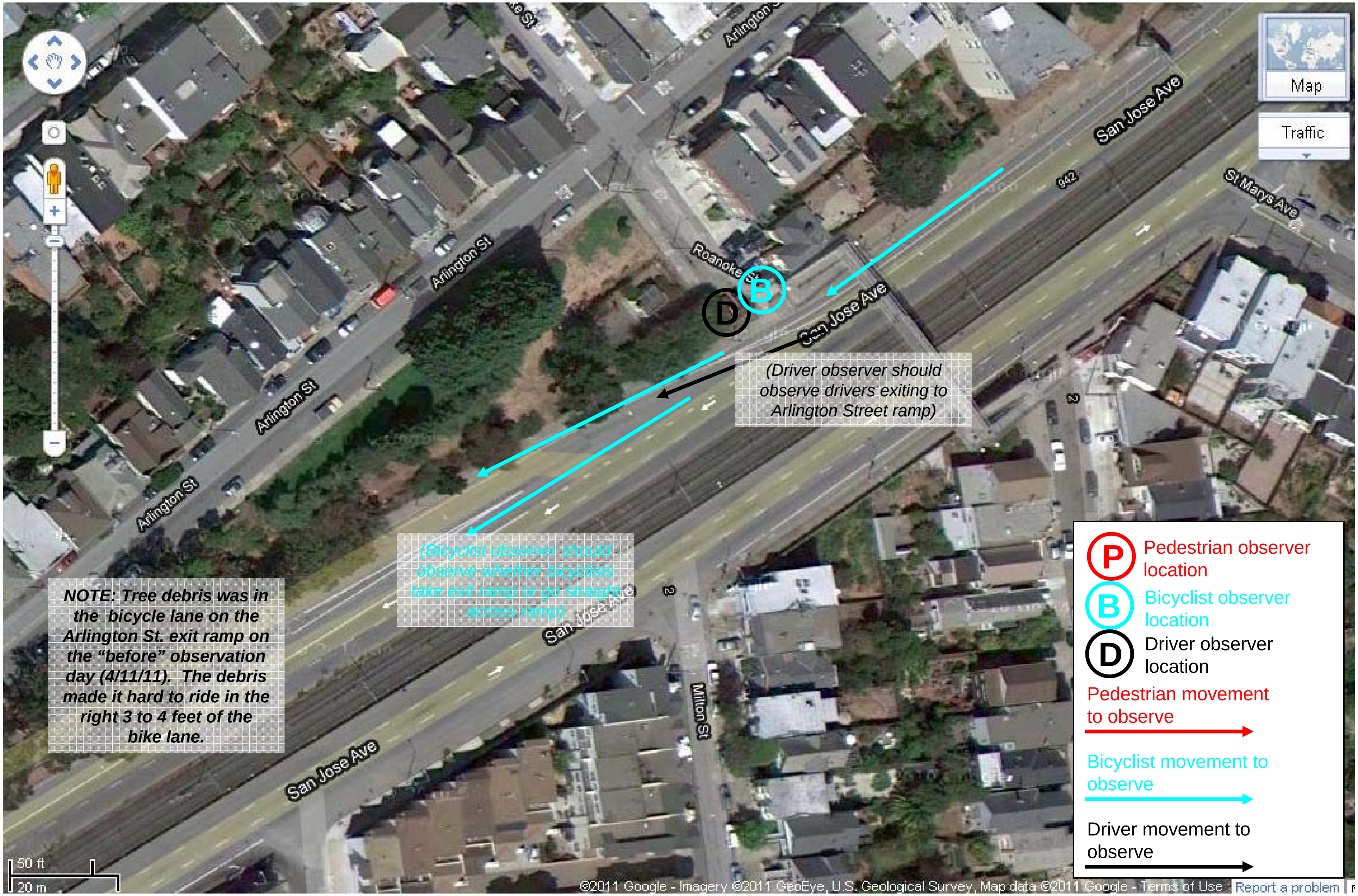
Pittsburg: Bailey Rd. & BART Access Rd.



Lafayette: Mt. Diablo Blvd. & Lafayette Cir.

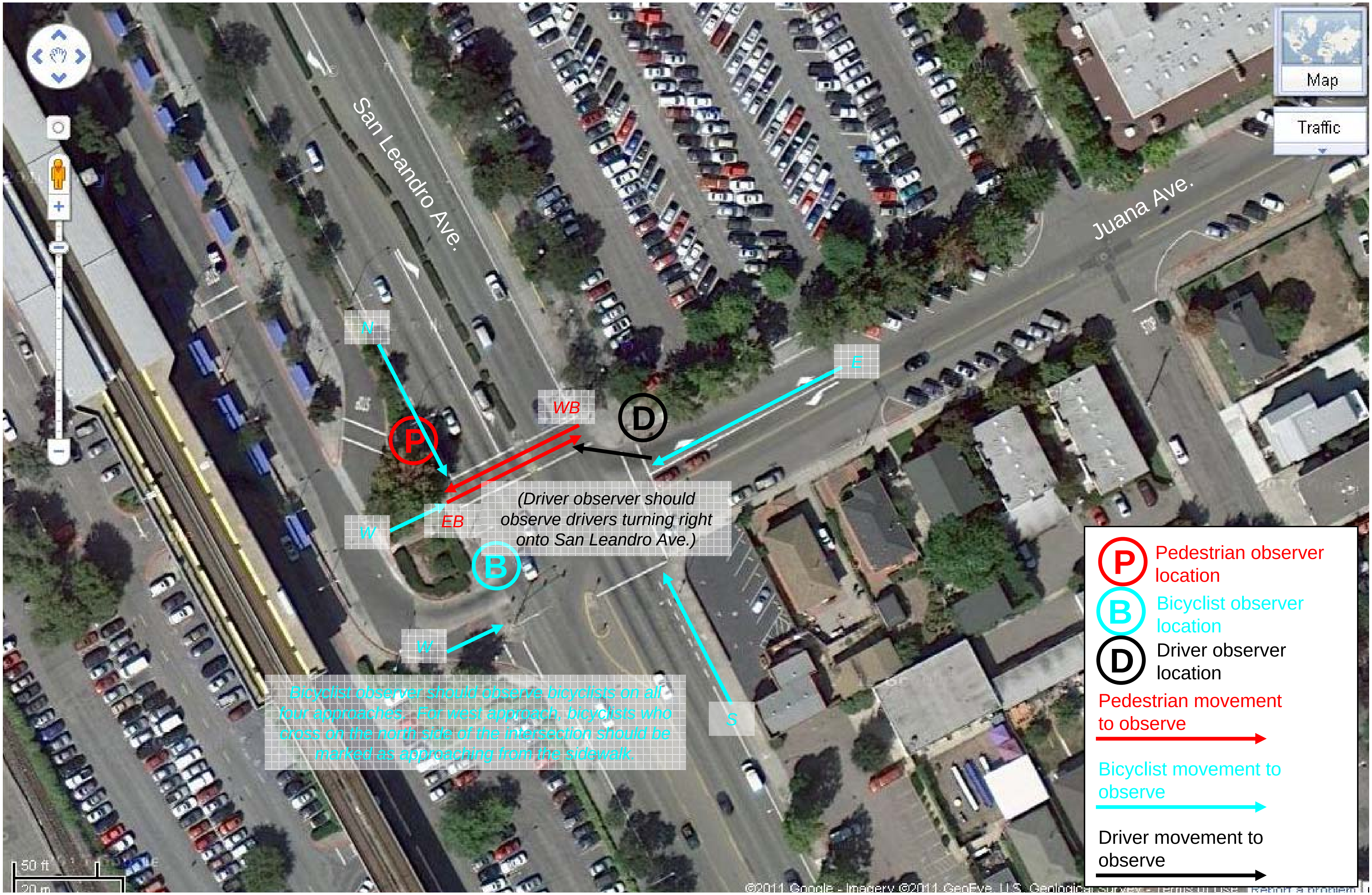


Glen Park (1): San Jose Ave. & Arlington St. Exit Ramp

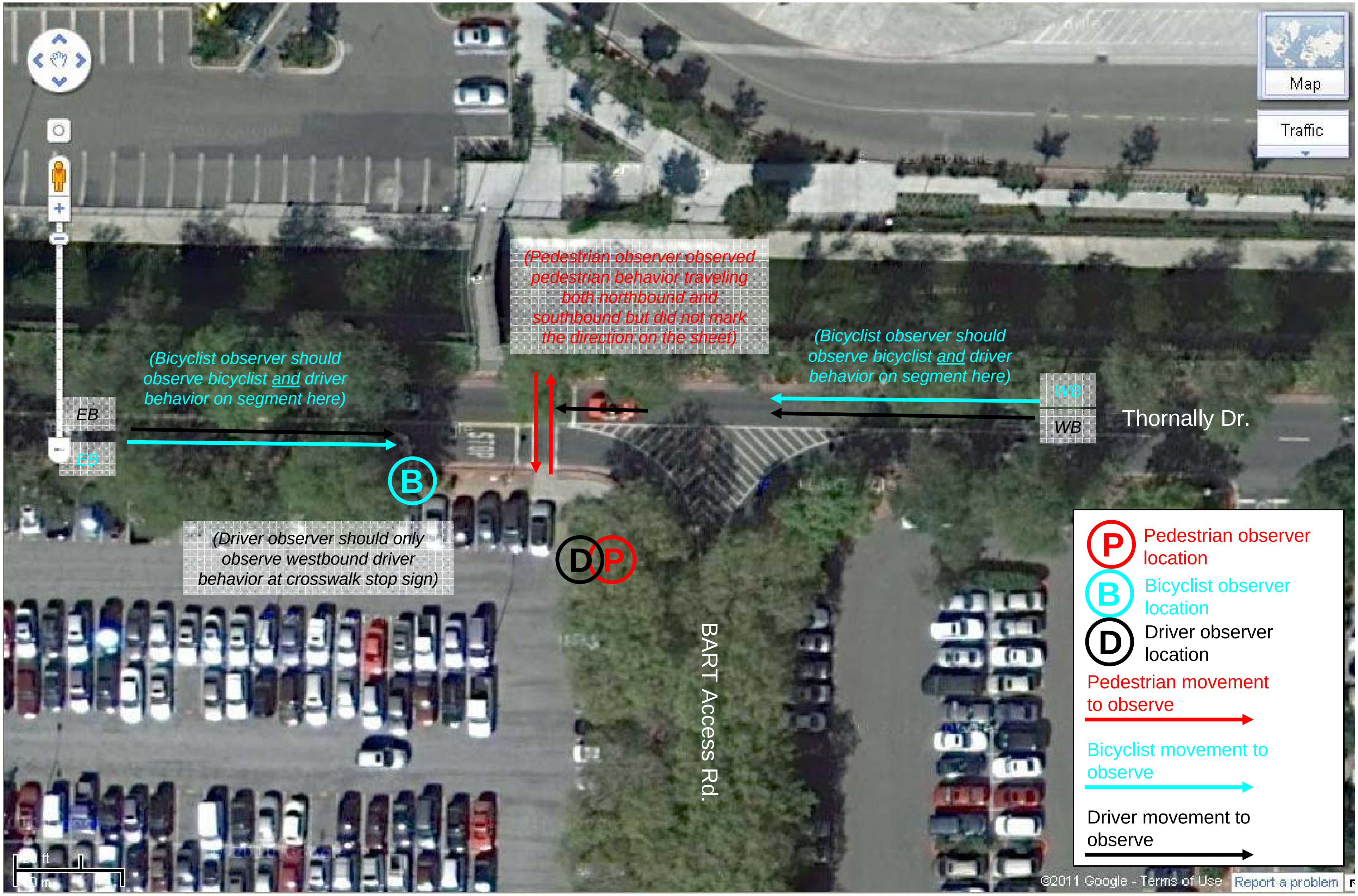


Glen Park (2): Bosworth St. & Diamond St.

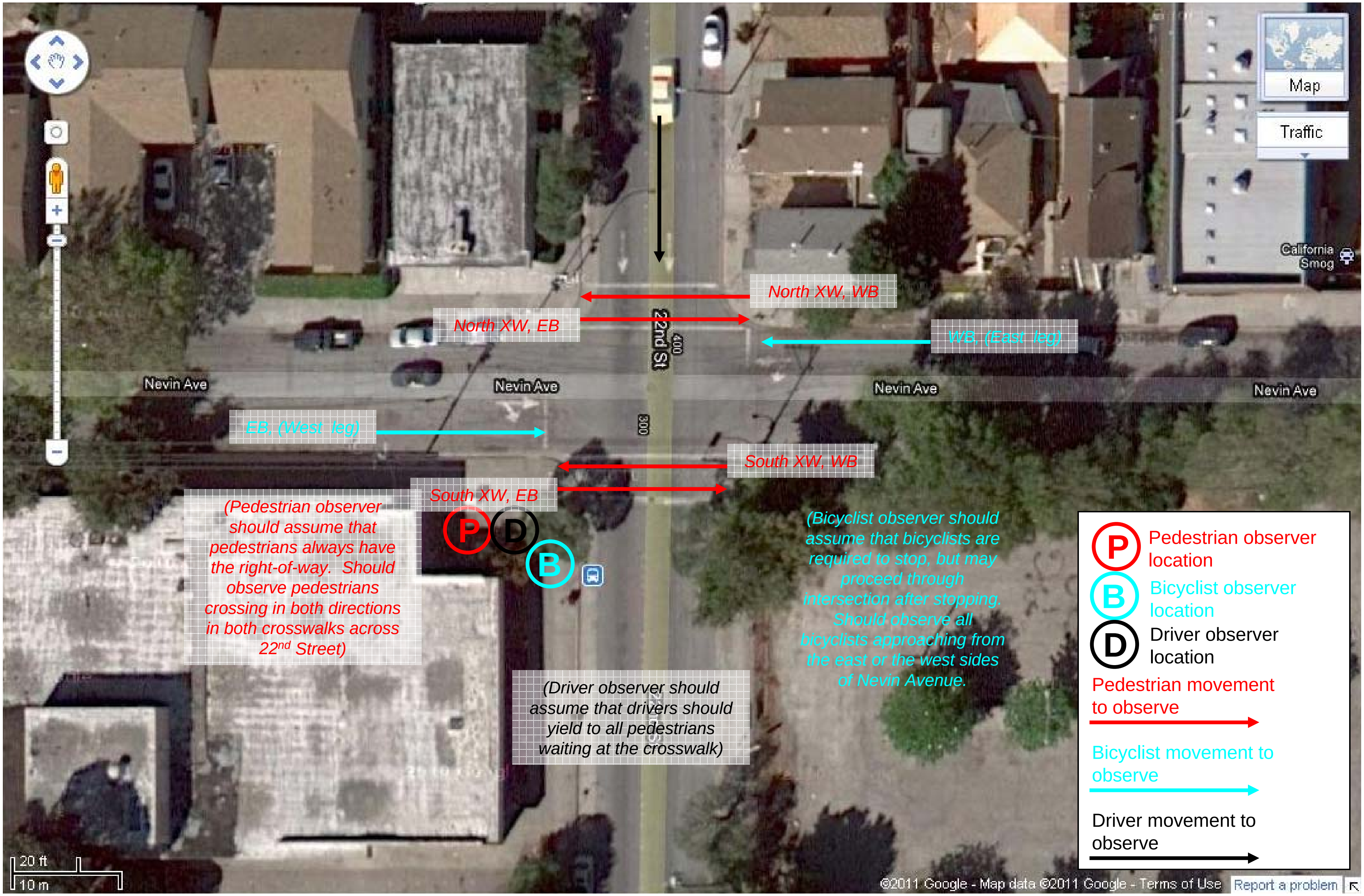
San Leandro: Juana Ave. & San Leandro Ave.



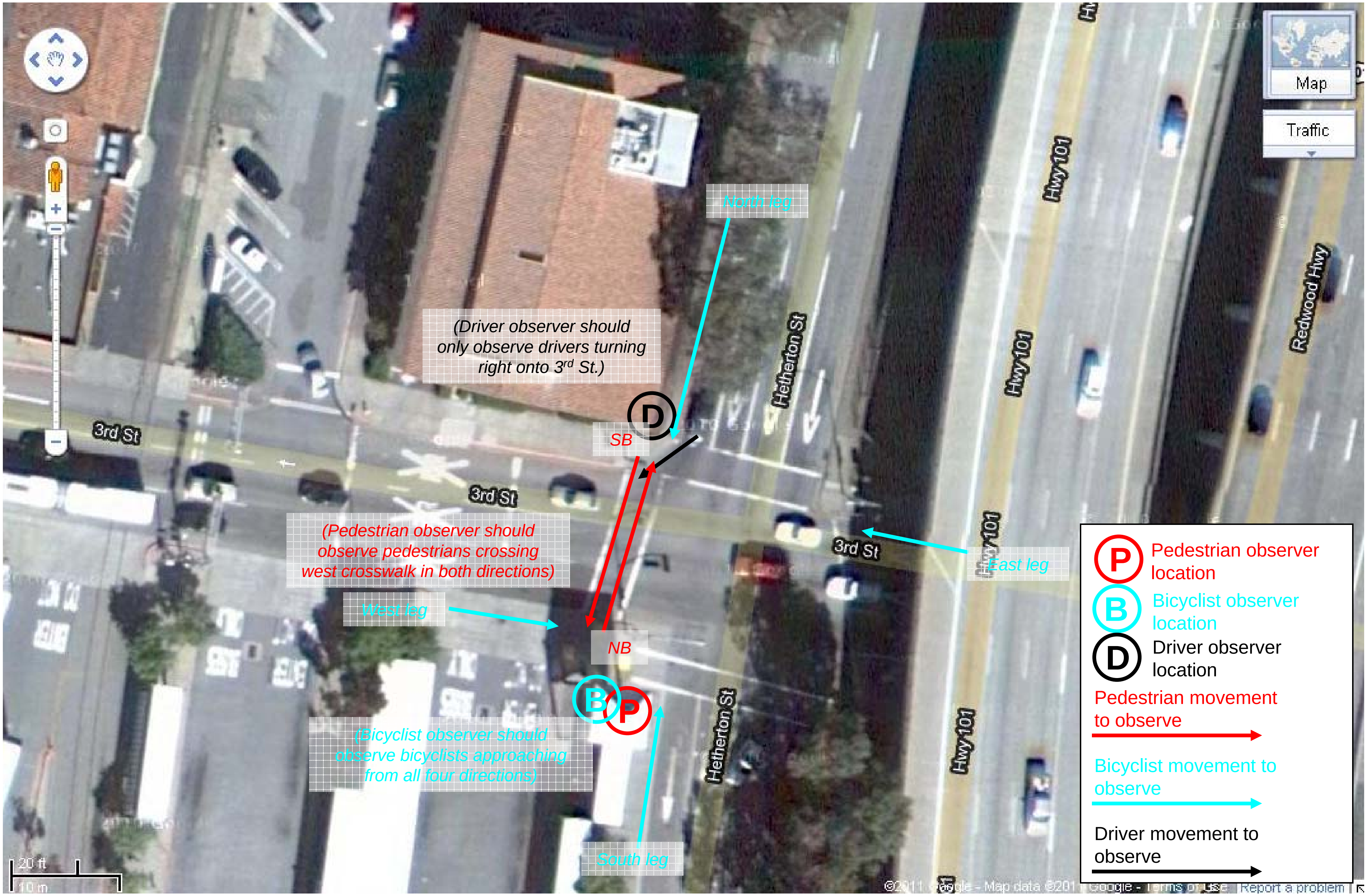
Bay Fair: Thornally Dr. & BART Access Rd.



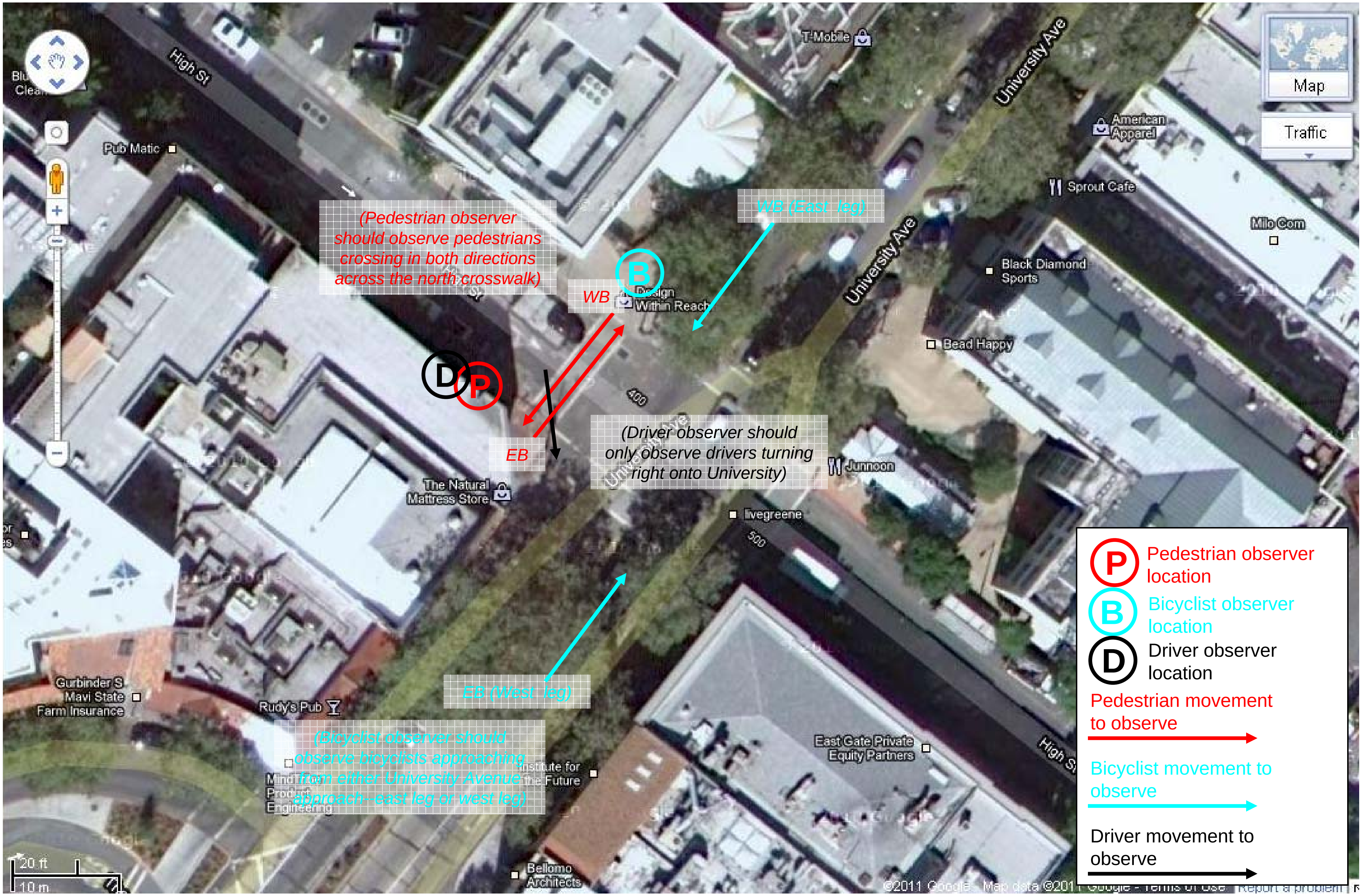
Richmond: Nevin Ave. & 22nd St.



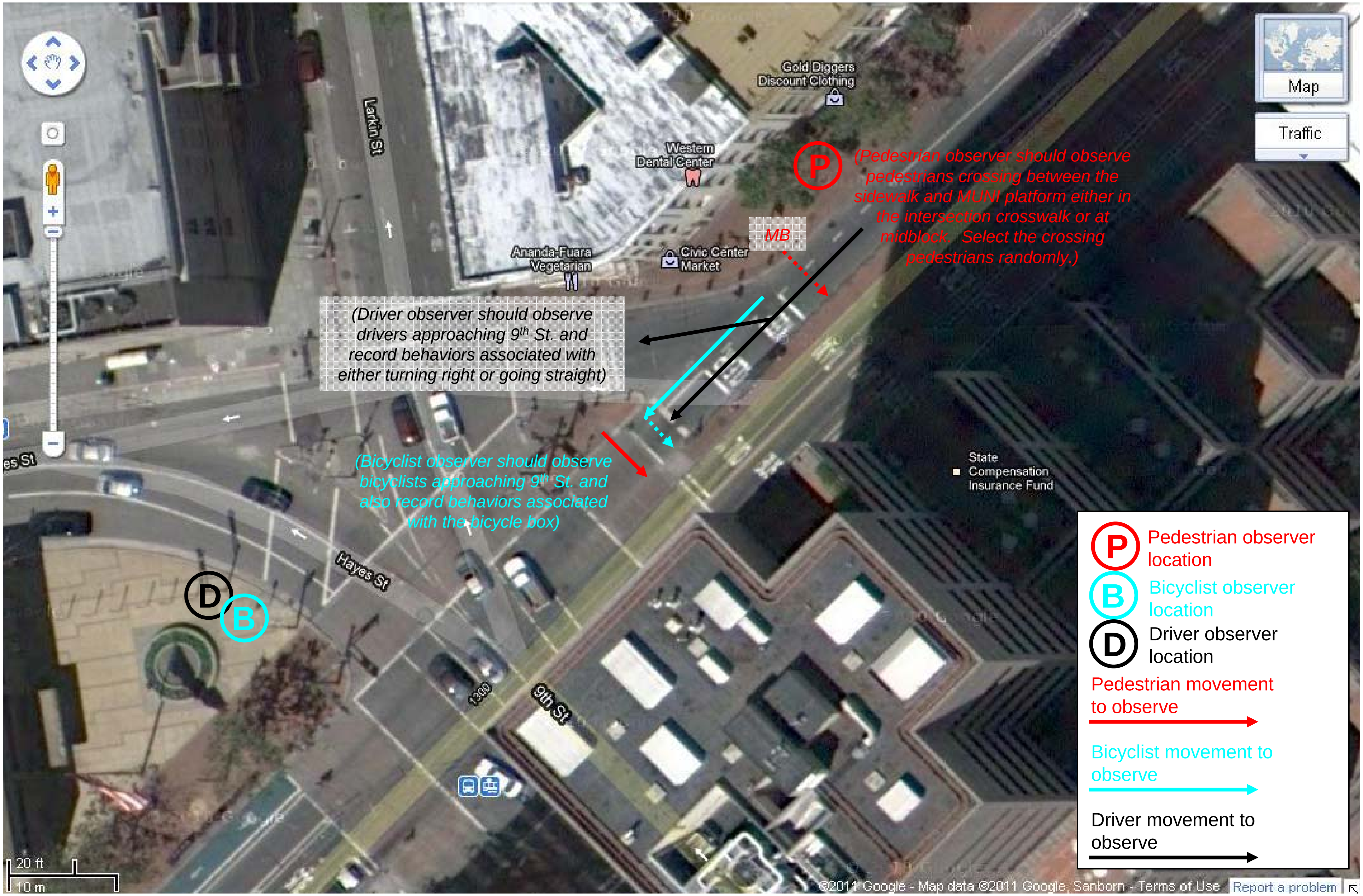
San Rafael: Hetherton St. & 3rd St.



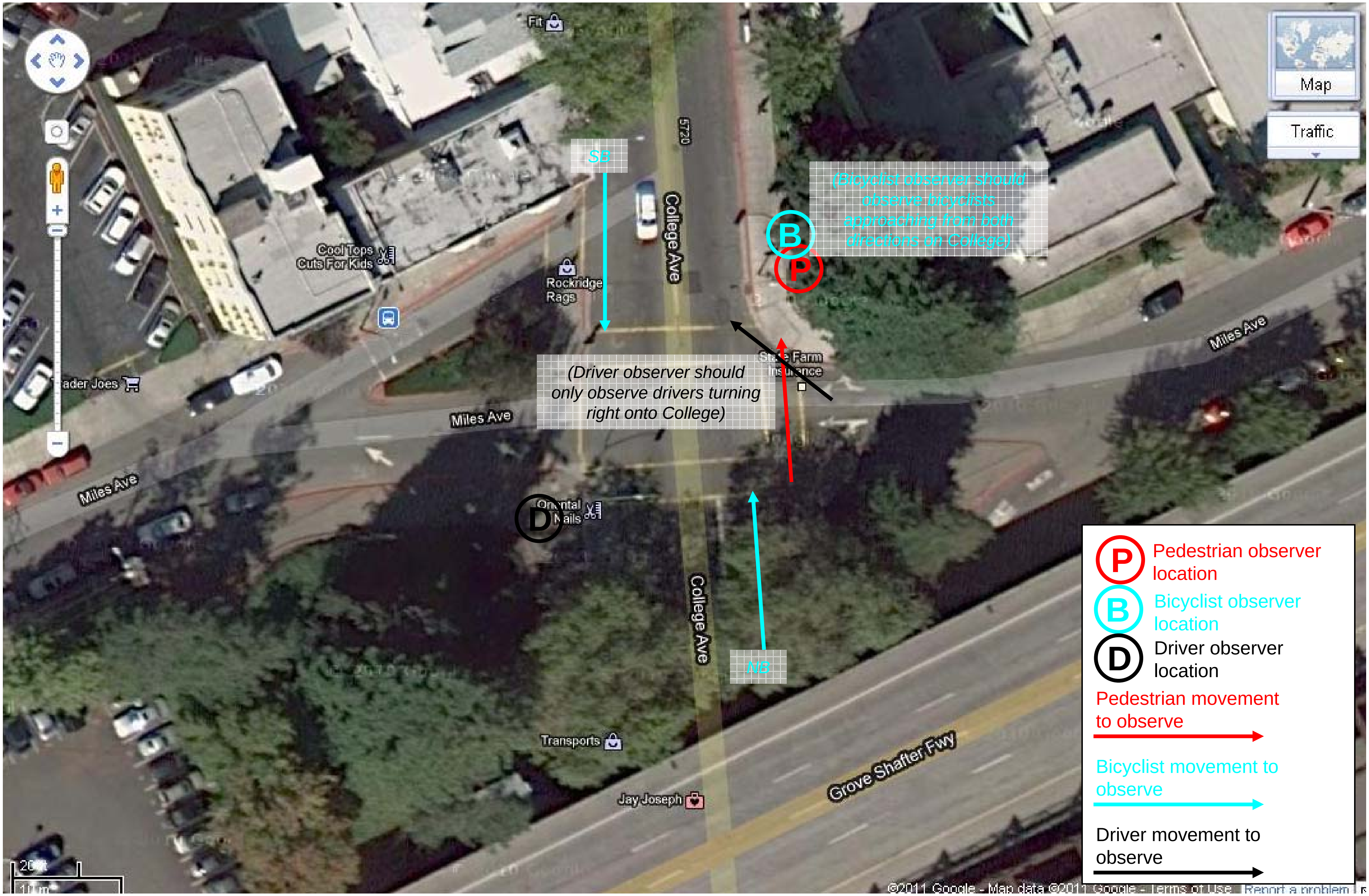
Palo Alto: University Ave. & High St.



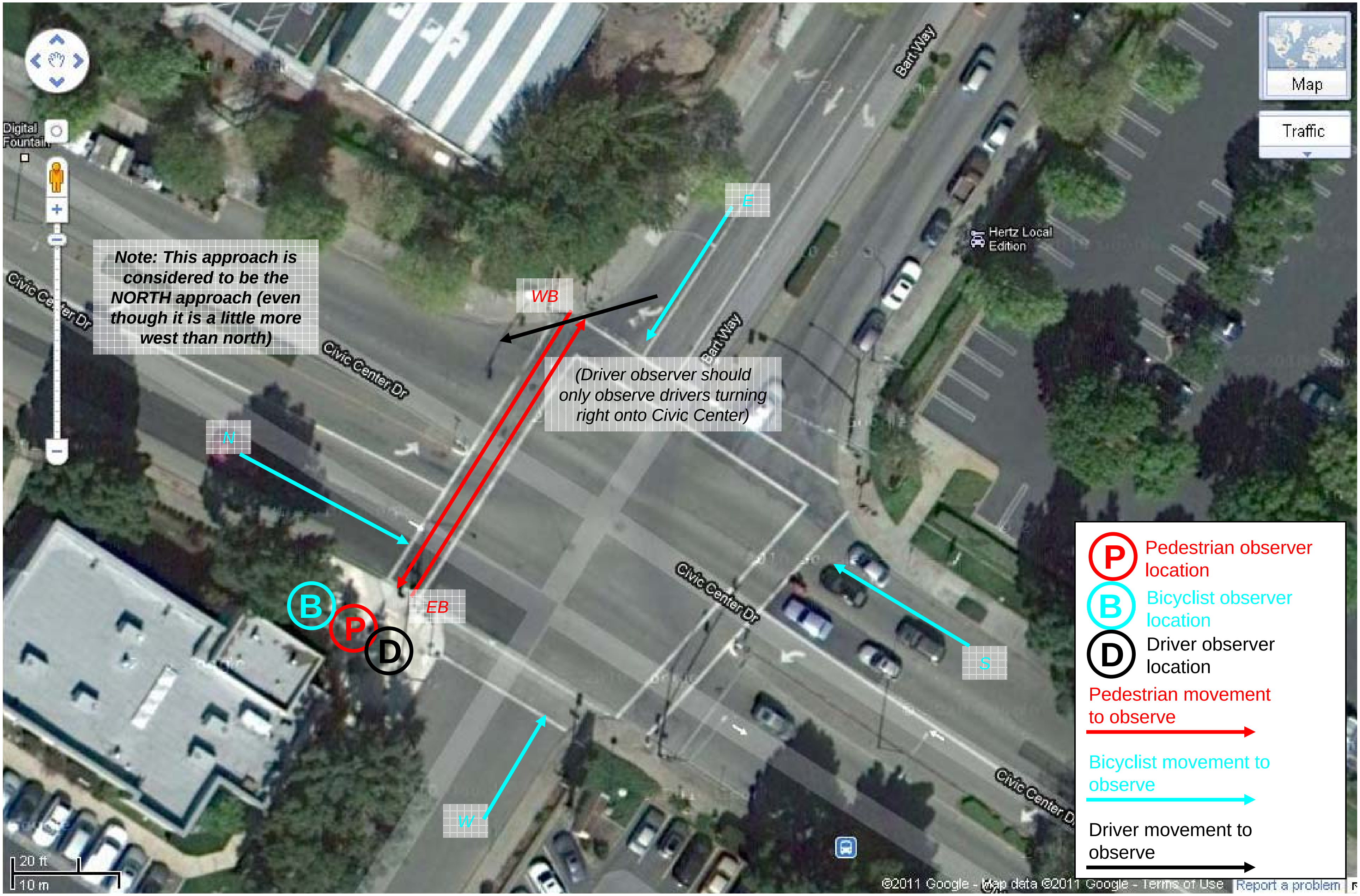
Civic Center: Market St. & 9th St.



Rockridge: College Ave. & Miles Ave.



Fremont: Civic Center Dr. & BART Way



SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

MEMORANDUM

TO: Station Agents **DATE:** April 1, 2011

FROM: Paul Liston, Manager, Train Operations Support

SUBJECT: MTC Survey at Selected BART Stations in April

This memorandum authorizes survey takers from Fehr & Peers Transportation Consultants to conduct a **passenger survey on BART platforms at 10 selected stations** in April between the hours of **6 a.m. and 12 noon**. This survey is being conducted as part of a Metropolitan Transportation Commission (MTC) study.

During the survey, **two survey takers** will distribute and collect surveys on the platform. Survey takers shall not impede customer movement on the platforms including boarding/off-boarding trains and elevators/escalators. **The survey takers will wear green safety vests and name tags, carry photo ID, and carry this permission letter while working on this project.** Please allow the survey takers to exit and enter through the swing gate at the station being surveyed if needed, upon presentation of this letter.

The following stations will be surveyed on the following dates*:

Date	Station Surveyed
Monday, April 4	Lafayette
Tuesday, April 5	San Leandro
Wednesday, April 6	Bay Fair
Thursday, April 7	Fremont
Monday, April 11	Glen Park
Tuesday, April 12	Richmond
Wednesday, April 13	Balboa Park
Thursday, April 14	Rockridge
Monday, April 18	Pittsburg
Wednesday, April 27	Civic Center

If make-up days are needed due to rain or other reasons, surveying may be conducted on Thurs, April 21, Thurs, April 28, Mon, May 2, or Thurs, May 5 (stations TBD).

Your cooperation and assistance with this study are greatly appreciated.

cc: M. Wetter, A. Weinstein

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

MEMORANDUM

TO: Station Agents **DATE:** September 13, 2012

FROM: Paul Liston, Manager,
ACTO – C Line Train Operations Support

SUBJECT: **MTC Survey at Selected BART Stations in September and October 2012**

This memorandum authorizes survey takers from Fehr & Peers Transportation Consultants to conduct a passenger survey on BART platforms at four (4) selected stations in September and October between the hours of 6 a.m. and 12 Noon. This survey is being conducted as part of a Metropolitan Transportation Commission (MTC) study.

During the survey, two survey takers will distribute and collect surveys on the station platform. Survey takers shall not impede customer movement on the platforms including boarding/disembarking trains and elevators/escalators/stairs. The survey takers will wear green safety vests and name tags, carry photo ID, and carry this permission letter while working on this project. Please allow the survey takers to exit and enter through the swing gate at the station being surveyed upon presentation of this letter.

The following stations will be surveyed on the following dates:

Date	Station Surveyed
Friday, September 21	Rockridge (on-site training)
Thursday, September 27	Rockridge
Tuesday, October 2	Civic Center
Thursday, October 4	Lafayette
Tuesday, October 9 or Wednesday, October 10 or Thursday, October 11	Fremont

Your cooperation and assistance with this study are greatly appreciated.

cc: M. Wetter, A. Weinstein, R. Lockhart

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

MEMORANDUM

TO: Station Agents **DATE:** September 11, 2013

FROM: Tera Hankins
Senior Operations Supervisor

SUBJECT: MTC Survey at Selected BART Stations in September and October 2013

This memorandum authorizes survey takers from UC Berkeley to conduct a passenger survey on BART platforms at five (5) selected stations in September and October between the hours of 6 a.m. and 12 Noon. This survey is being conducted as part of a Metropolitan Transportation Commission (MTC) study.

During the survey, two survey takers will distribute and collect surveys on the station platform. Survey takers shall not impede customer movement on the platforms including boarding/disembarking trains and elevators/escalators/stairs. The survey takers will wear green safety vests and name tags, carry photo ID, and carry this permission letter while working on this project. Please allow the survey takers to enter and exit through the swing gate at the station being surveyed upon presentation of this letter.

The following stations will be surveyed on the following dates:

Date	Station Surveyed
Tues, Sept. 17	Rockridge (on-site training)
Wed, Sept. 18	Pittsburg
Thurs, Sept. 19	Bay Fair
Tues, Sept. 24	Balboa Park
Thurs, Sept. 26	Glen Park
Wed, Oct. 2	Pittsburg (if needed)

Your cooperation and assistance with this study are greatly appreciated.

cc: M. Wetter, A. Weinstein

BART Station Access Survey

The information you provide on this survey will be used by the Metropolitan Transportation Commission for their Safe Routes to Transit Study. Your responses will be anonymous and will only be analyzed together with other responses. You may refuse to answer any survey question. This survey will take approximately 1 minute to complete. Thanks for your help!

The following questions gather basic information about your journey to the BART station entrance today.

1) Where did you start traveling from this morning (e.g. home, hotel, etc.)?
Nearby Intersection (e.g., Main & 1st) ________________________&________________________ City: _________________

2) If you stopped to do any activities this morning (e.g., coffee shop, school, daycare), where did you stop? (list all)
Nearby Intersection: ________________________&________________________ City: ________________
Nearby Intersection: ________________________&________________________ City: ________________
Nearby Intersection: ________________________&________________________ City: ________________
Why did you stop at these locations? (circle all that apply) Food/Drink, Shopping, Child Care, School, Work, Meet/Pick-Up

3) From the time you left the doorway of where you started traveling this morning until you entered this BART station, how many total minutes have you spent using each type of transportation (including travel between all of your stops, walking to & from bus stops, and walking to & from parking spots, but not in buildings)? Please make your best guess.
Walking: _____, Bicycling: _____, Bus: _____, BART: _____, Car/Truck: _____, Other (Please specify_________): _____

4) Besides BART fare, how much have you paid for any of the following transportation costs today?
Automobile parking fees (includes BART parking lot): $ ___.___, Bus/Muni fares: $ ___.___, Tolls: $___.___

5) Over the last year, about how often did you enter the BART system through this station? (check one)
☐5 or more times per month, ☐1 to 4 times per month, ☐Less than 1 time per month, ☐This is my first visit today

6) What is the maximum number of bags/packages you carried at any time when traveling to BART this morning? (check one)
☐0, ☐1, ☐2, ☐3, ☐4 or more

7) Including yourself, how many people are traveling with you on BART today? (check one)
☐1, ☐2, ☐3, ☐4 or more

Please provide the following general information about yourself.

8) Sex: ☐Female, ☐Male	9) Age: ☐Under 18, ☐18-24, ☐25-34, ☐35-44, ☐45-54, ☐55-64, ☐Over 64	
10) # adults/children in household Adults: ____, Children (<18): ____	11) # of automobiles and motorcycles in your household: ____	12) # of bicycles in your household: ____
13) Do you have a monthly bus pass: ☐Yes, ☐No	14) Do you have physical limitations that prevent you from doing the following? Walking: ☐Yes, ☐No, Bicycling: ☐Yes, ☐No, Driving: ☐Yes, ☐No	

If you have any additional comments, please write them on the back side of this survey form. ----->

(For Official Use Only) **Survey Number:______ BART Station:______ Survey Distribution Time:______**

BART Station Access Survey

The information you provide on this survey will be used by the Metropolitan Transportation Commission for their Safe Routes to Transit Study. Your responses will be anonymous and will only be analyzed together with other responses. You may refuse to answer any survey question. This survey will take approximately 3 minutes to complete. Thanks for your help!

The following questions gather basic information about your journey to the BART station entrance today.

1) Where did you start traveling from this morning (e.g. home, hotel, etc.)?
Nearby Intersection (e.g., Main & 1st) ________________________&________________________ City: _________________

2) If you stopped to do any activities this morning (e.g., coffee shop, school, daycare), where did you stop? (list all)
Nearby Intersection: ________________________&________________________ City: ________________
Nearby Intersection: ________________________&________________________ City: ________________
Nearby Intersection: ________________________&________________________ City: ________________
Why did you stop at these locations? (circle all that apply) Food/Drink, Shopping, Child Care, School, Work, Meet/Pick-Up

3) From the time you left the doorway of where you started traveling this morning until you entered this BART station, how many total minutes have you spent using each type of transportation (including travel between all of your stops, walking to & from bus stops, and walking to & from parking spots, but not in buildings)? Please make your best guess.
Walking: _____, Bicycling: _____, Bus: _____, BART: _____, Car/Truck: _____, Other (Please specify_________): _____

4) Besides BART fare, how much have you paid for any of the following transportation costs today?
Automobile parking fees (includes BART parking lot): $ ___.___, Bus/Muni fares: $ ___.___, Tolls: $___.___

5) Over the last year, about how often did you enter the BART system through this station? (check one)
☐5 or more times per month, ☐1 to 4 times per month, ☐Less than 1 time per month, ☐This is my first visit today

6) What is the maximum number of bags/packages you carried at any time when traveling to BART this morning? (check one)
☐0, ☐1, ☐2, ☐3, ☐4 or more

7) Including yourself, how many people are traveling with you on BART today? (check one)
☐1, ☐2, ☐3, ☐4 or more

Please provide the following general information about yourself.

8) Sex: ☐Female, ☐Male

9) Age: ☐Under 18, ☐18-24, ☐25-34, ☐35-44, ☐45-54, ☐55-64, ☐Over 64

10) # adults/children in household
Adults: ____, Children (<18): ____

11) # of automobiles and motorcycles in your household: ____

12) # of bicycles in your household: ____

13) Do you have a monthly bus pass: ☐Yes, ☐No

14) Do you have physical limitations that prevent you from doing the following?
Walking: ☐Yes, ☐No, Bicycling: ☐Yes, ☐No, Driving: ☐Yes, ☐No

Please provide your perceptions and opinions related to traveling to the BART station.

15) In terms of traffic safety, how concerned are you about being involved in an accident when traveling to this BART station… (circle one number)
While walking? (Not concerned) 1 2 3 4 5 (Very concerned)
While bicycling? (Not concerned) 1 2 3 4 5 (Very concerned)
While riding in an automobile? (Not concerned) 1 2 3 4 5 (Very concerned)

16) How much of a problem do you think air pollution is when traveling to this BART station... (circle one number)
While walking? (Not a problem) 1 2 3 4 5 (Significant problem)
While bicycling? (Not a problem) 1 2 3 4 5 (Significant problem)
While riding in an automobile? (Not a problem) 1 2 3 4 5 (Significant prob.)

17) Have you noticed any changes to streets, sidewalks, intersections, bus stops, or station facilities within one-half mile of this BART station in the last year? ☐Yes, ☐No
If Yes, what changes?

A) ____

B) ____

C) ____

18) If you have noticed changes to the BART station area or nearby roadways and sidewalks in the last year (listed in Question 17), how helpful have these changes been for traveling to this station… (circle one number) (3 is neutral or no opinion)

Change A
By walking? (Much worse) 1 2 3 4 5 (Much better)
By bicycling? (Much worse) 1 2 3 4 5 (Much better)
By bus/Muni? (Much worse) 1 2 3 4 5 (Much better)
By automobile? (Much worse) 1 2 3 4 5 (Much better)

Change B
By walking? (Much worse) 1 2 3 4 5 (Much better)
By bicycling? (Much worse) 1 2 3 4 5 (Much better)
By bus/Muni? (Much worse) 1 2 3 4 5 (Much better)
By automobile? (Much worse) 1 2 3 4 5 (Much better)

Change C
By walking? (Much worse) 1 2 3 4 5 (Much better)
By bicycling? (Much worse) 1 2 3 4 5 (Much better)
By bus/Muni? (Much worse) 1 2 3 4 5 (Much better)
By automobile? (Much worse) 1 2 3 4 5 (Much better)

***(For Official Use Only)* Survey Number:______ BART Station:______ Survey Distribution Time:______**

Transit Station Access Survey

The information you provide on this survey will be used by the Metropolitan Transportation Commission for their Safe Routes to Transit Study. Your responses will be anonymous and will only be analyzed together with other responses. You may refuse to answer any survey question. This survey will take approximately 1 minute to complete. Thanks for your help!

The following questions gather basic information about your journey to the transit station entrance today.

1) Name the closest street intersection to your home, hotel, or other location where you first started traveling today:
Nearby Intersection (e.g., Main & 1st) ________________________&________________________ City: __________________

2) If you stopped to do any activities this morning (e.g., coffee shop, school, daycare), where did you stop? (list all)
Nearby Intersection: ________________________&________________________ City: _________________
Nearby Intersection: ________________________&________________________ City: _________________
Nearby Intersection: ________________________&________________________ City: _________________
Why did you stop at these locations? (circle all that apply) Food/Drink, Shopping, Child Care, School, Work, Meet/Pick-Up

3) How many total minutes did you spend traveling to this transit station by each of the following modes (include travel between all of your stops, walking to & from bus stops, and walking to & from parking spots, but not in buildings)? Please make your best guess.
Walking: _____, Bicycling: _____, Bus: _____, BART: _____, Car/Truck: _____, Other (Please specify_________): _____

4) Besides BART fare, how much have you paid for any of the following transportation costs today?
Parking fees (includes BART parking lot): $ __.____, Bus/Muni fares: $ __.____, Tolls: $__.____, Or check: ☐No costs ($0.00)

5) Over the last year, about how often did you enter the BART system through this station? (check one)
☐5 or more times per month, ☐1 to 4 times per month, ☐Less than 1 time per month, ☐This is my first visit today

6) What is the maximum number of bags/packages you carried at any time when traveling to BART this morning? (check one)
☐0, ☐1, ☐2, ☐3, ☐4 or more

7) Including yourself, how many people are traveling with you on BART today? (check one)
☐1, ☐2, ☐3, ☐4 or more

Please provide the following general information about yourself.

8) Sex: ☐Female, ☐Male

9) Age: ☐18-24, ☐25-34, ☐35-44, ☐45-54, ☐55-64, ☐65+

10) # adults/children in household
Adults: ____, Children (<18): ____

11) # of automobiles and motorcycles in your household: ____

12) # of bicycles in your household: ____

13) Do you have a monthly bus pass: ☐Yes, ☐No

14) Do you have physical limitations that prevent you from doing the following?
Walking: ☐Yes, ☐No, Bicycling: ☐Yes, ☐No, Driving: ☐Yes, ☐No

If you have any additional comments, please write them on the back side of this survey form. ----->

(For Official Use Only) **Survey Number:______ BART Station:______ Survey Distribution Time:______**

Transit Station Access Survey

The information you provide on this survey will be used by the Metropolitan Transportation Commission for their Safe Routes to Transit Study. Your responses will be anonymous and will only be analyzed together with other responses. You may refuse to answer any survey question. This survey will take approximately 3 minutes to complete. Thanks for your help!

The following questions gather basic information about your journey to the transit station entrance today.

1) Name the closest street intersection to your home, hotel, or other location where you first started traveling today:
Nearby Intersection (e.g., Main & 1st) ________________________&________________________ City: __________________

2) If you stopped to do any activities this morning (e.g., coffee shop, school, daycare), where did you stop? (list all)
Nearby Intersection: ________________________&________________________ City: _________________
Nearby Intersection: ________________________&________________________ City: _________________
Nearby Intersection: ________________________&________________________ City: _________________
Why did you stop at these locations? (circle all that apply) Food/Drink, Shopping, Child Care, School, Work, Meet/Pick-Up

3) How many total minutes did you spend traveling to this transit station by each of the following modes (include travel between all of your stops, walking to & from bus stops, and walking to & from parking spots, but not in buildings)? Please make your best guess.
Walking: _____, Bicycling: _____, Bus: _____, BART: _____, Car/Truck: _____, Other (Please specify_________): _____

4) Besides BART fare, how much have you paid for any of the following transportation costs today?
Parking fees (includes BART parking lot): $ ___.___, Bus/Muni fares: $ ___.___, Tolls: $___.___, Or check: ☐No costs ($0.00)

5) Over the last year, about how often did you enter the BART system through this station? (check one)
☐5 or more times per month, ☐1 to 4 times per month, ☐Less than 1 time per month, ☐This is my first visit today

6) What is the maximum number of bags/packages you carried at any time when traveling to BART this morning? (check one)
☐0, ☐1, ☐2, ☐3, ☐4 or more

7) Including yourself, how many people are traveling with you on BART today? (check one)
☐1, ☐2, ☐3, ☐4 or more

Please provide the following general information about yourself.

8) Sex: ☐Female, ☐Male

9) Age: ☐18-24, ☐25-34, ☐35-44, ☐45-54, ☐55-64, ☐65+

10) # adults/children in household
Adults: ____, Children (<18): ____

11) # of automobiles and motorcycles in your household: ____

12) # of bicycles in your household: ____

13) Do you have a monthly bus pass: ☐Yes, ☐No

14) Do you have physical limitations that prevent you from doing the following?
Walking: ☐Yes, ☐No, Bicycling: ☐Yes, ☐No, Driving: ☐Yes, ☐No

Please provide your perceptions and opinions related to traveling to the BART station.

15) In terms of traffic safety, how concerned are you about being involved in an accident when traveling to this BART station… (circle one number)

While walking? (Not concerned) 1 2 3 4 5 (Very concerned)
While bicycling? (Not concerned) 1 2 3 4 5 (Very concerned)
While riding in an automobile? (Not concerned) 1 2 3 4 5 (Very concerned)

16) How much of a problem do you think air pollution is when traveling to this BART station... (circle one number)

While walking? (Not a problem) 1 2 3 4 5 (Significant prob.)
While bicycling? (Not a problem) 1 2 3 4 5 (Significant prob.)
While riding in an automobile? (Not a problem) 1 2 3 4 5 (Significant prob.)

17) Have you noticed any changes to streets, sidewalks, intersections, bus stops, or station facilities within one-half mile of this BART station in the last year? ☐Yes, ☐No
If Yes, what specific changes?

A) ____

B) ____

C) ____

18) If you have noticed changes to the BART station area or nearby roadways and sidewalks in the last year (listed in Question 17), how helpful have these changes been for traveling to this station… (circle one) (neutral includes no opinion)

Change A
By walking? Much worse, Worse, Neutral, Better, Much better
By bicycling? Much worse, Worse, Neutral, Better, Much better
By bus/Muni? Much worse, Worse, Neutral, Better, Much better
By automobile? Much worse, Worse, Neutral, Better, Much better

Change B
By walking? Much worse, Worse, Neutral, Better, Much better
By bicycling? Much worse, Worse, Neutral, Better, Much better
By bus/Muni? Much worse, Worse, Neutral, Better, Much better
By automobile? Much worse, Worse, Neutral, Better, Much better

Change C
By walking? Much worse, Worse, Neutral, Better, Much better
By bicycling? Much worse, Worse, Neutral, Better, Much better
By bus/Muni? Much worse, Worse, Neutral, Better, Much better
By automobile? Much worse, Worse, Neutral, Better, Much better

***(For Official Use Only)* Survey Number:______ BART Station:______ Survey Distribution Time:______**

Bicyclist Behavior Observation Sheet (Intersection Approach)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe all bicyclists approaching the intersection from one direction. Circle their position on the roadway/sidewalk (T = travel lane, B = bicycle lane, SW = sidewalk). Observe whether they are wearing a helmet (Y = yes, N = no), gender (F = female, M = male), and age group. If you cannot tell the gender or age of the bicyclist, make your best guess. Note how the bicyclist behaves at the intersection (RS = bicyclist stops at red light and waits until green to enter the intersection, RX = bicyclist enters intersection when light is red, TR = bicyclist turns right on red (may have stopped or not), SS = bicyclist stops or slows significantly at stop sign before entering intersection, SX = bicyclist enters intersection without slowing significantly at a stop sign, GY = bicyclist passes through light on green/yellow). Circle all behaviors that apply. Do not count people who are walking their bicycles. Mark a line below the latest completed observation every 15 minutes, and label that line with the time.

RS = Stops at Red Light
RX = Runs Red Light
TR = Turns Right on Red
SS = Stops/Slows at Stop Sign
SX = Runs Stop Sign
GY = Enters on Green or Yellow

Count	Position	Helmet	Gender	Esimtated Age Group	Intersection Behavior
1	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
2	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
3	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
4	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
5	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
6	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
7	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
8	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
9	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
10	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
11	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
12	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
13	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
14	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
15	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
16	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
17	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
18	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
19	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
20	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
21	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
22	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
23	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
24	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
25	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
26	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
27	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
28	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
29	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
30	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
31	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
32	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
33	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
34	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
35	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
36	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
37	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
38	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
39	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY
40	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS TR RX SS SX GY

Market St. Bicyclist Behavior Observation Sheet

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe all bicyclists approaching the intersection from one direction. Circle their position on the roadway/sidewalk (T = travel lane, B = bicycle lane, SW = sidewalk). Observe whether they are wearing a helmet (Y = yes, N = no), gender (F = female, M = male), and age group. If you cannot tell the gender or age of the bicyclist, make your best guess. Note how the bicyclist behaves at the intersection (RS = bicyclist stops at red light and waits until green to enter the intersection, RX = bicyclist enters intersection when light is red, BK = bicyclist blocks automobiles turning right at the intersection (bicyclist may be stopped or not), BB = bicyclist stops in bike box directly in front of cars (not in the right part of the bike box that is durectly downstream of the bike lane), stops or slows significantly at stop sign before entering intersection, OT= , GY = bicyclist passes through light on green/yellow). Circle all behaviors that apply. Do not count people who are walking their bicycles. Mark a line below the latest completed observation every 15 minutes, and label that line with the time.

RS = Stops at Red Light
RX = Runs Red Light
BK = Blocks Right-Turn Automobiles
BB = Uses Bike Box IN FRONT OF cars
OT =
GY = Enters on Green or Yellow

Count	Position	Helmet	Gender	Esimtated Age Group	Intersection Behavior
1	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
2	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
3	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
4	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
5	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
6	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
7	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
8	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
9	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
10	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
11	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
12	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
13	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
14	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
15	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
16	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
17	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
18	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
19	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
20	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
21	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
22	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
23	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
24	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
25	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
26	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
27	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
28	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
29	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
30	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
31	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
32	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
33	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
34	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
35	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
36	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
37	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
38	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
39	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY
40	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	RS RX BK BB OT GY

Bicyclist Behavior Observation Sheet (Street Segment)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Nearby Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe all bicyclists passing by the location you are standing in the middle of the block. Please circle their position on the roadway/sidewalk (T = travel lane, B = bicycle lane, SW = sidewalk). Also observe whether they are wearing a helmet (Y = yes, N = no), gender (F = female, M = male), and age group. If you cannot tell the gender or age of the bicyclist, make your best guess. Note how the bicyclist behaves when riding along the street segment after clearing the previous intersection (NR = Normal riding, DZ = Riding in the "door zone" within 3 feet of parked cars, SA = Bicycling in front of traffic and slowing automobiles down, EB = Erratic behavior--not maintaining a relatively straight line of travel or swerving in and out of traffic). Circle all behaviors that apply. Do not count people who are walking their bicycles. Mark a line below the latest completed observation every 15 minutes, and label that line with the current time.

NR = Normal Riding
DZ = Riding in Door Zone
SA = Slowing Autos Down
EB = Erratic Behavior

Count	Position	Helmet	Gender	Estimated Age Group	Segement Behavior
1	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
2	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
3	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
4	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
5	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
6	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
7	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
8	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
9	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
10	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
11	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
12	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
13	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
14	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
15	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
16	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
17	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
18	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
19	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
20	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
21	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
22	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
23	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
24	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
25	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
26	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
27	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
28	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
29	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
30	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
31	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
32	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
33	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
34	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
35	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
36	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
37	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
38	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
39	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB
40	T B SW	Y N	F M	0-17 18-34 35-49 50-64 65+	NR DZ SA EB

Market St. Driver Behavior Observation Sheet

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe all drivers approaching the crossing from one direction when a bicyclist is approaching, at, or in the intersection. Note how the driver behaves while approaching the crossing (GR = Driver passes through the intersection legally because they enters intersection on green light, ST = Driver stops at red light, EN = Driver encroaches into bicycle box by crossing over stop bar line, RY = Driver turns right after yielding to bicyclist, RX = Driver turns right without yielding to bicyclist (bicylist within 20 feet of conflict point), SK = Driver slows abruptly or skids to yield to bicyclist, SP = Driver speeds through intersection, HK = Driver honks at bicyclist. Circle all behaviors that apply. Mark a line below the latest completed observation every 15 minutes, and label that line with the time.

GR = Enters intersection on green
ST = Stops at Red Light
EN = Encroaches Into Bike Box
RY = Turns Right after Yielding to Bicyclist
RX = Turns Right without Yielding to Bicyclist
SK = Slows Abruptly or Skids to Yield
SP = Speeds through Intersection
HK = Honks at Bicyclist

Count					Crossing Behavior
1					GR ST EN RY RX SK SP HK
2					GR ST EN RY RX SK SP HK
3					GR ST EN RY RX SK SP HK
4					GR ST EN RY RX SK SP HK
5					GR ST EN RY RX SK SP HK
6					GR ST EN RY RX SK SP HK
7					GR ST EN RY RX SK SP HK
8					GR ST EN RY RX SK SP HK
9					GR ST EN RY RX SK SP HK
10					GR ST EN RY RX SK SP HK
11					GR ST EN RY RX SK SP HK
12					GR ST EN RY RX SK SP HK
13					GR ST EN RY RX SK SP HK
14					GR ST EN RY RX SK SP HK
15					GR ST EN RY RX SK SP HK
16					GR ST EN RY RX SK SP HK
17					GR ST EN RY RX SK SP HK
18					GR ST EN RY RX SK SP HK
19					GR ST EN RY RX SK SP HK
20					GR ST EN RY RX SK SP HK
21					GR ST EN RY RX SK SP HK
22					GR ST EN RY RX SK SP HK
23					GR ST EN RY RX SK SP HK
24					GR ST EN RY RX SK SP HK
25					GR ST EN RY RX SK SP HK
26					GR ST EN RY RX SK SP HK
27					GR ST EN RY RX SK SP HK
28					GR ST EN RY RX SK SP HK
29					GR ST EN RY RX SK SP HK
30					GR ST EN RY RX SK SP HK
31					GR ST EN RY RX SK SP HK
32					GR ST EN RY RX SK SP HK
33					GR ST EN RY RX SK SP HK
34					GR ST EN RY RX SK SP HK
35					GR ST EN RY RX SK SP HK
36					GR ST EN RY RX SK SP HK
37					GR ST EN RY RX SK SP HK
38					GR ST EN RY RX SK SP HK
39					GR ST EN RY RX SK SP HK
40					GR ST EN RY RX SK SP HK

San Jose Ave. Driver Behavior Observation Sheet (Approaching Exit Ramp)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe all drivers approaching the San Jose Ave. exit ramp for Arlington St. when a bicyclists is near the exit ramp. Note how the driver behaves while approaching the exit ramp (OK = Driver passes through the bicyclist crossing legally because they have the right-of-way, YY = Driver yields to let bicyclist cross, YX = Driver does not yield to bicyclist when legally required to do so, SP = Driver speeds past the bicycle crossing, HK = Driver honks at bicyclist, SK = Driver slows abruptly or skids to a stop in order to yield to a bicyclist. Circle all behaviors that apply. Count people who are walking their bicycles. Mark a line below the latest completed observation every 15 minutes, and label that line with the time.

OK = Passes crossing because has ROW
YY = Yields to Let Bicyclist Cross
YX = Does not Yield to Bicyclist
SP = Speeds past Bicyclist Crossing
HK = Honks at Bicyclist
SK = Slows Abruptly or Skids to Yield

Count					Crossing Behavior
1					OK YY YX SP HK SK
2					OK YY YX SP HK SK
3					OK YY YX SP HK SK
4					OK YY YX SP HK SK
5					OK YY YX SP HK SK
6					OK YY YX SP HK SK
7					OK YY YX SP HK SK
8					OK YY YX SP HK SK
9					OK YY YX SP HK SK
10					OK YY YX SP HK SK
11					OK YY YX SP HK SK
12					OK YY YX SP HK SK
13					OK YY YX SP HK SK
14					OK YY YX SP HK SK
15					OK YY YX SP HK SK
16					OK YY YX SP HK SK
17					OK YY YX SP HK SK
18					OK YY YX SP HK SK
19					OK YY YX SP HK SK
20					OK YY YX SP HK SK
21					OK YY YX SP HK SK
22					OK YY YX SP HK SK
23					OK YY YX SP HK SK
24					OK YY YX SP HK SK
25					OK YY YX SP HK SK
26					OK YY YX SP HK SK
27					OK YY YX SP HK SK
28					OK YY YX SP HK SK
29					OK YY YX SP HK SK
30					OK YY YX SP HK SK
31					OK YY YX SP HK SK
32					OK YY YX SP HK SK
33					OK YY YX SP HK SK
34					OK YY YX SP HK SK
35					OK YY YX SP HK SK
36					OK YY YX SP HK SK
37					OK YY YX SP HK SK
38					OK YY YX SP HK SK
39					OK YY YX SP HK SK
40					OK YY YX SP HK SK

Driver Behavior Observation Sheet (Street Segment)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Nearby Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe all drivers passing by the location you are standing in the middle of the block. Note how the driver behaves when passing a bicyclist along the street segment after clearing the previous intersection (DC = Passing too close to bicyclist--within 3 feet, DN = Passing far enough from bicyclist, SP = Speeding on roadway segment with bicyclist present, HK = Honking at bicyclist, EB = Erratic behavior--not maintaining a relatively straight line of travel or swerving in and out of traffic). Circle all behaviors that apply. Mark a line below the latest completed observation every 15 minutes, and label that line with the current time.

DC = Passes too Close to Bicyclist
DN = Passes Far Enough from Bicyclist
SP = Speeds on Segment w/ Bicyclist
HK = Honks at Bicyclist
EB = Erratic Behavior

Count					Segement Behavior
1					DC DN SP HK EB
2					DC DN SP HK EB
3					DC DN SP HK EB
4					DC DN SP HK EB
5					DC DN SP HK EB
6					DC DN SP HK EB
7					DC DN SP HK EB
8					DC DN SP HK EB
9					DC DN SP HK EB
10					DC DN SP HK EB
11					DC DN SP HK EB
12					DC DN SP HK EB
13					DC DN SP HK EB
14					DC DN SP HK EB
15					DC DN SP HK EB
16					DC DN SP HK EB
17					DC DN SP HK EB
18					DC DN SP HK EB
19					DC DN SP HK EB
20					DC DN SP HK EB
21					DC DN SP HK EB
22					DC DN SP HK EB
23					DC DN SP HK EB
24					DC DN SP HK EB
25					DC DN SP HK EB
26					DC DN SP HK EB
27					DC DN SP HK EB
28					DC DN SP HK EB
29					DC DN SP HK EB
30					DC DN SP HK EB
31					DC DN SP HK EB
32					DC DN SP HK EB
33					DC DN SP HK EB
34					DC DN SP HK EB
35					DC DN SP HK EB
36					DC DN SP HK EB
37					DC DN SP HK EB
38					DC DN SP HK EB
39					DC DN SP HK EB
40					DC DN SP HK EB

Pedestrian Behavior Observation Sheet (Roadway Crossing)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe individual pedestrians approaching the crossing from one direction. Please circle the size of the group they are walking with (1, 2, 3, 4+) and position on the roadway/sidewalk (T = travel lane, SW = sidewalk). Also observe physical disabilities, gender (F = female, M = male), and age group. If you cannot tell the gender or age of the pedestrian, make your best guess. Note how the pedestrian behaves at the crossing (GY = pedestrian crosses through light on green/yellow, RX = pedestrian starts crossing on green/yellow but light turns red before they finish crossing, RS = pedestrian stops at red light and waits until green to cross, JW = pedestrian crosses against red light, SS = pedestrian looks both directions for approaching traffic before crossing, SX = pedestrian crosses without looking for traffic in both directions, RN = pedestrian runs or hurries to avoid approaching traffic, CP = pedestrian uses cell phone or other mobile device while walking or waiting, MB = pedestrian crosses at midblock location--at least 3 feet outside of crosswalk lines). Circle all behaviors that apply. Count people who are walking their bicycles. Mark a line below the latest completed observation every 15 minutes, and label that line with the time.

- GY = Crosses on Green or Yellow
- RX = Light Turns Red while Crossing
- RS = Stops and Waits at Red Light
- JW = Jaywalks Against Red Light
- SS = Looks Before Entering Crosswalk
- SX = Enters Crosswalk w/o Looking
- RN = Runs or Hurries to Avoid Cars
- CP = Uses Cell Phone or other Device
- MB = Crosses at Midblock

Count	Group Size	Position	Disabilities	Gender	Estimated Age Group	Crossing Behavior
1	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
2	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
3	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
4	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
5	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
6	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
7	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
8	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
9	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
10	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
11	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
12	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
13	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
14	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
15	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
16	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
17	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
18	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
19	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
20	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
21	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
22	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
23	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
24	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
25	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
26	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
27	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
28	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
29	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
30	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
31	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
32	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
33	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
34	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
35	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
36	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
37	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
38	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
39	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB
40	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	GY RX RS JW SS SX RN CP MB

Market St. Pedestrian Behavior Observation Sheet (Muni Platform Crossing)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe individual pedestrians crossing between the sidewalk and the MUNI platform. Please circle the size of the group they are walking with (1, 2, 3, 4+) and position where the pedestrian is crossing from (M = MUNI platform, SW = sidewalk). Also observe physical disabilities, gender (F = female, M = male), and age group. If you cannot tell the gender or age of the pedestrian, make your best guess. Note how the pedestrian behaves at the crossing (XW = pedestrian crosses within the marked crosswalk at the intersection, MB = pedestrian crosses at midblock location--at least 3 feet outside of crosswalk lines, JW = pedestrian crosses against red traffic signal, BT = pedestrian crosses between stopped cars, LK = pedestrian looks for approaching cars before crossing automobile lane, LX = pedestrian enters crosswalk without looking for approaching cars, RN = pedestrian runs or hurries to avoid cars, CP = pedestrian uses cell phone or other device). Circle all behaviors that apply. Count people who are walking their bicycles. Mark a line below the latest completed observation every 15 minutes, and label that line with the time.

XW = Crosses within the Marked Crosswalk
MB = Crosses midblock (not at XW)
JW = Crosses against red light
BT = Crosses Between Stopped Cars
LK = Looks before crossing auto lane
SX = Enters Crosswalk w/o Looking
RN = Runs or Hurries to Avoid Cars
CP = Uses Cell Phone or other Device

Count	Group Size	Position	Disabilities	Gender	Estimated Age Group	Crossing Behavior
1	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
2	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
3	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
4	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
5	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
6	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
7	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
8	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
9	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
10	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
11	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
12	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
13	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
14	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
15	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
16	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
17	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
18	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
19	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
20	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
21	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
22	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
23	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
24	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
25	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
26	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
27	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
28	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
29	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
30	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
31	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
32	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
33	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
34	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
35	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
36	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
37	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
38	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
39	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP
40	1 2 3 4+	M SW	Y N	F M	0-17 18-34 35-49 50-64 65+	XW MB JW BT LK SX RN CP

Pedestrian Behavior Observation Sheet (Street Segment)

(UC Berkeley Safe Transportation Research & Education Center)

Surveyor Name:

Street Name: Nearby Intersecting Street:

Day of Week: Date: Time of Count Period:

Temperature: Weather Conditions (sunny, cloudy, rainy, etc.):

Description of Count Location:

Observe individual pedestrians passing by the location you are standing in the middle of the block. Please circle the size of the group they are walking with (1, 2, 3, 4+) and position on the roadway/sidewalk (T = travel lane, SW = sidewalk). Also observe physical disabilities, gender (F = female, M = male), and age group. If you cannot tell the gender or age of the pedestrian, make your best guess. Count people who are walking their bicycles. Note how the pedestrian behaves along the segment (WT = pedestrian is moving same direction as adjacent traffic, AT = pedestrian is moving in opposite direction as adjacent traffic, RN = pedestrian is running, CP = pedestrian uses cell phone or other mobile device while walking or waiting). Circle all behaviors that apply. Mark a line below the latest completed observation every 15 minutes, and label that line with the current time.

WT = Walking with Adjacent Traffic
AT = Walking against Adjacent Traffic
RN = Running
CP = Using cell phone or other device

Count	Group Size	Position	Disabilities	Gender	Estimated Age Group	Segement Behavior
1	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
2	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
3	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
4	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
5	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
6	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
7	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
8	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
9	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
10	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
11	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
12	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
13	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
14	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
15	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
16	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
17	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
18	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
19	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
20	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
21	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
22	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
23	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
24	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
25	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
26	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
27	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
28	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
29	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
30	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
31	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
32	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
33	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
34	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
35	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
36	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
37	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
38	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
39	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP
40	1 2 3 4+	T SW	Y N	F M	0-17 18-34 35-49 50-64 65+	WT AT RN CP

Appendix F – Additional Survey Findings

F1. Mode Shares

Time Period	Obs. (n=)	Walk (%)	Bike (%)		Bus (%)	Drive (%)	Non-motorized modes only (%)	Alternative modes only (%)
Pre, Control	418	43.8	4.0		8.9	60.7	28.9	39.3
Pre, Treatment	924	46.5	3.7		21.5	46.3	28.9	53.7
Post, Control	467	41.4	7.4		8.7	60.1	31.5	39.9
Post, Treatment	1,194	47.2	7.5		23.7	43.2	31.7	56.8
Change: Treatment		0.7	3.8	**	2.3	-3.2	2.8	3.2
Change: Control		-2.4	3.4	**	-0.2	-0.6	2.5	0.6
Difference-in-Difference		3.1	0.4		2.5	-2.5	0.3	2.5

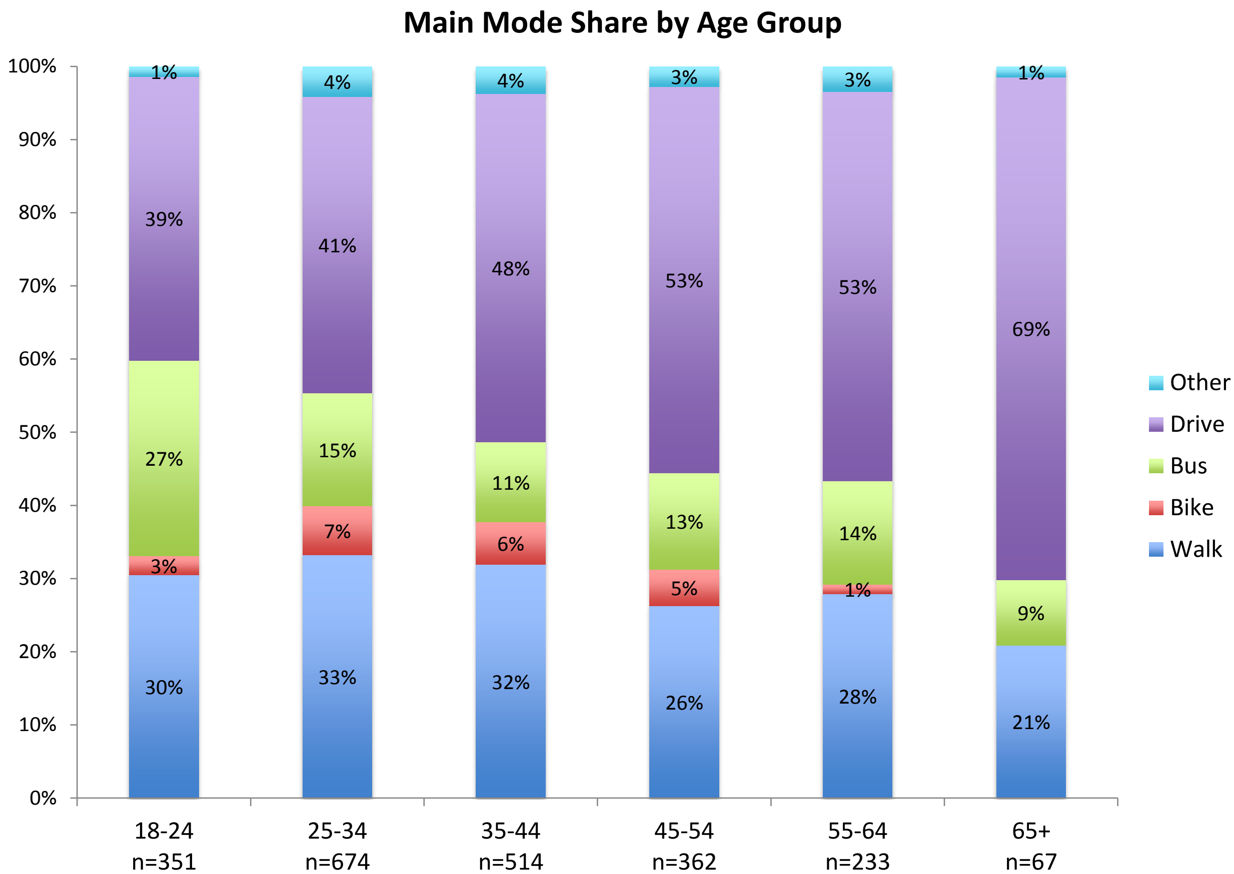
Notes:
Mode shares add horizontally to more than 100% since more than one mode may have been used.
Statistical tests are two-tailed t-tests. Changes have one asterisk if significant at the 10% level, two if significant at the 5% level.

F2. Main Mode Shares

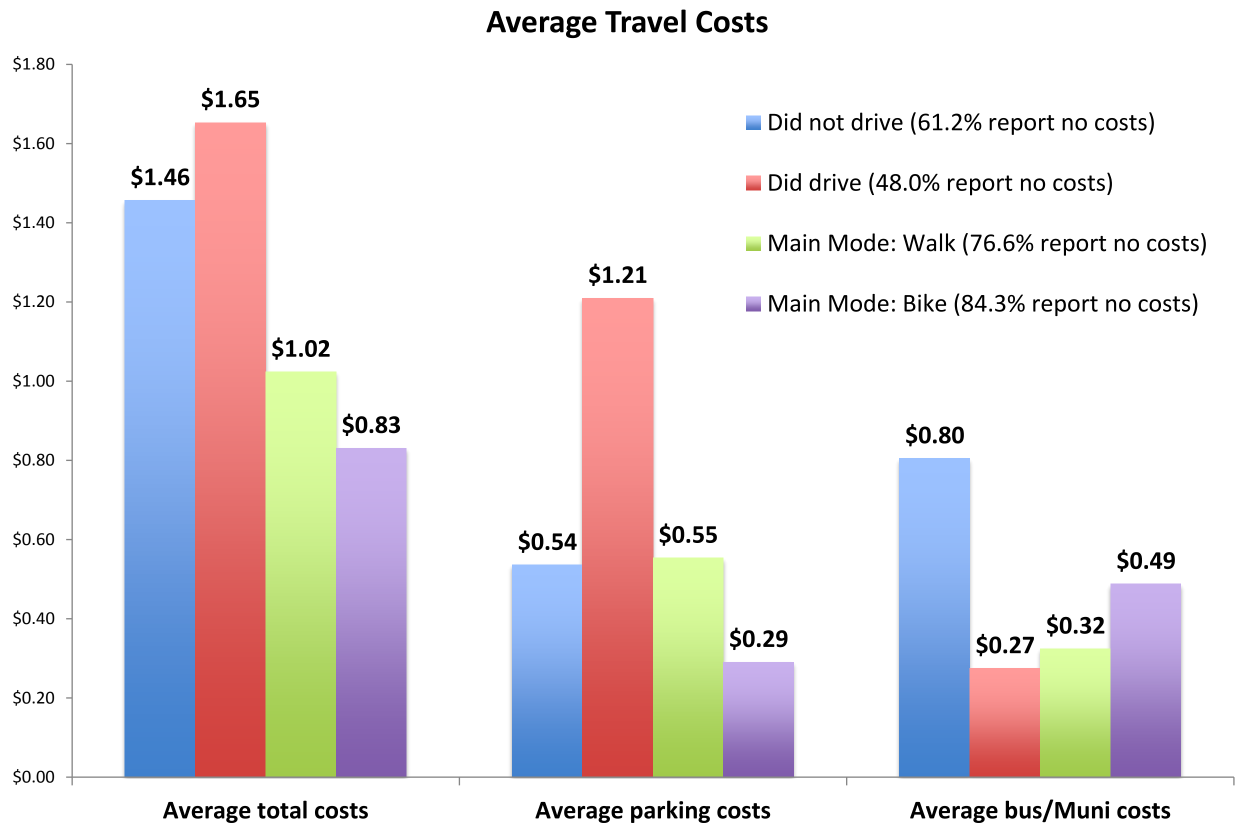
Time Period	Obs. (n=)	Walk (%)	Bike (%)		Bus (%)	Drive (%)	Non-motorized modes only (%)	Alternative modes only (%)
Pre, Control	340	31.2	3.2		7.4	57.4	34.4	42.6
Pre, Treatment	710	30.6	3.0		19.0	42.3	33.5	57.7
Post, Control	378	29.6	6.3		5.8	56.9	36.0	43.1
Post, Treatment	918	30.1	6.4		20.3	40.1	36.5	59.9
Change: Treatment		-0.5	3.5	**	1.2	-2.2	3.0	2.2
Change: Control		-1.5	3.1	**	-1.5	-0.5	1.6	0.5
Difference-in-Difference		1.0	0.4		2.8	-1.7	1.4	1.7

Notes:
Mode shares sum horizontally to 100%, with category "other" not presented here.
Statistical tests are two-tailed t-tests. Changes have one asterisk if significant at the 10% level, two if significant at the 5% level.

F3. Main Mode by Age Group



F4. Average Travel Costs by Main Mode



F5. Percentage Expressing Concern about Traffic Safety while Traveling to Station

Station	While Walking Pre (%)	Post (%)	Pre (n=)	Post (n=)
Balboa Park	14.3	25.9	21	27
Bay Fair	N/A	4.2	N/A	24
Civic Center	11.9	25.0	42	28
Fremont	10.0	19.4	20	31
Glen Park	16.7	11.4	18	35
Lafayette	17.2	0.0	29	5
Palo Alto	7.1	28.6	14	7
Pittsburg	23.1	16.2	13	37
Rockridge	11.1	5.3	27	19

Station	While Biking Pre (%)	Post (%)	Pre (n=)	Post (n=)
Balboa Park	17.6	13.0	17	23
Bay Fair	N/A	27.3	N/A	11
Civic Center	43.8	37.5	32	24
Fremont	11.8	29.0	17	31
Glen Park	22.2	13.0	18	23
Lafayette	24.1	0.0	29	2
Palo Alto	15.4	80.0 **	13	5
Pittsburg	23.1	9.1	13	33
Rockridge	25.9	66.7 *	27	6

Station	While Driving Pre (%)	Post (%)	Pre (n=)	Post (n=)
Balboa Park	19.0	28.6	21	21
Bay Fair	N/A	14.3	N/A	21
Civic Center	20.0	25.0	40	24
Fremont	25.9	25.8	27	31
Glen Park	16.7	16.7	18	30
Lafayette	13.8	8.0	29	25
Palo Alto	13.6	6.7	22	15
Pittsburg	37.5	18.4	16	38
Rockridge	7.7	16.1	26	31

Notes:
Percentages represent share of respondents who indicated a 4 or 5 on a 5-point Likert scale, with higher scores indicating higher perceptions of traffic risk.
Statistical tests are two-tailed t-tests on the change in percentage. Changes have one asterisk if significant at the 10% level, two if significant at the 5% level.
The observation counts (n=) are the total number of respondents to the question about perceptions of traffic risk, not just the number of respondents indicating a 4 or 5.

F6. Main Mode Share among Respondents Concerned about Traffic Safety, by Location Type

Mode for which concerned about traffic safety	Location Type	Obs. (n=)	Walk (%)	Bike (%)	Bus (%)	Drive (%)	Other (%)	Non-motorized modes (%)	Alternative modes (%)
Walking	Urban	32	43.8	3.1	31.3	15.6	6.3	46.9	84.4
Walking	Suburban	21	28.6	0.0	9.5	61.9	0.0	28.6	38.1
Biking	Urban	49	30.6	16.3	30.6	18.4	4.1	46.9	81.6
Biking	Suburban	25	24.0	0.0	8.0	68.0	0.0	24.0	32.0
Driving	Urban	38	34.2	0.0	26.3	39.5	0.0	34.2	60.5
Driving	Suburban	35	17.1	0.0	8.6	74.3	0.0	17.1	25.7

Notes:

Percentages represent main mode shares among the subset of respondents who indicated a 4 or 5 on a 5-point Likert scale, with higher scores indicating higher perceptions of traffic risk.

The observation counts (n=) are the number of respondents indicating a 4 or 5, among which the main mode shares are calculated.

F7. Station Age Group Profiles, Pre and Post Time Periods

	Balboa Park		Bay Fair		Civic Center		Fremont		Glen Park		Lafayette		Palo Alto		Pittsburg		Rockridge	
Age Group	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
18-24	23.5%	14.6%	24.7%	26.8%	11.0%	13.5%	18.4%	16.9%	15.6%	21.1%	6.9%	6.7%	14.0%	16.9%	14.2%	31.8%	10.2%	10.6%
25-34	25.8%	38.2%	24.7%	27.6%	48.5%	45.5%	33.3%	51.3%	23.4%	29.8%	23.8%	16.3%	31.6%	30.1%	20.9%	21.2%	28.4%	29.8%
35-44	24.2%	19.1%	16.4%	18.1%	22.1%	25.3%	25.9%	18.8%	21.9%	20.2%	18.5%	30.9%	21.1%	19.3%	29.1%	12.9%	27.3%	28.0%
45-54	13.6%	13.5%	19.2%	13.4%	13.2%	9.6%	14.9%	8.8%	25.0%	12.3%	28.5%	20.8%	14.0%	21.7%	23.0%	14.7%	19.3%	18.8%
55-64	9.8%	12.4%	13.7%	11.0%	4.4%	5.1%	5.2%	3.8%	10.9%	13.2%	16.9%	18.0%	15.8%	9.6%	12.2%	14.7%	11.9%	9.2%
65+	3.0%	2.2%	1.4%	3.1%	0.7%	1.1%	2.3%	0.6%	3.1%	3.5%	5.4%	7.3%	3.5%	2.4%	0.7%	4.7%	2.8%	3.7%
Obs. (n=)	132	89	73	127	136	178	174	160	64	114	130	178	57	83	148	170	176	218

F8. Station Gender Profiles, Pre and Post Time Periods

	Balboa Park		Bay Fair		Civic Center		Fremont		Glen Park		Lafayette		Palo Alto		Pittsburg		Rockridge	
Gender	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Female	48.1%	52.3%	68.9%	53.6%	51.1%	38.9%	55.1%	46.4%	50.0%	57.0%	53.0%	55.8%	48.3%	33.7%	54.3%	60.8%	54.4%	51.8%
Male	51.9%	47.7%	31.1%	46.4%	48.9%	61.1%	44.9%	53.6%	50.0%	43.0%	47.0%	44.2%	51.7%	66.3%	45.7%	39.2%	45.6%	48.2%
Obs. (n=)	135	88	74	138	139	180	176	166	66	121	134	181	58	89	151	181	180	220