A Health Impact Assessment

of the

East Bay
Bus Rapid Transit (BRT)
Project

Human Impact Partners

UC Berkeley Schools of Public Health and City & Regional Planning

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Dedicated to Audrey Rhodes Warming
1990-2012

For whom smarter street design might have made a difference.

Acknowledgements

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ES Executive Summary

ES1 Introduction and Background

AC Transit has recently approved an East Bay Bus Rapid Transit (BRT) route connecting three cities – Berkeley, Oakland and San Leandro. This heavily congested 14.38-mile travel corridor goes through downtown areas and communities of color that are mostly low-income and transit dependent. As of 2012, the AC Transit Board proposed and approved a shortened BRT route running from Downtown Oakland to San Leandro. This Health Impact Assessment (HIA) will analyze the portion of the BRT alignment that runs along International Blvd in the City of Oakland.

The proposed BRT is a high quality bus service aimed to increase service frequencies, expand transit capacity, and enhance bus reliability and speeds. For most of Oakland, the proposed BRT will have a dedicated bus lane with level boarding, substantial shelters that include extended canopies for waiting patrons, bus service operating at 5 minute headways, lighting, and security features among other transit improvements.

The surrounding communities of the BRT corridor that will directly benefit from these improvements are ethnically diverse and have a median household income of $35,097. This number is below the median household income for Oakland overall. These communities also experience significantly poorer health outcomes compared to Alameda County, with diabetes and asthma related hospital visits over 50% greater and mortality 20% higher. Life expectancy along the BRT alignment is 3 years less than in Alameda County as a whole.

An HIA is a public engagement and decision-support tool that can be used to assess planning and policy proposals, and make recommendations to improve the health outcomes associated with those proposals. Environmental, social, demographic, and economic conditions drive the health and wellbeing of communities. Factors such as transportation, employment and income, noise, air quality, access to goods and services, and social networks have well-demonstrated and reproducible links to health outcomes. HIA investigates these relationships in the context of specific policy proposals and makes predictions related to health outcomes through a six step process defined in the full report.

This HIA is intended to inform the decision and implementation of the East Bay BRT Project to improve public health outcomes resulting from the Project and was conducted in partnership with transportation advocacy organization, TransForm, and several community organizations with constituents who will be affected by the proposal.

ES2 Scoping

As part of the HIA process, the health determinants that could be affected by the proposal were identified. The issues included in the scope of this HIA were selected with input from community stakeholders and local residents and were divided into four main pathways: mobility, access to goods and services, traffic safety, crime and safety and air quality.

ES3 FINDINGS

ES3.1 Mobility

Mobility can impact health through various pathways including time, cost, and travel safety. A transportation system with multiple modes of travel can improve commute times, increase physical activity and reduce environmental and health costs associated with personal vehicle trips.[1]

The mobility analysis of this report focuses on the effects of BRT implementation on mode of travel, commute times, parking, and emergency response times. Mode share is estimated to shift from auto trips to transit trips by 1% in 2015 and 2% in 2035. Commute times are expected to decrease by up to 22% in 2015 and up to 36% in 2035. Although the analysis did not find concrete evidence of impacts on emergency vehicles response times, the addition of a BRT dedicated lane is likely to improve the mobility of emergency vehicles. In addition, the BRT implementation will include a series of improvements to further enhance mobility. These include a platform design to allow level boarding, station spacing to decrease commute times, and pedestrian access and safety improvements at stations to encourage walking to bus stops.

ES3.2 Access to Goods and Services

During the community workshops for the International Blvd Transit-Oriented Development Plans, residents voiced a need for more grocery stores; retail and other neighborhood commercial services; banks; and community facilities. Transportation is commonly cited as a barrier to accessing amenities and can affect one's ability to receive adequate health care and quality produce among many other services. An examination of the presence and distribution of community clinics within the corridor suggest that a high proportion of the population (81%) are within walking distance (a half mile) of a community clinic, however, access to a hospital is much less accessible. Improved transit service can reduce the number of forgone or missed appointments and improve health outcomes. This may be particularly beneficial for those who require frequent treatments. Improved transit service can also increase access to fresh produce. Although there is an abundance of small grocery or corner stores in the area there are only a few large grocery stores.

As noted by other BRT systems, BRT implementation can help to catalyze financial and political investment in transit-oriented development around BRT stations. The establishment of new institutions and services can improve access to goods and services. The degree to which development actualizes depends on other factors such as the commitment, support and collaboration of policymakers, businesses, and community members, but if effectively supported, can lead to the revitalization of communities.

ES3.3 Traffic Safety

Traffic-related collisions result in a high burden of preventable injuries and deaths. In traffic collisions, bicyclists and pedestrians are most vulnerable to fatality and injury. International Blvd has very high pedestrian and bicycle collision rates as compared to the City of Oakland and Alameda County. The East Bay BRT project has the potential to significantly improve pedestrian and bicycle safety along International Blvd by reducing motor vehicle volumes and speeds,

reducing mixed-flow motor vehicle traffic by 1 lane in each direction, and implementing a variety of pedestrian and bicycle infrastructure upgrades. Median stations and crossing islands, curb bulbouts, high visibility crosswalks, and new traffic and pedestrian signals will improve the pedestrian environment. Proposed Class II bike lanes and the removal of buses from curbside lanes along the corridor will enhance the built environment for cyclists on International Blvd.

Pedestrian-vehicle and bicycle-vehicle collisions are expected to decrease along the International Blvd corridor in 2015 and 2035 with BRT in operation, compared to a No-Build scenario at these time points. Reductions in motor vehicle speeds along International Blvd will also reduce the severity of collisions on the corridor. Despite these gains, however, the BRT project is expected to result in minimal changes to mode share in a broader study area surrounding International Blvd. Proposed pedestrian upgrades included in the Final Environmental Impact Report include only those directly on International Blvd. Thus, the BRT will do little to mitigate projected rates of pedestrian and bicycle collisions in the neighborhood surrounding International Blvd from now to 2035.

ES3.4 Crime and Safety

Crime can impact health in various ways. It can affect health directly, leading to injuries and death, as well as indirectly, affecting stress levels through heightened fear and poor mental health. With BRT implementation, risks to personal security can be mitigated with shorter wait times at bus stations. Much of the real and perceived risk from bus travel comes from security risks traveling to and from stops as well as waiting for buses.[2] A greater increase in ridership can also result in a higher level of crime prevention from "eyes on the street." Additionally, the location of stations may also be a deterrent of crime. Stations constructed on the median increase the visibility of waiting passengers to people and cars passing by on the street. This has the potential to decrease crimes committed against waiting passengers, and also to deter perpetrators on the streets near stations because waiting passengers will have better visibility of the activities on either side of the street. Lastly, hiring roving ticket inspectors as proposed with the BRT implementation increases the presence of security personnel and represent an improvement in crime prevention.

ES3.5 Air Quality

The East Bay BRT project has the potential to effect human health through its impacts on local air quality. BRT operations will affect mode share along the International Blvd corridor, and to the extent to which travelers switch from higher-polluting travel modes (i.e. cars, light trucks and heavy trucks) to BRT, there could be local air quality improvements.

The East Bay BRT project will likely have minor beneficial impacts on air quality and attendant air quality-related health impacts. The most significant air quality issues for communities along International Blvd stem not from traffic along International Blvd, but rather from vehicle-related pollution from the adjacent I-880 freeway and the Union Pacific railway where they run parallel to International Blvd as well as large concentration of stationary sources of air pollution, including manufacturing and construction uses, as well as auto-related uses, such as repair shops and gas stations.

Communities along International Blvd would experience significantly greater health benefits from efforts to reduce vehicle travel along I-880, reduce diesel train traffic (through either reduced trips or electrification of the line) along the Union Pacific rail line and a reduction of both agency-recognized and community-mapped stationary sources of pollution.

Impacts Summary Table

Health Determinant	Impact of BRT	Magnitude	Severity	Strength of Evidence	Uncertainties and Qualifications
Mobility	+	Mod–Major	Minor	♦	Mobility will increase for the majority of the Study Area, but could potentially decrease for a very small proportion of the population in specific locations.
Access to Goods and Services	+	Mod-Major	Minor	♦	The relationship between access to goods and services and health outcomes is dependent on many factors (e.g., income and culture) in addition to transit resources.
Traffic Safety	+	Minor	Major	♦♦	Changes in pedestrian and bicycle activity are uncertain. Other factors related to traffic safety (e.g., speed) were not predicted.
Crime and Safety	+	Minor-Mod	Moderate	♦♦	Many other factors (e.g., law enforcement) contribute to perceptions of crime and crime rates than those that are relevant to BRT.
Air Quality	+	Minor	Moderate	♦♦♦	Given the regional scope of the FEIR analysis, local air quality impacts are uncertain.

Explanations:

- *Impact* refers to whether the proposal will improve health (**+**), harm health (**-**), or whether results are mixed (**~**).
- *Magnitude* reflects a qualitative judgment of the size of the anticipated change in health effect (e.g., the increase in the number of cases of disease, injury, adverse events): Negligible, Minor, Moderate, Major.
- *Severity* reflects the nature of the effect on function and life-expectancy and its permanence: High = intense/severe; Mod = Moderate; Low = not intense or severe.
- *Strength of Evidence* refers to the strength of the research/evidence showing a causal relationship between the effects of the proposal on the health determinants and health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = causal relationship certain. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

ES4 CONCLUSION

Implementation of the Oakland BRT offers an opportunity to benefit the communities surrounding International Boulevard. Continued community participation is key to implementing a system that will not only be well utilized but help mitigate health concerns. This is an opportunity to both set an example in regional transportation efforts and create a model for developing healthier communities internationally.

1 Introduction

The Alameda/Contra Costa Transit District (AC Transit) has recently approved an East Bay Bus Rapid Transit (BRT) route connecting three cities – Berkeley, Oakland and San Leandro. This heavily congested 14.38-mile travel corridor goes through downtown areas and communities of color that are mostly low-income, and transit dependent.

Bus rapid transit is defined as "a rapid mode of transportation that can provide the quality of rail transit and the flexibility of buses."[3] BRT is intended to provide a level of service that is similar to a rail line – reliable, faster, more efficient and with greater capacity than a regular bus line, but that is flexible to various travel contexts and physical environments and less expensive (e.g., lower construction, operating and vehicle costs) than a rail system. The proposed East Bay BRT line aims to accomplish these goals through a dedicated bus lane with level station boarding for most of Oakland and north San Leandro, center-running bus lanes and platforms, optimized bus stop locations, more frequent service, transit signal priority, new traffic and pedestrian signals, repaving and other street and sidewalk treatments.

The expectation is that with implementation of BRT, residents and workers will be able to travel between home, work, school, and other commercial and public services more efficiently, and that auto travel and congestion may decrease as a result of providing a viable alternative to driving cars. If these expectations are realized, BRT has the potential to positively impact the health of residents and workers. Increasingly, research illustrates that a range of transportation policies, plans, and projects can substantially impact health. For example, transportation decisions influence exposure to air pollution and noise; pedestrian and bike conditions; traffic safety; crime and safety; and access to goods and services and jobs. In turn, evidence connects these "determinants of health" to health outcomes such as asthma, cancer, cardiovascular disease, diabetes, injuries, adverse birth outcomes, and mental illness.

AC Transit, the project proponent and primary decision-maker, decided to create a BRT system following the 2001 completion of a two-year Major Investment Study (MIS)[4]. The MIS examined other BRT project alternatives such as light rail transit and low-cost bus improvements and identified BRT as the best option. A draft Environmental Impact Report (DEIR)[5] was circulated for public review in May 2007 and the Final EIR (FEIR)[6] was approved by AC Transit in April 2012. The alignment through the City of Oakland requires the approval of the Oakland City Council. The Oakland City Council vote is the decision this HIA is meant to inform.

Although the EIR process is intended to identify impacts to health and the environment of proposed transportation projects such as this one, the process typically falls short of adequately considering the range of health impacts associated with transportation planning. Conducting a Health Impact Assessment (HIA) on the BRT proposal can help to identify potential health benefits and risks associated with the project and offer recommendations for optimizing health impacts for all people affected by the plan. In addition, this information has the potential to inform the community's understanding of the risks and benefits of the project so those affected by it can use the City Council vote as an opportunity to advocate for changes to enhance benefits and mitigate harms. In addition, understanding the wider implications of transportation decisions

can yield projects that result in better outcomes – both in terms of transportation outcomes and health outcomes – and might help to more fully account for resident, business, and community concerns in transportation decision-making processes.

For these reasons and others described in Section 2 below, primary partners Human Impact Partners (HIP) and TransForm decided to work with community stakeholders to conduct this HIA on AC Transit's BRT proposal along International Boulevard. The California Endowment provided funding for the HIA through their Building Healthy Communities program in East Oakland. In addition to HIP and TransForm, HIA partners included Oakland Community Organizations (OCO), Allen Temple Baptist Church (Allen Temple), and students from UC Berkeley's graduate schools of City & Regional Planning and Public Health. The HIA was conducted between February and June of 2012.

This report is organized into the following sections:

1. Executive Summary – Summarizes the report
2. Introduction – Introduces the context of the HIA
3. Background and Screening – Provides background and description of the screening process for this HIA
4. HIA Scope – Describes the scoping process, including identification of populations affected by the decision, geographic area of focus, health determinant categories, research questions, assessment methods, and data sources used in the HIA.
5. Assessment Findings – Presents research connecting each health determinant to health outcomes, existing conditions for each health determinant, and forecasted impacts of the project on health.
6. Recommendations – Outlines recommendations based on the findings of the impact assessment and community processes
7. Monitoring – Outlines a plan for tracking the effects of the HIA on the decision and on health determinants and outcomes
8. Conclusions – Summarizes overall conclusion of the HIA
9. References – Lists references cited throughout the report
10. Appendices – Includes the HIA pathway diagrams and scope.

2 Background and Screening

In this section we describe the East Bay BRT Project and the local context, provide an overview of HIA, and describe how the decision was made to conduct this HIA.

2.1 BRT PROPOSAL BACKGROUND

The present BRT proposal is the product of over 10 years of work examining the feasibility of providing new or improved transit service and developing the specific plans for the transit corridor that stretches from Berkeley through Oakland to San Leandro. Initial feasibility studies had three main purposes: to understand transit needs, identify improvement options to address these needs, and to build public, community and agency support for one transit improvement alternative.

Based on the MIS evaluation and input from leaders of community-based organizations, the general public and elected officials, a recommended public transit alternative was selected by the Policy Steering Committee in July of 2001 and approved by the AC Transit Board of Directors in August of 2001. Bus Rapid Transit was recommended as the preferred vehicle and operations technology for the corridor because this option met the greatest number of the following evaluation criteria set by AC Transit and the cities of Berkeley, Oakland, and San Leandro[7]:

1. Improve access to major employment and educational centers and enhance connections to other AC Transit services, BART, ferry services and other transit providers;
2. Improve transit service reliability;
3. Provide frequent transit service;
4. Ensure security, cleanliness and comfort waiting for and riding on transit;
5. Support transit-oriented residential and commercial development;
6. Increase the percentage of trips made by transit, and reduce the percentage by automobile;
7. Identify a set of transit improvements that has a high probability of being funded;
8. Improve ease of entry and exit on vehicles for all transit riders, including persons with disabilities; and
9. Provide an environmentally friendly transit service that contributes to air quality improvement.

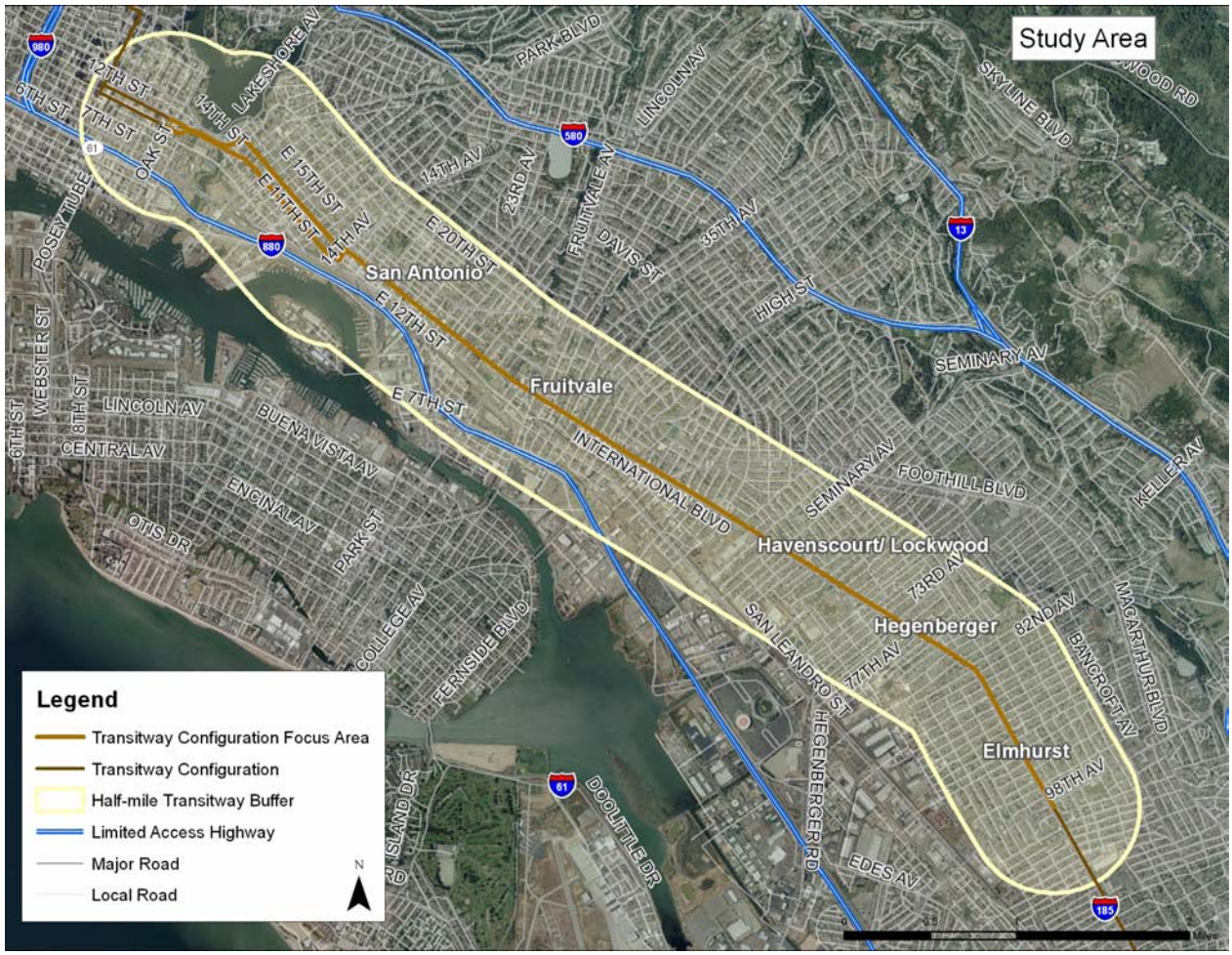
Light Rail Transit (LRT) was considered the long-term goal, but since LRT is a more costly system and it was anticipated that funding would not be available, a BRT system was proposed with the thought that BRT could be designed to facilitate a future upgrade to LRT.

The original 2007 East Bay BRT Plan proposed a BRT line running approximately 18 miles from San Leandro, through East Oakland to downtown Oakland, where it turned north to downtown Berkeley (the Locally Preferred Alternative, or LPA). The current Downtown Oakland-San Leandro (DOSL) proposal (see Section 3.2), which was unanimously approved by the AC Transit Board of Directors on April 25, 2012, runs from San Leandro to Downtown Oakland. Although this HIA focuses on a portion (International Blvd, see Section 2.3) of the currently proposed plan, the following information for the originally proposed LPA corridor

between San Leandro and Berkeley is presented for context. At the time the MIS was completed, buses in the LPA corridor carried 40,000 riders a day – nearly 20 percent of AC Transit's total ridership, and the corridor was home to 320,000 people. The LPA corridor is centered on downtown Oakland, the East Bay's largest city. Southeast of downtown Oakland, one-third of the full LPA corridor passes through some of the densest (over 25,000 residents per square mile) residential neighborhoods in the entire San Francisco Bay Area.[8] The southeastern end of the corridor is anchored at the Bay Fair Bay Area Rapid Transit (BART) station, a major transfer station for three BART lines and seven local bus routes. This station also serves the Bay Fair Mall, a regional shopping mall.

As described in Section 2.3 below, this HIA focuses on the southeastern part of the DOSL corridor that runs through Oakland along International Blvd. This portion, referred to in this report as the Study Area, begins at the intersection of Madison Street and 11th/12th Streets, and travels over seven miles through the neighborhoods of San Antonio, Fruitvale, Havenscourt/Lockwood, Hegenberger, and Elmhurst. Most of these neighborhoods are also considered to be part of the larger area known as East Oakland, which is composed of many neighborhoods all of which are southeast of Lake Merritt. The corridor is well connected to other parts of the county, the Bay Area and beyond through public transportation (including AC Transit, BART, and Amtrak) and highway networks. Interstate 880 (I-880) runs along the length of the corridor and sits between the bay and International Blvd. The Union Pacific Railroad also run between International Blvd. and I-880 (see Figure 1).

Figure 1. Study Area



Note: Half-mile transitway buffer is identified as the Study Area in this HIA

At the same time the BRT proposal has been under consideration, the neighborhoods along International Blvd have been engaged in a planning process, known as the International Blvd Transit Oriented Development (TOD) Plan, to guide and facilitate development around the transit resources that are assets for the area and to capitalize on other citywide zoning, urban design and economic redevelopment and revitalization efforts. An active set of community stakeholders provided feedback on Oakland's International Blvd TOD Plan in 2010-2011, and the plan was approved in March 2011.

According to the FEIR, this project has the potential to improve travel times by up to 36% by 2035, in a part of the city where there is a large proportion of transit dependent residents. To meet the objectives of improving transit speeds and reliability, increasing transit ridership, and facilitating development in existing transit corridors, the BRT proposal was developed to emulate the best features of rail transport through use of dedicated bus lanes, level-boarding, intersection redesign and streetscape improvements, bus traffic signal priority, state-of-the-art buses, and proof-of-payment systems.

2.2 HIA DESCRIPTION AND STEPS

HIA is a combination of procedures, methods and tools by which a policy or project may be judged for its potential health effects on a population, and the distribution of those effects within the population.[9] HIA can be used to improve the quality of public policy decision making through evidence-based recommendations to enhance predicted positive health impacts and minimize negative ones.

While there is no "typical" health impact assessment, best practice standards outline six steps in conducting an HIA:

- **Screening**: determines the need for and value of an HIA
- **Scoping**: identifies the potential health impacts to evaluate
- **Assessment**: Uses qualitative and quantitative data, expertise and experience to judge the magnitude and direction of potential health impacts
- **Recommendations**: Presents evidence-based (when possible) mitigation strategies for addressing any identified negative health impacts
- **Reporting**: delivers results to stakeholders through reports and presentations
- **Monitoring**: tracks the effects of the HIA on the decision and critically reviews the HIA process

2.3 DECIDING TO CONDUCT THE EAST BAY BRT HIA (SCREENING)

Screening, the first step in HIA, establishes the value and feasibility of an HIA for a particular decision-making context. Screening informs the decision to conduct an HIA by answering screening criteria.

This screening process was conducted informally through a series of phone calls and meetings between TransForm and HIP in January and February of 2012. The screening process revealed:

- There would be sufficient time to conduct a rapid HIA (during HIA screening, Oakland and San Leandro City Council votes were scheduled for May and/or June);
- The proposal has the potential to affect the environmental or social determinants of health (see below);
- Health inequities are possible given that the population living in much of the corridor is predominantly low income, of color and transit dependent, and also based on potentially unequal geographic distribution of impacts along various segments of the BRT corridor;
- Health was not already being considered in the decision-making process;
- There was potentially openness on the part of City Council members to the findings and recommendations from an HIA and recommendations could improve the project for health;
- There was relationship-building potential and community stakeholders could be interested in giving input into the HIA and decision-making process; and
- Funding for the HIA was available from The California Endowment's East Oakland Building Healthy Communities program.

Regarding health impacts specifically, a variety of HIAs conducted on BRT or light rail projects throughout the country and internationally have demonstrated many positive impacts on the health of communities. These range from improved air quality to increased levels of physical

activity, access to amenities and employment and educational opportunities, improved pedestrian safety, reduction of traffic collisions and injuries, and ambient noise reduction.

During HIA screening, the geographic focus of the HIA was also determined. The seven-mile International Blvd corridor was selected as the Study Area because bus ridership is higher than most other areas in the East Bay, and residents in this area are more vulnerable to poverty, homicide, heart disease, diabetes, and asthma compared to the rest of Oakland[10] (health status indicators are discussed further in Section 4.2).

City Councils in the two cities along the Downtown Oakland-San Leandro portion of the East Bay BRT route (Oakland and San Leandro) will each vote to approve the final proposed BRT Plan for their city and choose which elements of the proposal to accept or reject. As of this writing, city council votes are scheduled for July 2012.

Based on the above conclusions of the screening process, it was determined that an analysis of health impacts of the East Bay BERT project's seven-mile International Blvd segment would add value to the decision-making process. In addition, it was anticipated that offering health-oriented project recommendations would have the potential to improve public health outcomes in the Study Area. As a result of HIA screening, HIP and TransForm decided to move forward with the HIA.

HIP and TransForm subsequently reached out to local community organizations in the Study Area, OCO and Allen Temple, and provided grant funding to each organization to contribute to the HIA scoping, assessment, and recommendations steps.

Contributors to this HIA are identified in Table 1 below.

Table 1. Contributors and Roles in HIA Process

Organization	Role
Project Team	
Human Impact Partners	Led all aspects of HIA process, wrote HIA report
UC Berkeley graduate students	Contributed to HIA Assessment
TransForm	Coordinated partnerships, provided guidance during HIA process, reviewed HIA report
Community Stakeholders	
Oakland Community Organizations (OCO)	Contributed to HIA scope, provided feedback on analysis findings and recommendations
Allen Temple Baptist Church / Allen Temple Arms Senior Community	Contributed to HIA scope, provided feedback on analysis findings and recommendations

3 HIA Scope

In the scoping stage of HIA, relevant stakeholders develop goals for the HIA and prioritize research questions and methods to guide the assessment. In this section, we describe the goals for the HIA; the decision alternatives evaluated and the overall timeline; the process for developing the HIA scope; the primary health determinants and research questions assessed; the geographic area of analysis; community input; and assessment methods used in the HIA.

3.1 GOALS

To begin the HIA scoping process, the Project Team agreed on the following goals to guide the HIA:

- Identify the potential public health benefits and impacts of the BRT proposal
- Seek consensus about the health benefits and impacts of the BRT proposal
- Develop recommendations to inform the city council vote and improve the BRT proposal so that health improves as well
- Engage and involve community members in the HIA
- Increase awareness about HIA as a tool for identifying health impacts of decision-making

3.2 DECISION ALTERNATIVES AND TIMELINE

Given the BRT proposal had already been through draft and final EIR processes by the time the HIA process began, the HIA focused on the decision alternative that had been approved by AC Transit and was most likely to be before the City Council for approval. As described above, the two alternatives considered in the FEIR were the Locally Preferred Alternative (LPA) and the Downtown Oakland to San Leandro (DOSL) alignment. The specifications of the two are the same apart from the geographic extent of the alignments. The LPA Alternative would span the entirety of the East Bay BRT corridor (from Berkeley to San Leandro), while the DOSL Alternative would implement the project starting in Downtown Oakland and terminating in Downtown San Leandro. Because the DOSL Alternative overlaps with our Study Area and is the alternative being considered by the City Council at the time of this writing, it was the focus of the HIA.

The DOSL Alternative consists of the following features:

- Dedicated median bus lanes for exclusive use by buses and emergency vehicles (referred to as median running transitways).
- Single-platform, center median stations with level boarding.
- Stations spaced on average 0.31 miles apart
- Proof of payment ticket validation
- Transit signal priority (TSP), new traffic signals, pedestrian signals, and transit-only signals
- Real-time traveler information
- Substantial shelters that include extended canopies with amenities for the comfort and convenience of passengers
- Lighting
- Security features (e.g., closed circuit television and emergency phones)
- Pedestrian access and safety improvements at stations

- Bus service operating at 5-minute headways during peak and midday periods
- Low-floor, low-emission vehicles
- Bicycles allowed inside of buses

For our analyses we compared the DOSL Alternative to a No-Build scenario for the year 2015. Additional details about the proposal and analyses for the year 2035 may be presented where relevant.

3.3 DEVELOPING THE SCOPE

Considering the DOSL Alternative proposal, the Project Team then went on to consider the ways in which these plans could impact health outcomes. To do this, we developed what are called *pathway diagrams*, which are visual representations of the hypothesized connections between the specifics of the BRT proposal and health outcomes. The diagrams (see Appendix A) include the alternative under consideration, the primary health-related effects of implementing the alternative, the secondary and intermediate health-related effects that flow from the primary effects, and finally the health outcome effects that flow from the intermediate health-related effects of the alternative. These hypotheses about the relationships between the proposal and health are informed by public health and other research, and help to guide the research questions, data and analysis methods of the HIA.

Based on the hypotheses outlined in pathway diagrams, the identified potential impacts that the BRT proposal could have on health, reviews of the International Blvd TOD Plan, and feedback from community (see Section 3.3.4 below) the Project Team selected the following broad categories on which to focus the HIA assessment:

- Resident Mobility
- Access to Goods and Services
- Traffic Safety
- Safety from Crime
- Air Quality

Section 3.3.1 summarizes these potential pathways and provides evidence of their relevance to the health of residents in the Study Area.

3.3.1 Health Determinants

Mobility

Mobility can be defined as the ease of commuting to one's destinations such as retail, jobs and public services. Increased access can translate into faster trips and more time spent with family and other social opportunities. Studies have shown the importance of social connectivity in reducing stress, increasing years of life, and access to supportive resources.[11] Mobility can also include emergency vehicle access to households either within the Study Area or accessed by International Blvd. A dedicated bus lane with emergency vehicle access can affect length of emergency response times for those in need of emergency services and in some cases, determine rates of survival.

Access to Goods & Services

More efficient transit translates to better access to neighborhood resources, such as food outlets and places to receive health and human services. In addition, improved public transit efficiency along the corridor can stimulate economic activity along International Blvd. The International Blvd TOD Plan is a community-supported, coordinated effort to organize and catalyze this potential effect of the BRT project. Community input on the TOD Plan for International Blvd called for increased access to healthy food and limiting fast food and liquor stores along the corridor. Better access to the resources needed for a healthy lifestyle leads to better overall health for the individual and community.

Traffic Safety

City of Oakland documents, including the International Blvd Transit Oriented Development Plan (2011), Bicycle Master Plan (2007), and Pedestrian Master Plan (2001), indicate that International Blvd has among the highest pedestrian-vehicle and bicycle-vehicle collision rates in Oakland. The pedestrian environment along this corridor is poor, and there are no bicycle lanes on International Blvd.

Projected reduction in private vehicle traffic volume along International Blvd, and changes to the pedestrian and bicycle environments included in the BRT Plan are likely to alter pedestrian and bicycle safety along the International Blvd corridor. At public meetings about the TOD Plan for International Blvd held in 2010, community members emphasized the importance of creating an enhanced environment for pedestrians and bicycles along the corridor through better pedestrian crossings and new bicycle lanes. They also prioritized traffic calming along the corridor and in adjacent neighborhoods. Pedestrian and traffic safety concerns were also highlighted at public meetings held by AC Transit regarding the BRT project.

Safety from Crime

Safety features, including lights, security cameras, and emergency telephones, increased ridership and more frequent service at BRT stations may reduce crime and vandalism at stations and in the surrounding areas. Beautification effects of the project could result in changes in community pride and cohesion and could reduce crime or perceptions of crime. Reducing crime, prostitution, substance abuse and gang activity were priorities mentioned in community meetings regarding the International Blvd TOD Plan and in scoping meetings for this HIA.

Air Quality

The East Bay BRT FEIR considered the air quality impacts of BRT primarily on a regional basis. The FEIR found that BRT would have either no significant, or an overall positive, impact on regional air quality, due primarily to the reduction in total VMT along the corridor and associated vehicle emissions reductions. AC Transit estimates that East Bay BRT operations will result in 7,700 fewer single trips and 42,000 fewer miles traveled per day by personal vehicles by 2035. This corresponds to predicted reductions in air pollutants.

A major shortcoming of the FEIS analysis, however, was that it did not give detailed attention to potential *localized* air quality impacts along International Blvd. Aside from CO analysis at five specific intersections along the International Blvd segment, there was no site-specific air quality analysis performed. There was also no consideration given to other mobile emissions sources from I-880 and the Union Pacific Railroad, or to other stationary sources along the alignment.

3.3.2 Research Questions

From these scoping categories, the Project Team developed a set of research questions to assess the impact of the BRT proposal on these elements. Indicators, data sources, and analytical methods to answer research questions were also identified. The research questions were reviewed and prioritized by Community Stakeholders as well. The final scope is included as Appendix B. Prioritized research questions included:

- How will the project impact taking public transit, walking biking and driving?
- How will the project impact resident's ability/time to get to and from other places in the region?
- How will the project impact pedestrian and bike environments and safety?
- How will the project impact injuries from motor vehicle, pedestrian and bicycle accidents?
- How will the project impact levels of safety, crime and violence?
- How will the project impact air quality?
- How will the project impact access to public and private goods and services?
- How will the project impact any of these elements for vulnerable populations?

All of these research questions were analyzed, although modifications to certain indicators included in the original scope were made in some cases. All of the above research questions were also analyzed with vulnerable populations in mind. Vulnerable populations in the Study Area include seniors, youth, and residents without access to vehicles. Many seniors don't drive cars and are thus dependent on public transit. Allen Temple offers senior residences and many other services for seniors along International Boulevard between 76th Ave and 101st Ave, so attention should be focused on this area. Particularly relevant research questions for analyzing health impacts to seniors and other residents who don't drive cars are physical access to BRT stations, access to public and private goods and services, time spent on trips, traffic safety, quality of the pedestrian environment, and safety from crime.

Youth consistently use AC Transit buses to get to school, so this population will be a big user of BRT services as well. In addition, young people are more vulnerable to health hazards associated with poor air quality. Thus, all of the above research questions are relevant to youth residents.

3.3.3 Geographic Area of Analysis

The specific geographic area of focus for this HIA (the Study Area) is a half-mile radius around the section of the proposed alignment starting at the Madison Street station (near Downtown Oakland and Lake Merritt) and ending at the 98th Avenue station on International Blvd. We chose a half-mile buffer because this was considered a preferred maximum distance that residents might be willing to walk to access a BRT station (see Figure 1). The Transit Capacity and Quality of Service Manual[12] has defined walking distance of a transit stop to be a quarter-mile for a bus stop or a half-mile for access to a busway or rail station. Specific distances for rapid transit have not been well studied and therefore a half-mile buffer was used to capture the majority of users. Some of the analyses utilize data from the FEIR, which makes predictions about conditions for geographic areas that differ slightly from our Study Area. The screenline analysis, which provides trip estimates for different modes of travel and is used in the mobility and traffic safety sections, refers to the "BRT Corridor," which is essentially International Blvd,

and "Parallel Routes", which are major roadways and transit corridors running parallel to the BRT alignment.

The HIA utilized data from several different sources. Because not all sources provide data for the same geographic scale, there are some differences in the geographic units for which indicators are assessed. Data for some indicators are presented for Census areas, such as blocks or tracts, while other data are presented for ZIP Codes. A Census block is roughly equivalent to a city block. A tract is a small, relatively permanent statistical subdivision of a county, designed to contain roughly similar numbers of residents (1,000 to 8,000 people) who are relatively homogeneous with respect to their demographics, economic status and housing conditions. ZIP codes are larger than tracts and are defined by the U.S. Postal Service for the purposes of mail delivery. In Oakland, individual ZIP codes can contain communities with significantly differing demographic characteristics; therefore, data based on ZIP codes do not reveal differences for these smaller communities.

We selected the individual geographies that most closely approximated the half-mile buffer around the proposed alignment by taking the geographies that intersected the buffer. When Census tract-level data were available, we defined the Study Area using 29 census tracts (see Figure 2).

When only ZIP code-level data were available, we defined the Study Area using four ZIP codes (see Figure 3). Despite the relatively large size of ZIP codes, there is a fair amount of overlap between the half-mile buffer around the proposed alignment and the ZIP codes included in this analysis, with the exception of one ZIP code, which stretches far outside the boundaries of the buffer. The data source and geographic areas utilized are listed below (see Table 2).

Figure 2. Study Area with Census Tracts

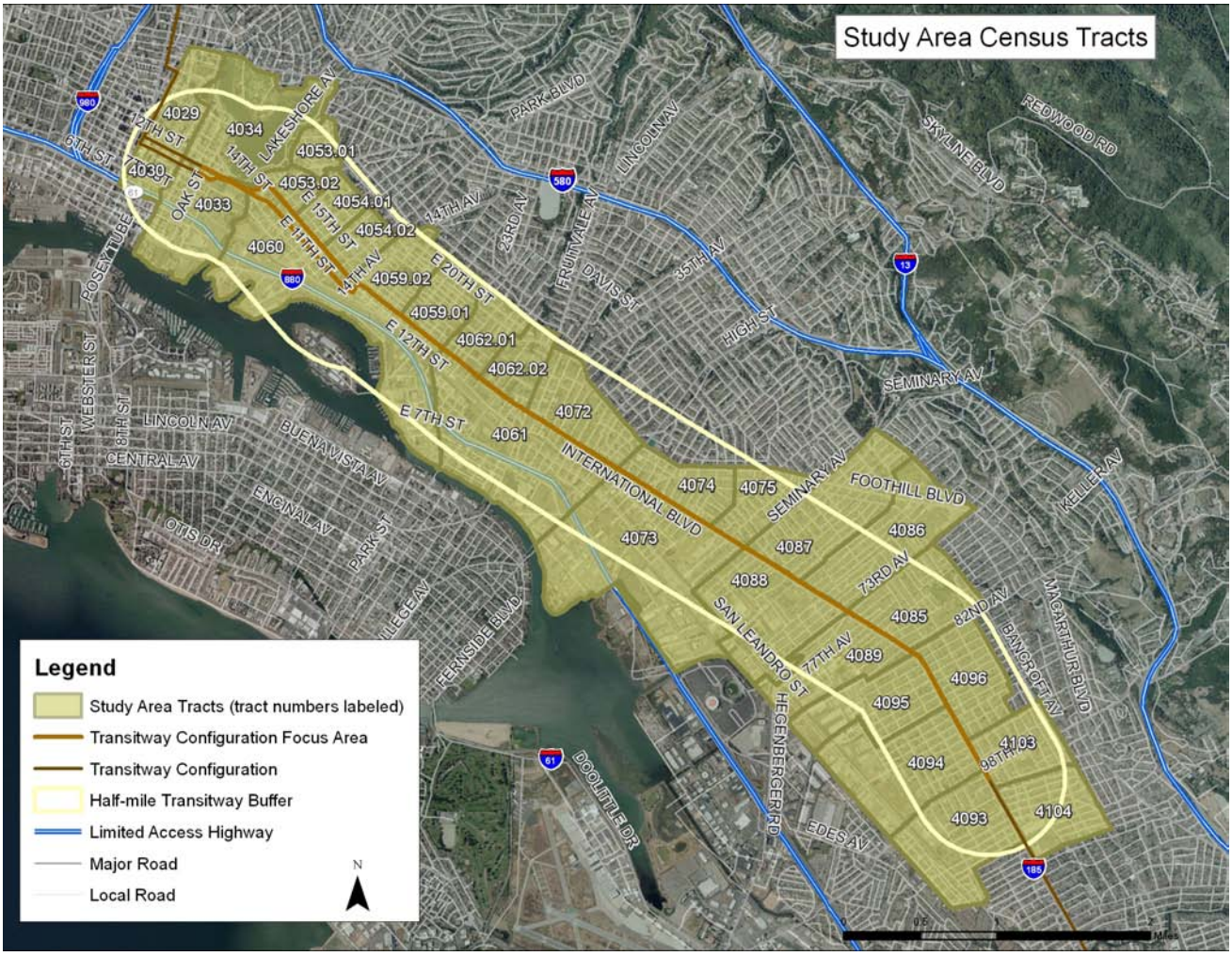
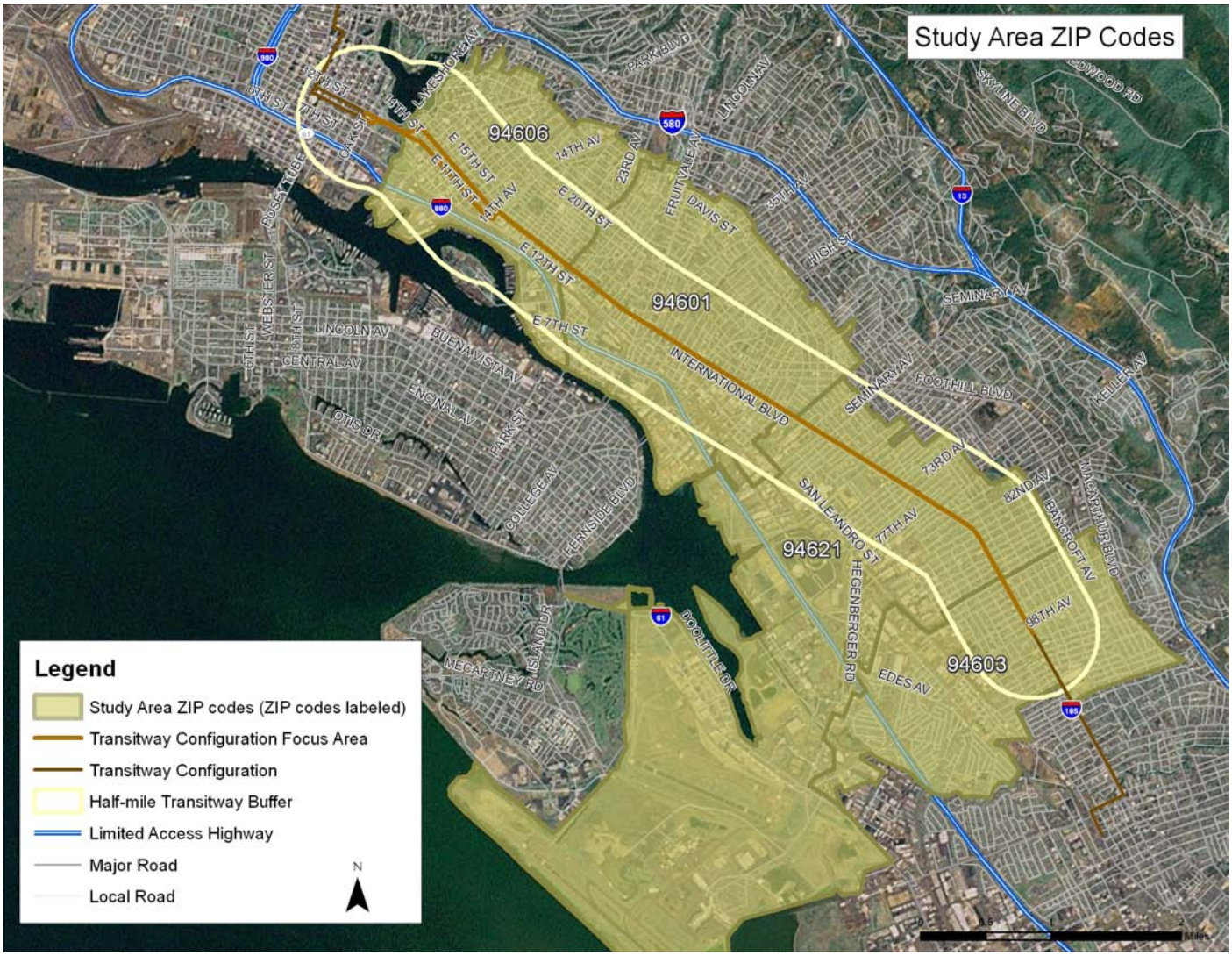


Figure 3. Study Area with ZIP Codes



3.3.4 Community Input into the HIA

Incorporating community input throughout the HIA process and soliciting feedback on HIA products are core components of HIA practice. For this HIA three community meetings were held. The first, on March 22, 2012, focused on gathering input on the HIA scope and those present included members of Oakland Community Organizations (OCO), which is a faith-based organization made up of members from Oakland schools and religious institutions. At that meeting, HIP presented information on the HIA process, draft scope, and timeline, as well as more broadly on why considering health in the BRT process added value. There were about 25 participants present during the meeting (3 English speakers, approximately 15 Spanish speakers, two facilitators, 3 observers including two children of participants and one UC Berkeley student). After presenting the scoping categories and some of the research questions *(as described above)*, participants broke up into two groups and answered the following questions: Are we planning to look at the right issues in this HIA? What's missing? How would you

prioritize the issues included in the draft scope? Due to the large number of Spanish-speaking participants, immediate translation was provided and one of the breakout groups was facilitated in Spanish.

Overall, meeting participants confirmed that the HIA was examining the "right" issues. The issues brought up the most were pedestrian walkability and safety, crime and violence. A specific population that participants were particularly concerned about were youth, because they are frequent users of buses and public transit to get to and from school and activities. Based on feedback from the participants, HIP made a number of changes to the HIA scope, including:

- Added *student and senior populations* as vulnerable populations
- Added *public schools* to the list of public services whose access is analyzed
- Added *parking* analysis
- Added analysis of *bus emissions*

The second meeting took place on April 23, 2012 and included a small group of leaders from Allen Temple Baptist Church (ATBC), an Oakland-based church with over 5000 members. There were three members of the Project Team and six members from ATBC present. The purpose of the meeting was to give leaders an understanding of HIA, as well as discuss the potential of this East Bay BRT HIA. The Project Team had already completed a fair amount of data collection, therefore the meeting was not expected to dramatically change the assessment plan. However, feedback from the meeting insured our research to the extent possible represented the particular concerns of this group. Some issues that were highlighted included: mobility for seniors and the compliance of the proposal with the Americans with Disabilities Act, especially in reference to the proposed station selection and spacing; pedestrian safety for seniors; and emergency vehicle access.

The third community meeting, on May 15, 2012, combined both groups—OCO and a larger collection of members from ATBC – and was held at Allen Temple Arms, a senior living facility. The meeting was focused on reporting HIA findings (see Section 4) and presenting draft recommendations (see Section 5 for final recommendations). About fifty community residents attended the meeting. After presenting the HIA findings, HIP posed the following questions to the meeting participants:

- What information about existing conditions in the Study Area sounded most/least true?
- Is there any relevant information you would add to our findings?
- What impacts identified in the HIA are most important to you?
- Which of the draft HIA recommendations are most important to you?
- Do you have ideas for other BRT-specific recommendations/mitigations that might address the health impacts that the HIA identified?
- Do you have any concerns or recommendations at certain sites?

The feedback resulted in additional research being conducted on a couple issues and several suggestions for recommendations being incorporated into the HIA.

3.4 SOURCES OF DATA AND ASSESSMENT METHODS

Research relevant to this project was gathered from multiple sources, with a focus on information about the various topics discussed in the Assessment section as related to health.

Sources included recently completed HIAs that provided a wealth of literature about health impacts, and public health literature databases, and grey literature available online. We searched such databases for information about BRT in relation to the categories discussed in the Assessment section. The BRT research included examples both in the U.S. and internationally. Some of the information about BRT systems in other countries pre-dated U.S. systems and some was not relevant, but we tried to focus on geographies with demographics that were comparable to Oakland.

Secondary data provided the main source of data for the assessment. The U.S. Census was used for most demographics information; travel data came from the EIR; health outcomes and related data were provided by ACPHD staff and reports they have published; information on crime was taken from the Oakland Crimespotting website; and automobile-pedestrian and -bicycle collision data came from the Statewide Integrated Traffic Records System (SWITRS). More information about the sources used for each health determinant is listed below.

Table 2. Data Sources, Geographies, and Methods

Health Determinant	Data Sources	Geography	Methods
Demographics	Census	Tracts	Descriptive analysis
Health Status	ACDPH	ZIP Codes	Descriptive analysis
Mobility	Census Draft and Final Environmental Impact Reports	Tracts BRT Corridor Parallel routes	Descriptive analysis
Access to Goods and Services	Final Environmental Impact Reports Literature on healthy food outlets Network for a Healthy California, CDPH Alameda County Public Health Department – list of clinics	Blocks Point Locations	Descriptive analysis GIS Analysis
Traffic Safety	Draft and Final Environmental Impact Reports California Highway Patrol Statewide Integrated Traffic Records System (SWITRS) data City of Oakland reports & plans Accident prediction modeling from traffic safety literature	Point locations BRT Corridor City of Oakland	Descriptive analysis Geographic Information Systems (GIS) analysis Quantitative and Qualitative forecasting

Safety from Crime	Info Alameda County Oakland Crimespotting	Police Precinct Point location by precinct	Descriptive analysis GIS analysis
Air Quality	Draft and Final Environmental Impact Reports EMFAC 2007 emissions model CALINE emissions dispersion model BAAQMD Google Earth tools City of Oakland reports West Oakland Railyard Health Risk Assessments Literature on relationship between vehicle emissions and health	BRT Corridor and vicinity Point locations	Descriptive Analysis Quantitative and Qualitative forecasting

4 Assessment Findings

4.1 DEMOGRAPHICS OF THE STUDY AREA

Demographic data was taken from the 2010 decennial Census for tracts that intersected the Study Area. The total population living in the Study Area is around 118,000.[13]

Ethnicity

As evident in Figures 4, 5 and 6 below, ethnic composition of the Study Area is fairly diverse. The largest ethnic group in the Study Area is Hispanic/Latino, followed by African American. White and Asian populations are also well represented. As Figure 5 portrays, Hispanic/Latino populations are fairly spread out within the Study Area, while African American populations are slightly more concentrated in the southeastern portion.

Figure 4. Population of the Study Area by Ethnicity

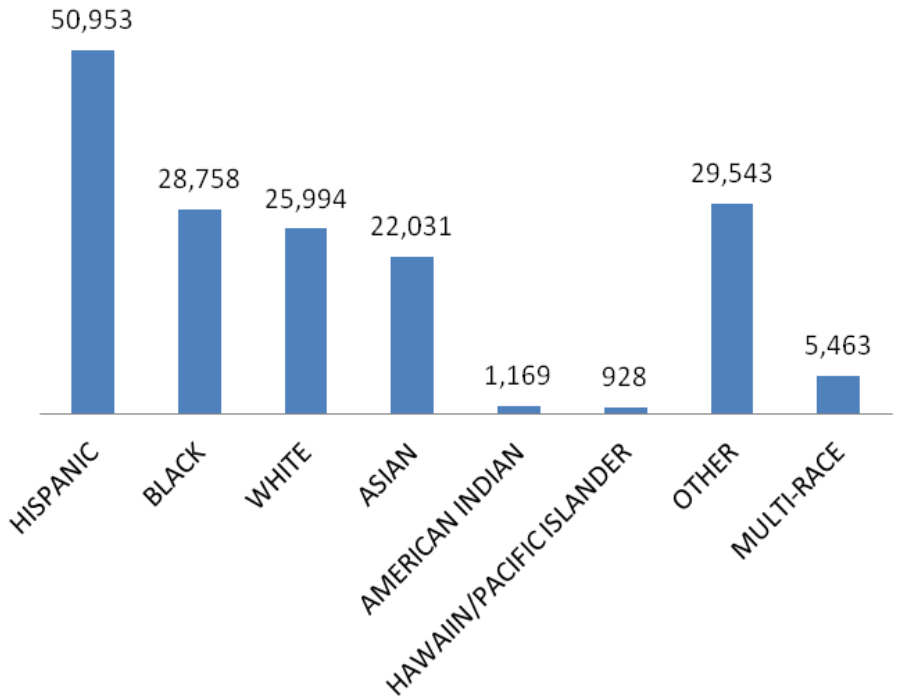


Figure 5. Population by Hispanic Race/Ethnicity

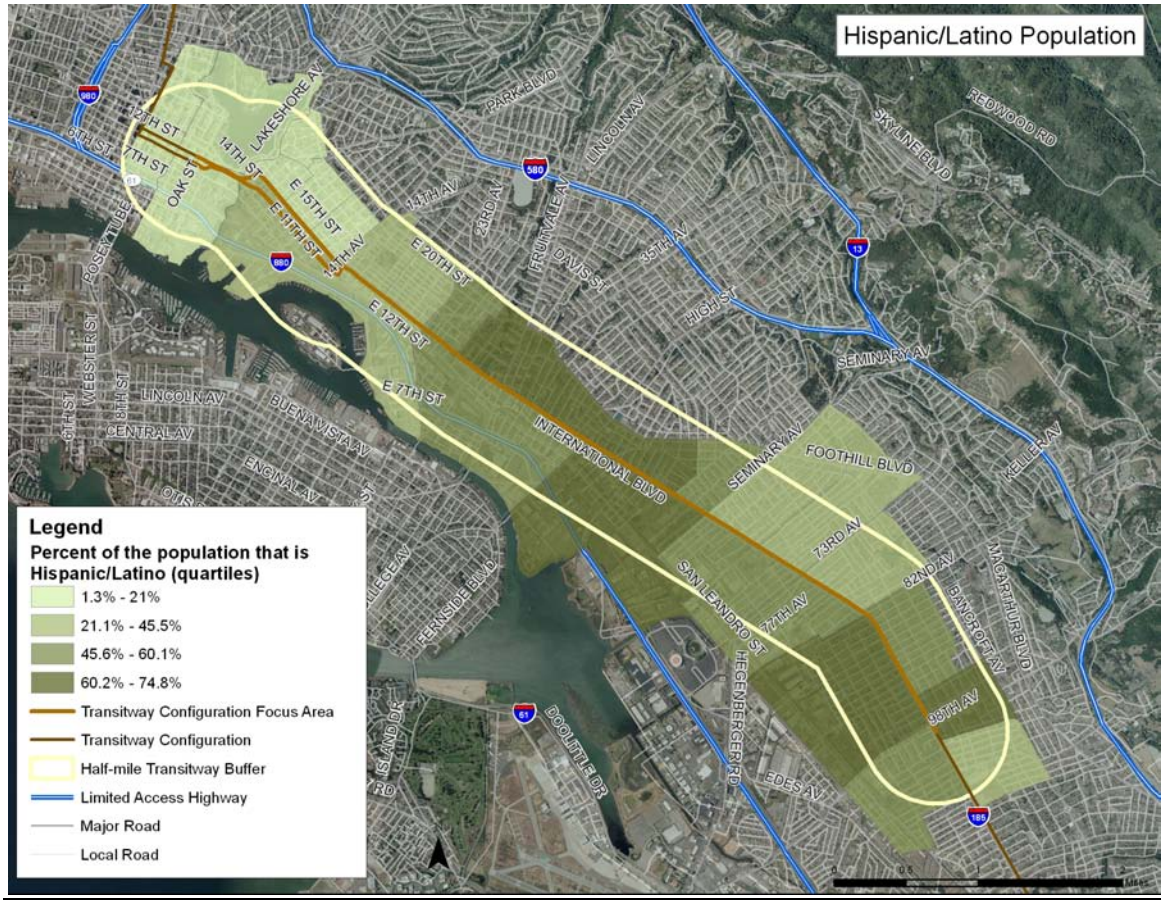
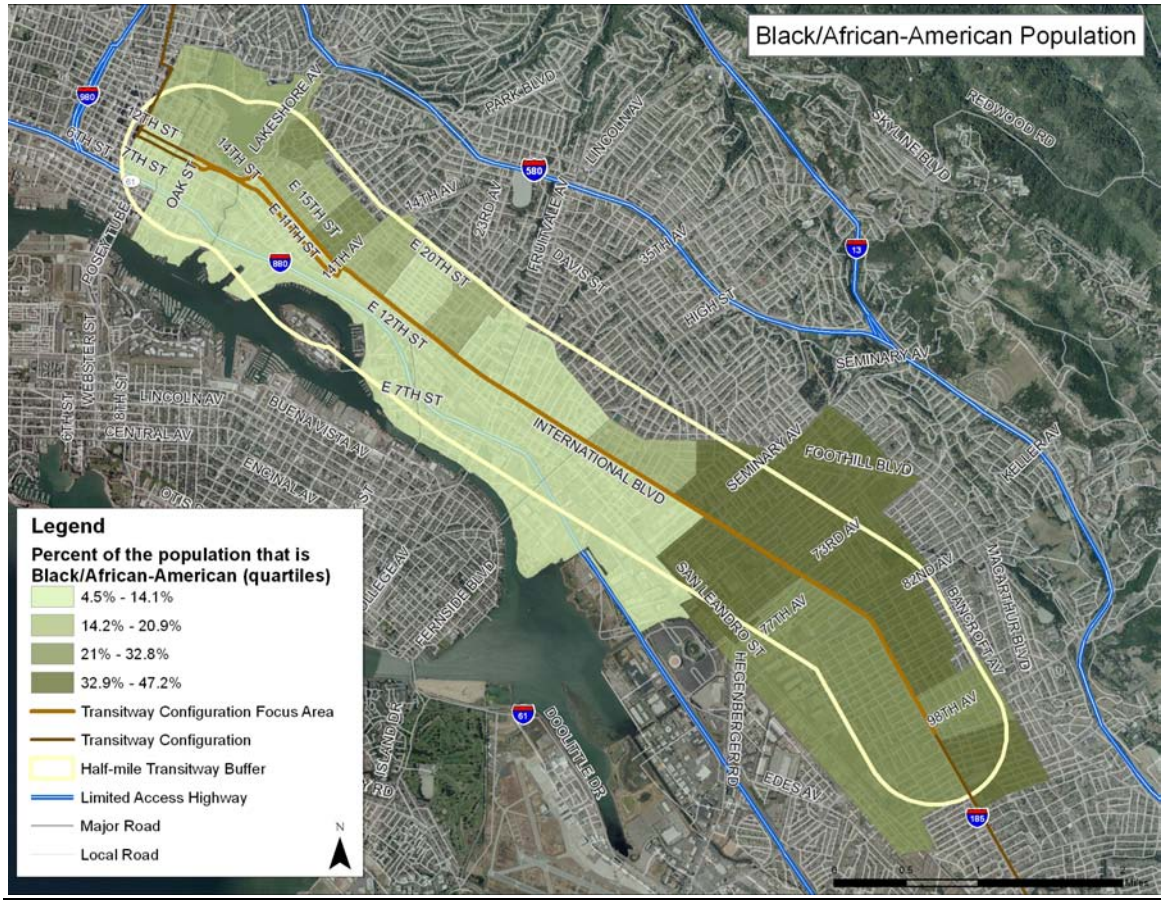


Figure 6. Population by Black or African-American Race/Ethnicity



Income

The median household income for the Study Area is $35,097 which is below the median household income of $40,055 for Oakland overall.

Seniors and School-Age Youth

In considering the differential impacts of BRT on different populations, it is important to note the distribution of elderly populations who are more likely to have mobility impairments as well as youth who rely on public transit to travel to and from school and constitute a significant proportion of riders. As shown in Figure 7, senior residents are concentrated in the northwestern portion of the Study Area, but are distributed throughout the area as well. Figure 8 illustrates that youth are more concentrated in the southeastern portion of the Study Area.

Figure 7. Senior Residents in Study Area

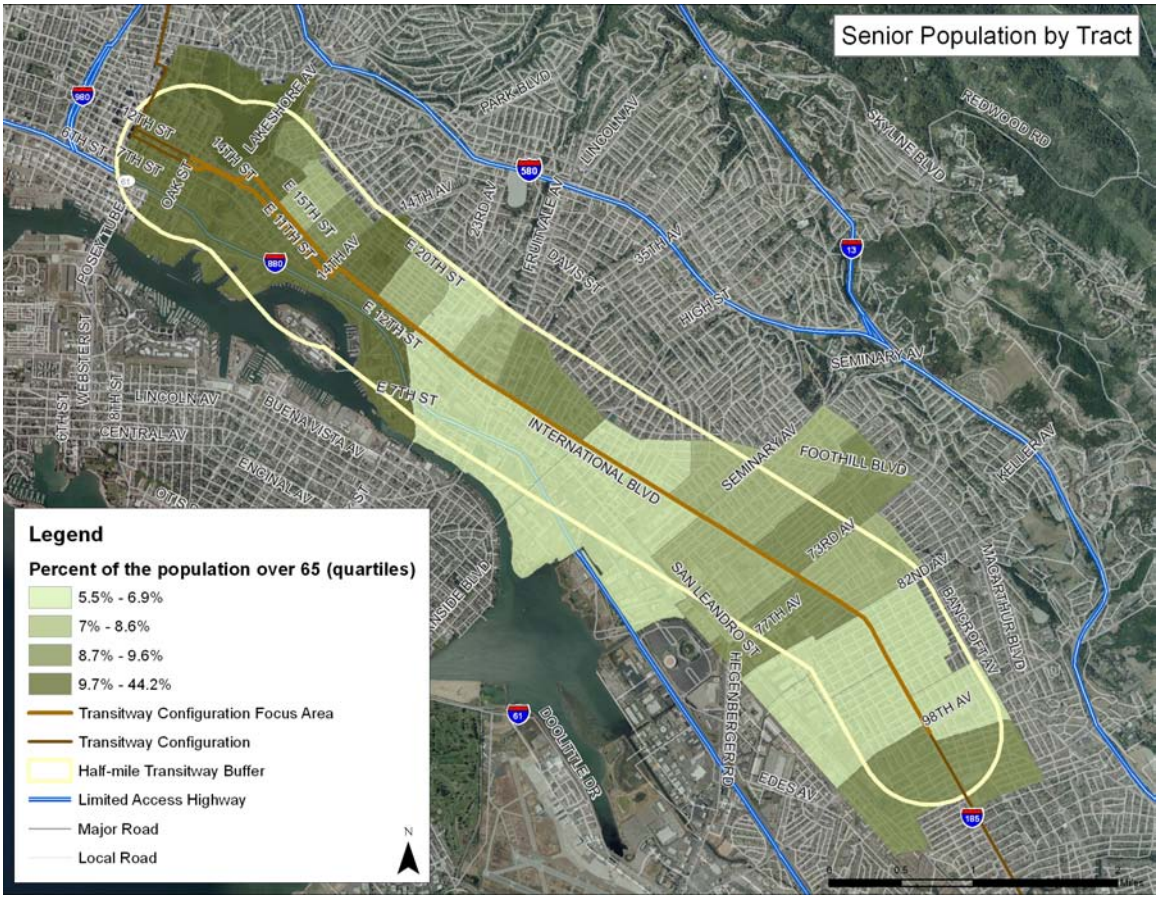
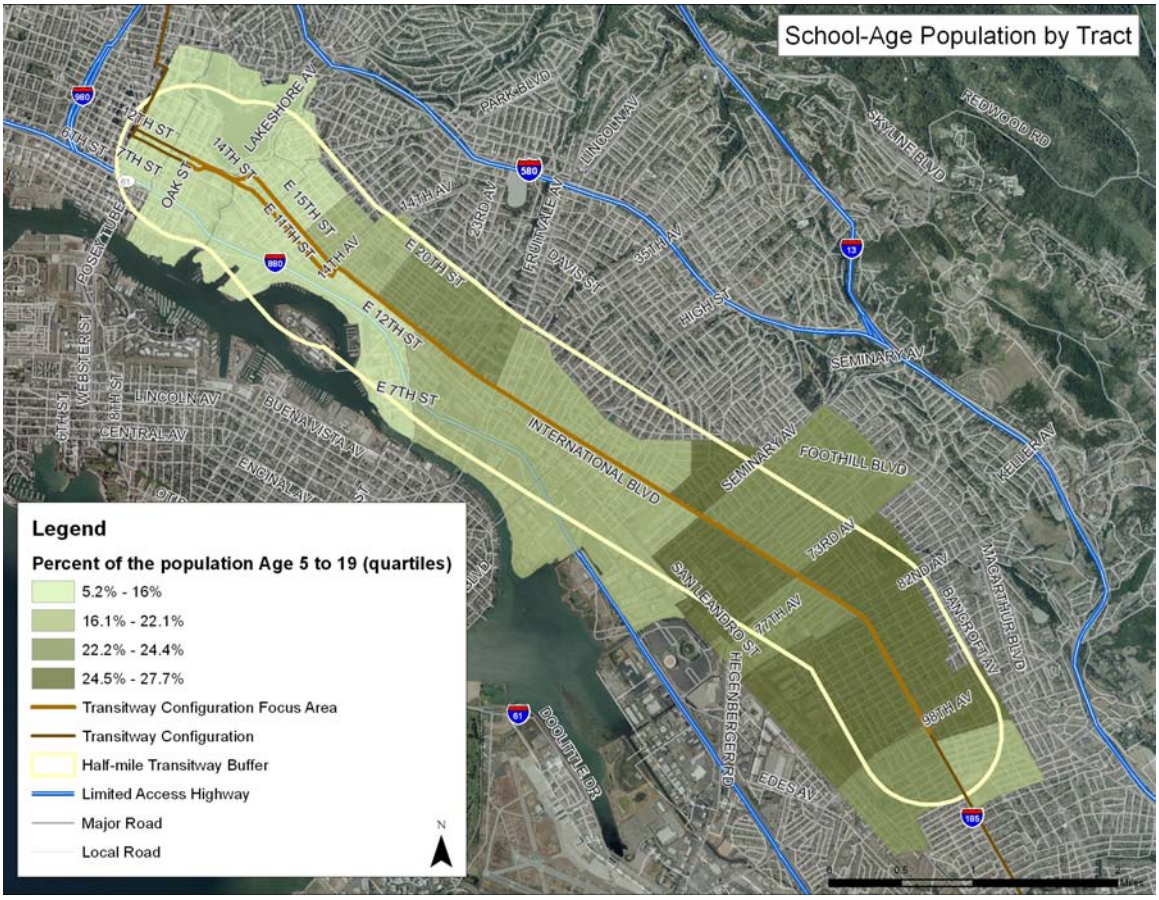


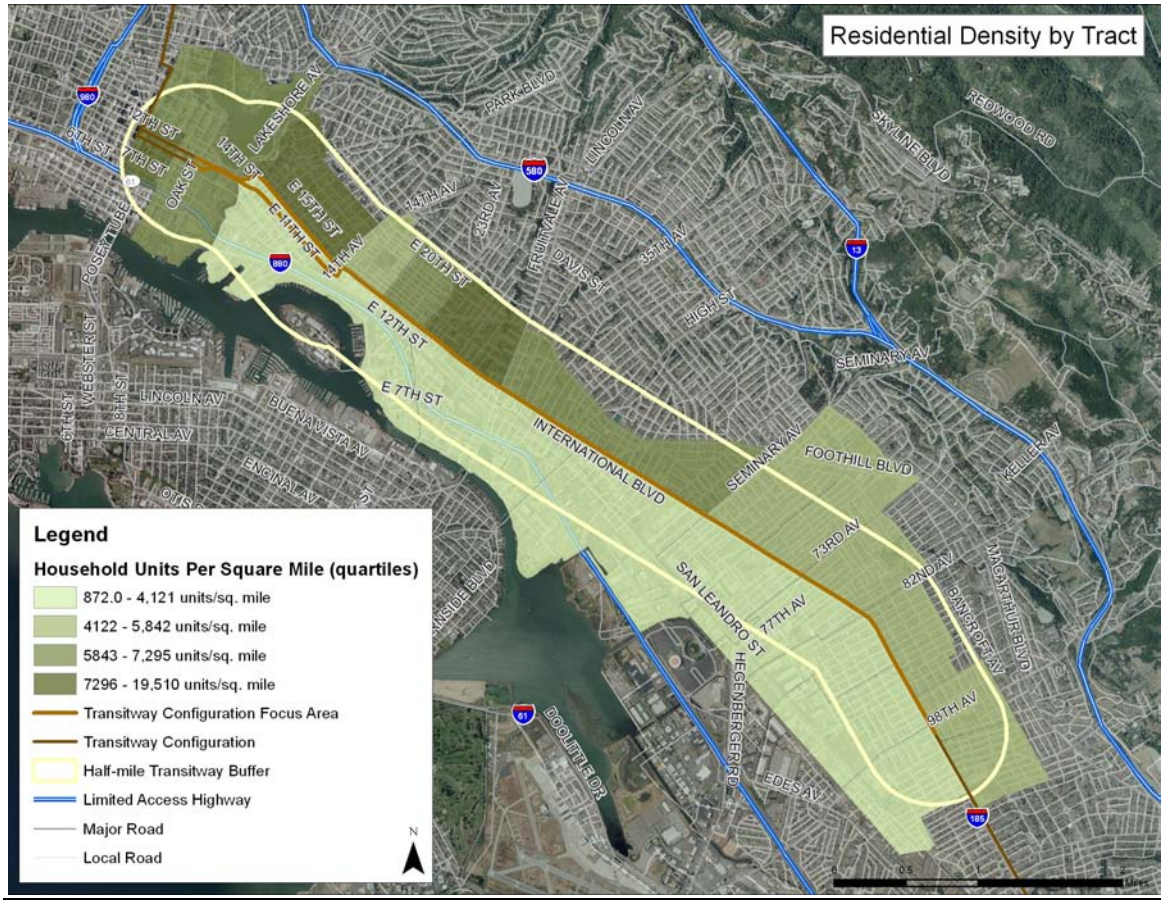
Figure 8. School-Age Youth in Study Area



Residential Density

As portrayed in Figure 9, residential density is greater north of International Blvd as compared to areas south of International Blvd.

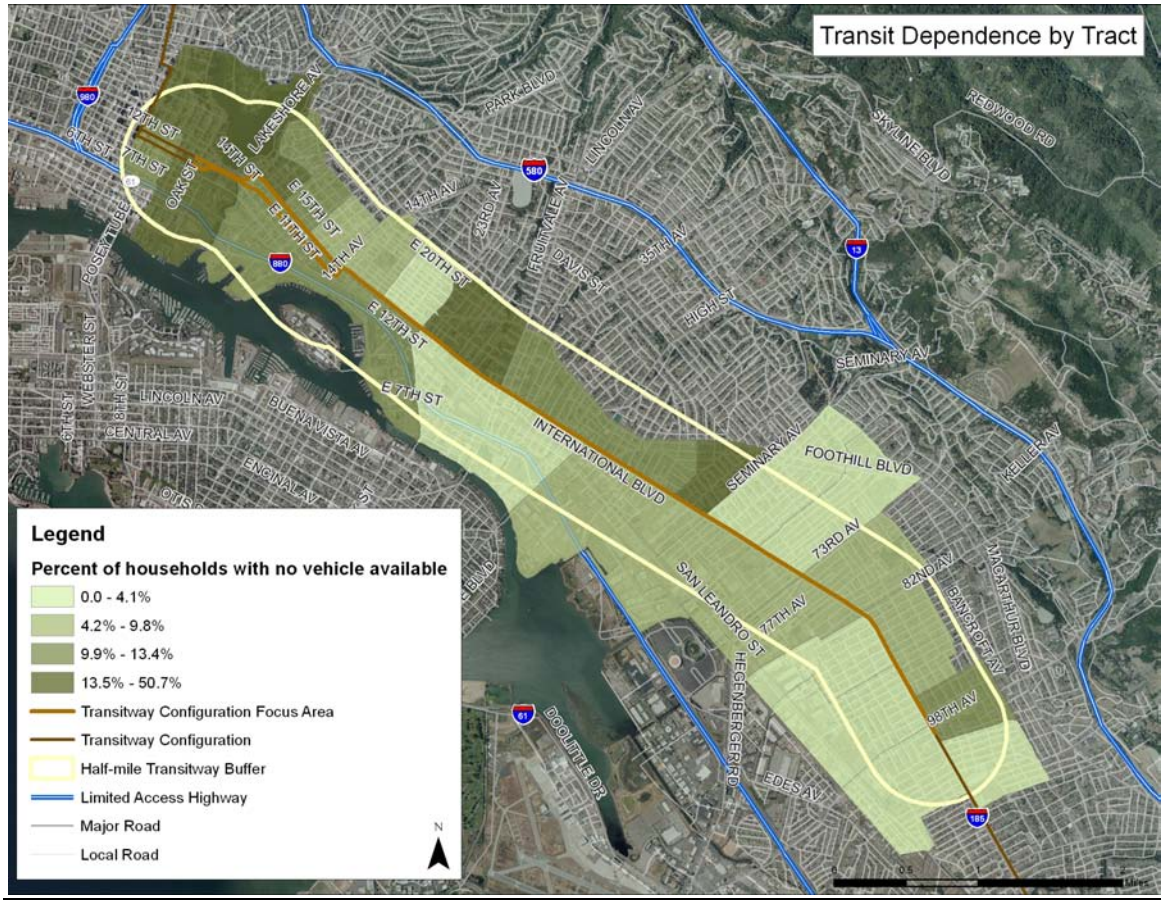
Figure 9. Residential Density in Study Area



Car Ownership

As portrayed in Figure 10, some tracts in the Study Area contain many (greater than 13.5%) households without cars; therefore, these populations are dependent on public transit resources such as buses or BRT. These households are concentrated in the western portion of the Study Area near downtown Oakland, where transit resources are more accessible.

Figure 10. Households Without Cars in Study Area



4.2 HEALTH STATUS OF THE STUDY AREA

The communities within the Study Area share a number of important health indicators that suggest overall health is poorer than the Alameda County average. Any health benefits of the East Bay BRT project will thus be beneficial to Study Area communities, while any health hazards could exacerbate already poor health conditions.

The Alameda County Health Department provided the following data comparing the Study Area to the County (see Table 3). For all-cause mortality, data was provided by Census tract along the alignment. Data on hospitalization rates, however, is organized by ZIP code, and ZIP codes represent larger geographical areas.

Each of the health indicators relates to one or more of the five health determinants analyzed in this HIA (see Appendix A). Asthma emergency room visits, for example, are related to air quality, unintentional injury emergency room visits are related to traffic safety and safety from crime. Obesity and diabetes related hospitalization rates are associated with access to healthy food and to emergency services, generally.

Table 3. Selected Health Indicators, East Bay BRT Study Area & Alameda County (Rates per 100,000)

	All-Cause Mortality	Obesity-Related Hospitalizations	Diabetes-Related Hospitalizations	Unintentional Injury Emergency Room Visits[14]	Asthma Emergency Room Visits	Life Expectancy
Health Pathway		Activity/Access	Activity/Access	Traffic Safety	Air Quality	All
Alameda County	641	335	1,026	6,227	520	81.1
Study Area	773	460	1,695	7,659	819	76.6
Difference	**21%**	**38%**	**65%**	**23%**	**57%**	**3.3 yrs**

Source: Alameda County Department of Public Health; Office of Statewide Health Planning and Development, 2010
Note: obesity-related hospitalizations are classified when obesity is listed as the primary reason for hospitalization or one of the first four underlying causes.

The ZIP codes along the BRT alignment have significantly poorer health for these indicators compared to Alameda County. The mortality rate is 1/5 higher, and diabetes- and asthma-related hospital visits are more than 50% higher. Life expectancy in ZIP codes along the BRT alignment is 3 years less than in Alameda County as a whole.

As health and demographics data illustrate, communities along the BRT alignment, in general, earn lower incomes, are more racially and ethnically diverse, and experience poorer health outcomes. The health impacts of the East Bay BRT project are examined with this background in mind.

4.3 MOBILITY

Mobility can have powerful effects on the time, costs, and safety associated with travel, which in turn can impact health. Encouraging a transportation system composed of multiple modes of transportation, including auto, bicycle, pedestrian, bus, and rail transit can improve travel times and/or increase physical activity while reducing environmental and health costs associated with personal vehicle trips.[15]

This mobility analysis considers the effects of the BRT proposal on public transit access and ridership, mode share (including in particular walking and bicycling), public transit use, the distance people have to walk to reach BRT stops, traffic volumes, street parking, and mobility of emergency vehicles. We also considered the effects on the pedestrian and bicycle environment and traffic safety, but this is presented in a separate section (see Traffic Safety, Section 4.5).

4.3.1 Research Connecting Mobility to Health

Mobility reflects how quickly and easily one can get to where one needs to go. Faster and easier travel, which is a function of land use planning as well as speed of travel, leads to more free time and more access to necessary goods and services. This can improve health by increasing social cohesion and allowing more time for health-promoting activities as well as ensuring that people have access to what is needed to live healthy lives. Mobility also reflects mode choice (i.e. means of travel: car, walking, or bus—one uses to get to a destination), which is a function of land use planning and density as well as transportation infrastructure. More mode choice leads to more active transport (i.e., walking and biking), which leads to better health as a result of increased physical activity. Last, the term can describe accessibility of routine destinations. More access to goods and services necessary to live healthy lives leads to better health.[16] The first two concepts—ease of travel and mode choice—are the focus of this chapter. The last concept described—access to goods and services—is the focus of the Access to Goods and Services section.

<u>Impacts of Access to Goods and Services</u>
See Section 4.4 for additional information about health impacts of access to goods and services.

<u>Impacts of Transportation on Physical Activity</u>
Transportation and land use patterns can have beneficial effects on health by encouraging physical activity and walking for leisure.[17] Physical activity can prevent obesity, diabetes, and heart disease, reduce stress, improve mental health, and promote longevity.[18] Although there are many ways to encourage physical activity, active transportation, such as walking and bicycling, is a practical way to do so. A "walkable" or "livable" neighborhood, characterized by mixed residential and commercial uses with easy access to a variety of food and retail options, parks and open space, and modes of transport, can lead to more exercise and less obesity by significantly reducing the need to drive.[19] [20] [21] [22] Other traffic variables that encourage walking on streets include traffic calming measures, street connectivity, access to public spaces, well-maintained and well lit sidewalks, traffic conditions that encourage maximum pedestrian visibility to drivers, safety from crime, and the presence of well-marked bike lanes. [23] [24] [25]

Walking tends to be particularly accessible as a form of physical activity for elderly, disabled, and lower-income people who have few opportunities to participate in sports or formal exercise

programs. Bicycling is another practical option for improved mobility, with faster travel speeds than walking, extending the acceptable travel distance to 1.5–2 miles or more.

Several studies have quantified the benefits of built environmental form on physical activity:

- All-cause mortality is 28% lower for people who commute by bicycle 3 hours per week compared to non-cyclists.[26] [27]
- People who walk an average of 29 minutes seven days a week are 22% less likely to die from any cause compared to those who do not achieve this level of physical activity.[28]
- Saelens has shown that people walk on average 70 minutes per week longer in pedestrian-oriented neighborhoods.[29]
- A study in the U.S. showed that each additional hour spent in a car per day was associated with a 6% increase in the likelihood of obesity. Each additional hour walked per day was associated with a 4.8% reduction in the likelihood of obesity.[30]
- A study in Atlanta, Georgia looked at people living in walkable vs. car-dependent neighborhoods, and found that those living in car-dependent neighborhoods drove an average of 43 miles per day (vs. 26 in walkable neighborhoods), and walked much less (only 3% walked vs. 34% in the walkable areas).
- Americans who use public transit spend a median of 19 minutes daily walking to and from transit; 29% achieve more than or equal to 30 minutes of physical activity a day solely by walking to and from transit, enabling them to reach the Center for Disease Control's (CDC's) recommended amount of physical activity (30 minutes a day, five times a week.[31]
- According to an analysis of U.S. travel survey data, 16% of all recorded walking trips are part of transit trips, and these tend to be longer than average walking trips.[32]
- Pedestrian safety is critical to converting urban forms to increase walking. A neighborhood with significant obstacles to walking–such as high traffic volumes and speeds, narrow sidewalks, poorly connected streets, unsafe intersections, and a lack of lighting—is likely to reduce walking on residential streets.[33] [34]
- Active transportation–for example, walking and biking–has many benefits relating to health, including improved air quality, noise reduction, reduced motor vehicle–related accidents, increased physical activity, improved social cohesion, and decreased stress and chronic disease. Having safe routes to school and around neighborhoods can promote walking and biking to destinations such as schools, churches, friends, and stores. Having alternatives to large, busy roads may achieve this goal. Walkable streets are also associated with increases in social cohesion and reduced rates of obesity.[35]

Impacts of Public Transportation on Mode Share

For many people, particularly low-income populations without access to automobiles, affordable and convenient mass transportation is necessary for most daily activities: to get to work, to take children to school and child care, to shop for groceries and other retail services, and to obtain timely medical care. Disconnected and lengthy transit routes make the experience of doing daily activities more time intensive, tiring, and stressful.

Public transportation has many benefits relating to health, due to improvements in air quality, noise reduction, reduced motor vehicle–related accidents, increased social cohesion, and reduced stress. Several studies have described the benefits of public transportation:

- A more dense mix of uses, well served by mass transportation systems, can ensure access to essential needs and services while reducing VMT, thereby reducing environmental and health costs associated with personal vehicle trips.[36]
- Public transit use (instead of driving) reduces noise and air emissions from cars. Road traffic noise is a function of vehicle volume, vehicle speed, vehicle type, and road conditions. Moderate levels of vehicle-associated noise significantly affect sleep, school and work performance, temperament, hearing impairment, blood pressure, and heart disease.[37]
- Workers with access to public transit are more likely to walk, bike, and take public transit to work than those without.[38]
- Long commutes can distance an individual from his/her community and decrease social connectivity. Social connection has a variety of health impacts, ranging from reducing stress, having a longer lifespan, to supplying access to emotional and physical resources.[39] [40] For the elderly and the disabled, limited access to public transit creates barriers to participation in community and civic life, potentially leading to feelings of depression and alienation.[41] Taking public transportation aids in decreasing isolation and encourages what city-planning advocate Jane Jacobs referred to as "casual contact from unplanned social interactions."[42]
- A household with two adults that uses public transit saves an average of $6,251 per year compared to an equivalent household that owns two cars. The savings associated with taking public transit can be used for other necessities such as health care, food, housing, and clothing, and thereby lead to improved health.[43]

Impacts of Commute Times

As discussed in the Access to Goods section (Section 4.4), better access to the resources needed for a healthy lifestyle leads to better overall health for the individual and community. Travel times to places of employment, medical services and food can affect health in the form of stress and social connectivity. According to the National Household Travel Survey, 20% of trips are taken for commute purposes. Long commute times can negatively impact social connection, which can affect stress, lifespan and access to emotional and physical resources.[44]

Impacts of Transportation Costs

Low-income populations often spend over 30% of their income on transportation costs, with vehicle ownership being one of the most costly types of transportation. Public transportation could save the average two-adult household $6,251 compared to an equivalent household that owns two cars. The savings associated with taking public transit could then be used for health care, food, housing, and clothing, thereby leading to improved health.[45] Another study by the American Public Transportation Association found that households that use public transportation and live with one less car could save $9,000 on average every year, and reduce driving by 4,400 miles each year per household.[46]

Impacts of Parking

The impacts of parking on health have been documented through various health pathways. Parking availability not only encourages private vehicle use as a primary mode of transportation, but contributes to traffic congestion as a result of cars searching for free parking. In effect, parking contributes to increased air pollution, noise, crashes, and traffic congestion. Circling for free parking typically accounts for over 8% of total traffic.[47] One study cites searching for parking in Westwood, CA as an example of distances traveled during parking searches in busy areas. The average distance traveled when looking for free spaces in Westwood is about half a mile and, as the study points out, if one were to add all circling drivers in the area, the extra distance traveled would account for 3,600 vehicle miles traveled each day or two round trips to the moon over the course of a year.[48]

Studies have also shown that less available parking increases transit ridership and revenue and decreases the cost required by the city and the developer to build and maintain parking.[49] Costs associated with overdevelopment of parking are often a result of parking generation studies evaluating peak periods of demand in areas with no public transit option.[50] These studies often over-account for the number of spaces actually needed and can deter promotion of other modes of travel.

Impact of Parking on Social Cohesion and Elderly Resident Satisfaction

Although research is limited in respect to the correlation of available parking spaces to likelihood of family visitation of the elderly, a handful of studies have suggested parking to be valued. Past research seems to suggest that parking increases residential satisfaction among the elderly. Although parking is not always considered in plans for elderly developments for the assumption that older people do not drive, studies suggest that it's an important determinant of livability.[51]

At the same time, many studies have supported a decline in parking spaces to enhance the walkability of an area and resident satisfaction is often higher for those with access to more natural surroundings.[52] [53]

Impacts of Emergency Vehicle Response

Altering traffic flow of emergency response vehicles can have serious health implications for those in need of emergency services. Emergency response time describes the timeframe in which an emergency vehicle reaches the person from the start of the emergency. Decreasing the response time of the emergency vehicle through planning decisions (e.g., a dedicated bus lane for emergency vehicle use) can improve traffic flow for both the emergency vehicles traversing the city and other vehicles maneuvering around parked and active emergency vehicles. In turn, a decreased response time can have serious health implications for the person seeking services. Recent studies highlight the following consequences of emergency response times:

- A study determining the effect of response times on survival found that risk of death was three times higher for patients whose response time exceeded 5 minutes, compared to those whose response was less than 5 minutes (1.58 vs. 0.5%).[54]
- A separate study identified a survival benefit when response time was less than 4 minutes for patients with intermediate or high-risk mortality.[55]

- An American Heart Association study in 1996 showed that Seattle, with a response time of less than 7 minutes, saved 30% of its sudden cardiac arrest victims. New York, with an average response time of 12 minutes saved only 2%.[56]

Public health literature has yet to reach consensus on the precise effect of emergency response time on survival. The studies cited above report a survival advantage for patients reached below thresholds of 4 or 5 minutes for response times to emergency calls. In lieu of federal regulation, medical industry standards establish that, for cardiac arrest, between 8 and 10 minutes is an appropriate response time from collapse to shock time.[57] Studies cited in American Heart Association's 2010 guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care document the effects of time to defibrillation on survival from sudden cardiac arrest (SCA). For every minute between time of collapse and defibrillation, survival rates from SCA decrease 7% to 10% if no CPR is provided.[58] Shortening response time could decrease morbidity and improve survival for many types of illness and injury.[59]

Federal and state governments do not mandate a required timeframe within which units must respond to an emergency, and a department may define its own response time depending on the start point, end point, and interim time points chosen.[60]

A recent study[61] demonstrated a link between emergency response times and land use patterns. An association was found between urban sprawl and increased emergency medical system response time as well as a higher probability of delayed ambulance arrival following motor-vehicle crashes in U.S. counties with prominent features of sprawl, such as low-density construction, limited street connectivity, and segregation of residential development from civic and commercial districts. There was almost twice the probability of a delayed ambulance compared with counties exhibiting smart-growth characteristics.

In some cases medical emergency response times depend on the response times of police services. While the literature does not provide any supporting evidence of the impacts of more efficient police response times on crime rates, increased response times could affect survival rates of victims of violent crimes. Local first-responder policies require law enforcement officers to arrive at the scene of violent-crimes before paramedics and emergency medical technicians are able to assist. This policy intends to keep medical professionals safe but often delays the response time of medical services.[62] Therefore increasing response times of all emergency response vehicles can assist with medical emergencies and improve survival rates.

Although it seems likely that access to a dedicated BRT lane, which would be available for emergency response vehicles, will improve emergency response time, there are limitations to this speculation. A study in Rochester, New York evaluated the causes of delay for emergency response and found 65% of the delay in response to cardiac cases a result of the patient's deliberation as to whether or not to seek help.[63] The study also found transportation delays to account for only 5% of total response delays. Because transportation delay is reported as a small percentage of total response delay, it has not often been analyzed. More research is needed to better understand the direct time benefits of BRT dedicated lanes on emergency vehicle response time.

While there is minimal research on the effects of BRT dedicated lanes on emergency vehicle response time, studies on HOT (high-occupancy toll) lanes that permit emergency vehicle use

report low usage. Research conducted by the Texas Transportation Institute on HOT lanes explain low usage to be a result of many factors including access points not matching response needs. The Institute has also found issues in some areas of the country where off-duty law enforcement officers have used the HOV lanes for personal reasons. Additionally, there have been misunderstandings with regards to who classifies as emergency vehicle personnel. Studies evaluating the effects of HOT lanes, however, are also limited and more research is needed to determine the impacts on emergency vehicle response times.

Established Standards Related to Access to Public Transportation

In July 1999, the U.S. Department of Transportation (USDOT) issued an Accessibility Policy Statement pledging a fully accessible multimodal transportation system. Accessibility in federally assisted programs is governed by the USDOT regulations (49 CFR part 27) implementing Section 504 of the Rehabilitation Act (29 U.S.C. 794). The FHWA has enacted regulations for the implementation of the 1990 Americans with Disabilities Act (ADA), including a commitment to build transportation facilities that provide equal access for all persons. These regulations require application of the ADA requirements to Federal-aid projects, including Transportation Enhancement Activities.

Title VI of the Civil Rights Act the 1964 and Executive Order 12898 (1994) on Environmental Justice support similar protections of equal access for all persons to transportation infrastructure.

There are currently no ADA guidelines on appropriate distances between bus stop placements, however, the American Public Transportation Association and AC Transit both offer recommendations.[64] Typical distances people are willing to walk to transit range from .25 to .33 miles (a 5 to 10 minute walk). Many people are willing to walk farther distances to access higher-order services, such as a BRT route. Despite distance recommendations, AC transit states that irregular block lengths, topography, proximity to special needs facilities (e.g. senior center), and major transfer points are all factors that may modify the distance between bus stop placement. [65]

4.3.2 Existing Conditions for Mobility

Transportation Mode Share

The 2000 Bay Area Travel Survey reports that 76.2% of total trips in Alameda County were made by motor vehicle, 8.1% by transit (4.1% by bus), 12.2% by walking, and 2.1% by bicycle. For households within a half-mile of rail stations and ferry terminals, transit mode share increased to 25.7% (17.5% by bus), walking to 19.5%, bicycling to 3.3%, and driving decreased to 48.2% of mode share.[66] Due to its proximity to current bus transit resources, mode share for the population living along International Blvd is anticipated to more closely reflect the sample of Alameda County households living within half-mile of a transit station.

The US Census Bureau's 2006-2010 American Community Survey provides census tract data showing the means of transportation to work among workers 16 years and older (see Table 4). Although trips to work make up only an estimated 20% of total trips taken, they represent an important source of transportation mode share data during peak travel hours.[67] Based on the census tract analysis, summarized below, the Study Area population is more transit dependent and utilizes public and active transportation at a higher rate than the population in Alameda County overall (see Figure 10).

Across Alameda County, 91% of households and 96% of working residents have access to a car for regular use, while only 88% of workers in the Study Area have access to a car.[68] [69] In the Study Area, 65% of workers over the age of 16 drove to work, compared to 77% of all Alameda County workers. About 18% of the Study Area population takes public transportation to work, 7% walks, and less than 1% rides bicycles to work. The remaining percentage represents people who work from home or utilize other means of transportation (taxi cab, motorcycle, etc). Approximately half the population in the Study Area spends less than 25 minutes commuting to work.

The TOD Plan is another source claiming that residents living in Census tracts surrounding International Blvd utilize bus transportation at a higher rate than residents of Oakland overall. The AC Transit bus routes currently serving the International Blvd corridor, Lines 1 and 1R, are both among the top three most heavily used AC Transit routes, and experienced approximately 24,000 average passenger boardings per weekday in 2009.

Table 4. Commute Characteristics in International Blvd Study Area and Alameda County

Percent of workers 16 and older who took the following mode of transportation to work:	**Study Area**	**Alameda County**
Car, truck, or van (drove alone)	53%	66%
Car, truck, or van (carpooled)	12%	11%
Public transportation (excluding taxicab)	18%	11%
Walked	7%	4%
Bicycle	0.81%	2%
Percent of workers 16 years and over with no vehicle available	12%	4%

Source: U.S. Census, 2006-2010 American Community Survey 5-Year Estimates

Traffic, pedestrian, and bicycle counts provided in the FEIR represent another source of mode share data for International Blvd (see Table 5). Motor vehicle counts were compiled for nine locations along International Blvd in Oakland, while bicycle and pedestrian counts were taken at five locations. At a snapshot in time during peak commute hours, 600-1600 motor vehicles per hour (vph) were counted going both directions at each intersection along International Blvd, with highest traffic levels at International Blvd near Fruitvale Ave during morning peak and at International Blvd and 66th Ave during afternoon peak hours. Pedestrian volumes were also highest at International Blvd and Fruitvale Ave (536 pedestrians/hour), while bicycle counts were consistently low across the corridor, ranging from 22-40 bicycles per hour counted at each intersection.

Table 5. Vehicle, Pedestrian, and Bicycle Counts at Intersections along International Blvd

Motor Vehicle (MV) Volumes	Average MV Count (vehicles per hour)	MV Count Range Across 9 Locations (vph)
AM Peak Northbound	711	400-1000
AM Peak Southbound	489	200-600
PM Peak Northbound	711	400-900
PM Peak Southbound	856	600-1000

Location	Pedestrian Volume (PM Peak – Peds/hr)	Bicycle Volume (PM Peak – Bikes/hr)
Intl Blvd / 14th Ave	69	37
Intl/ Fruitvale Ave	536	34
Intl / High St	218	40
Intl /Hegenberger	248	30
E 14th/98th Ave	144	22
Average Count	**243**	**32.6**

Source: FEIR, 2012

California Department of Transportation reported motor vehicle traffic volumes at five locations along International Blvd from 98th Ave to 44th Ave for 2010. The mean reported average annual daily traffic (AADT) for these five locations is 23,000.[70]

Public Transit Routes and Ridership

In 2008-2009, daily weekday bus ridership across all AC Transit lines was 236,000. Average weekday boardings of 1 and 1R in Oakland—the lines the proposed BRT would directly replace—are 16,097. Routes 1 and 1R are among the five busiest AC Transit routes, and 67.5% of boardings for these routes occur in Oakland. Other transit services in the Study Area include BART, AirBART, the Capitol Corridor Intercity Passenger Rail, Amtrak, and ParaTransit.

Commute Times

Commute trips comprise approximately 20% of all trips.[71] The average commute time for residents living in the county is 28 minutes. Those living in the Study Area have a similar average commute time of 27 minutes. The average commute time for Californians is somewhat shorter, 26.5 minutes. Table 6 provides the percentage of residents by commute times in the Study Area by proximity and mode. The percent of public transportation trips in Alameda County taking 60 minutes or more far exceeds that of any other mode, which shows the need for more efficient public transit service such as BRT. Driving yields the highest percentage of trips in the 15–19 minute range.

Table 6. Commute Travel Time by Proximity and Mode

		Minutes									
Method of Travel	Placement	<10	10-14	15-19	20-24	25-29	30-34	35-44	45-59	60+	Mean travel time
All Modes	Study Area	6%	13%	18%	16%	4%	20%	6%	8%	10%	28
	Alameda County	9%	13%	15%	14%	6%	15%	7%	10%	12%	29
Drive	Study Area	5%	15%	21%	18%	4%	19%	5%	8%	5%	24
	Alameda County	8%	14%	16%	15%	6%	14%	7%	9%	10%	28
Carpool	Study Area	7%	10%	20%	15%	5%	21%	4%	8%	12%	28
	Alameda County	7%	11%	14%	13%	5%	15%	8%	11%	16%	33
Public Transportation	Study Area	1%	2%	6%	10%	4%	24%	10%	17%	26%	42
	Alameda County	1%	2%	5%	9%	4%	18%	10%	19%	31%	45

Source: 2006–2010 American Community Survey 5-Year Estimates

Transportation Costs

In Alameda County, the average household earning less than $20,000/year spends over half its income on transportation compared to 7% of income from a household earning $100,000/year.72 A report by the Urban Land Institute showed that in a specific area of the East Bay including Oakland, average median household income is $40,000 and households spend 63% of their income on housing and transportation costs. The City of Oakland spends about 25% of income on transportation costs.[73]

Parking

According to the FEIR,[74] vehicle parking in the Study Area is a combination of on-street (curb parking, either right hand parallel, left-hand parallel or angle parking) and surface lots as well as structures off-street. On-street parking is almost entirely available to the public, either as metered or unmetered spaces.

Off-street parking is a mix of public and private. Public spaces may be metered or unmetered while private spaces are restricted to authorized individuals. Included in the category of off-street parking are commercial and retail lots and garages accessible to the public under specific conditions.

There are approximately 2,194 total spaces along the DOSL project alignment. Of the total spaces, about 495, or approximately 23%, are currently metered.

Emergency Vehicle Response Times

In 2009, The Oakland Police Department's average response time for the highest priority calls (i.e. violent crimes) was 15 minutes.[75] The department claims this to be 10 minutes longer than other agencies. Despite a drop in 155 officers due to budget cuts the last couple of years, officials claim that response times have not further slowed. As described in Section 4.3.1, police response times affect patients involved in violent-crime scenes as local emergency medical technicians

and paramedics are required to wait for law enforcement officers before responding to medical emergencies.

As of November 1, 2011, the county has partnered with Paramedics Plus to provide emergency medical services for the county's residents. The November contract allows the county to fine Paramedics Plus if emergency vehicle response time exceeds 8 minutes and 30 seconds for high-priority calls.[76] Alameda County also monitors response times for Paramedics Plus, and all cities are in the process of implementing a new electronic patient care record (EPCR) system that will help facilitate the collection of response time data. Further analysis on response times can be analyzed with data from Alameda County.

4.3.3 Impacts of BRT Proposal on Mobility and Associated Health Outcomes

Mode of Travel

Volume of motor vehicles along International Blvd is expected to decrease with implementation of BRT, while transit ridership and pedestrian traffic will increase.

The FEIR provides two sources of mode share and vehicle and transit volume data:

1. The Roadway Traffic Volumes, which predicts traffic volumes along the proposed BRT alignment, were obtained by applying growth factors from the travel demand forecast model for 2015 and 2035 for No-Build and BRT Conditions to 2009 observed counts.
2. The screenline analysis was performed to compare the effects of the different alternatives on travel patterns for different transit corridors and modes. The screenline analysis indicates total person trips crossing an imaginary line, perpendicular to the BRT alignment, in the afternoon peak hour. The screenline is also drawn across all major parallel roadways and transit corridors in the vicinity of the BRT alignment (see Figure 11). Person trips are estimated at the screenline roadways for International Blvd and the parallel routes.

Figure 11. AC Transit Screenline Locations (FEIR, 2012)

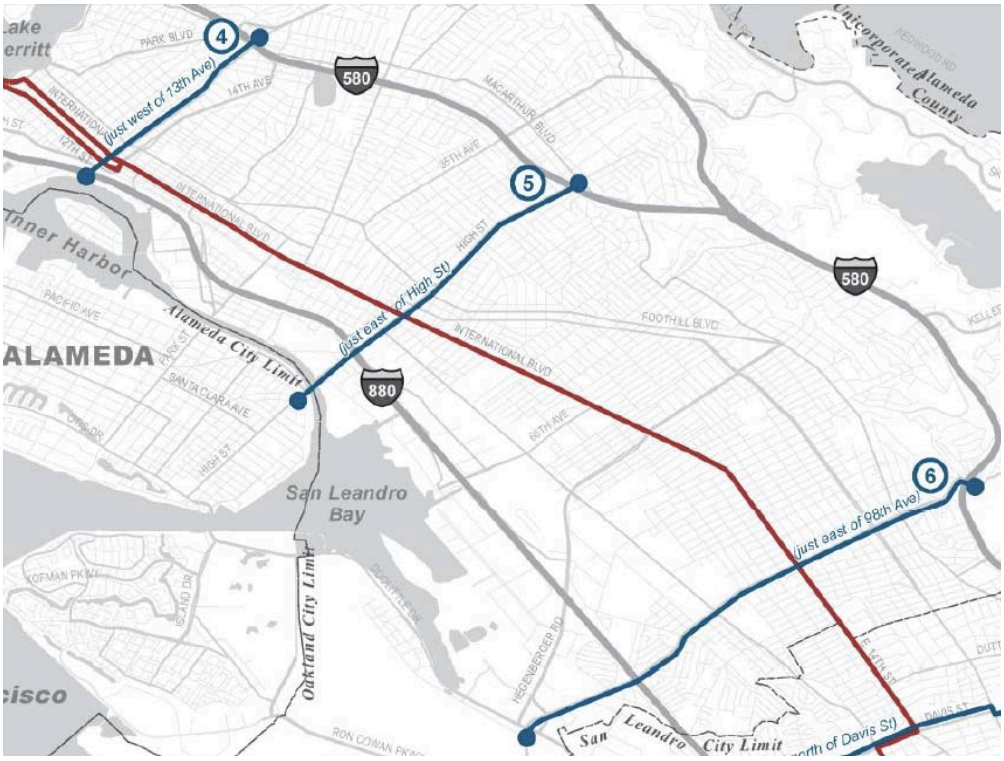


Table 7 was constructed from the non-motorized transportation section (3.3) of the FEIR and the Roadway Traffic Volumes estimates shown in map images of the vehicular traffic section (FEIR section 3.2). Table 7 shows both existing pedestrian and bicycle volumes and predicted future motor vehicle volumes (in vehicles per hour or vph) for five intersections along International Blvd (different locations than the screenline analysis). Results show that *if no BRT system is implemented*, average vehicle volumes during afternoon peak hours are expected to increase from 1580 vph to 1840 vph in 2015 and to 2590 vph in 2035. This scenario will result in increasing traffic congestion and decreased level of service at intersections along International Blvd. *Motor vehicle traffic along the study corridor will decrease if BRT is implemented in 2015 and increase from current levels in 2035 if BRT is operating; although, this increase is less than it would be in the No-Build scenario*. [77]

Table 7. Existing Conditions & Projected PM Peak Hour Motor Vehicle Volumes for 2015, 2035

Location	2009 Total Pedestrian Volume	2009 Total Bicycle Volume	2009 Total Motor Vehicle	2015 No-Build Total Motor Vehicle	2015 BRT Total Motor Vehicle	2035 No-Build Total Motor Vehicle	2035 BRT Total Motor Vehicle
Intl Blvd/ 14th Ave	69	37	1100	1400	1100	1950	1300
Intl Blvd/ Fruitvale Ave	536	34	1700	2000	1300	2700	1700

Intl Blvd / High St	218	40	1700	2000	1300	2800	1700
Intl Blvd /Hegenberger	248	30	1600	1900	1500	2700	1700
E 14th /98th Ave	144	22	1800	1900	1400	2800	1700
Average Count	**243**	**32.6**	**1580**	**1840**	**1320**	**2590**	**1620**

Source: FEIR, 2012; Motor Vehicle numbers taken from FEIR Roadway Segment Volumes maps (Figures 3.2-4, 3.2-7, 3.2-11, 3.2-14, 3.2-17).
Note: motor vehicle volumes are measured in vehicles per hour (vph)

Tables 8 and 9 were constructed from the screenline analysis results presented in section 3.2 of the FEIR. Vehicle and transit trips for three screenlines presented are relevant to the Study Area: near 13th Ave, High Street, and 98th Ave (# 4, 5, 6 in Figure 11 above). These results allow us to see how the project will impact choice of transportation mode (auto, bus or BART trips) for the BRT Alignment (International Blvd) and the parallel routes in the different years, with and without BRT implementation. Auto trips are in person trips, not vehicle trips, so to get numbers roughly equivalent to those of the Roadway Traffic Volumes analysis, divide the number of person trips by 1.2 (assuming an average rate of 1.2 persons per vehicle).

Table 8. Estimated Person Trips on the BRT Corridor and Parallel Routes by Mode in 2015 and 2035 in No-Build and BRT Scenarios

	Total Auto Person Trips		Total Transit Person Trips		
	BRT corridor	Parallel routes	Bus trips on BRT corridor	Bus trips on Parallel routes	BART
2015					
Total[1] No-Build trips	6,400	118,900	2,900	5,400	38,800
Total[1] trips with BRT implemented	4,500	120,100	5,200	4,100	38,400
2035			2,035		
Total[1] No-Build trips	8,400	135,700	3,900	6,800	57,900
Total[1] trips with BRT implemented	5,500	136,900	7,500	5,200	60,700
Percentage Increase					
No-Build 2015 to 2035	23.8%	12.4%	25.6%	20.6%	33.0%
BRT 2015 to 2035	18.2%	12.3%	30.7%	21.2%	36.7%

Source: Screenline Projection Data for 3 locations from FEIR 3.2 Vehicular Traffic Analysis (2012)
[1] Totals are combined trips for the three screenline locations

Percentage change in auto and transit trips. Results show that between 2015 and 2035, if BRT is *not* implemented, there will be a 23.8% increase in auto trips on the BRT corridor and a 12.4% increase on parallel routes. *If BRT is implemented, between 2015 and 2035, there would be a lesser increase in auto trips compared to the No-Build* (18.2% vs. 23.8% on the corridor). On parallel routes the percentage increase from 2015 to 2035 is roughly equivalent between BRT and No-Build scenarios (12.3% change with BRT vs. 12.4% change without). This reflects a decrease in automobile traffic along International Blvd. with BRT, but a slight increase in automobile traffic on parallel routes.

Looking at transit person trips, if BRT is *not* implemented, between 2015 and 2035, there would be a 25.6% increase in bus trips on the corridor and a 20.6% increase on parallel routes. BART

would also show an increase of 33% if BRT were not implemented. With BRT implementation, bus trips increase by 30% on the corridor and by 21.2% on parallel routes between 2015 and 2035. BART increases by 36.7% if BRT is implemented. *These BRT scenario transit trip increases are bigger compared to the No-Build scenario.* Transit ridership shifts from bus lines on parallel routes and BART (slightly) to the BRT alignment, so there are more bus trips taken on International Blvd and fewer trips being taken on routes nearby. Looking specifically at the International Blvd corridor, mode shift is more dramatic.

Table 9. Estimated Mode Share Percentages on the BRT Corridor and Parallel Routes in 2015 and 2035 in No-Build and BRT Scenarios

	Total Person Trips	Auto Trips		Transit Trips		
2015		BRT corridor	Parallel routes	Bus trips on BRT corridor	Bus trips on Parallel routes	BART
No-Build Mode Share	172,400	3.7%	69.0%	1.7%	3.1%	22.5%
BRT Mode Share	172,300	2.6%	69.7%	3.0%	2.4%	22.3%
2035						
No-Build Mode Share	212,700	3.9%	63.8%	1.8%	3.2%	27.2%
BRT Mode Share	215,800	2.5%	63.4%	3.5%	2.4%	28.1%

Change in mode share. Table 9 shows similar results as Table 8 above, just presented differently. Comparing conditions at implementation, in 2015, auto trip mode share on International Blvd is lower with BRT implementation vs. the No-Build Scenario. However, auto trip mode share is higher with BRT implementation compared to the No-Build on parallel routes in 2015. For transit trips in 2015, BRT is expected to promote more bus trips on International Blvd, but fewer bus trips on parallel routes and slightly fewer BART trips compared to No-Build.

Comparing conditions in 2035, auto trip mode share on International Blvd is still lower with BRT implementation vs. the No-Build Scenario and the difference between the two scenarios has increased by 2035. The situation on parallel routes for auto trips reflects a shift in mode choice away from autos to transit, as the percentage of auto trips of all trips for both the No-Build and BRT Scenarios has decreased from around 70% in 2015 to around 63% in 2035. The difference in auto trips on parallel routes between the No-Build and BRT scenarios is very slight at this point, however the No-Build has a slightly higher percentage of auto trips on parallel routes (63.8% for No-Build vs. 63.4% for BRT).

For transit trips in 2035, BRT is still expected to capture a larger percentage of the bus trips on the corridor compared to No-Build (1.8% for No-Build vs. 3.5% for BRT). The proportion of bus trips taken on parallel routes with BRT implementation in 2035 is still lower for BRT compared to No-Build and is expected to stay the same compared to 2015 percentages. BART trips are expected to increase for both scenarios compared to 2015 and BRT captures slightly more BART trips than the No-Build scenario.

Looking at the whole region together (International Blvd and parallel routes) in Table 10, if BRT is implemented, the percentage of auto trips in the region surrounding International Blvd (including International Blvd and parallel routes) will decrease from 2015 to 2035 and when comparing BRT to a No-Build scenario (for either year); however BRT decreases auto trips more than No-Build. Transit will make up 34% of person trips in the region if BRT is implemented in 2035, compared to 32% of trips in a no-build scenario, representing a 2% shift away from automobiles towards transit.

Table 10. Estimated Mode Share Percentages for the BRT region in 2015 and 2035 in No-Build and BRT Scenarios

	No-Build		BRT Implementation	
	Auto	Transit	Auto	Transit
2015 Mode share	73%	27%	72%	28%
2035 Mode share	68%	32%	66%	34%

Source: Screenline Projection Data for 3 locations from FEIR 3.2 Vehicular Traffic Analysis (2012)

The FEIR includes other projections for changes in transit patrons. Current average weekday AC Transit boardings are projected to increase from a No-Build 2015 projection of 24,600 across the full DOSL corridor to 36,000 in 2015, and 53,300 in 2035 if the BRT system is implemented from downtown Oakland to San Leandro. This represents a 46% increase over the No-Build option for 2015 and a 56% increase over the no-build option in 2035.

Commute Times

Commute times between Downtown Oakland and San Leandro BART are expected to decrease by 20 to 22% along the BRT corridor in 2015, a savings of about 10 minutes (see Table 11). *By 2035, BRT implementation will decrease travel times by 34 to 36%* (see Table 12). The reduced commute time of BRT commuting compared to bus commuting could encourage drivers to use public transit rather than personal vehicles. In turn, this could lead to increased access to jobs, schools, and other goods and services, less income spent on transportation, and more time available for activities. Considering that a high proportion of transit trips in the Study Area take over 45 minutes, and that public transit has the highest mean travel time of any mode (42 minutes; see Table 6), many people will benefit from reduced commute times facilitated by BRT.

Table 11. Commute Times in 2015 Under BRT and No-Build Scenarios

	No-Build Conditions (2015)		DOSL Alternative (2015)			
Time Period	Average Speed (mph)	Travel Time (minutes)	Average Speed (mph)	% Increase over No-Build	Travel Time (minutes)	% Decrease from No-Build
AM Peak	11.5	47.3	14.5	25.7%	37.6	20.5%
Midday	11.2	48.7	14.3	27.3%	38.2	21.5%
PM Peak	10.7	50.7	13.6	26.2%	40.2	20.8%

Source: DOSL Alternative Commute Time Data from FEIR 3.1-19 Transit Conditions (2012)

Table 12. Commute Times in 2035 Under BRT and No-Build Scenarios

	No-Build Conditions (2035)		DOSL Alternative (2035)			
Time Period	Average Speed (mph)	Travel Time (minutes)	Average Speed (mph)	% Increase over No-Build	Travel Time (minutes)	% Decrease from No-Build
AM Peak	9.3	58.9	14.1	51.7%	38.8	34.1%
Midday	9.1	60.1	13.8	52.5%	39.4	34.4%
PM Peak	8.7	62.9	13.6	56.4%	40.2	36.1%

Source: DOSL Alternative Commute Time Data from FEIR 3.1-20 Transit Conditions (2012)

Parking

The proposed BRT Plan would result in the displacement of on-street parking spaces. There are currently 2,194 curbside parking spaces in the DOSL corridor. Under the DOSL Alternative currently being considered, 530 spaces will be removed in order to implement BRT improvements, mitigate primary traffic impacts, and provide streetscape improvements for pedestrians.[78] An additional 78 parking spaces will be removed or relocated due to off-alignment secondary impacts from traffic mitigation. Thus, total displacements under the DOSL Alternative are estimated to be 607 spaces. Throughout the entire proposed LPA corridor, the highest numbers of displacements and spaces proposed for mitigation occur in Oakland.

The No-Build Alternative is still likely to alter the existing configuration and supply of curb parking as well. Regardless of the BRT Plan, the city would like to improve crosswalks and provide pedestrian bulbouts, which will likely alter parking availability.

Parking Mitigations

The DOSL proposal would mitigate lost parking by 37% of the number displaced. *A net loss in parking is not expected to dramatically affect individuals intending to park in the area. There are substantial parking resources in the corridor, including many alternatives to the curbside spaces removed by proposed BRT and related project improvements.*

Table 13. Proposed Parking Mitigations

		Proposed Mitigation		
District	Curb Spaces Displaced	Metered Spaces Relocated	Non-metered Spaces Relocated	Total Proposed Mitigation
Downtown	28	27	4	31
East Oakland	537	79	104	183
North San Leandro	42	10	0	10
Totals	**607**	**116**	**108**	**224**

Source: DOSL Alternative Parking Data from FEIR 3.4-69 Parking (2012)

Emergency Vehicle Response Times

A traffic-free dedicated bus lane is likely to improve emergency vehicle response time by allowing emergency vehicles to bypass congestion. This lane will also be available for cars to bypass parked emergency vehicles to improve traffic flow. Response times for all emergency

vehicles could potentially benefit from this change although existing research on precise improvements is limited.

There is no available research specific to current response times in the Study Area, but response time data can be obtained from Alameda County for future analysis.

Summary of Impacts on Mobility

Table 14 below summarizes the mobility impacts described in this section.

Table 14. Summary of Impacts of Alternatives on Mobility

Proposal Features	**No-Build Alternative**	**DOSL Alternative**	**Impact on Mobility**
Transportation Mode Share (% auto trips)	73% of person trips will be auto trips by 2015 68% of person trips will be auto trips by 2035	72% of person trips will be auto trips by 2015 66% of person trips are auto trips by 2035	Mode share shifts person trips from auto to public transportation between 2015 and 2035 and from No-Build to the DOSL Alternative. *The shift from auto to public transit trips indicates an improvement in transportation options. The DOSL Alternative improves public transportation access and enhances mobility at a slightly better percentage than the No-Build Alternative.*
Transportation Mode Share (% public transit trips)	27% of person trips will be public transit trips by 2015 32% of person trips will be public transit trips by 2035	28% of person trips will be public transit trips by 2015 34% of person trips will be public transit trips by 2035	
Proposal Features	**No-Build Alternative**	**DOSL Alternative**	**Impact on Mobility**
Public Transit Ridership	24,600 boardings by 2015 34,000 boardings by 2035	36,600 boardings by 2015 (DOSL) 53,300 boardings by 2035 (DOSL)	Increased ridership allows for fewer auto trips. *Both alternatives may decrease auto trips, although the DOSL Alternative predicts additional transit boardings. This increase in boardings is a result of additional transportation options and denotes an improvement in mobility.*
Commute Times	47 to 51 minutes in 2015	38 to 40 minutes in 2015	Commute times are expected to decrease by 20 to 22% along the corridor in 2015 and 34 to 36% in 2035.

	59 to 63 minutes in 2035	39 to 40 minutes in 2035	*The DOSL Alternative suggests faster commute times in comparison to the No-Build Alternative. Quicker commutes allow for better access to goods and services and indicate a positive effect on overall mobility.*
Parking	Unsure of exact number displaced	Displacement of 607 spaces, although 224 will be replaced	*Both alternatives require displacement of parking, although analysis shows adequate parking alternatives off the corridor.*
Emergency Vehicle Response Time	8 minute and 30 seconds for high-priority calls 15 minute response time for violent crimes.	TBD. Limited research available on emergency vehicle response time post BRT implementation. Possible improvement with access to a BRT dedicated bus lane.	*The No-Build Alternative baseline response time may improve with BRT implementation due to a dedicated bus lane, but further research is needed to analyze impacts.*

Summary of Health Impacts of BRT Related to Mobility

Positive health outcomes are likely to result from increased transit ridership along the corridor, faster commute times, and potentially faster emergency response times. Additional BRT ridership will correspond with more walking and biking to access BRT, which will increase physical activity among residents. A more transit-friendly system will provide better access to goods and services and leave more time for social connectivity as well as healthy activities such as exercise.

4.3.4 Mobility-Related Recommendations

To maximize the health benefits of improved transit service to mobility, the following are recommended actions:

1. Implement BRT as proposed
   - Reduced parking enhances increased public transportation ridership
   - Faster commute times increase mobility and access to jobs and goods and services.
   - Dedicated bus lanes improve emergency response times

2. Increase Mobility

- Consider bringing an AC Transit office into East Oakland, where transit ridership is high. Community residents have expressed their need for easier access to AC Transit resources such as Clipper Card purchases.
- Implement a locally sponsored shuttle that offers free rides to BRT stops to improve BRT accessibility and increase ridership. Cleveland's Downtown Trolley system currently sponsored by the Dollar Bank is an example of this kind of service.
- Increase bus stop safety (see Crime and Safety, Section 4.6)
- Further consult with community leaders regarding station placement to ensure BRT station locations accommodate resident mobility concerns (note that AC Transit has already adjusted station spacing to address community concerns).
- Conduct public transportation education days at public schools along the BRT corridor to increase culture of generational awareness and buy-in for public transit
- Provide free student BRT passes for students and senior to increase use and ownership

4.4 ACCESS TO GOODS AND SERVICES

Adequate access to goods and services is an essential part of healthy daily lives. This section focuses on impacts of a BRT system on resident access to healthcare, healthy food, and other resources.

4.4.1 Research Connecting Access to Goods and Services to Health

Good health requires such resources as nutritious foods, clean air and water, opportunities for physical activity, and health care for the prevention and treatment of illnesses. The quality, quantity, and distribution of those resources in the physical-social environment affect how individuals within the community access those resources for health. The Neighborhood Completeness Indicator tool, developed by the San Francisco Department of Public Health (SFDPH), identified key public and private services that meet the daily needs of neighborhood residents.

Table 15. Key Public and Retail Services for Neighborhoods

Key Public Services	**Key Retail Services**
• Child care centers	• Auto Repair Shops
• Community Centers	• Banks
• Community Gardens	• Beauty and Barber Shops
• Public Health Facilities	• Bike Repair Shops
• Libraries	• Dry Cleaners
• Open Space	• Eating Establishments
• Parks ½ Acre or Larger	• Gyms
• Post Offices	• Hardware Stores

• Public Art Installations • Public Schools • Recreational Facilities	• Laundromats • Pharmacies • Retail Food Markets • Video Rental Stores/Movie Theaters

Source: SFDPH Program on Health, Equity, and Sustainability

Not only does the presence of these services improve residents' access to them, their location determines the distance that residents have to travel to reach them. Greater proximity can result in decreased vehicle miles traveled as well as making these destinations more likely to be within walking distance.[79] Furthermore, while all of these key services are important for health, this assessment is limited to an analysis of transportation access to *healthcare and healthy food*.

Access to Healthcare and Health Outcomes

Access to healthcare is a key determinant of health and health disparities, both in the prevention and treatment of illnesses.[80] Healthcare is important for many indicators of our health, including: general physical and mental health status; the prevention of disease, disability, and death; maintaining quality of life; and prolonging life expectancy.[81] Chronic diseases, accounting for seven out of ten deaths in the U.S., are often preventable.[82]

Common measures of health care access include health insurance coverage, other financial barriers to entry into the healthcare system, having a usual source of care, and the timeliness of receiving care.[83] Because this HIA analyzes impacts of a transportation resource, this analysis of healthcare access considers transportation and proximity as measures of access.

Access to Prenatal Infant Care and Health Outcomes. There are also certain types of services for which receiving timely care is particularly important. Prenatal care is the healthcare received by pregnant mothers and is recommended as early as the first trimester.[84] Research shows there is an association between prenatal care and positive birth outcomes.[85] [86] In addition, prenatal care has other benefits, such as serving as a form of continuous care for women's health, in some cases providing a woman's first comprehensive health assessment, and offering education in family planning, parenting and community resources.[87]

Women, Infants, and Children (WIC) is a national program promoting healthy pregnancies through healthy eating. WIC serves low-income families with infants or children less than five years of age by providing education in nutrition, immunization, and breastfeeding as well as providing checks for healthy foods redeemable at participating local grocery stores and farmers markets. WIC participation increases the likelihood of initiating prenatal care early in pregnancy.[88] Non-participation in WIC has been identified as a key determinant of inadequate prenatal care utilization in African American women.[89] [90]

Transportation and Healthcare Access. Low income parents of Latino children have identified transportation difficulties as one of the major access barriers to health care.[91] Another study of non-elderly urban poor populations also found that transportation is a barrier to healthcare access particularly for those who are not working, do not have a telephone, or are living below poverty level.[92] Missed appointments limits the quantity and quality of care received.[93]

Arranging for transportation can be particularly difficult for treatments requiring multiple visits such as chemotherapy. Without available and affordable transportation, patients may forgo treatment or needed care.[94] For more elderly cancer patients, the decision to receive radiation therapy are more influenced by nonmedical factors such as impaired access to transportation.[95]

Related to prenatal care, providers and women receiving Medicaid both perceived transportation as a barrier to receiving prenatal care.[96] [97] Service-related barriers, such as child care, long waits for appointments, and transportation, as opposed to financial or personal barriers, were the most significant factors influencing decisions to initiate prenatal care for low-income women, according to a Texas study.[98] In a similar study in Kentucky, women who initiated late prenatal care experienced significantly more transportation difficulties in getting to prenatal appointments.[99]

Much of the research literature on transportation access to healthcare focuses on personal vehicle use, with public transportation considered as an alternative mode of transportation. Some of the noted challenges of relying on public transportation include reliability of service, adequate bus or train network coverage, affordability, and accessibility for people with disabilities.[100] Although public transportation is a source of health care transport for some, more research is needed to fully evaluate the effects of public transportation on health care access.

One study showed that those who used public transportation had 4 more chronic care visits a year than those who did not use public transportation.[101]

Another study surveying inner city Latino parents in Boston about major barriers to health care found 6% of their study population to cite arranging transportation as a major barrier of access to healthcare for their child.[102]

Access to Healthy Foods and Health Outcomes

Diet-related disease is one of the top sources of preventable deaths among Americans, with the burden of overweight and obesity falling disproportionately on populations with the highest poverty rates.[103] [104] It is well known that nutritious eating and regular physical activity aid in the prevention of chronic medical conditions, especially diabetes, cardiovascular diseases and cancers.[105] Furthermore, these behaviors can alleviate the effects of conditions that increase the risk for other poor health outcomes such as obesity.[106]

Lack of access to healthy food is one of the barriers, particularly for low-income communities, to healthy eating. Low-income neighborhoods are typically three times less likely to have a supermarket compared to middle and upper income neighborhoods.[107] [108] National data finds that low-income households without autos often borrow autos or drive with friends to purchase groceries outside their neighborhoods.[109] There may also be a resulting increased dependence on mass transit for grocery shopping stores.

4.4.2 Existing Conditions for Access to Goods and Services

During community workshops held as part of the International Blvd TOD plan civic engagement process, residents voiced that they wanted to see more grocery stores, retail and other neighborhood commercial services, more banks, more community facilities, among other

resources. According to the TOD Plan, some of the key issues facing International Blvd communities are the lack of grocery stores, lack of parks and green space, reduced access to jobs and economic opportunity, and lack of retail and shopping.[110]

The Final Environmental Impact Report[1] contains maps of community amenities within the LPA route through Berkeley, Oakland, and San Leandro. These include schools, hospitals, emergency services, libraries, cultural centers, parks, community facilities, and houses of worship. This HIA specifically examines transportation access within the Study Area to healthcare services, including community clinics, and healthy food outlets.

Data from Alameda County Public Health Department and from existing literature was retrieved to depict various aspects of access and utilization of amenities. Additionally, GIS analysis was used to identify and count amenities located within the Study Area. GIS was also used to calculate the percentage of the population within the Study Area that is within a half mile of an amenity (regardless of whether the amenity was located within the Study Area). A maximum of a half-mile distance is generally a proxy for a destination to be considered within walking distance. Geographical proximity is one aspect of access. Other access factors include individual mobility impairments or crime.

Access to Healthcare Services

Insurance Coverage and Usual Source of Care. According to the 2008 American Community Survey, the City of Oakland has the highest percentage of adults, ages 18-54, without health insurance (22%) in Alameda County (15%).[111] Data from inpatient hospitalizations from 2006-2008 show that Oakland had one of the lowest levels of private coverage (less than 40%) in the County. Oakland has the highest proportion of inpatient visits paid by Medi-Cal (31%).

Community clinics are a major source of primary care for uninsured and underserved populations. Forty percent of Medi-Cal recipients receive primary care at community clinics compared to 49% through private doctors. The Transportation for Healthy Communities Collaborative conducted a survey of residents throughout the Bay Area including Oakland and found that 54% receive primary care at clinics, compared to 19% at a hospital emergency room and 27% at a family doctor.[112]

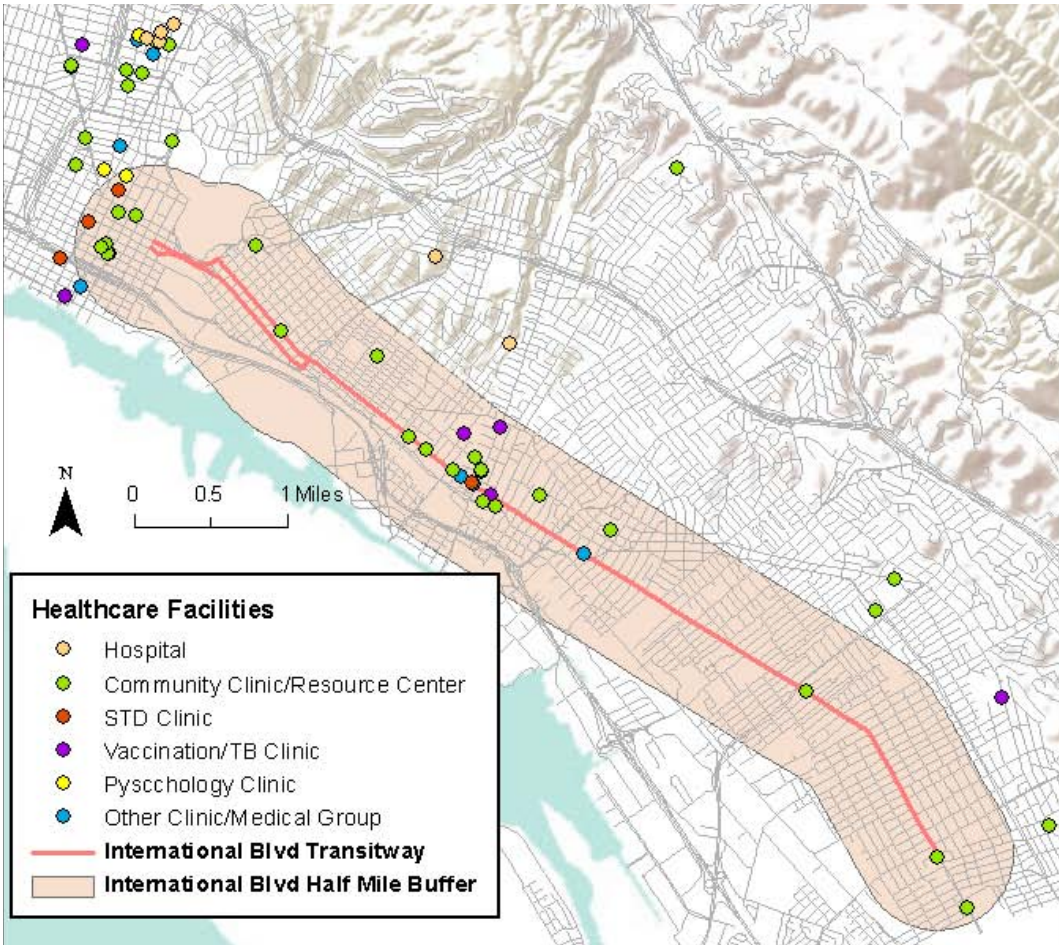
Existing Healthcare Facilities and Services. A list of various types of healthcare facilities was compiled using data from the Alameda County Public Health Department website (http://www.acphd.org/clinics.aspx, as of March 28, 2012) and Office of Statewide Health Planning & Department (www.oshpd.ca.gov/HID/Products/ Listings .html, as of March 28, 2012). Those within the Study Area were counted (Table 16) and mapped (Figure 12).

[1] Vol. 1 Part 9 Section 4.4.2.1 and Appendix D

Table 16. Healthcare Services within Study Area

Type of Healthcare Services	Count
Hospital	0
Community Clinic/Resource Center	21
STD Clinic	3
Vaccination/TB Clinic	3
Psychology Clinic	1
Other Clinic/Medical Group	5
Chronic Dialysis Clinic	0

Figure 12. Healthcare Facilities in International Blvd Corridor



Note: Data presented here reflects ZIP codes 94601, 94603, 94606, and 94621 only. These ZIP codes approximate the Study Area and do not directly align with Study Area. Therefore, some healthcare facilities in the Study Area are not portrayed here, and some healthcare facilities portrayed here are outside the Study Area.

It's worth noting that many of these facilities are located along the BRT corridor including La Clinica de la Raza, the Native American Health Center, East Oakland Health Center, WIC, the Street Level Health Project, San Antonio Neighborhood Health, Baart 14th Street Clinc, and Lifeline Treatment Services.

Transportation and Healthcare Access. Residents without a car rely primarily on either public transportation, biking and walking as their mode of transportation to medical appointments. The figure below shows the proportion of alternative transportation modes by major race groups in Alameda County.

Figure 13. Mode of Transportation to Medical Visits for Households Without a Car in Alameda County

Source: 2007 California Health Interview Survey.

The Transportation for Healthy Communities Collaborative (THCC) united three agencies – the Transportation and Land Use Coalition, Center for Third World Organization, and People United for a Better Oakland (PUEBLO). In 2002, THCC published "Roadblocks To Healthcare: Transportation Barriers to Healthy Communities"- a report assessing transportation access to healthcare for fifteen low-income communities in the Bay Area. Their survey revealed:

> 55% of respondents reported having missed, been late to, or not attempted to go to a medical appointment due to transportation problems. Missed appointments are a major problem for patients and clinics alike: a group of five clinics in Oakland and Berkeley reports that no-show rates range from 30 to 40% for their general-population clinics.[113]

In the same report, THCC used GIS network analysis to calculate the percentage of the population with "transit access" to hospitals and community clinics separately.[2] Table 17 reveals the results for the Oakland neighborhoods that overlap with the Study Area.

[2] The analysis used the following parameters (Transportation for Health Communities Collaborative, 2002):

> The identification of health care facilities within a 30-minute transit travel time was calculated based on transit routes running at mid-day on weekdays. Total travel time was calculated as the sum of time spent:
>
> - walking to a bus stop or BART/light-rail station;
> - waiting for the bus/train to arrive;
> - traveling on the bus/train; and
> - walking from the bus stop/train station to the health care facility.
>
> Data Sources: transit route data from MTC (2001), population data from 2000 U.S. Census, and health facility data from California Office State Health Planning Department (2000).

Table 17. 2002 THCC Report: Percentage of Residents with Transit Access to Hospitals and Community Clinics

	Percentage of Residents with transit access to a	
	hospital	community clinic
Central East Oakland	0%	78%
Elmhurst	7%	83%
Fruitvale	7%	91%
San Antonio	80%	99%

To calculate the percentage of the Study Area population within half-mile proximity of healthcare facilities (not considering the transit time dimension), a GIS analysis was conducted using 2010 U.S. Census population data by Census block.

Table 18. International Blvd Corridor Population Within 1/2 Mile of a Healthcare Facility

Type of Healthcare Services	**% of Population in Study Area Within ½ Mile of Healthcare**	**% of Population in Study Area Not Within 1/2 Mile of Healthcare**
Hospital	**1%** (1405)	**99%** (109,916)
Community Clinic/Resource Center	**81%** (90,168)	**19%** (21,153)
STD Clinic	**23%** (25,323)	**77%** (85,998)
Vaccination/TB Clinic	**25%** (28,182)	**75%** (83,139)
Psychology Clinic	**3%** (2,987)	**97%** (108,334)
Other Clinic/Medical Group	**3%** (3,556)	**97%** (107,765)
Chronic Dialysis Clinic	**35%** (39,424)	**65%** (71,897)

Despite the differences between the THCC analysis and this GIS analysis (proximity and transit time vs. only proximity; 2000 data vs. 2010 data), the two analyses yield similar themes. San Antonio was the only neighborhood with good transit access (80%) to Highland Hospital, a County hospital, within a 30 minute transit trip. Otherwise, access by transit and proximity to a hospital are low (less than 10%) for the Study Area. Access to community clinics is much higher: < 78% (THCC analysis) and 81% (GIS analysis with 2010 data). This makes sense given that the majority of community clinics in the Study Area are on International Blvd.

These calculated percentages of transit access may underestimate the magnitude of the transportation barrier as residents are further constrained by personal finances for transit fares and the community clinic's target demographic or specialty.

Access to Prenatal and Infant Care

Availability of Prenatal Care and Services. The California Department of Public Health administers the Black Infant Health Program – a prenatal service program providing long-term case management, health education, and skill-building sessions aimed at improving the health and social conditions for African American mothers and their families. Another program targeting low-income African American families is the Improving Pregnancy Outcomes Program (IPOP) run by Alameda County Public Health Department and federally funded by the Maternal and Child Health Bureau. Eligible participants must be African American, low-income, and pregnant or with a child less than 2 years old. Furthermore, participants must live in the certain

ZIP codes corresponding to target neighborhoods – the Fruitvale District, East Oakland, West Oakland, Emeryville, and North Oakland.

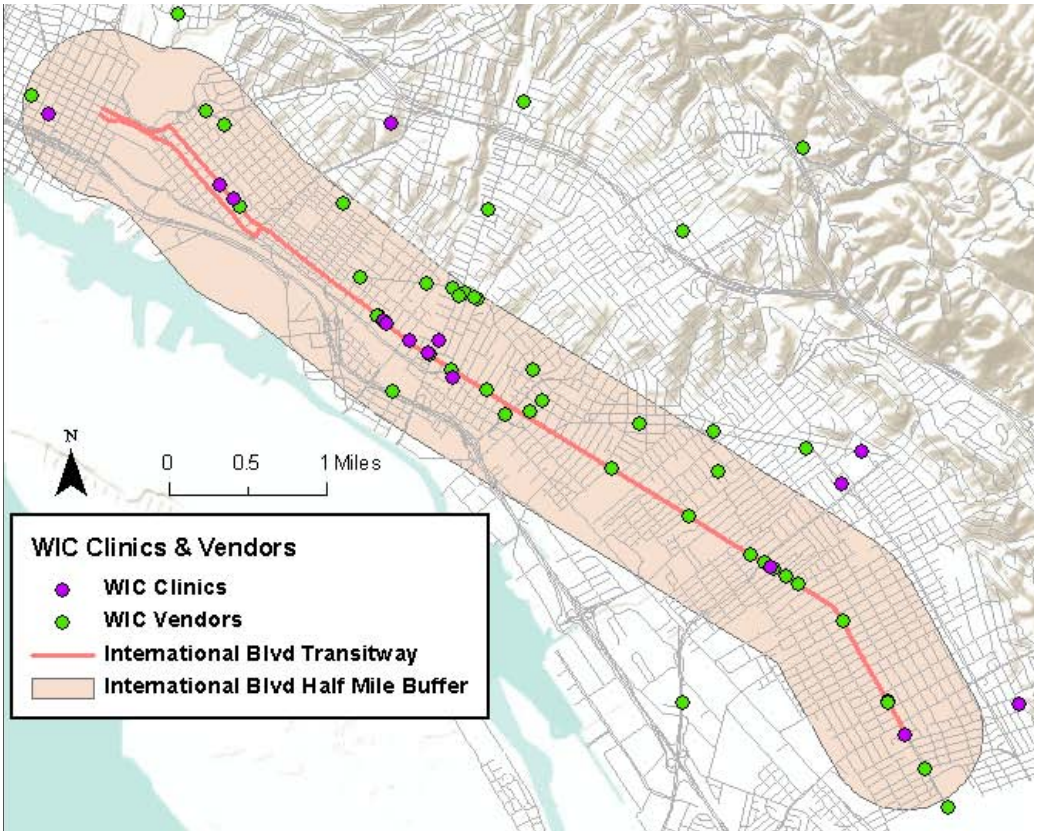
Alameda County Public Health maintains a Clearinghouse information line 1-888-604-INFO and online list for pregnant women to find local prenatal care providers participating in the state-wide Comprehensive Perinatal Services Program (Alameda County Public Health Department, 2011). Through the Presumptive Eligibility Medi-Cal Program, and Pregnant Only Medi-Cal Programs, low-income and undocumented pregnant women can be eligible to receive free standard obstetric services, nutrition, health education and social support.[114]

Table 19. Prenatal Services in Oakland and International Blvd Corridor

Prenatal Service	Address	Presumptive Eligibility Medi-Cal Providers	WIC Clinic	Located in Study Area
Alameda County HealthCare Srvcs	3600 Telegraph Avenue		*	
Alta Bates Summit Perinatal Ctr	350 30th Street, Suite 205	*	*	
Asian Health Services	818 Webster Street	*	*	*
Clinica Alta Vista Teen Clinic/ La Clinica de la Raza	1515 Fruitvale	*	*	*
East Bay Perinatal Medical Assoc.	2648 International Blvd.	*	*	*
East Oakland Health Center	7450 International Blvd.	*	*	*
Eastmont Mall	7200 Bancroft Ave. Ste 204		*	
Eastmont Wellness Center	6955 Foothill Blvd.	*	*	
Edward Lampley, M.D.	9925 International Blvd.	*	*	*
Highland Prenatal Clinic	1411 East 31st Street, C-1	*	*	
La Clinica de la Raza	3451 East 12th Street	*	*	*
La Clinica de la Raza	2716 International Blvd.		*	*
Lifelong Medical Care	9933 MacArthur Blvd.	*	*	
Native American Health Center	2950 International Blvd.	*	*	*
Native American Health Center	3124 International Blvd.Rm 103		*	*
ReGynesis Health Services	9925 International Blvd.,Ste #2	*		*
San Antonio Health Center	1030 International Blvd.	*	*	*
San Antonio Neighborhood Health	839 International Blvd.		*	*
West Oakland Health Center	700 Adeline Street	*	*	
	Total	**14**	**18**	
	Located within Study Area	**9**	**11**	**12**

There are 14 prenatal service sites that are affiliated with the Presumptive Eligibility Medi-Cal Program, and Pregnant Only Medi-Cal Programs in Oakland; 9 of these are in the Study Area. In Oakland, there are 18 total prenatal service sites that area affiliated with the WIC program; 11 of these are located in the Study Area. The Study Area has a total of 12 community clinics with prenatal services. Additionally, there are 55 vendors catering to WIC program participants in Oakland; 35 of which are located in the Study Area.[115]

Figure 14. WIC Clinics and Vendors in International Blvd. Corridor



Note: Data presented here reflects ZIP codes 94601, 94603, 94606, and 94621 only. These ZIP codes approximate the Study Area and do not directly align with Study Area. Therefore, some WIC clinics and vendors in the Study Area are not portrayed here, and some WIC clinics and vendors portrayed here are outside the Study Area.

Using GIS analysis, nearly all (96%) of the Study Area population is within half-mile of a WIC vendor and more than half (64%) are within half-mile of a WIC clinic.

Utilization of Prenatal Care. Specific rates of utilization of Black Infant Health Program and WIC could not be located. But overall, Black Infant Health Program covers almost 8% of all African American births in California.[116] Data from the Alameda County Public Health Department revealed that 87.8% of mothers in the Study Area have received prenatal care in their first-trimester (M. Beyers, ACDPH, personal communication, May 3, 2012). This is slightly better than Oakland overall (87.3%) and slightly under the county average (88.1%).[117] By race groups, Pacific Islanders, Latinos, and African Americans had lower early prenatal care than the county average at 72.2%, 84.1%, and 85.1% respectively.

Low birth rates are important determinants in reducing infant mortality. Despite relatively good access to prenatal care, low birth rates in Alameda County have not improved. There are other determinants of low birth rate such as poor maternal nutrition, low family income, racism, and many other factors. Oakland has the sixth highest rate of low birth rate (7.6%) in Alameda County. Low birth rate varies more by race with African Americans 1.5 to 2.5 times higher than those of Whites or Latinos.[118]

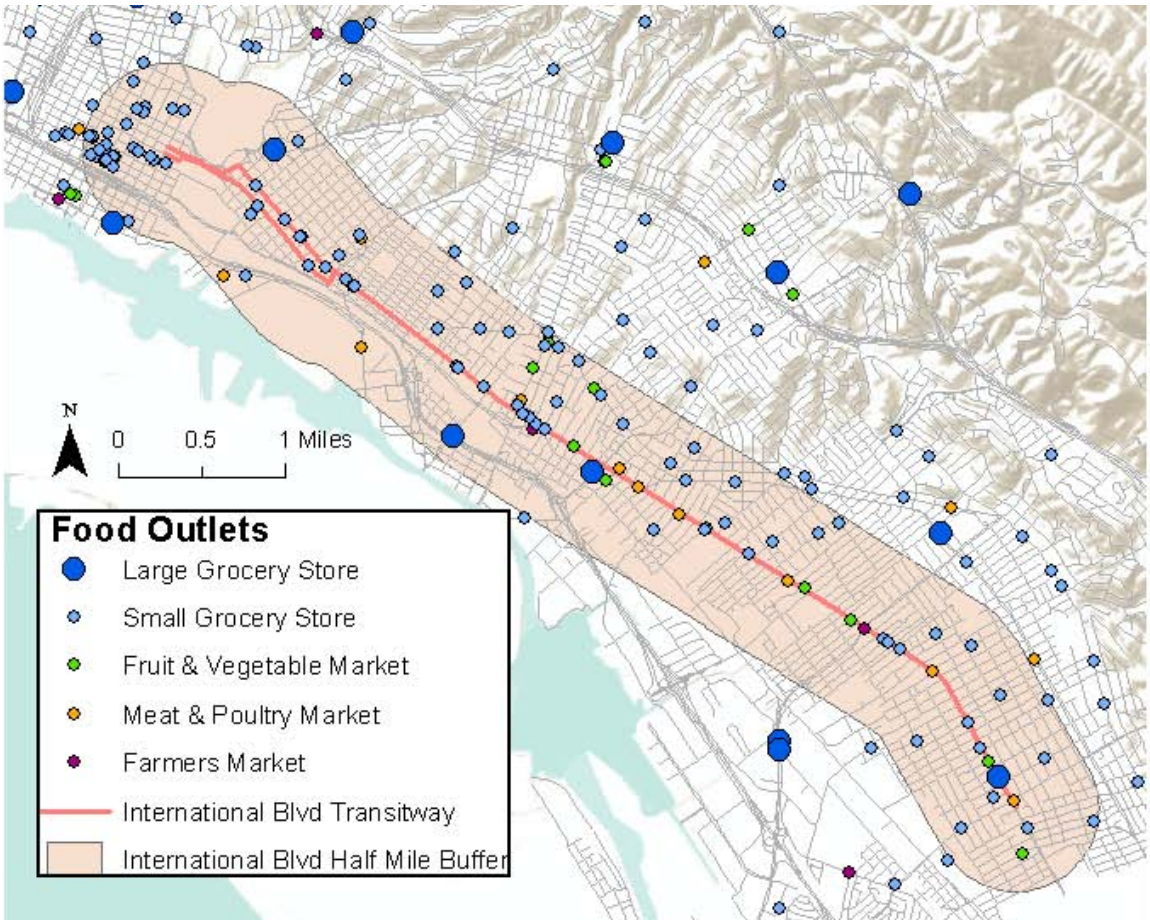
Access to Healthy Foods

The International Blvd TOD Plan acknowledged the lack of healthy and affordable foods along the corridor. The "Getting to Market" study identified two nodes along International Blvd as "Low Access Areas" (LAAs): between 14th Avenue and Fruitvale Avenue, and between 65th Avenue and 79th Avenue. Additionally, the Retailer Survey conducted by Oakland Community Organizations (OCO) as part of this project found no large full-service supermarkets."[119] The Network for a Healthy California by the California Department of Public Health (www.cnngis.org, accessed March 28, 2012) provided listings of healthy food outlets by various types. Retail and fast food establishments were excluded. Using GIS, the food outlets within East Oakland were identified and mapped and those within the Study Area were tabulated (Table 20).

Table 20. Goods and Services within ½ Mile of International Blvd

Type	Count
Large Grocery Stores	4
Small Grocery Stores	108
Fruits/Vegetable Markets	10
Meat/Poultry/Fish Markets	18
Farmers Markets	4

Figure 15. Healthy Food Outlets in International Blvd. Corridor



Note: Data presented here reflects ZIP codes 94601, 94603, 94606, and 94621 only. These ZIP codes approximate the Study Area and do not directly align with Study Area. Therefore, some food outlets in the Study Area are not portrayed here, and some food outlets portrayed here are outside the Study Area.

Table 21. International Blvd Corridor Population Within 1/2 Mile of a Grocery Store

	% of Population in Study Area Within Half a Mile	% of Population in Study Area Not Within Half a Mile
Large grocery store (> 20 employees)	**49%** (62,089)	**51%** (63,907)
Grocery store of any size	**99%** (110,423)	**1%** (898)

According to this analysis, food outlets do exist throughout the Study Area, so resident dissatisfaction described in the International Blvd TOD plan and noted above may have to do with other factors such as quality or cost. A more realistic picture of access to healthy foods accounts for the fact that the quality of produce is often poorer, selection is limited, and prices are higher in smaller grocery stores. Low-income residents may often choose to not shop at their neighborhood grocery store.[120] Further travel is necessary to access quality and more affordable groceries.[121] Even the large grocery stores that do exist may be subpar compared to higher income neighborhoods.[122]

Regarding nutrition levels across Alameda County, about 57.4% of children[123] and 49.8% of adults[124] consume less than the recommended 5 servings of fruit or vegetables daily. The HOPE Microzone Assessment in 2009[125] surveyed fruit and vegetable consumption at various locations in Oakland "flatlands", east of I-580. The results for the locations that fall within the Study Area have been extracted below.

Table 22. Rate of Fruits & Vegetable Consumption in Three Study Area Locations

	98th & Edes	23rd & Foothill	Melrose Neighborhood (approx. E. 12th St and 50th Ave)
On average, how many times per day do you eat fruits and vegetables?	2.54	2.45	2.63
How many times per week do you eat a meal prepared from fresh ingredients	4.5	4.67	5.42

Transportation and Food Access. While the food security issue in Oakland is complex, transportation difficulties and time traveled are often mentioned as factors that exacerbate the problem. Oakland residents are concerned about transportation to grocery stores. A needs assessment of food access in East Oakland revealed that lack of time, access, and transportation were one of several major barriers to buying nutritious foods.[126] In 2009, a study of the Oakland food system, co-authored by Policy Link, Fair Food Network, and the C.S. Mott Group, revealed that almost all Oakland residents interviewed were unsatisfied with food shopping options. "Limited transportation hindered their ability to reach their preferred stores. Many do not own vehicles, and are forced to carpool, walk, or ride one or more buses to shop at stores outside of their neighborhood."[127] A resulting policy recommendation was to "develop transportation strategies to link residents of underserved areas with healthy food retailers."

According to the 2009 HOPE Microzone Assessement[128] which surveyed low-income neighborhoods across Oakland, 37.5% of those who didn't have a car used bus or BART to get to food stores (15% total out of 40% without cars). Another key finding from their study was that "Local corner stores sell little fresh food so residents travel to grocery stores 20-30 minutes away." This time estimate of 20-30 minutes is an average across all transportation mode types so the travel time to grocery stores by public transit is most likely longer than 20-30 minutes. Data from the 2007 California Health Interview Survey[129] shows similar results for Alameda County. The figure below depicts mode of transportation to grocery stores with public transportation use ranging between 13% and 35% amongst the different race groups.

Figure 16. Mode of Transportation to the Grocery Store for those in Households Without a Car for Regular Use in Alameda County

Source: 2007 California Health Interview Survey

4.4.3 East Bay BRT Proposal Impacts on Access to Goods and Services

According to the Final Environmental Impact Report,[3] none of the existing community facilities will be displaced by the BRT project. Improved transit to these community facilities is expected to improve access through multiple pathways. Quicker and more reliable travel times will make it easier and more attractive for people to make trips to amenities. Also, the establishment of BRT can spur financial investment in establishing new businesses and amenities along the corridor thereby making resources for health more plentiful and accessible within the community.

Improved Transit Service

The improvement in transit service is not uniform throughout the day or week. According to predictions in the FEIR, the average BRT speed (the DOSL Alternative) will increase between 25.7% and 27.3%, depending on the time of day, for travel southeast of downtown Oakland in 2015 compared to the No-Build Alternative (see Table 11 in Section 4.3.3). The average BRT speed for the DOSL Alternative will increase between 51.7% and 56.4%, depending on the time of day, in 2035 compared to the No-Build Alternative (see Table 12 in Section 4.3.3).

Impact of Improved Transit on Access to Healthcare and Prenatal Services

Given that most community clinics and prenatal services are along International Blvd and the majority of residents use community clinics for primary care, it is reasonable to expect that time traveled to these community clinics will decrease, as compared to the No-Build Alternative. The percent decrease depends on starting location relative to a BRT stop.

[3] FEIR Vol. 1 Part 9 Section 4.4.2.1

Particularly for those requiring multiple visits such as dialysis patients, transportation barriers can translate to significant decreases in health outcomes. A large international study on travel time and dialysis patient outcomes found "problems with transportation contributing to both skipped and shortened treatments were more common in those with longest travel times. These results highlight travel time as a potentially modifiable variable affecting both mortality and HR-QOL [health-related quality of life]."[130] Patients who traveled 16-30 minutes, 31-60 minutes, and 60 or more minutes had a statistically significant adjusted relative risk for all-cause mortality (1.03, 1.07, 1.20 respectively) compared to travel times of 15 minutes or less. Thus the predicted percent decrease in travel times due to BRT may decrease mortality risk for dialysis patients anywhere from 0 to 13% with the biggest decrease for those traveling longer distances (e.g. change in travel time from 60+ minutes to 45 minutes).

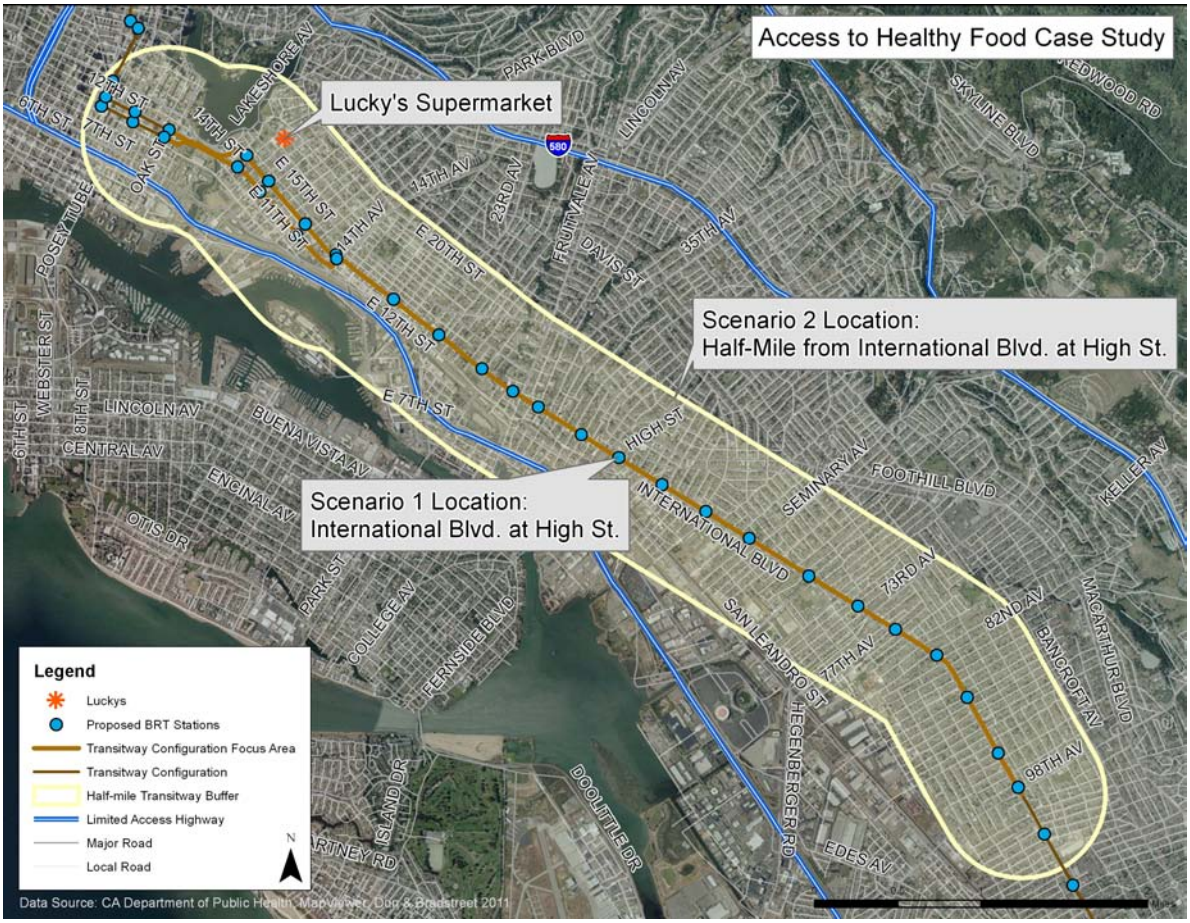
However, one literature review weighing the evidence on travel and cancer treatment found evidence to currently be inconclusive.[131] Factors such as flexibility, safety, cost, and reliability of travel modes to cancer treatment complicates the relationship between distance traveled and cancer treatment. One survey of 1,822 mammography facilities determined that "efforts to increase screening rates by reducing travel time or distance alone—by expanding the reach of mobile mammography units, for example— may not be effective if appointment wait times remain long due to limited capacity." Therefore, the impact of several saved minutes of travel time on the decision to make a trip, may be mitigated by factors such as perceived reliability and safety of the BRT as well as other dimensions of accessibility such as wait time (Jones et al., 2008).[132] Nonetheless, these findings point to the potential benefit of removing transportation-related barriers, as there may be other influencing factors, but the cost savings that can be seen with improved speed, reliability and image of transit service can help to offset some of the barriers to care.

Some health care providers have already taken steps in enhancing public transportation to improve health care access. In 2008, the Cleveland Clinic and University Hospitals in Cleveland, Ohio invested in Cleveland's BRT route, the HealthLine.[133] In exchange for the investment, the hospitals received naming rights of the line and stations at the hospitals' main campuses. A University Hospitals spokesperson explained the investment as a way to increase access to health care. Although evidence of improved access to the hospital has yet to be reported, the large investment from local hospitals to improve access to acknowledges the value of BRT systems to health care providers.

Impact of Improved Transit on Access to Healthy Food

Case Study of Change in Travel Time. As an example of BRT's impact on travel time to a grocery store, a case study analysis of travel times before and after BRT service begins in the Study Area was conducted. Lucky is one large, full-service grocery store located in the Study Area, and can be accessed by current bus route 1R and will also be accessed by the proposed BRT line. This analysis considers mid-day weekday trips to Lucky on public transit.

Figure 17. Case Study: Map of Trip to the Grocery Store



The 1R bus route travel time was calculated using the average bus speed in the figure above multiplied by the distance (from start to the nearest bus stop by Lucky). The closest bus stop to Lucky is the same for the existing 1R route and the proposed BRT. The average wait time was assumed to be half the headway time (i.e. half the time between buses). The current headway for 1R is 12 minutes. The expected headway for the BRT is 5 minutes. Walking speed was assumed to be 2.7 miles per hour. A second scenario displays the travel time for someone on the perimeter of the Study Area, ½ mile distance from the bus stop at International Blvd and High St. *The case study illustrates that the proportion of time saved from faster bus speeds is between 21% and 33%. For those needing to walk longer distances or transfer to or from other bus lines, their total travel time will not decrease as much.*

Table 23. Case Study: Change in Travel Time for a Grocery Store Trip

	Travel Time to Nearest Grocery Store		Time saved	% decrease in travel time
Start Location	With Existing 1R Bus Route	With Proposed BRT Route		
Scenario 1: Bus Stop at International Blvd & High St	20 min	13.5 min.	6.5 min.	33%
Scenario 2: 1/2 Mile from Bus Stop at International Blvd & High St.	30 min.	23.5 min.	6.5 min.	21%

Impact through the Establishment of New Facilities

Existing literature on BRT and transit-oriented development have pointed to the significant and positive impact on land use by BRT. The level and type of investment near BRT stations have been comparable to that near rail transit.[134] The quantification of the impact of BRT on land use, and development is difficult for a couple of reasons. First the relatively recent emergence of many BRT projects nationwide limits the assessment of long-term development impacts. Secondly, transit-oriented development around BRT stations occurs in a context of widely varying political, economic, and cultural factors. While it may be difficult to quantify the impact of BRT on development as compared to a No-Build scenario, a review of the literature in 2009 by the National Bus Rapid Transit Institute found that: "The reports that have been produced, however, assert that BRT has the ability to attract developers when significant investment has been made near transit nodes."[135] Cleveland's BRT investment is an example of potential economic investment resulting from BRT implementation. As of 2011, Cleveland's 2008 BRT system has accounted for $4.3 billion of real estate investment along the BRT line.[136]

Table 24. Examples of Economic Development Stemming from BRT Projects (National Bus Rapid Transit Institute, 2009)

BRT Project	Investment in Development
Boston – Silver Line Corridor	$650 million in development along Silver Line corridor
Pittsburgh – Martin Luther King Jr. East Busway	53 new developments (from years 1983-1996)
Ottowa,Canada	$1 billion in new construction along BRT Transitway including 6 new office buildings, a cinema, expansion of shopping center and hospital; $600 million (1996-1998) spent on 3,211 residential units and 436,858 sq meters of institutional and commercial buildings
Eugene, Oregon	Increase in commercial interest in property along Emx route; city planning began encouraging higher density development.

Impact of New Healthcare Facilities on Access to Healthcare Services. *While it would be beneficial to residents' access to care for new healthcare facilities to get established in the Study Area, it is not clear that the investment effect of BRT would attract these types of facilities.*

Further, the impact of establishing new healthcare facilities in the corridor will depend more on to what degree services are affordable and adequate (other than the transportation dimension).

Impact of New Grocery Stores on Access to Healthy Foods. *From the literature, map of grocery stores, and TOD plan, it is evident that there is a particular need in the Study Area for large, full-service grocery stores or supermarkets.* There are already many small grocery stores and corner stores. The limitations of small grocery stores and corner stores have been discussed previously. Thus, investment in infrastructure in the Study Area would make a significant impact if the grocery stores introduced were full-service supermarkets. The establishment of new grocery stores can significantly improve access to healthy foods, much more so than simply decreased travel times. The presence of a large national chain grocery store also has the potential to drive down the prices in neighboring smaller grocery stores.[137] Increasing the availability of supermarkets may reduce the prevalence of obesity and overweight.[138] However, any health effects from supermarket establishment are very long-term.

Summary of Health Impacts of BRT Related to Access to Healthcare and Healthy Foods

A good proportion (81%) of Study Area residents are currently within walking distance (half mile) of some sort of community clinic. Distance to the nearest hospital is much farther. Transportation is commonly cited as a barrier to accessing amenities. By providing faster and more reliable access to hospitals and other healthcare facilities, the proposed BRT system can reduce the number of forgone or missed appointments, thus improving health outcomes. This may be particularly beneficial for those who require frequent treatments.

There is currently an abundance of small grocery or corner stores such that everyone in the corridor is within walking distance of one. However, residents have reported that local small grocery or corner stores do not sell a lot of fresh food. There are very few large grocery stores in the Study Area. Research suggests improving access to a full-service grocery store can increase fruit and vegetable consumption and lower Body Mass Index.[139] [140] This analysis suggests that since the proposed BRT system would enable shorter travel times to full service grocery stores, residents who use public transit to access grocery stores may benefit from improved access to fruits and vegetables, better nutrition, and a lower BMI. In turn, these positive impacts are related to reduced rates of associated chronic diseases.

However, other dimensions of access such as affordability and availability of specific healthcare services, quality of service, or crime may more strongly influence access. A decrease in travel time even under the best conditions may not necessarily make a significant difference in utilization of health services or change in grocery shopping patterns given current availability and quality of services and goods.

Other significant impacts of BRT on access to goods and services are demonstrated in its ability to catalyze financial and political investment in transit-oriented development around BRT stations. The establishment of new institutions and services can improve access to goods and services and revitalize communities. The degree to which development is realized depends on

other factors such as market forces and the commitment, support and collaboration of policymakers, businesses, and community members.

4.4.4 Access to Goods and Services-Related Recommendations

To maximize the health benefits of improved transit service to goods and services, the following are recommended actions:

1. Implement BRT as proposed. BRT will enable faster access to existing goods and services resources in and outside of Study Area and BRT will catalyze financial and political investment in areas surrounding BRT stations, likely leading to additional goods and resources in these areas.
2. Facilitate the development of a full-service supermarket along International Blvd. City agencies (e.g., Planning and Public Health Departments) should work with community partners and developers to develop a set of incentives (e.g., tax credits, predevelopment assistance, or regulatory incentives) that attract grocery retailers to this area.
3. Align development in this area with community priorities as expressed in the International Blvd Transit-Oriented Development Plan, such as walkable neighborhoods; accessible social services; parks and green space, businesses that provide daily goods and services; entertainment, recreation, arts and culture; celebration of cultural diversity; inclusive mixed income housing; community facilities; more street lighting; improved trash collection and cleanup of illegal dumping; graffiti abatement; and increased police presence.

4.5 TRAFFIC SAFETY

The East Bay BRT project and associated infrastructure changes along International Blvd may affect human health through impacts on traffic safety. There are several mechanisms through which traffic safety could be impacted. Changes to mode share, including a shift away from private motor vehicles and towards transit, walking, and bicycling may alter the frequency of pedestrian-vehicle and bicycle-vehicle collisions on the corridor. These collisions can result in injury or death. However, a network of sidewalk, roadway, and engineering improvements along the BRT corridor may improve the physical environment and safety for pedestrians and bicycles. At the same time, potential reduced motor vehicle speeds on the corridor would reduce the *severity* of collisions that do occur. This section will provide an overview of traffic-safety related health impacts, describe existing conditions with respect to traffic-related injuries and fatalities along the International Blvd corridor, and discuss how the East Bay BRT project will affect traffic collisions and associated injury and mortality rates along the project corridor.

4.5.1 Research Connecting Traffic Safety to Health

The main health outcomes associated with traffic-related collisions are physical injury and death. In most developed countries, there has been a reduction in road collision fatalities and injuries over the last 50 years, despite an increase in vehicle volumes on roads.[141] Nationwide, bicycle and pedestrian fatality rates have decreased from 1975 to 2009. Pedestrian fatalities among all

age groups have gone down.[142] In particular, *all* traffic fatalities among children under age 15 fell 60% from 1991 to 2006, and fatalities for *pedestrians* in this age group fell by 75%.[143] [144] While fatalities for young (<16 years) bicyclists have decreased, they have increased for bicyclists over 16 years.[145] Similarly, pedestrian injuries decreased from 84,000 in 1995 to 69,000 in 2008 (18%), and bicyclist injuries decreased from 61,000 to 52,000 (15%).[146] These decreases were seen even though national and state level data underestimate pedestrian and bicycle injury rates, particularly those that occur off main roadways.[147] [148]

Despite falling rates of injury and death, a high burden of preventable injuries and deaths due to traffic-related collisions remains. Factors influencing the frequency and severity of collisions include speed and mass of vehicles, type of road, mode share, weather conditions and time of day.[149] Failure to obey traffic laws and right of way, use of cell phones, driver inattention or sleep deprivation can also contribute to collisions.[150]

In traffic collisions, bicyclists and pedestrians are most vulnerable to fatality and injury.[151] Across 51 large U.S. cities in 2009, walking accounted for 12.7% of trips, yet pedestrians made up 27% of traffic fatalities. Similarly, 1.1% of trips were made on bicycles, but bicyclists accounted for 3.1% of traffic fatalities.[152] As the speed of impact between the motor vehicle and the pedestrian increases, the risk of pedestrian fatality and severe injury increases.[153] [154] The Federal Highway Administration reports that in a pedestrian-motor vehicle collision at 5 mph, pedestrians have a 5% chance of death, but this chance of fatality increases to 45% at 30 mph and 85% at 40 mph (2002).[155] A study of pedestrians over 15 years old struck by forward-moving vehicles in six U.S. cities found that risk of death was 10% for a pedestrian struck at 23 mph, 25% at 32 mph, 50% at 42 mph, 75% at 50 mph and 90% at 58 mph impact speed. Likewise, the risk of severe injury was 10% at 16 mph, 25% at 23 mph, 50% at 31 mph, 75% at 39 mph and 90% at 46 mph impact speed. The study also found that 70-year-old pedestrians were more vulnerable to severe injury than 30-year-old pedestrians hit at the same speed, such that risk of severe injury or death for a 70-year old pedestrian hit by a car traveling at 25 mph is approximately equal to risk for a 30-year old pedestrian hit at 35 mph.[156]

The volume of motor vehicles, pedestrians, and bicycles is also a key predictor of vehicle-pedestrian or vehicle-bicycle collision frequency.[157] As the volume of motor vehicles increases, the frequency of collisions would be expected to increase. Similarly, it can be expected that as pedestrian or bicycle volumes increase, collision rates would also increase. This was found in a study of 15 U.S. cities—increasing pedestrian volume increased frequency of pedestrian collisions. [158]

Intersection characteristics, including the presence of more right turn lanes, nearby commercial driveways and properties, and a greater percentage of residents younger than age 18 within 0.25 mile, increase the frequency of pedestrian collisions.[159] A Census tract level model of pedestrian-vehicle injury collisions for San Francisco, California found that factors including traffic volumes, lack of public transit, street and land use characteristics, and proportion of populations in poverty or over age 65 all influences collision rates.[160] A variety of pedestrian features, such as highly visible crosswalks, curb bulbouts, reduced street width (which corresponds to reduced time exposed to traffic), and warning signals, and median safety islands support enhanced pedestrian safety.[161] Re-timing traffic signals with leading pedestrian intervals,

which give pedestrians several seconds to cross the street before motor vehicles are given a crossing signal, has been shown to be an effective strategy for reducing pedestrian injuries in New York City, and increasing the percent of vehicles yielding to pedestrians in San Francisco.[162]

Bicycle safety is also influenced by volume of motor vehicles, frequency of trucks and heavy vehicles in traffic, and built environment features. As the number of motor vehicles increases, bicycle-vehicle collisions per cyclist increase.[163] A higher proportion of trucks and higher speeds increase severity of bicycle-vehicle collisions.[164] [165] While bike paths improve bicycle safety on arterials, a recent study in Berkeley, CA found it is safer for bicycles to ride on bicycle boulevards - side streets with signage and improvements for bicycles as well as traffic calming or reduction - than on arterial streets.[166] Rates of collision were 2-8 times higher on arterial streets than on parallel bicycle boulevards, although the proportion of collisions resulting in severe injury were not significantly different.

Existing BRT Projects and Traffic Safety

An analysis of BRT systems implemented in 13 international cities (no US cities) found mixed results for traffic safety and BRT. In Guadalajara, Mexico and Bogotá, Colombia collision rates decreased after implementation of BRT, but in Dehli, collision fatalities increased. In some cities, such as Mexico City, bicyclists often competed with buses to use curbside dedicated BRT bus lanes and increased BRT bus/bicycle crashes occurred.[167] This phenomenon is not expected to be a concern for the East Bay BRT, given that BRT lanes will be median running, and separate bike lanes will be added along International Blvd. or adjacent corridors.

In Los Angeles, the rate of accidents along the BRT Orange Line is lower per mile than the rate along conventional bus Metro Rapid service routes, where buses operate in mixed traffic.[168] However, from 2005-2010, there were 58 accidents at intersections along the 14.5-mile Orange Line corridor, primarily due to motor vehicle driver error under new roadway conditions. To reduce accidents and deter private motor vehicles from running red lights, in 2010 Los Angeles Metro ordered BRT buses to reduce intersection speed from 25 mph to 10 mph, increased pedestrian and driver warning signage, increased signal length to give buses more time to clear intersections, and added 12 photo enforcement cameras at high-risk intersections.

4.5.2 Existing Conditions for Traffic Safety

Traffic-related collision, injury and mortality rates depend on the volume and speed of motor vehicles along a corridor, the volume of pedestrians and bicycles, and characteristics of the street and sidewalk environment. The Mobility section (Section 4.3) reviews existing conditions for each of these features in the International Blvd Study Area. The following describes existing conditions for motor vehicle-pedestrian/bicycle collisions in Alameda County and along International Blvd over the last decade.

Traffic Collisions, Injuries and Fatalities

All reported traffic-related collisions that result in fatality, injury, or property damage are recorded in the Statewide Integrated Traffic Records System (SWITRS), which is maintained by the California Highway Patrol. For the years 1996-2008, there were 136,592 reported traffic-related collisions in Alameda County, including 107,053 collisions resulting in injury or death.

SWITRS data shows a decline in rates of collision fatality and injury over the last decade in Alameda County; the **number of traffic fatalities and injuries decreased significantly from 2000-2004 to 2005-2009.**

Table 25. Persons Killed in Alameda County: 2000-2009

	Year									
County	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Alameda	**114**	**111**	**112**	**113**	**103**	**102**	**98**	**106**	**88**	**72**

Table 26. Persons Injured in Alameda County: 2000-2009

	Year									
County	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Alameda	**13,266**	**12,601**	**12,919**	**11,671**	**11,326**	**11,078**	**10,439**	**9,972**	**9,158**	**8,536**

Source: CA Highway Patrol 2009 Annual Report

According to the International Blvd TOD Plan, the intersection of High Street and International Blvd had the highest rate of collisions between motor vehicles along International Blvd. There were 28 vehicle-vehicle collisions at this intersection from 2007-2009, but none involved bicycles or pedestrians (City of Oakland, 2010)**.**[169]

Pedestrian Environment

Planning and implementation of pedestrian facility projects in Oakland is coordinated by the City's Bicycle and Pedestrian Facilities Program, and nearly every capital improvement project in Oakland affects pedestrian facilities.[170] In 2002, the City of Oakland adopted a Pedestrian Master Plan, which identified existing pedestrian conditions, routes to key pedestrian destinations, and made policy and design recommendations for pedestrian facilities. The plan identified International Blvd as a problem region for pedestrian-vehicle collisions, and put forward regions along the International Blvd corridor as priority areas for streetscaping, crosswalk and other pedestrian infrastructure improvement projects.

The BRT's FEIR captured the major pedestrian activity centers along the BRT project corridor. They include business districts as well as hospitals, schools, shopping centers, public buildings, and places of worship. Table 27 highlights the major pedestrian activity center intersections along International Blvd on the proposed BRT line.

Table 27. Pedestrian Activity Centers along International Blvd

Nearest BRT International Blvd. Alignment Intersection	**Activity Center Name**	**Activity Center Type**
8th Avenue	Eastlake Retail District	Shopping Area

Fruitvale Avenue	Fruitvale BART station Fruitvale retail district St. Elizabeth High School St. Elizabeth Church	Transit facility Shopping area High School House of Worship
Seminary Avenue	Rainbow Recreation Center	Recreational facility
Havenscourt Blvd	Havenscourt Middle School	Educational institution
78th Avenue	Post office	Government Office
82nd Avenue	Allen Temple Arms	Senior facility
85th Avenue	Allen Temple Baptist Church	House of worship
90th Avenue	Post Office Library	Government office Public Library
98th Avenue	Elmhurst Middle School	Educational institution
105th Avenue	Durant Square Shopping Center	Shopping center

Source: FEIR, 2012

The International Blvd TOD Plan reports that the corridor has continuous, but narrow sidewalks, with many cuts in curbs, which increase the likelihood of motor vehicles crossing the path of pedestrians walking on sidewalks. There are also long gaps between crosswalks and traffic signals across International Blvd, and many locations thus require pedestrians to cross four lanes of traffic with no signal. Outside the Fruitvale area, crime, blight, and the lack of features, like benches, trees, and trashcans, also make the environment less desirable for pedestrians. The TOD Plan emphasizes poor pedestrian environments near intersections with High Street and 73rd Avenue/Hegenberger Avenue.[171]

Vehicle-Pedestrian Collisions

Increased pedestrian vulnerability to severe injury and death in traffic collisions in Oakland is illustrated by statistics. While 4% of overall Oakland collisions involved pedestrians, pedestrians made up 39% of traffic accident fatalities. According to the Pedestrian Master Plan, from 1996-2000, International Blvd had the highest rate of collisions involving pedestrians per road mile in Oakland and 10% of Oakland's pedestrian-vehicle collisions took place on this corridor. Three of the City's top 10 problem intersections for pedestrian-vehicle collisions were located along International Blvd (at International and 35th Ave, 64th Ave, 90th Ave). Among Oakland's vehicle-pedestrian collisions from 1996-2000, drivers were at fault in 51% of collisions, and pedestrian violations occurred in 31% of collisions. Half of the vehicle-pedestrian accidents occurred while the pedestrian was in a crosswalk.[172]

A more detailed geospatial analysis of SWITRS data for Alameda County from 1996-2008 demonstrates that annual pedestrian-vehicle collision injury and fatality rates within the Study Area were over 16 times higher than rates for Alameda County overall, with a mean of 16 collisions per square mile in this region each year (Table 28). The total population living in the Study Area is around 118,000.[173] Annual pedestrian injury/fatal accidents in the Study Area totaled 124. Thus, population pedestrian injury rates due to traffic-related collisions were around 105/100,000 population. This exceeds the Healthy People 2020 target of 20.3 pedestrian injuries/100,000 population by 5 times.[174]

In pedestrian injury collision hot spots along International Blvd illustrated in Figure 18, there were a mean of 69 collisions per square mile each year. Nearly all locations along International Blvd in Oakland had high or very high pedestrian injury/mortality rates relative to Alameda County overall. Hot spots with very high densities of pedestrian injuries and fatalities relative to all of Alameda County, which are referred to in Table 28, include:

- Downtown Oakland
- International Blvd from 24-25th Ave
- Derby to 38th Ave (including Fruitvale)
- 48-50th Ave
- 73rd Ave/Hegenberger
- 79-83rd Ave
- 88th-96th Ave.

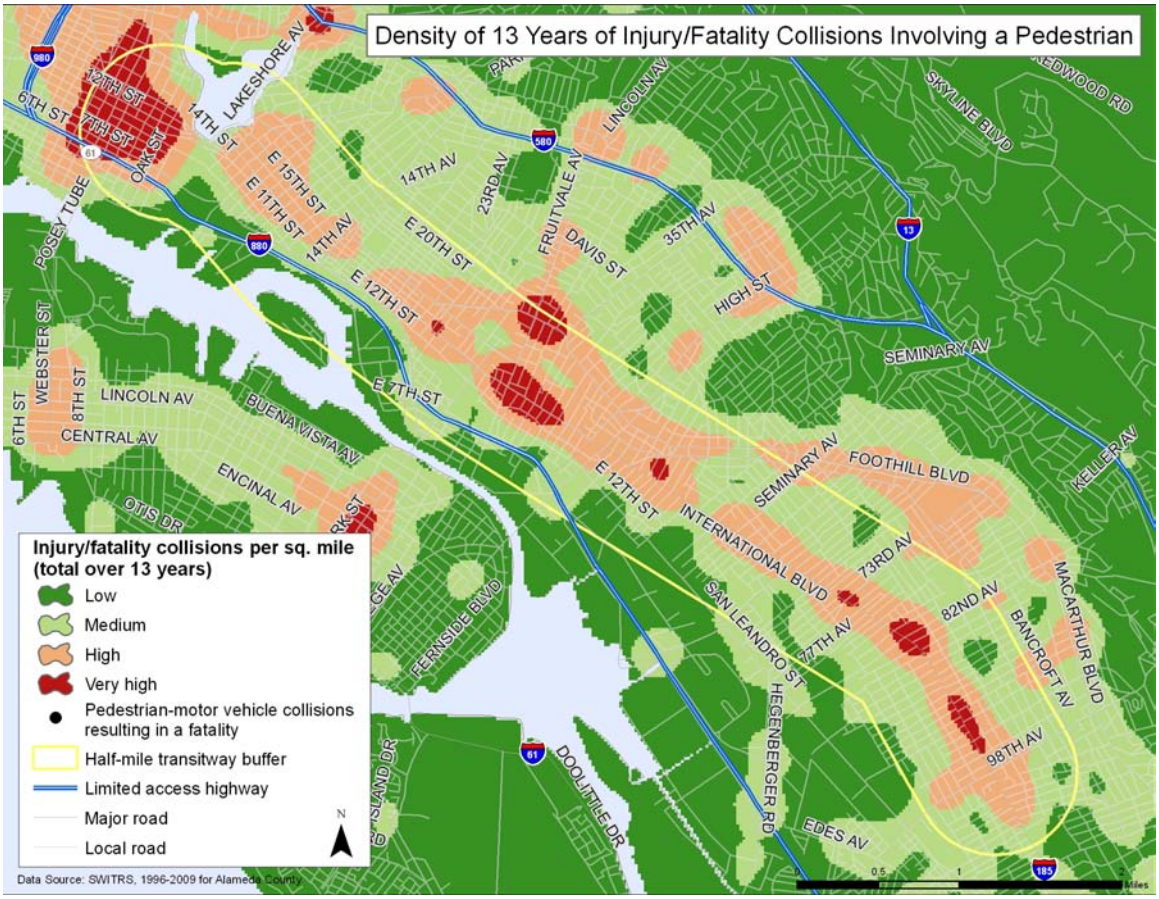
In Alameda County and the area around International Blvd, pedestrian-vehicle injury and fatality rates decreased over time from 1996-2000 to 2001-2004 to 2005-2008.

Table 28. Counts & Densities of Injury/Fatality Collisions Involving a Pedestrian for 3 Areas

	Hot spots		**Study Area**		**Alameda County**	
	Collision Count	Collisions/sq. mile[1]	Collision Count	Collisions/sq. mile[2]	Collision Count	Collisions/sq. mile[3]
Total for 13 years	600	898.78	1608	213.65	9015	12.22
Total 1996-2000	237	355.02	653	86.76	3777	5.12
Total 2001-2004	197	295.10	514	68.29	2820	3.82
Total 2005-2008	166	248.66	441	58.59	2418	3.28
Average per Year	46	**69.14**	124	**16.43**	693	**0.94**

[1]Hot Spot Area = 0.667568 miles sq.; [2]Buffer Area = 7.526502 miles sq.; [3]Alameda County Area = 737.4415 miles sq.
Data obtained through kernel density analysis of SWITRS data in GIS

Figure 18. Densities of Injury/Fatality Collisions Involving a Pedestrian in Study Area



Pedestrian Safety Near Schools

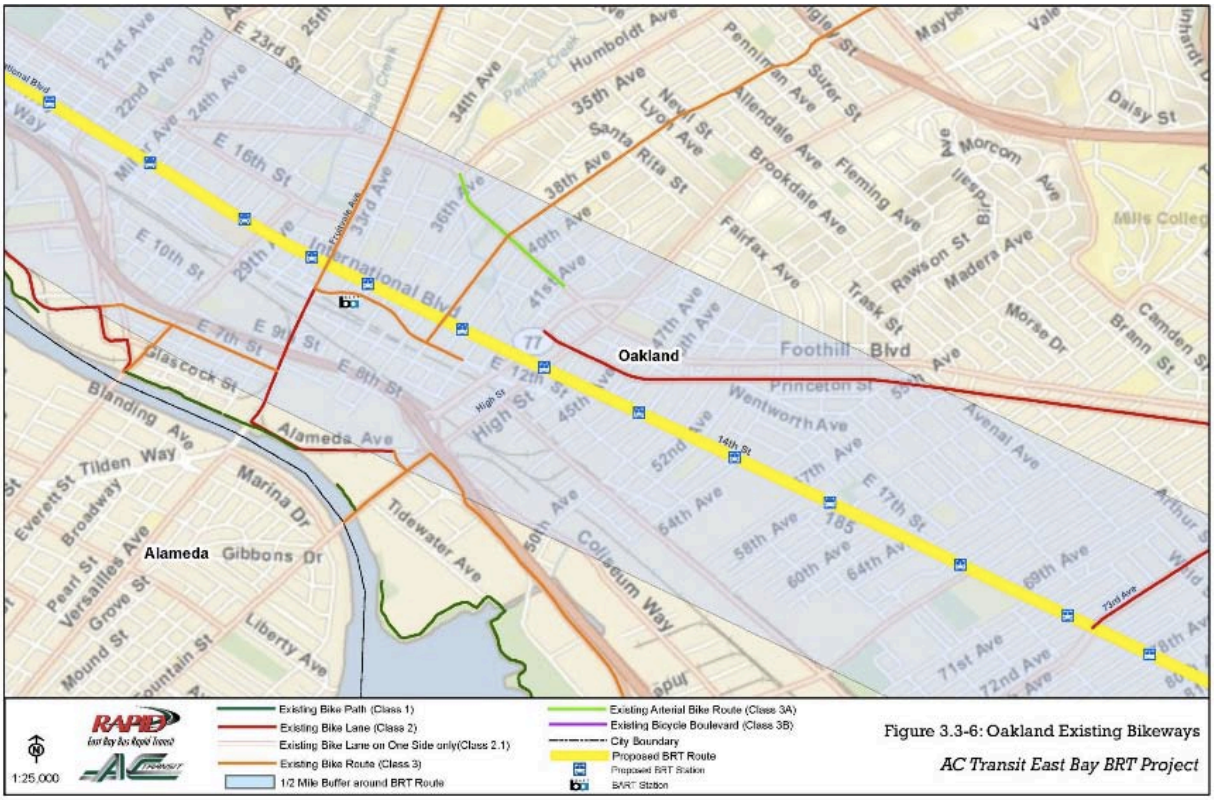
School children make up 20% of the population in the Study Area,[175] and tend to walk and take transit more than the general population. At community scoping meetings for this HIA as well as for the TOD Plan, community members raised pedestrian safety for students on their way to and from schools on or near International Blvd as a key priority. In particular, the Havenscourt-Lockwood sub-area (57th-61st Ave), and around Lockwood (67th Ave) and Whittier (64th Ave) school areas were mentioned. An analysis of pedestrian and bicycle collisions near Oakland schools from 2007-2009 indicates that there were 18-303 collisions within a half-mile of all schools along International Blvd during that time period.[176] Collisions occurred within a half-mile of all Study Area schools during these three years. Oakland Unified School District and numerous individual Oakland schools have been awarded federal and state Safe Routes to School funding from 2005-2011 to improve pedestrian infrastructure and traffic safety education for schools.[177]

Bicycling Environment

The current bicycling environment along International Blvd is in need of improvement. There are no separate bike lanes or designated routes along International Blvd, and very few along adjacent streets (Figure 19). Cyclists and buses compete for right lane road space, often "leap frogging" back and forth. Bicycles are currently accommodated on the current AC Transit buses. However, each bus can only accommodate two bicycles each on front-mounted racks. Bicycle parking and

other amenities are good near the Fruitvale BART station, but discontinuous along the rest of the proposed BRT alignment.[178] [179]

Figure 19. Existing Bikeways Near International Blvd BRT Route



Source: FEIR, 2012

Vehicle- Bicycle Collisions

In a ranking of 68 large California cities for risk of bicycle collisions relative to the number of bicycles on the road, Oakland ranked as California's 4th safest cities for cyclists. There were 1957 collisions involving bicycles in Oakland from 1995 to 2004. Of these, 93% of collisions occurred between a bicycle and a moving motor vehicle. During this time period, the number of total annual bicycle accidents decreased significantly, despite an increase in the number of bicycles on Oakland's roads.[180] Of 514 Oakland collisions involving a bicycle from 2007-2009, 3 resulted in fatalities, 37 in severe injuries, and 474 in less severe injuries.[181]

Between 2007 and 2009, International Blvd had the 3rd highest number of bicycle collisions of all corridors in Oakland. During that period, at least 2 bicycle collisions occurred along International Blvd at each of the following intersections: Seminary, 50th, 45th, and 22nd Avenues.[182] Three or more bicycle accidents occurred at International Blvd and 73rd/Hegenberger, 78th Ave, and 98th Ave.[183] A more detailed geospatial analysis of SWITRS data for Alameda County from 1996 to 2008 demonstrates that annual bicycle collision injury and fatality rates in the Study Area were over 7 times higher than rates for Alameda County overall, with a mean of 6 collisions per square mile in this region each year (Table 29 and Figure 20). In Alameda County and the area around the International Blvd, bicyclist injury and fatality

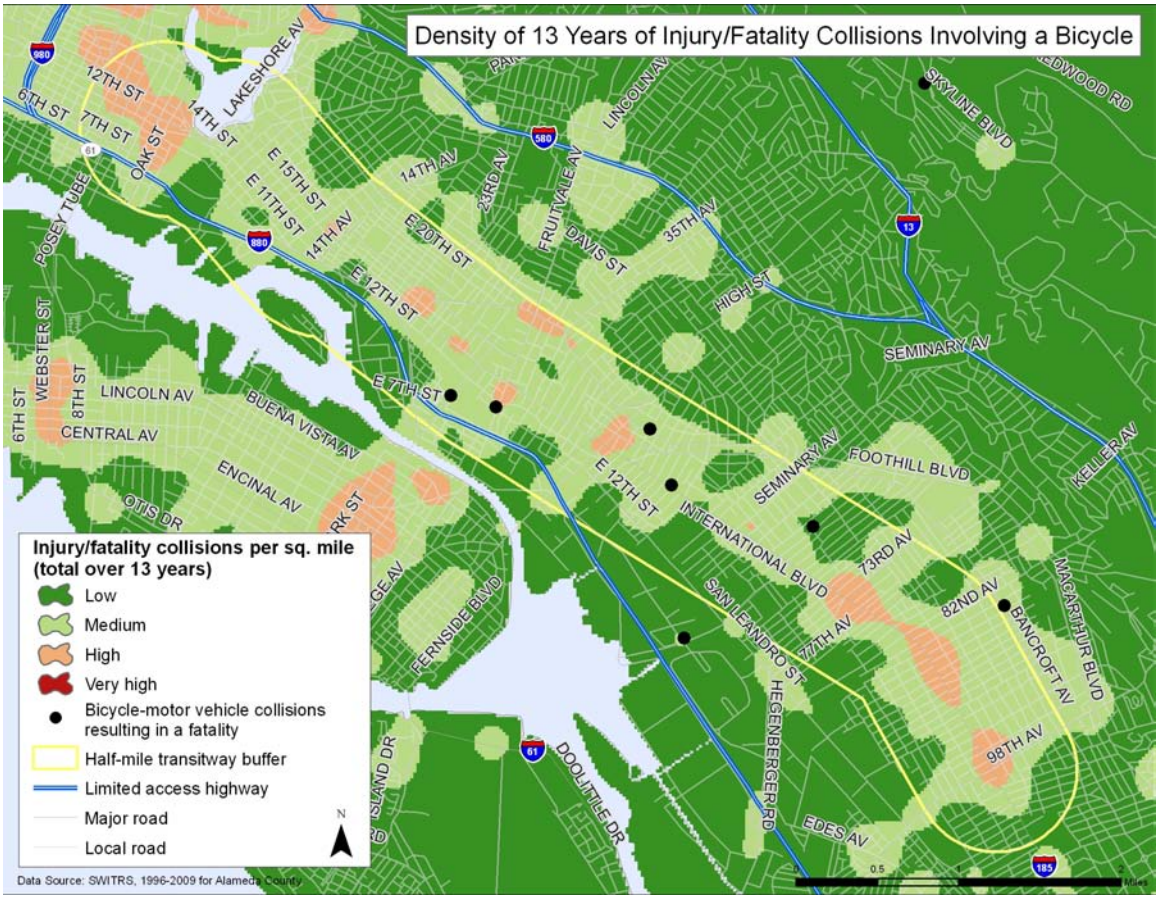
rates decreased over time from 1996-2000 to 2001-2004 and remained approximately the same in 2005-2008.

Table 29. Counts & Densities of Injury/Fatality Collisions Involving a Bicycle

	Study Area		Alameda County	
	Collision Count	Collisions/sq. mile[1]	Collision Count	Collisions/sq. mile[2]
Total for 13 years	568	75.47	7443	10.09
Total 1996-2000	226	30.03	3291	4.46
Total 2001-2004	167	22.19	2079	2.82
Total 2005-2008	175	23.25	2073	2.81
Average per year	**44**	**5.81**	**573**	**0.78**

[1]Buffer Area = 7.53 miles sq.; [2]Alameda County Area = 737.44 miles sq.
Data obtained through kernel density analysis of SWITRS data in GIS

Figure 20. Densities of Injury/Fatality Collisions Involving a Bicycle in Study Area



Source: SWITRS Data, 1996-2008

4.5.3 East Bay BRT Project Impacts on Traffic Safety

The existing conditions section above identified the current lack of bicycle and pedestrian amenities and safety features along International Blvd. Within the City of Oakland and Alameda County overall, the Study Area is a region of high concern for pedestrian-vehicle and bicycle-vehicle collisions. This section will outline how the proposed BRT project is expected to affect health of pedestrians and bicyclists in the Study Area by altering frequency and severity of fatal and non-fatal traffic-related injuries.

Vehicle-Pedestrian and Vehicle-Cyclist Collisions

Summary of BRT Impacts on Factors Related to Vehicle-Pedestrian and Vehicle-Cyclist Collisions.

- Changes to sidewalks, intersections, and streets are expected to improve the pedestrian environment along International Blvd.
- Results from the screenline analysis (presented in Mobility, section 4.3) predict that the BRT project will decrease motor vehicle volume along International Blvd in both 2015 and 2035 compared to the No-Build Alternative. However, for major roadways and transit corridors parallel to the BRT alignment, vehicle volumes are expected to increase slightly in 2015 and 2035 compared to the No-Build Alternative.
- Screenline results (see Mobility, section 4.3) also predict increases in transit trips; therefore, the BRT Project is likely to increase pedestrian and cyclist volumes along International Blvd in both 2015 and 2035 compared to the No-Build Alternative. However, for parallel routes, pedestrian and cyclist volumes are expected to decrease slightly in 2015 and 2035 compared to the No-Build Alternative.
- BRT is expected to reduce vehicle speeds along International Blvd.
- BRT changes to the bicycle infrastructure are expected to improve the bicycle environment along International Blvd.

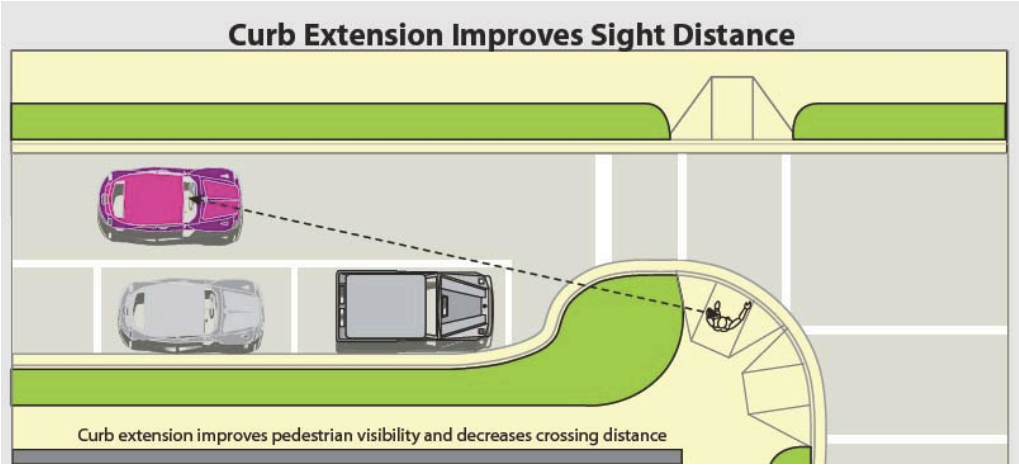
These findings were used to estimate the following predictions.

BRT changes to stations, intersections, sidewalks and streets improve the pedestrian environment, which affects vehicle-pedestrian collisions. As noted in the existing conditions section, almost the entire length of International Blvd in Oakland has a high rate of pedestrian-vehicle collisions compared to average rates in Alameda County. A number of the types of pedestrian environment upgrades recommended in the Oakland Pedestrian Master Plan and International Blvd TOD Plan are included in the BRT Plan (FEIR, 2012). BRT design features, which will enhance pedestrian safety and reduce pedestrian-vehicle collisions along the full LPA corridor include:

- Reducing mixed-flow motor vehicle traffic from 2 to 1 lane in each direction. This will reduce vehicle volume, speed, and the number of lanes of mixed-flow traffic pedestrians must cross.
- Median stations will serve as pedestrian safety islands or “refuges” in the middle of International Blvd. Pedestrians will be able to cross half of the street’s 4 or more lanes at one time. Additional refuges proposed at non-station locations.

- High visibility crosswalks will connect sidewalks to BRT median stations at signalized intersections and will be placed at high pedestrian volume non-signalized intersections. Crosswalks provide pedestrians right of way and improve driver awareness of pedestrians.
- Curb extensions and bulbouts at various corners along International Blvd will reduce the distance pedestrians must walk while crossing the wide street. They also improve visibility for pedestrians and vehicle drivers and calm traffic in the pedestrian zone (Figure 21).

Figure 21. Curb Extension Impact on Sight Distance



- Accessible pedestrian signals, which provide an audible ticking sound while the visual walk sign is displayed, will be used to improve safety for visually impaired pedestrians. Wheelchair accessible push buttons will be used on signals.
- Roads will be re-paved and curb ramps upgraded to better serve mobility impaired people and strollers.
- Signals will have countdown timers and be timed according to new pedestrian walk times of 3 ft/second, rather than 4 ft/second rate, which is out of date.
- For problem non-signalized intersections, flashing yellow warning signals and pedestrian warning signs will be installed.

To illustrate how these pedestrian features will improve pedestrian safety at specific problem locations, design features at pedestrian-vehicle collision hotspots identified in the existing conditions spatial analysis are displayed in Table 30:

Table 30. Pedestrian and BRT Design Features along International Blvd

Pedestrian Collision Hotspot or Priority School Area on International Boulevard	BRT Design Features	Pedestrian Centers
24-25th Ave	• Median BRT Station at Miller Ave (NW of 24th Ave) • Sidewalk extensions (more extensive curb bulbouts) at 25th Ave • Highly visible crosswalks throughout	San Antonio TOD Plan Catalyst Area

	• New pedestrian-only signals at non-signalized BRT station intersections	
Derby to 38th Ave (includes Fruitvale)	• Median BRT Stations at 31st, 34th Ave • Pedestrian refuge at 33, 36, 37th Ave • Sidewalk extensions (more extensive curb bulbouts) at 33rd, 36th Ave • Highly visible crosswalks throughout • New pedestrian-only signals at non-signalized BRT station intersections • Traffic signal at Fruitvale & International Blvd	Fruitvale BART station, retail district, St. Elizabeth High School & Church, TOD Plan Catalyst Area
48-50th Ave	• Median BRT Stations at 48th Ave • Pedestrian refuge at 50th Ave • Sidewalk extensions (more extensive curb bulbouts) at 50th Ave • Highly visible crosswalks throughout • New pedestrian-only signals at non-signalized BRT station intersections • New traffic signal at 50th Ave	
73rd Ave/Hegenberger	• Median BRT Stations at 72nd Ave • Sidewalk extension at 72nd Ave • Highly visible crosswalks throughout • 2 new pedestrian-only signals at non-signalized BRT station intersections (71st, 72nd Ave)	TOD Plan Catalyst Area
79-83rd Ave	• Median BRT Stations at 82nd Ave • Sidewalk extension at 83nd Ave • Median landscaping from 81st-83rd - median refuge island • Highly visible crosswalks throughout • New pedestrian-only signals at non-signalized BRT station intersections	Allen Temple Arms senior facility, TOD Plan Catalyst Area
88th-96th Ave	• Median BRT Stations at 87th, 94th Ave • Median landscaping from 81st-83rd - median refuge island • Highly visible crosswalks throughout • New pedestrian-only signals at nonsignalized BRT station intersections; signal at 92nd	Post office, library, TOD Plan Catalyst Area

Data from FEIR & AC Transit BRT Plan Drawings

Changes in vehicle, pedestrian and cyclist volumes affect the frequency of vehicle-pedestrian and vehicle-cyclist injury collisions. Using total person trips for three screenline locations in the Study Area from AC Transit's screenline analysis and an equation specified by Elvik (2009),[184] which estimates the effects on injury collisions of increased walking and bicycling, the following model predicts the percent change in vehicle-pedestrian/cyclist injury collisions that we would expect given the different mode share predictions associated with the No-Build and BRT scenarios in 2015 and 2035. The model was used to predict changes in vehicle-pedestrian/cyclist injury collisions on International Blvd and major roadways and transit routes nearby and parallel to International Blvd. We combined pedestrian and cyclist predictions because we did not have even an approximate source for bicycle trip predictions in future years. The model reflects two assumptions: the risk to pedestrians and cyclists declines with an increase in pedestrians and cyclists and the risk to each pedestrian/cyclist increases with an increase in

motor vehicles. *Thus a shift of trips from motor vehicle to non-motorized modes will lead to a decline in auto-pedestrian and auto-cyclist collisions*.

The screenline analysis predicts changes in auto person trips for future years; however, pedestrian and cyclist trips are not projected. Therefore, to complete the model, transit riders are used as a proxy for pedestrians and cyclists. Because many people walk or ride their bikes to transit stations, this provides a way to approximate the pedestrians and bicycles walking or bicycling on International Blvd and in the area overall. We recognize there are flaws in this assumption, as not all transit trips originate from people walking or cycling from their places of origin or to their destinations. Therefore, the pedestrian and cyclist transit proxy may overestimate the number of pedestrians and cyclists. However, some pedestrians and cyclists walk or ride to their final destination without boarding or existing transit systems, which implies an underestimate of actual pedestrians and cyclists using the transit proxy. The estimates do not account for any planned pedestrian or bicycle infrastructure upgrades associated with the BRT project and TOD plan, which could result in even more pedestrians or cyclists choosing to walk or ride. The over and underestimate effects of the pedestrian/cyclist proxy may cancel each other out in the end. Further, scaling the estimates to account for any over or underestimates would still result in the same percentage change in collisions.

$$\% \text{ Change in Vehicle-Pedestrian/Cyclist Injury Collisions} = \frac{(MV_{t2})^{0.7} * (PED/CYC_{t2})^{0.4}}{(MV_{t1})^{0.7} * (PED/CYC_{t1})^{0.4}}$$

Where:

MV = Number of motor vehicle trips
PED/CYC = Number of pedestrian/cyclist trips (using number of transit person trips as proxy)
t1 = Time period 1
t2 = Time period 2
Exponents MV = 0.7 and PED/CYC = 0.4 were selected based on Elvik's analysis.

In the absence of person trip data for existing 2009 conditions, person trips for the no-build 2015 scenario were used as baseline for the model.

Vehicle-pedestrian/cyclist collisions on International Blvd
Considering the summary presented above and after calculating the percentage change in vehicle-pedestrian/cyclist collisions for the different time periods and BRT scenarios using Elvik's model, results (see Table 31) show that at implementation, *in 2015, there are estimated to be 1.3% fewer injury collisions on International Blvd with the BRT system in place than there would be if it were not implemented (No-Build). Looking ahead to 2035, there are estimated to be 3.4% fewer injury collisions on International Blvd with the BRT system in place than there would be if it were not implemented (No-Build).*

Vehicle-pedestrian/cyclist collisions on routes parallel to International Blvd
Screenline analysis estimates for person trips on routes parallel to International Blvd indicate that there will be some transference of auto trips to parallel roadways because there will be less vehicle capacity on International Blvd. This affects the expected number of injury collisions on these parallel routes with the BRT system in place compared to if it were not implemented (No-

Build). *In 2035, there are estimated to be 1.4% more injury collisions on parallel routes with the BRT system in place than there would be if it were not implemented (No-Build).*

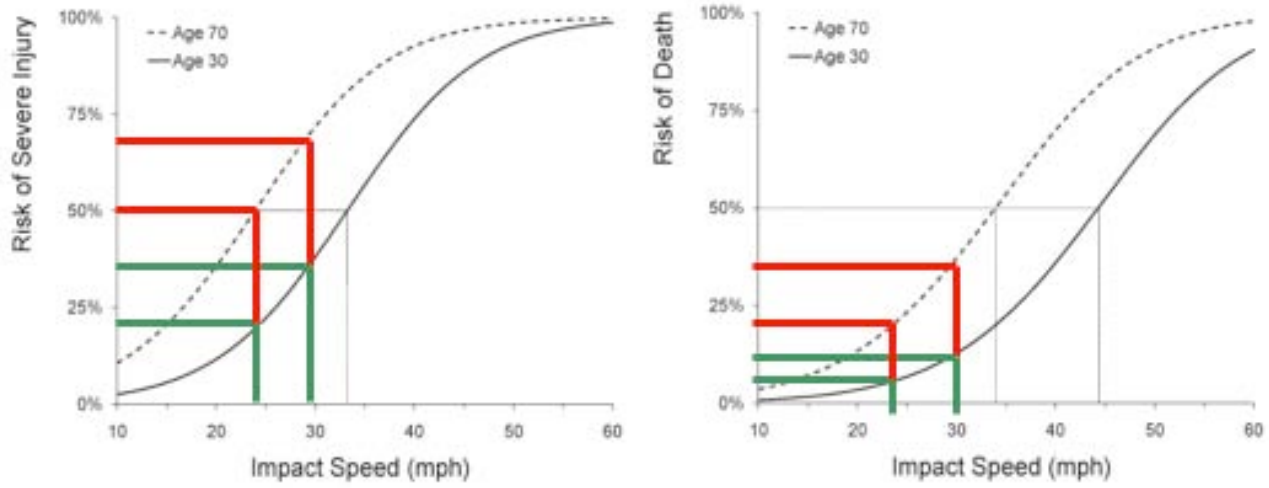
Table 31. Expected Percentage Change in Vehicle-Pedestrian/Cyclist Collisions in 2015 and 2035

	Geography	
Scenarios	**International Blvd**	**Routes Parallel to International Blvd**
2015 with BRT vs. 2015 No-Build	-1.3%	-0.9%
2035 with BRT vs. 2035 No-Build	-3.4%	1.4%

Changes in vehicle speeds affect severity of vehicle-pedestrian collisions. As traffic speeds increase, risk of injury or death for pedestrians struck by a moving vehicle increases. A study of pedestrians ages 15 and over struck by a moving car, truck, van or SUV in 6 U.S. cities found that a pedestrian struck at 16 mph has a 10% average risk of severe injury. Risk increases to 25% at 23 mph impact speed, 50% at 31 mph, 75% at 39 mph, and 90% at 46 mph. Risk of death was 10% at 23 mph, 25% at 32 mph, 50% ad 42 mph. The study also found that 70-year-old pedestrians were more vulnerable to severe injury than 30-year-old pedestrians hit at the same speed.[185]

Due to lane reductions and engineering features, the East Bay BRT Plan predicts that automobile speeds along the corridor will decrease by 18-23% along the BRT corridor.[186] The FEIR air quality analysis estimates current vehicle speeds of 30 mph along the International Blvd corridor, equivalent to the posted speed limit. If speeds drop 18-23%, vehicles would drive in the range of 23-25 mph. *Thus, risk of severe injury for a pedestrian struck would drop by approximately 20% for elderly pedestrians and 10% for younger adult pedestrians*. Risk of pedestrian death from a vehicle-pedestrian impact would decline by approximately 12% for elderly pedestrians and 5% for younger adult pedestrians. As reported in the demographics section, seniors make up 10% of the population in the Study Area.

Figure 22. Risk of severe injury (left) and death (right) in relation to impact speed

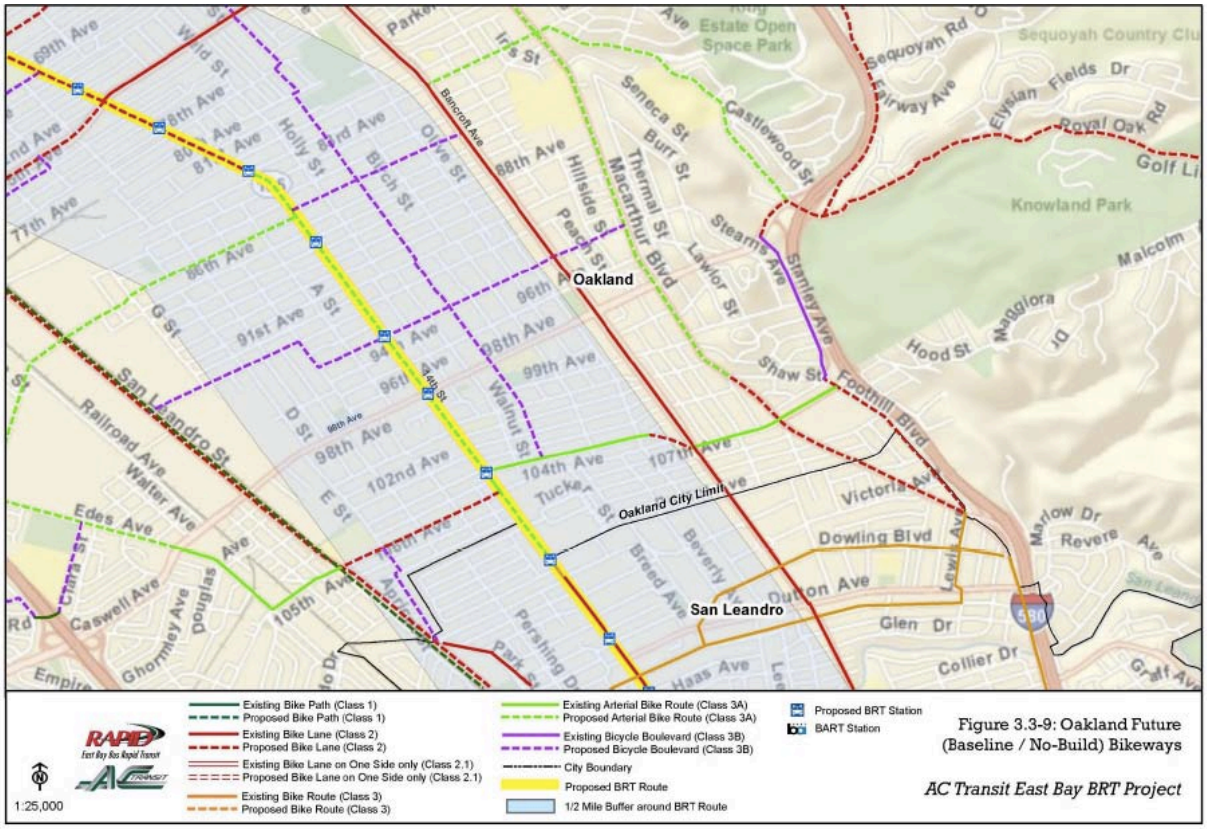


Notes: Risks shown are in a sample of 442 pedestrians struck by a single forward-moving vehicle year 1989-1999, US. Risks are adjusted for pedestrian age, height, weight, body mass index, and type moving vehicle. Panel shows average risk for pedestrians age 30 (solid line) vs. age 70 (dashed line), standardized to the distribution of type of striking vehicle for pedestrians struck in the US in years 2007-2009. Serious injury is defined as AIS score of 4 or greater and includes death. Green line (age 30) and red line (age 70) shows reduction in risk of injury and death when speed decreases from 30 mph to 24 mph.

Changes in vehicle speeds affect severity of vehicle-bicycle collisions. *The reduction in vehicle speeds predicted with BRT implementation is also expected to reduce the severity of collisions that occur between vehicles and bicycles.* This conclusion is based on the analysis of speeds and vehicle-pedestrian collisions, as data was not available to make a more specific prediction of the level of severity reduction.

BRT changes to the bicycle infrastructure improve the bicycle environment, which affects vehicle-bicycle collisions. Median running dedicated bus lanes will remove buses from lanes closest to curbs along International Blvd. This will reduce competition between bicycles and buses for curbside lanes and eliminate the need for bus and bicycle "leap frogging" in competition for lane space. The final East Bay BRT Plan adopted elements of the City of Oakland's Bicycle Master Plan. New Class II striped bike lanes will be added on East 12th Street from 3rd Avenue through 14th Avenue and on International Blvd. from 54th-81st Ave. A Class III un-striped bike lane will run from 81st Ave to the San Leandro city limit (Figure 23). Proposed north-south bike lanes would also connect with International Blvd at 4th Avenue, 14th Avenue, 16th Avenue, 22nd Avenue, 54th/55th Avenues, Havenscourt Blvd./69th Avenue, Hegenberger Expressway, 85th Avenue, and 94th Avenue. *Repaving streets along International Blvd. during BRT construction will also make the environment safer for cyclists. Proposed bicycle boulevards will increase bicycle safety. Repaving streets along International Blvd. during BRT construction will also make the environment safer for cyclists.*

Figure 23. Proposed Bike Lanes in Study Area



Source: FEIR, 2012

In addition to bike lanes, features of the BRT stations and BRT buses will make multimodal bicycle-BRT commuting more convenient than current bicycle-bus commuting. BRT buses will each have 2-4 hooks for bicycles inside the bus. Level boarding from station to bus will make loading bicycles onto buses easier.

Summary of Health Impacts of BRT Related to Traffic Safety

The East Bay BRT project has the potential to significantly improve pedestrian and bicycle safety along International Blvd. Vehicle-pedestrian and vehicle-bicycle collisions are expected to decrease along International Blvd when the BRT system operates in 2015 and 2035, compared to the No-Build scenario at these time points. Consequently, the future burden of injuries and deaths for pedestrians and bicycles from traffic-related collisions will be reduced along International Blvd.

Reductions in motor vehicle speed will reduce severity of collisions on the corridor, while reductions in motor vehicle volumes will result in decreased frequency of collision, even as the volume of pedestrians and bicycles increases. A network of proposed pedestrian amenities and infrastructure changes along International Blvd are also expected to improve pedestrian safety and encourage walking. Similarly, proposed bike lanes and removing buses from curbside lanes along the corridor will enhance the built environment for cyclists on International Blvd.

Despite these gains, however, the BRT project is expected to result in minimal changes to mode share in a broader Study Area surrounding International Blvd. Hence, traffic is expected to shift away from International Blvd, resulting in higher rates of collisions for pedestrians and bicycles utilizing routes nearby and parallel to International Blvd. Proposed pedestrian upgrades included in the FEIR include only those directly on International Blvd. Thus, the BRT will do little to mitigate projected rising rates of pedestrian and bicycle collisions from now to 2035 in the neighborhoods surrounding International Blvd.

4.5.4 Traffic Safety-Related Recommendations

To maximize the health benefits of improved transit service to traffic safety, the following are recommended actions:

1. Implement all pedestrian and bicycle upgrades outlined in the FEIR and project plans.
2. Ensure dedicated lanes are median running, as these have been shown to reduce cyclist-bus conflicts.
3. Ensure separated bike lanes are added along International Blvd.
4. Consider adding more bike lanes to adjacent corridors than are currently planned.
5. Address pedestrian environment deficiencies at intersections that have had high rates of pedestrian-vehicle and bicycle-vehicle collisions (see HIA report for specific locations).
6. Set a minimum 13-foot width requirement for sidewalks. This should include an 8-foot “clear” zone free of trees, furniture and other obstructions to pedestrians.
7. Conduct an in-depth study of signal timing at intersections along the BRT corridor. Re-time signals with leading pedestrian intervals, which give pedestrians several seconds to cross the street before motor vehicles are given a crossing signal. Time signals to allow pedestrians to cross at 3, rather than 4, feet per second.
8. Place additional flashing warning signs, high visibility crosswalks, and reduce motor vehicle speed limits in front of schools, senior centers, and libraries.

9. Ensure that enhanced pedestrian crossings are available at least every 600 feet along International Blvd.
10. To reduce conflicts between BRT buses and vehicles, limit BRT bus intersection speeds to 10 mph. Place additional warning signs and flashing signals at intersections where left-turn conflicts will occur to remind motorists not to turn against the signal.
11. Post 'No Trucks' signs to direct truck traffic away from 85th Ave, a designated local street. Strictly enforce use of nearby truck routes on 73rd Ave and 98th Ave to avoid conflicts between trucks, cars, bicycles, and pedestrians.
12. Implement the Neighborhood Traffic Management Program as proposed in the FEIR, including traffic calming measures, and involve community input in this process.

4.6 CRIME AND SAFETY

BRT represents an improvement in residents' access to the resources in the community and region. However, safety is one component of access. If safety risks or perceptions of risk are present around bus stops, this indicates access and health and wellbeing are compromised.

4.6.1 Research Connecting Crime and Safety to Health

Crime and health

Crime impacts health in a number of ways. Physical assaults, homicides and rapes/sexual assaults are direct and adverse health outcomes for a community. In many low-income communities, homicides account for the largest number of years of potential life lost. Separately, witnessing and experiencing community violence has been shown to be associated with longer term behavioral and emotional problems in youth.[187] [188] In addition to causing injuries and death, violent crime can influence stress levels by indirectly causing fear, stress, and poor mental health.[189]

Living in an area with high actual and perceived crime can decrease use of public space, including sidewalks, retail, parks, and community centers. This has an impact on rates of physical exercise and social networks, which subsequently can impact many physical and mental health outcomes. Fullilove (1998) found that fear of crime limits mobility and/or physical activity in a neighborhood, inhibiting social interactions.[190] In a study in Greenwich, London, the participants who reported feeling unsafe to go out in the day were 64% more likely to be in the lowest quartile of mental health.[191]

Crime also can be a predictor for risk of certain health conditions. In a large-scale study involving over 600,000 residents in Sweden, the rate of violent crime in an individual's neighborhood predicted their risk for coronary heart disease, regardless of individual demographic and socioeconomic measures.[192] Separately, in a Baltimore, Maryland study of 65 neighborhoods, residents were more likely to have had a heart attack and were at increased odds of obesity if they lived in what were considered the most hazardous neighborhoods compared to the least hazardous neighborhoods.[193] The relationship could not be explained by differences in resident demographics, wealth, education, alcohol consumption, tobacco use, diet, or physical activity, suggesting a neighborhood relationship.[194] Hazardous neighborhoods were determined

by a measure based on social disorganization, public safety, physical disorder, and economic deprivation.

Many factors contribute to both real and perceived public safety. For example, household income, housing conditions, land use, and community and cultural vitality have all been linked to rates of crime, which in turn impact real and perceived public safety. While real and perceived rates of crime and safety may not be the same measurement, the outcome is the same: community members limit their activities, which reduces social interactions and subsequent community vitality.

Real and perceived risks to personal safety

There are differing risks perceived on transit vehicles themselves versus at stations, stops and surrounding areas. An evaluation of an AC Transit rapid bus line in Oakland, CA revealed that surveyed riders rated the safety *on buses* as "good" (3.08 on a scale of 1 to 5, 5 being excellent) and the average safety at and *around bus stops* as 2.86 (between fair and good). Within the San Pablo Avenue corridor portion of this line specifically, where the rapid bus system was implemented, riders gave the safety *on buses* an average rating of 2.93 and the safety at and *around stations* a rating of 2.77. These ratings reflect a concern among riders for their safety, but do not address how non-riders would rate the safety of the system and whether this has any bearing on their decision to take the bus.

To address this, a study was conducted along a transit route in Milwaukee that had a high degree of transit crime and vandalism, to determine the degree to which patronage is affected by crime.[195] The study determined that personal security was not as important as convenience of routes, fares, travel time, and frequency of service. A variation existed between regular users and non-users of the system with the non-users being more apprehensive about crime than the users. It was suggested that users had ridden the bus numerous times without incident and were therefore less fearful. Similarly, in a study concerning perception and incidence of crime on small public transit systems in the southeast, a contrast was found between the perceptions of transit users and non-users. The perceptions related to being unsafe waiting at a bus stop were 37% (residents/non-riders) compared to 8% (riders). The study recommended: 1) the creation of environments near transit service that provide a perception of safety, 2) educating people about the safety of public transit, and 3) developing economic incentives and system performance levels to entice people to experience the safety firsthand.[196]

Despite the fact that the perception of risk for non-riders may be exaggerated, there is still a safety risk associated with taking public transit. A victimization survey of 1088 households in west central Los Angeles found that the frequency of bus use was the most important correlate of being victimized.

While the personal safety of bus riders may be at greater risk compared to non-riders, transit systems do not usually *produce* more crime in the areas they serve and the systems themselves are not necessarily more dangerous than their surrounding areas. Most bus related crime occurs at bus stops, rather than on the buses themselves.[197] Generally, crime on transit systems reflects the crime rates of the neighborhoods through which the line travels.[198] This pattern has been confirmed by other researchers for both rail and bus systems.[199] [200]

Given the risks associated with bus travel, researchers have identified the aspects of bus stop environments that are likely to encourage and discourage crime. These findings are particularly important for identifying strategies for improving bus safety. Ligget, Loukaitou-Sideris, and Iseki (2002) collected data to characterize the areas around bus stops in terms of urban form (land uses and surrounding area conditions), the bus stop features themselves and street characteristics (street and sidewalk width, on street parking, and traffic levels). Looking at two types of crime (serious crimes, such as rape, robbery and assault) and less serious crimes (pickpocket and jewelry snatching and public nuisance or public offense such as public drinking, lewd or disorderly conduct, and drug dealing), they found a positive correlation between the existence of nearby undesirable establishments (liquor store, check cashing establishment, adult movie theaters and bookstores), the number of vacant lots and run-down establishments, and crime rates. They found crime rates tended to be lower when bus stops were directly visible from nearby establishments and (only marginally) when bus shelters were present. They found no association between the presence of streetlights and crime rates. Higher levels of traffic and pedestrians waiting for the bus were associated with lower crime rates.[201]

Similarly, Loukaitou-Sideris (1999) looked specifically at 10 bus stops with high crime in comparison to bus stops in the same vicinity with lower crime rates, and observed that eight of the high crime stops were not visible from the surrounding shops, lacked adequate lighting and public phones, had one or more liquor stores or bars nearby, and were not near any police substations. Seven of the 10 had vacant, semi-vacant and dilapidated buildings around them. The environments around the 10 stops also had a lot of litter and graffiti.[202] Other researchers have come to similar conclusions; that some land uses (schools, bars, liquor stores, pawn shops, and abandoned buildings) attract crime in their vicinity and that physical disorder (deteriorating building stock and public spaces, graffiti and litter) is also likely to contribute to crime in the neighborhood. [203] [204] [205] [206] [207] [208] Finally, AC Transit, in their report "Designing with Transit" find that active locations tend to have less bus stop crime than locations with less activity. Active locations include stores, schools, and other uses with foot traffic. They recommend not putting bus stops next to vacant buildings or vacant lots.[209]

Opportunities for Increasing Safety around Buses and Bus Stops

One theory to inform strategies for bus stop crime prevention is known as Crime Prevention Through Environmental Design (CPTED). CPTED is an approach to crime prevention that focuses on designing or re-designing public spaces to reduce crime opportunities and the fear of crime through natural, mechanical, and procedural means.[210] The four widely accepted elements of CPTED are:[211]

- *Natural Surveillance*: Open spaces and visibility, such as lighting (especially pedestrian-level lighting) and landscaping, help with natural surveillance.
- *Natural Access Control*: A way of guiding the flow of people by using strategies such as walkways, fences, lighting, etc. to properly guide people through the physical space while decreasing opportunities for crime.
- *Territorial Reinforcement*: creating differentiation between public and private spaces. Signage and pavement treatments are examples of territorial reinforcement.

- *Maintenance*: Operating under the assumption of the "broken window theory" where one unmaintained incident may lead to others. Maintaining clean and safe community spaces are a preventative measure for more crime.

CPTED holds promise for bus crime in particular, as one study showed that CPTED was successful in reducing robberies by 30-84%, depending on how many components of CPTED were implemented.[212] Mentioned previously, Loukaitou-Sideris et al. (1999) demonstrated that the bus stops with high crime rates were those that poorly reflected CPTED principles and in some cases the associations were statistically significant.[213] [214] Crime rates were higher for bus stops near alleys, multifamily housing, liquor stores and check-cashing establishments, vacant buildings, and graffiti and litter. In contrast, good visibility of bus stops from their surroundings and the existence of bus shelters contributed to lower crime rates.[215] Similarly, BRT in Bogotá has been credited with an 86% reduction in crime rates for areas within walking distance of the BRT corridor due to improvements in street order and cleanliness, renovations of public spaces, traffic improvements, and heightened policing; changes that in part reflect CPTED principles.[216]

Improved lighting has been offered as one key way to increase safety and reduce fear near station stops. The literature on the effectiveness of this strategy is promising but mixed. A systematic review of 13 studies that examined the effects of street lighting interventions on crime posted inconsistent results. Eight studies done in the U.S., which followed different methodologies, reported differences in crime rates for various crime types, time periods and times of day (night or day). Four of the eight studies concluded that the lighting intervention was effective (one of these concluded that it was effective for violent crimes only), while the other four found it ineffective. The authors of the review observed that the studies with "effective" results measured differences in crime during the day and night, while only night-time crimes were measured in the "ineffective" studies (with the exception of one "ineffective" study that looked at day and night). However, a meta-analysis of the eight studies provided evidence that improved street lighting can lead to a reduction in crime; as pooled data from the studies showed a 7% decrease in crime in the experimental areas compared with the control areas. Despite some inconsistencies (e.g., specific interventions, study designs and outcome measures), all five studies done in the U.K. concluded that street lighting improvements were effective at deterring crime. The meta-analysis of all 13 studies from the U.S. and U.K. concluded that crimes decreased by 20% in experimental areas compared with control areas, a significant effect of improved lighting.[217]

Another benefit noted in studies of the effects of street lighting is an increase in community cohesion and neighborhood satisfaction and, interestingly, this effect can mask the evidence of the effectiveness of improvements because (when reported crimes are the outcome measure) people tend to report crimes more when they feel an increased sense of community cohesion and responsibility.[218] Therefore, despite mixed results it seems clear that there is a positive effect of street lighting improvements on the well-being of residents in areas with higher crime rates.

Another common strategy to deter crime at public transit stations is the installation of cameras at stations. Evidence of the effectiveness of closed circuit televisions (CCTV) is mixed. In a systematic review of the crime prevention effects of CCTV, of 22 evaluations examined, 11 found a positive effect on crime prevention, five found an undesirable effect, and five found a null effect (no effect) on crime prevention of CCTV interventions. Looking at CCTV in public

transportation systems specifically, there is likewise conflicting evidence: two studies found a desirable effect, one found no effect and one found an undesirable effect on crime of CCTVs. The authors pooled effects from all studies and from the public transit-specific studies and found that, for all studies, the pooled effect was significant in the positive direction, although the crime prevention effect was very small (a four percent reduction in crime). For the four public transit studies, the pooled effect was a not significant six percent decrease in crime after CCTVs were installed.[219] The authors of this review note after reviewing many studies that CCTV can be most beneficial when it is used in conjunction with other crime reduction measures and when it is tailored to the local setting.[220]

Evidence from public transit research indicates that BRT personnel on buses will be a crime deterrent. LaVigne (1996) found that the only significant predictor of assaults at station parking lots in the Washington, D.C., Metro was the absence of an attendant in the evenings.[221] A study that compared the number of operating staff on the London Underground to reported crime levels (as a percentage of all crime in the Metropolitan Police Area) found that decreased levels of robbery and violence against persons were associated with increased Underground system operating staff for seven out of the ten years studied. Decreased theft from persons were associated with increased operating staff for only five of the ten years examined.[222] Therefore, evidence does suggest the presence of a guardian figure will have an impact on crime rates.

4.6.2 Existing Conditions for Crime and Safety

The following section reports on the existing conditions related to the above evidence on crime and safety.

Community Perspectives

Crime and violence are significant health concerns for residents near the proposed BRT line. Participants in the community engagement process of the International Blvd TOD Plan cited crime and violence having a big impact on community health and quality of life. Some of the outcomes participants hoped would come of planning activities in the Study Area were decreased crime, violence, substance abuse, and prostitution. They also cited the desire for more street lighting, improved trash collection and cleanup of illegal dumping, and stronger implementation of graffiti abatement programs. Further, people are fearful of waiting at bus stops because they perceive a lack of safety in the surrounding neighborhoods because of areas where gun violence, prostitution, and public indecency around liquor stores are problems. Residents identified several specific areas as problematic for these types of activities. These included: 89th Ave and International Blvd, 73rd Ave and International, and 22nd and 21st Avenues and International. They also suggested that gun violence around high schools poses a particular threat to the safety of passengers waiting near schools if the areas are not visible to school administrators.

Also, as previously noted, an evaluation of the San Pablo Avenue rapid transit line in Oakland revealed, in a survey of AC transit riders, that riders rated the safety on buses as “good” or between “fair” and “good”. Within the San Pablo corridor, where crime is more prevalent, riders gave the safety on buses an average rating of 2.93 and the safety at and around stations a rating of 2.77 (on a scale of 1-5, 5 being excellent).

Reported Crime in the Study Area

Info Alameda County puts out a fact sheet that reviews the previous 10 years of crime in the county.[223] The following are highlights from the most recent fact sheet, which covers the period 2001 to 2010:

- Since 2008, Alameda County's violent crime rate declined by 18%, nearly twice the decline seen in the USA and California overall.
- In 2010 Alameda County's violent crime rate exceeded the statewide rate by 50%.
- In 2010 Oakland ranked as the most violent city in California with a rate of 1,529 violent crimes per 100,000 people.
- Over the ten-year period Oakland contributed on average 77% of the murders in the County.

Data from the most recent year's crime review done by Info Alameda County show the following findings about Oakland (also reflected in Table 32):[224]

- Reported violent crime in 2011 was almost identical in volume to 2010
- Property crimes saw a 5.4% increase over the prior year
- There was a drastic jump in assaults with a firearm: up 25.5% in 2010 and up 27.6% compared to the previous five-year average
- Domestic violence saw a marked drop of almost 20%
- Likewise, reported incidences of rape were down 26.3%, and both drugs and prostitution saw large drops of 43.4% and 16.8%, respectively

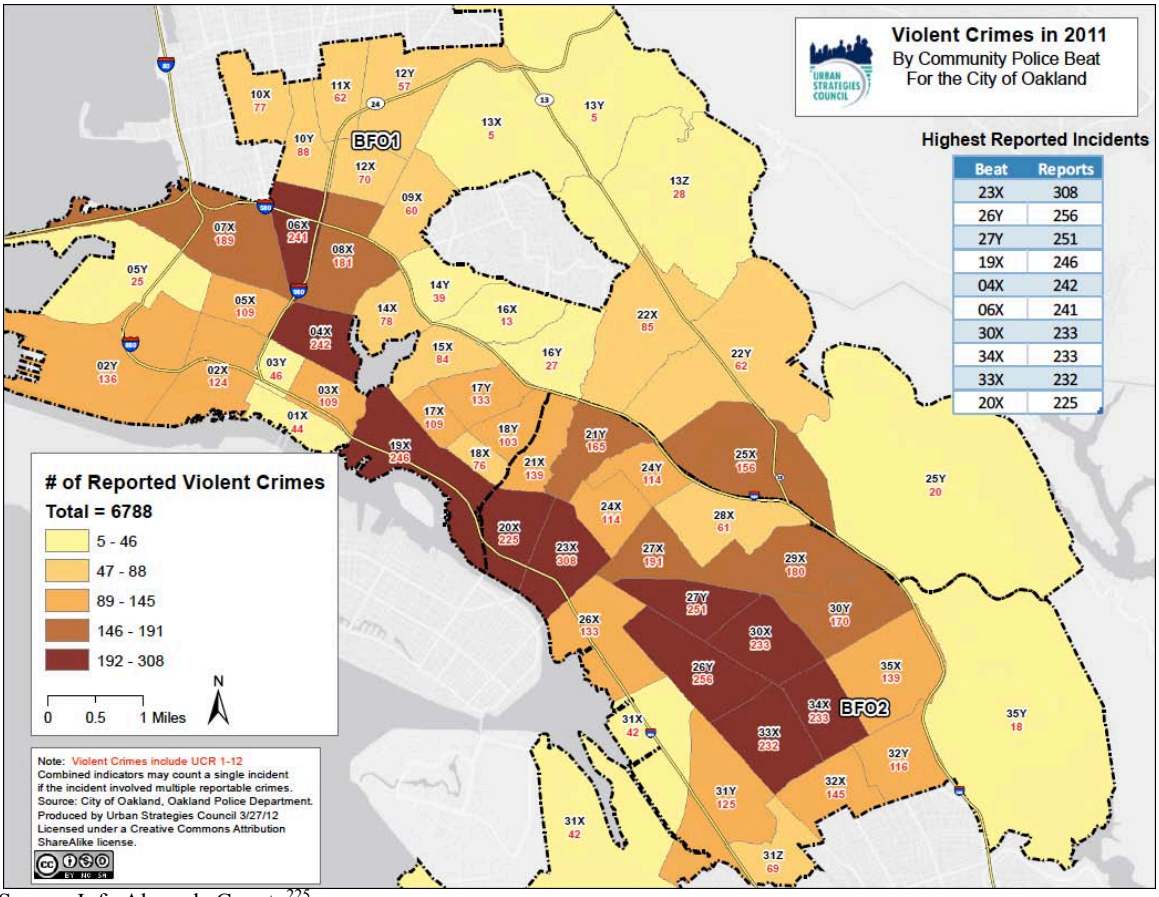
Table 32. Oakland Crime Review Summary, 2011

	2011	2010	2009	2008	2007	2006	5 Yr Avg	2011 vs 5 Year Avg
Violence	**6,805**	**6,787**	**7,132**	**6,582**	**6,416**	**5,699**	**6,570**	**3.6%**
Homicide	92	86	100	92	100	105	96	-4.0%
Assaults	3,046	3,088	3,261	3,056	2,855	2,531	2,973	2.5%
Assaults w/ Firearm	758	604	527	631	556	488	594	27.6%
Domestic Violence	308	383	570	479	452	346	423	-27.2%
Robbery	3,485	3,365	3,466	3,252	3,286	2,897	3,292	5.9%
Carjacking (Robbery)	188	220	259	285	282	261	249	-24.5%
Home (Robbery)	198	212	140	127	130	87	149	32.9%
Rape	182	247	303	181	175	165	209	-12.8%
Shootings	1,353	1,131	937	1,041	929	823	1,036	30.6%
Property	**25,995**	**24,658**	**28,404**	**21,334**	**21,437**	**20,043**	**23,645**	**9.9%**
Larceny	9,507	8,953	10,812	5,494	4,595	4,116	7,246	31.2%
Burglary	5,087	4,941	4,944	3,427	3,502	4,280	4,364	16.6%
Weapons	608	759	832	793	673	429	682	-10.9%
MVTheft	4,883	3,743	4,954	6,279	7,691	7,020	5,762	-15.3%
Drugs	1,834	3,058	4,205	4,076	3,582	2,673	3,238	-43.4%
Sex Crime	1,009	1,315	1,560	838	802	904	1,071	-5.8%
Prostitution	403	621	682	403	351	447	485	-16.8%
Other Sex Offence	606	656	877	433	451	457	580	4.5%
Over/Under compares the change in 2011 from the previous 5 year average								
Note these totals are based on all reported crimes provided by OPD and will not accurately reflect official UCR reported totals due to methdology differences. These numbers represent total counts of reports of each crime type.								
Produced by Urban Strategies Council on January 31, 2012. Released under a Creative Commons Share Alike License with Attribution								

The Oakland Police Department and Urban Strategies Council work together to produce maps and analyze crime data. Figure 24 represents police beats and levels of violent crime in 2011. There are 11 police beats that intersect the Study Area; these include 19X, 20X, 23X, 26X, 27X,

26Y, 27Y, 30X, 33X, 34X, and 32X. Eight out of the 10 police beats in Oakland with the highest numbers of reported violent crimes were located in the Study Area.

Figure 24. Violent Crimes in 2011 by Police Beat



Source: Info Alameda County[225]

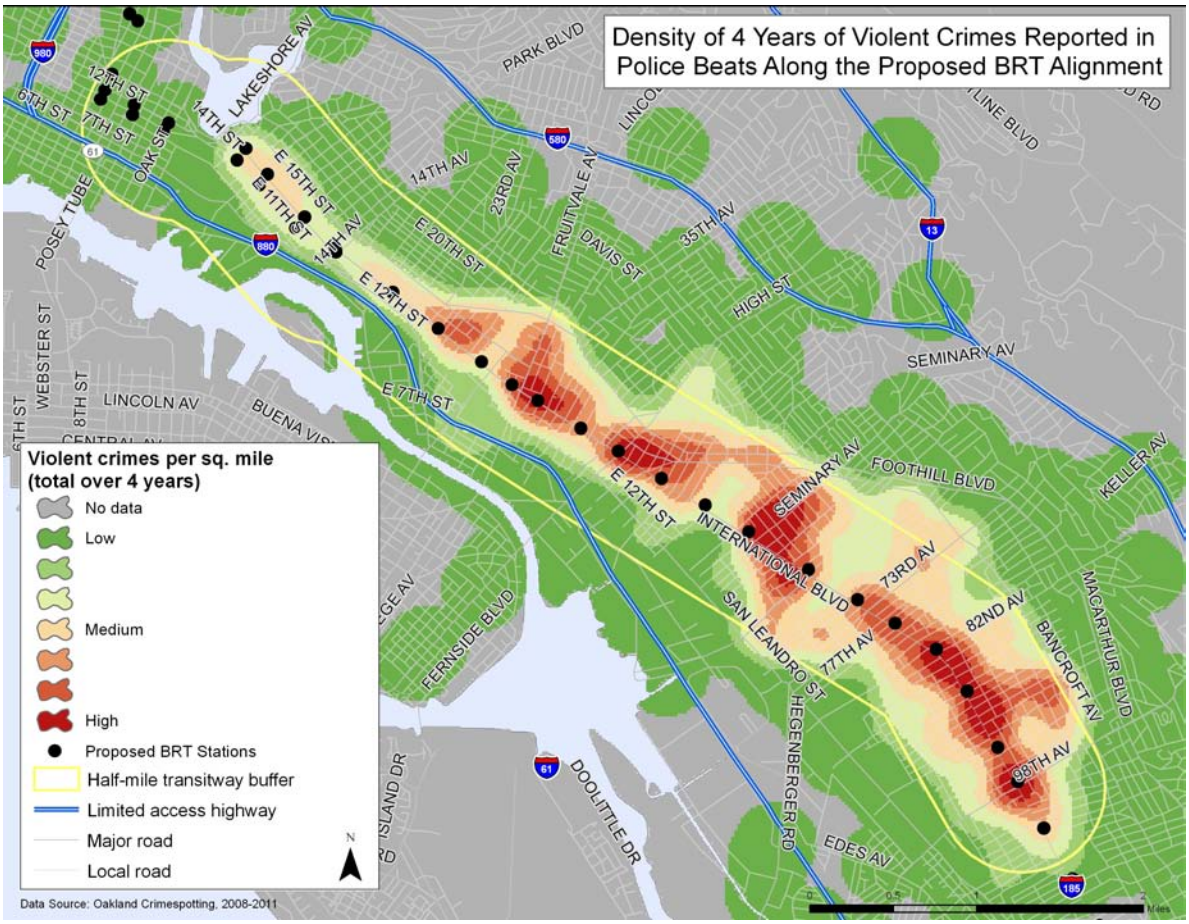
Existing reported incidences and types of crime in the Study Area were collected from Oakland Crimespotting.[226] Oakland Crimespotting is a web-based interactive map of crimes in Oakland and is intended for use as a tool to understand crimes in Oakland. Data used by Oakland Crimespotting (2007-present) is obtained from the City of Oakland's *CrimeWatch* and is limited by the type of *CrimeWatch* data available. Limitations of Oakland's *CrimeWatch* as identified on the *CrimeWatch* website are:

- Crime locations are intended to indicate the block in which the crime allegedly occurred
- Crime locations do not reflect the exact location of any particular crime
- Data are available by crime type, time period, and specific geographic boundary
- Geographic boundaries include council districts and police beats
- The City of Oakland intends the information provided by this web site is accurate; however, errors sometimes occur
- There are no implied or express warranties on the materials in this site; the materials that are provided will be subject to revision
- The service does not reflect official crime index totals as reported to the FBI's Uniform Crime Reporting program

- Listed crimes are subject to change for a variety of reasons, including late reporting, reclassification of some offenses and discovery that some offenses were unfounded

Additionally, the data presented through *CrimeWatch* and thus Crimespotting are only reported crimes. Incidences and types of crime presented here do not reflect arrests or crimes that were not reported. Limitations withstanding, the locations of crimes were downloaded and mapped for the 11 police beats intersecting the Study Area for the time period January 2008 through January 2012. Categories of crimes collected and presented here include violent crimes (aggravated assault, murder, robbery, or simple assault), property crimes (arson, burglary, theft, vandalism, or vehicle theft) and quality of life crimes (alcohol, disturbing the peace, narcotics, or prostitution). Based on these data, crime hot spots by type of crime in the area are presented in the figures below (Figure 25 - 27).

Figure 25. Violent Crime Hot Spots, January 2008 through January 2012



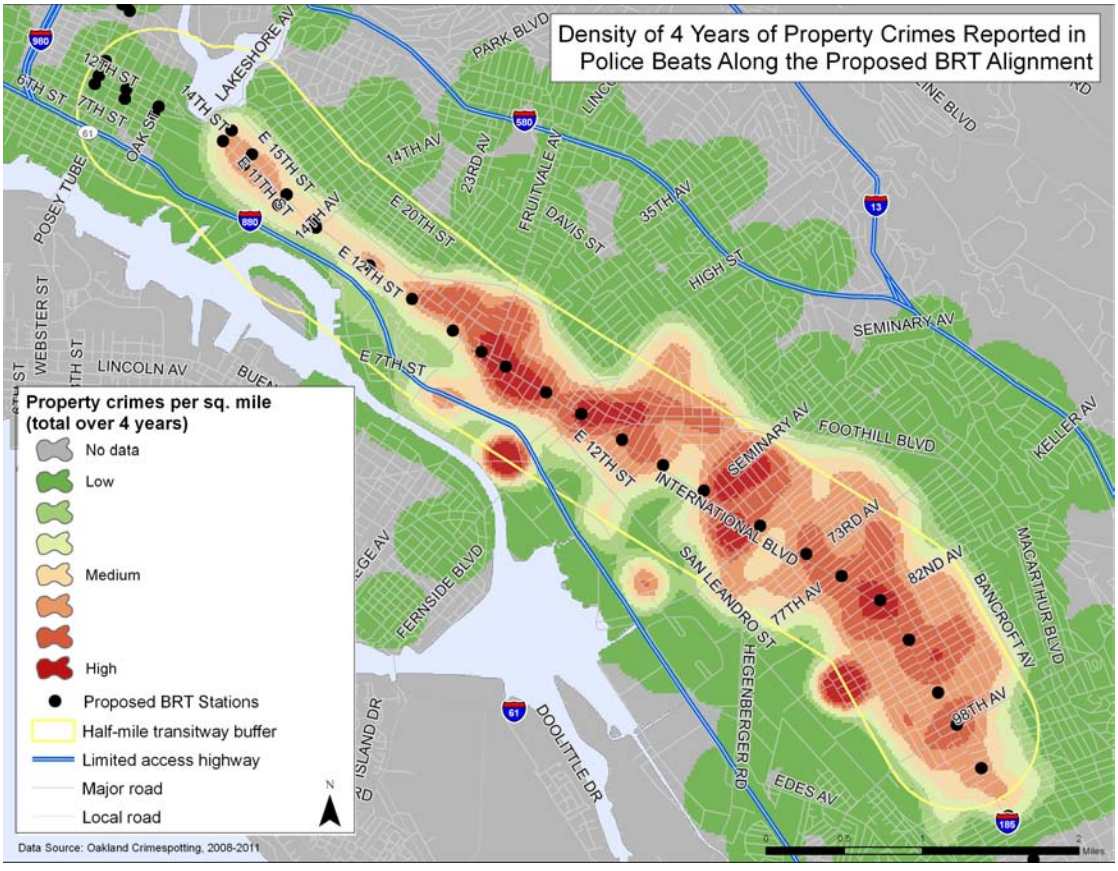
There are several hot spots for violent crime in the Study Area – represented by the darkest red color on the maps. These locations are considered hot spots because the density of reported violent crimes is high relative to the density for the rest of the area. There are about four hot spots. The first is located along International Blvd. between Fruitvale and 36th Ave and stretching north along Fruitvale Ave. The second is located along International Blvd between 42nd and 48th Ave and stretching north towards Bond St. The third is located near the

intersection of International Blvd and Seminary Ave, extending west to 57th Ave, east to 65th Ave, and northeast to Hayes St. The fourth is along International Blvd between 80th Ave and 100th Ave, with a slightly lesser density between 92nd and 95th Aves.

Some of the proposed stations (shown above in Figure 25) are located in these hot spots. About eight stations fall in these areas with higher densities of reported violent crimes. These are the following stations:

1. 31st Ave
2. 34th Ave
3. High St
4. 58th Ave
5. 82nd Ave
6. 87th Ave
7. 94th Ave
8. 98th Ave

Figure 26. Property Crime Hot Spots, January 2008 through January 2012



There are about seven property crime hot spots:

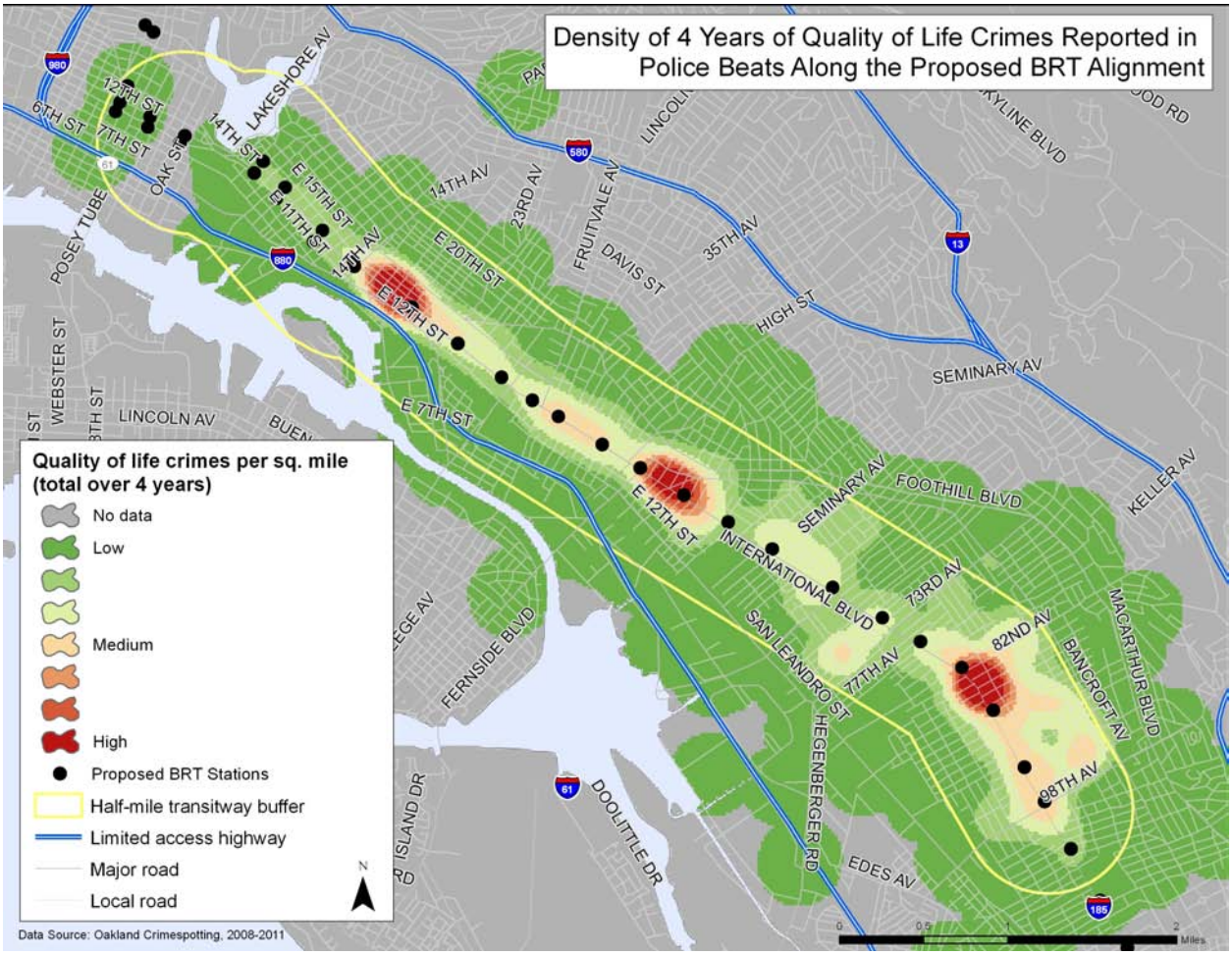
- Along International Blvd between around 30th to 39th Ave, extending south to E. 12th St and north to E. 16th St.
- Between 42nd Ave to 48th Ave, stretching north towards Foothill Blvd and Bancroft Way.

- Around Seminary Ave, approximately bounded by International Blvd, Fenham St, 62nd Ave, and 66th Ave.
- North of International Blvd, between 57th and 62nd Ave in the vicinity of Hilton St and Bancroft Ave.
- Around International Blvd between 79th and 84th Ave.
- Between High St, 37th Ave, Alameda Ave and 8th St.
- Between 85th Ave and 89th Ave, and G St and D St.

Some of the proposed stations (shown above in Figure 26) are located in these hot spots. About five stations fall in these areas with higher densities of reported property crimes. These are the following stations:

1. 31st Ave
2. 34th Ave
3. 39th Ave
4. High St
5. 82nd Ave

Figure 27. Quality of Life Crime Hot Spots, January 2008 through January 2012



There are about three quality of life crime hot spots. The first is located along International Blvd between 16th Ave and 20th Ave and 12th St and Gleason Way. The second is located along International Blvd between 44th and 48th Ave and Bancroft Way. The third is located along International Blvd bounded by 82nd Ave, 86th Ave, A St, and Plymouth St.

Some of the proposed stations (shown above in Figure 27) are located in these hot spots. About five stations fall in these areas with higher densities of reported quality of life crimes. These are the following stations:

1. 20th Ave
2. High St
3. 48th Ave
4. 82nd Ave
5. 87th Ave

BRT Features Related to Crime and Safety

There is research suggesting that the characteristics of the areas around bus stops could impact crime and perceptions of safety from crime.[227] The factors that the research shows may have an impact on crime and perceptions of safety are described in the principles of CPTED, which are: *Natural Surveillance, Natural Access Control, Territorial Reinforcement*, and *Maintenance*. These principles in the context of BRT equate to actual observers such as security personnel or video cameras, people or the perception of people to act as observers (e.g., "eyes on the street"), lighting, the designs of stations that facilitate the visibility and do not facilitate the victimization of waiting passengers, and nuisances around stops such as litter, vacant lots and buildings, broken windows and disorderly or threatening people. Any effects the BRT proposal may have on crime is translated through these elements of CPTED. The following describes existing conditions for the aspects of the BRT proposal that are related to crime and safety.

Service. Currently, the primary bus routes that operate along the proposed BRT system are Routes 1 and 1R. Route 1 consists of local service along the International Blvd corridor and Route 1R, new service that began in June 2007, provides limited express service along the same path. Route 1 has 15-minute headways during peak hours and 20-minute headways during off-peak hours and on weekends. Route 1R has 12-minute headways on weekdays and 15-minute headways on weekends. Routes 1 and 1R provide service between 5am and midnight only.

Security Personnel. The FEIR states AC Transit does not have its own security staff but does contract for security guards at some of their facilities. As part of AC Transit's ongoing effort to ensure safety and security, AC Transit has provided training to nearly 300 first responders in Oakland and the surrounding communities. AC Transit also has roving supervisors for the transit system who report on security issues they find along the transit routes and on the buses.

Stop/Station Features. Route 1 stops every few blocks and Route 1R bus stops are spaced on average approximately 0.5 miles apart along the route and are located near major activity centers and transfer points. There are approximately 18 bus shelters in the Study Area. Current bus shelters include a rain canopy and have some transparent sides, so bus patrons can be seen while waiting.

As part of Route 1R improvements, shelters have been installed at selected bus stops and limited

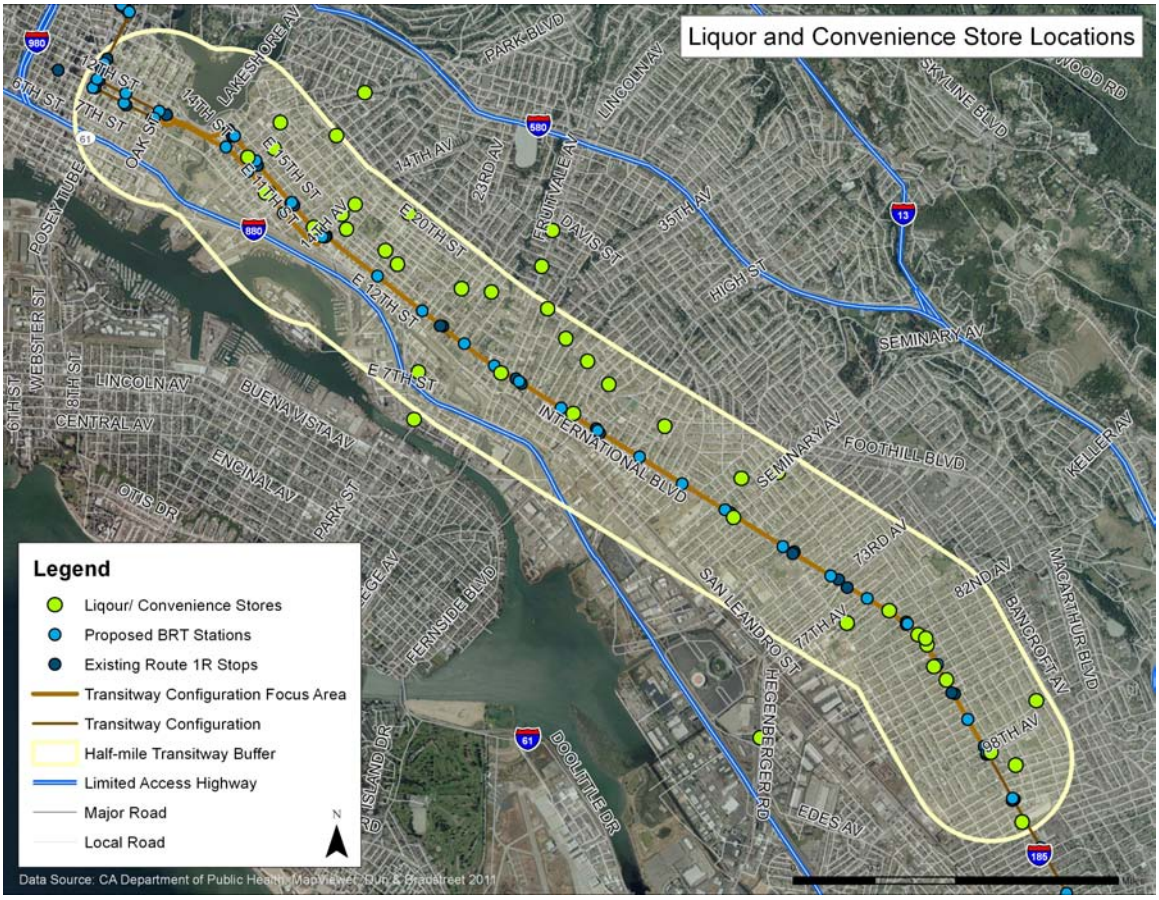
ITS elements consisting primarily of transit signal priority, and real time bus arrival information have been implemented.

Ridership. The FEIR lists the following existing ridership figures. Within the whole corridor (San Leandro to Downtown Berkeley), total weekday boardings on Routes 1 and 1R are **23,829**, and this includes 11,182 total (both northbound and southbound directions) for Route 1 and 12,647 for Route 1R. Within just the Oakland portion (Oakland-San Leandro border to Oakland-Berkeley border) on Routes 1 and 1R there are **16,097** daily boardings (67.5% of the corridor boardings), which includes 7,561 average daily boardings on a weekday on Route 1 and 8,536 average daily boardings on Route 1R.

Areas Surrounding Bus Stops. Looking at the street segments around the existing Route 1R stops in our Study Area with aerial photography[228], out of 14 stops, 5 appear to have more greenery or landscaped elements (e.g., there are more than 3 street trees present and/or a landscaped median), and 12 have commercial or mixed land uses, which could be considered active and crime deterrents; however, on the negative side, 9 stops appear to have a vacant lot or parking lot nearby, which reduces natural surveillance[229]. One thing to note is that stops could have both vacant spaces and commercial/mixed use land uses or other land uses that are not "active", so it is not possible to say the extent to which these built conditions may be contributing to conditions that are, or that feel, unsafe.

The community identified liquor stores as places where people gather and display behavior that is perceived as threatening to the safety of passengers waiting for the bus. There are 16 liquor stores and convenience stores along International Blvd in the Study Area. Figure 28 shows the locations of these stores. There are 9 stores located with 2 blocks of existing 1R bus stops (within 600 feet). Of the 14 existing Route 1R stops in the Study Area (some stops across the street from each other are considered one stop), there are liquor stores surrounding the following 7 stops: at International Blvd and 5th St, International and 14th Ave, International and 34th Ave, International and Seminary Ave, International and 82nd Ave, International and 90th Ave, and International and 98th Ave.

Figure 28. Locations of Liquor and Convenience Stores in Study Area ZIP Codes



Note: Data presented here reflects ZIP codes 94601, 94603, 94606, and 94621 only. These ZIP codes approximate the Study Area and do not directly align with Study Area. Therefore, some liquor stores in the Study Area are not portrayed here, and some liquor stores portrayed here are outside the Study Area.

4.6.3 Impacts of BRT Proposal on Crime and Safety and Associated Health Outcomes

Please see Table 33 below for a summary of predicted crime and safety impacts of the No-Build and DOSL Alternatives.

<u>Impacts of No-Build Alternative on Crime and Safety</u>
In general, conditions will remain the same as existing conditions (described above) for the No-Build Alternative as far as service, security personnel, some elements of stops/stations and the areas surrounding bus stops (at least according to what is mentioned as expected in the FEIR). There are, however, changes expected to some bus stops and future growth is predicted to contribute to changes in ridership.

Stop/Station Features. In the Study Area, there are minor streetscape improvements, such as crosswalk bulbouts, expected at International Blvd at 34th Ave and at International Blvd at 99th Ave. The FEIR does not elaborate on the extent of the changes expected.

The minor streetscape improvements that are expected to be made as part of the No-Build Alternative could contribute to a sense of community pride, which Farrington and Welsh concluded played a role in reducing crime rates and perceptions of safety in their systematic review of studies of the effects of street lighting on crime.[230] In addition, changes could contribute to the CPTED principles of Natural Access Control and Territorial Reinforcement. Natural Access Control refers to strategies such as walkways, fences and lighting that help guide the flow of people through space and decrease opportunities for crime. Territorial Reinforcement refers to the differentiation between public and private spaces through things like signage and pavement treatments. *Therefore the streetscape improvements could have a modest positive impact on crime prevention.*

Ridership. Future transit patronage in the project corridor is expected to increase from current levels primarily because of population and employment growth in the project corridor. Under the No-Build Alternative, boardings on Rapid Bus or other bus services operating along the LPA (full BRT proposal) are projected to increase to about **24,600** on the average weekday by 2015 and to about **34,000** on the average weekday by 2035, a 44 percent rise from current levels and 38 percent higher than forecast 2015 No-Build levels. This equates to a gain of about **420** new riders per year or nearly 2 percent increase in ridership per year. For Oakland specifically, the increase equates to **22,963** average daily weekday boardings by 2035, assuming an even distribution of population and employment growth across the corridor.

Expected changes in ridership due to population and employment growth means there may be additional people waiting at platforms and on buses that could serve as "eyes on the street". Researchers have shown that having more people around to serve as witnesses to a crime can be a crime deterrent.[231] [232] The CPTED concept of Natural Surveillance also reinforces this theory. *Therefore, increased ridership could have the effect of preventing crime on Routes 1 and 1R.*

Impacts of the DOSL Alternative on Crime and Safety

The FEIR proposes the following for the DOSL Alternative that may impact perceptions of and safety from crime.

Service. Routes 1 and 1R bus service in the project corridor will be eliminated and replaced by BRT operating in dedicated lanes. To compensate for the removal of Route 1 local bus stops, BRT stations will be spaced closer together than current Route 1R stops to allow and encourage use of BRT for local trips along the corridor.

Weekday BRT service will be provided at five-minute frequencies throughout the day, 10-minute frequencies in the evening, and hourly service from midnight to 5:00 a.m. On weekends, daytime service will be at 15-minute intervals in the northern part of the corridor and 7.5-minute intervals in the southern part. Evening service will be at 15-minute intervals. Proposed BRT service is much more frequent than existing service by Routes 1 and 1R.

When buses arrive at stops/stations more frequently, this reduces the amount of time passengers must wait at stations and reduces their exposure to crime risks in the community. Much of the real and perceived risk from bus travel comes from security risks waiting at stops or travelling to and from them.[233] *This proposal feature therefore reduces risks to personal security.*

Security Personnel. In addition to the above-mentioned first responders and roving supervisors, when the BRT project begins operation, there will be additional inspectors hired to check for validated tickets on-board the buses.[234] The roving ticket inspectors will be additional "eyes on the scene" who can report security issues to the local city police departments and back to AC Transit administration.

Security personnel improve perception of safety and have been shown to prevent crime.[235]

Roving ticket inspectors proposed with the DOSL Alternative represent an increase in the presence of security personnel and represent an improvement in crime prevention compared to the No-Build Alternative.

Stop/Station Features. There are 32 BRT stations proposed in the DOSL scenario; 22 of these are in the Study Area. In the majority of the Study Area, stations are proposed to be located in the middle of the street, with dedicated bus lanes on either side of the median platform and mixed flow traffic on either side of the dedicated bus lanes. Within the Study Area, there are 17 stations with this median alignment and five stations with side-running alignment proposed. Median stations will be designed to be 12 feet wide and 60 feet long and will be raised above the top of the roadway pavement. Stations along the curb will extend six to eight feet from the curb and will also be 60 feet long and raised above the roadway pavement. All median and curbside stations will include new lighting. Windscreens and framed, well-lit and transparent canopy shelters with benches will be constructed at all stops. Canopy shelters would be open to view from the street. Designs will use graffiti resistant surfaces. Information will also be communicated through active data displays (as with the No-Build Alternative), but there will be an increased number of stops/stations compared to the No-Build and thus more data displays. Finally, emergency telephones (or intercoms) and security cameras will be installed at all stations.

Changes to stops/stations could contribute to a sense of community pride, as these new features will improve the general look of the neighborhood. Some researchers suggest community pride is associated with an increase in resident-influenced crime prevention and criminal activity overall.[236]

Changes could contribute to the CPTED principles of Natural surveillance, Natural Access Control, and Territorial Reinforcement, which could help prevent crime. Regarding Natural Surveillance, stations constructed on the median increase the visibility of waiting passengers to people and cars passing by on the street. This has the potential to decrease crimes committed against waiting passengers, and also to deter perpetrators on the streets near stations because waiting passengers will have better visibility of the activities on either side of the street. New pavement striping and the well-defined spaces of new stations may help guide the flow of people through space and decrease opportunities for crime and will help differentiate public and private spaces, which is thought to have a crime deterring influence.[237]

Security cameras could contribute to the actual surveillance of criminal activity and could serve as a direct crime deterrent.

The DOSL Alternative is associated with far more investment and more drastic changes to stops/stations compared to the No-Build; therefore the proposal could result in a greater degree of crime prevention through the above mechanisms.

Fewer stops increase the likelihood that groups of people will be waiting together and improve personal security and the perception of safety. Therefore BRT is an improvement over Route 1 service, but not over Route 1R service. At the same time, fewer stops increase the distance passengers must walk to get on a bus, increasing their exposure to crime risks in the areas around stops. In this way, BRT is an improvement over Route 1R, but not over Route 1.

Further, anecdotal evidence from members of the community revealed that after the implementation of Route 1R service, which increased the distance between bus stops, this had a clustering effect on businesses whereby new businesses tended to locate around the Route 1R bus stops to take advantage of potential customers waiting for the bus. If the DOSL Alternative were implemented, this could contribute to business investment near proposed stops. This could improve Natural Surveillance conditions around the stops, as the presence of businesses with visibility of the station has been shown to deter crime.[238] However, this could also discourage business investment in the areas between stops, which could reduce the amount of natural surveillance going on in these locations. It is important to note, however, that the clustering effect may have only been apparent once there was a greater distance between stops. This could mean that there would be no relative negative effect of business location decisions (compared to Route 1 conditions), just a positive effect of the greater spacing. That said, perhaps moving stops closer together (than Route 1R) would diminish this benefit. It is difficult to determine the precise effect that station spacing would have on business location decisions and thus crime prevention through Natural Surveillance in this case.

Given the conflicting nature of these relationships between crime prevention and station spacing, the DOSL Alternative could have both a positive and a negative effect compared to the No-Build.

Ridership. Average Weekday boardings are predicted to increase as follows. Under the DOSL Alternative, they are expected to increase to **36,600**, which is an 11,400 increase over the No-Build. By 2035, the DOSL Alternative is expected to increase ridership to **53,300**. This is a 19,300 increase over the No-Build.

Increased ridership means there may be additional people walking to stops/stations, waiting at platforms and on buses that could serve as "eyes on the street." This Natural Surveillance has been shown to deter crime.

The DOSL Alternative predicts a greater increase in ridership; therefore the proposal could result in a higher level of crime prevention from "eyes on the street."

Areas Surrounding Bus Stops. Under the DOSL Alternative the streets where bus stops are located would be repaved, and intersections, curbs, and sidewalks changed. It is also expected that additional repaving and improvements to the pedestrian environment would be made as related projects during the BRT construction, assuming funding is made available. For example,

along state routes (e.g., Route 185/International Blvd from 42nd Avenue in Oakland to Davis Street in San Leandro, and along Route 61/Davis Street in San Leandro) it is required that ramps be brought up to ADA standards. There is also median landscaping planned for the spaces adjacent to the transitway as part of the BRT proposal. In fact, the FEIR states that the proposed design of the DOSL Alternative project will increase landscaped areas by approximately 1.5 acres total.

The improvements to streets, intersections, curbs and sidewalks could contribute to a sense of community pride, which has been associated with crime prevention.[239]

As discussed in the Access section (Section 4.4.3), literature shows that BRT can lead to economic investment, which has the potential to revitalize neighborhoods along the corridor. For example, as of 2011, Cleveland's 2008 BRT system has accounted for $4.3 billion of real estate investment along the BRT line.[240] *As such, the DOSL Alternative has the potential to increase the business presence along the line, thus increasing natural surveillance and "eyes on the street," which may prevent crime.*

Looking specifically at the presence of liquor stores around the proposed stations, as these types of establishments were suggested to make the bus stop or station environment feel particularly unsafe, currently there are 11 liquor and convenience stores located within 2 blocks (600 ft) of a proposed BRT station (see Figure 28 above). This is an increase in the liquor store presence around stops/stations compared to the Route 1R stops (2 more stores). Of the 22 proposed stations in the Study Area, there are liquor stores surrounding the following 8 stops (this is one more stop, compared to Route 1R, with a liquor store nearby): International Blvd and 5th Ave, International and 14th Ave, International and 31st Ave, International and 39th Ave, International and 58th Ave/Seminary, International and 82nd Ave, International and 87th Ave, and International and 98th Ave. Although there are slightly more stores near proposed stations compared to Route 1R stops, there are also more stations proposed compared to Route 1R. Further, this analysis assumes that the same stores are present in future years and that no new stores get established.

Overall, changes to the environments surrounding BRT stations could contribute to the CPTED principles of Natural Access Control and Territorial Reinforcement, which could help prevent crime. Considering the crime reduction effects of BRT in Bogota (86% area reduction in crime rates) that resulted from improvements in environments around stations, the East Bay BRT project has a high potential for increasing safety from crime. [241] *Improvements associated with both alternatives may improve safety. However, the DOSL Alternative is associated with far more investment and more drastic changes to sidewalk and street conditions, therefore the proposal could result in a greater degree of crime prevention.*

Table 33. Summary of Impacts of Alternatives on Crime and Safety

Proposal Features	No-Build Alternative	DOSL Alternative	Impact on Perception of Safety and Crime
Service	15/20 min headways on Route 1 12/15 min headways on Route 1R	5 min day/ 10 min evening / 7.5 min weekend	When buses arrive at stops/stations more frequently this reduces the amount of time passengers must wait at stations and reduces their exposure to crime risks in the community. *This aspect of the DOSL Alternative may improve safety.*
Security Personnel	Security guards at some facilities. Trained first responders. Roving supervisors.	Roving ticket inspectors	Security personnel improve perception of safety and have been shown to prevent crime (cite). *Roving ticket inspectors proposed with the DOSL Alternative are an increase in the presence of security personnel and represent an improvement in crime prevention compared to the No-Build Alternative.*
Stop/Station Features	Route 1 buses stop every few blocks Route 1R buses stop every 0.5 miles on average	BRT buses stop every 0.31 miles / 4.4 blocks apart on average 90% of stations are 0.4 miles apart	Fewer stops increase the likelihood that groups of people will wait together and improve personal security and safety perceptions. Therefore BRT could be an improvement over Route 1 service, but not over Route 1R service. Fewer stops increase the distance passengers must walk to get on a bus, increasing their exposure to crime risks in the areas around stops. Therefore, BRT could be an improvement over Route 1R, but not over Route 1. Businesses tend to cluster around bus stops, which could increase natural surveillance. *The DOSL Alternative stop spacing could have both a positive and a negative effect on crime prevention compared to the No-Build given changes and these relationships.*

Proposal Features	No-Build Alternative	DOSL Alternative	Impact on Perception of Safety and Crime
Stop/Station Features	A very small number of stops would see improvements	Changes planned at all stops to install new lighting, windscreens, framed and well-lit and transparent canopy shelters with benches, and security cameras	Improvements could contribute to a sense of community pride. Changes could contribute to the CPTED principles of Natural Surveillance, Natural Access Control and Territorial Reinforcement, which could help prevent crime. Security cameras could contribute to the actual surveillance of criminal activity and could serve as a direct crime deterrent. *The DOSL Alternative is associated with far more investment and more drastic changes to stops/stations compared to the No-Build; therefore the proposal could result in a greater degree of crime prevention through the above mechanisms.*
Ridership	24,600 boardings by 2015 34,000 boardings by 2035	36,600 boardings by 2015 (DOSL) 53,300 boardings by 2035 (DOSL)	Increased ridership means there may be additional people walking to stops/stations, waiting at platforms and on buses that could serve as "eyes on the street." *This aspect of both alternatives may improve safety. However, the DOSL Alternative is predicted to increase ridership more, therefore the proposal could result in a higher level of crime prevention from "eyes on the street."*
Areas Surrounding Stops/Stations	Minor streetscape improvements planned	Major streetscape improvements planned at stop intersections and in the roadways in between stops.	Improvements could contribute to a sense of community pride. Changes could contribute to the CPTED principles of Natural Access Control and Territorial Reinforcement, which could help prevent crime. *Improvements associated with both alternatives may improve safety. However, the DOSL Alternative is associated with far more investment and more drastic changes to sidewalk and street conditions, therefore the proposal could result in a greater degree of crime prevention.*

Proposal Features	No-Build Alternative	DOSL Alternative	Impact on Perception of Safety and Crime
Areas Surrounding Stops/Stations	No investment	Investment from the project in general	Research shows that investment in major transit systems contributes to the attraction of businesses to the vicinity of the transit route. *As such, the DOSL Alternative has the potential to increase the business presence along the line, thus increasing natural surveillance and "eyes on the street," which may prevent crime.*

Summary of Health Impacts of BRT Related to Crime and Safety

Physical assaults, homicides and rapes/sexual assaults are direct and adverse health outcomes associated with crime. In addition to causing injuries and death, witnessing, experiencing, and perceiving community violence can cause fear, stress, poor mental health, and long-term health impacts associated with stress.

No-Build Alternative. Few changes are made to risk factors for crime and safety under this alternative; however expected minor streetscape improvements could have a modest positive impact on crime prevention and increased ridership could help prevent crime in the area.

DOSL Alternative. This alternative could reduce passengers' risk while waiting for the bus; increase the presence of security personnel; increase the community's sense of pride from streetscape improvements and new stations; contribute to the crime preventing design concepts of Natural Surveillance, Natural Access Control and Territorial Reinforcement; and increase "eyes on the street" through increased ridership and new business investment. Overall, this Alternative poses the most positive conditions for safety from crime and violence.

4.6.4 Crime and Safety-Related Recommendations

To maximize the health benefits of improved transit service to crime and safety, the following are recommended actions:

1. Use safety ambassadors to patrol the streets and help keep them clean and safe near stations in hot spot areas for violent, property and quality of life crimes. Namely, near the following stations:
    1. 20th Ave
    2. 31st Ave
    3. 34th Ave
    4. 39th Ave
    5. High St
    6. 48th Ave
    7. 58th Ave
    8. 82nd Ave
    9. 87th Ave
    10. 94th Ave

11. 98th Ave

2. Station "AC Transit contracted security guards" (as described in project FEIR) at stations and other areas that are within higher crime hot spots (above listed stations).
3. Ensure that "AC Transit-trained first responders" (listed as such in the FEIR) are stationed along this part of the BRT route, where crime is higher, and train additional first responders if necessary to provide coverage.
4. Make the presence of these security personnel more public to increase awareness about AC Transit security measures.
5. Implement median running transitways, which may promote the visibility of waiting passengers, clearly mark access points, and may reinforce the territory of the station as safe, thus keeping people safe from risks to personal security while waiting for the train.
6. Ensure full coverage of streetlights at all proposed stations, in intersections planned for improvements, and in other parts of the route where BRT-related projects are planned and coordinate with other public agencies to ensure adequate street lighting throughout the length of the alignment (where BRT-related improvements are not planned).
7. Work with Crime Prevention Councils to ensure station designs uphold the principles of Crime Prevention Through Environmental Design (CPTED): Natural Surveillance, Natural Access Control, Territorial Reinforcement, and Maintenance.
8. Create an education and PR campaign to highlight the benefits and safety of public transit and BRT.
9. Limit permits for liquor stores near proposed stations and elsewhere along the BRT route.
10. Promote business development near proposed stops to ensure active uses near stations.

4.7 AIR QUALITY

The East Bay BRT project has the potential to impact human health through its impacts on local air quality. Buses in the BRT network will emit air pollutants, although their emissions profile may be better than buses currently operating along the corridor. BRT operations will affect mode share along the International Blvd corridor, and to the extent to which travelers switch from higher-polluting travel modes (i.e. cars, light trucks and heavy trucks) to BRT, there could be local air quality improvements. There could be air quality issues from localized emissions at bus stops and busy intersections. Project construction may also have localized air quality impacts.

This section will provide a basic overview of the health impacts of near-road air pollution, describe existing conditions with respect to air quality along the corridor, and discuss the air quality-related consequences of the East Bay BRT project.

4.7.1 Research Connecting Near-Road Air Pollution to Health

For many years, studies have demonstrated associations between exposure to vehicle-related pollutants and negative health impacts. There are health impacts associated with long-term exposures (that is, regular exposure over a period of years, like a resident in a neighborhood would experience, or a student at a school) and short-term, or acute, exposures (such as what a guest may experience, or a single exposure to vehicle exhaust at a particular intersection). The most common health impacts associated with long-term exposure relate to respiratory function in children, cardiovascular function, mortality and cancer.

Asthma In Children

By far the most frequently cited health impact of vehicle-related pollution pertains to asthma in children. Long-term exposure to vehicle-related pollution is associated with the onset of asthma in children;[242] the triggering of asthma symptoms in children;[243] and increased asthma-related hospitalizations in children.[244] Short-term exposures are associated with triggering asthma attacks among children with asthma, aggravation of lung disease, and respiratory inflammation.[245]

Lung Function in Children

The next most frequently cited health impact is related to reduced lung function in children who are exposed to vehicle-related pollution from truck traffic.[246] Reduced lung function in children is particularly serious as reduced lung development is a life-long condition that impacts adult health. Additionally, proximity to roadways has been associated with respiratory problems in children, such as wheezing, coughing and bronchitis.[247]

Cardiovascular Morbidity in Adults

Exposure to vehicle-related air pollution has been associated with heart disease and coronary calcification in adults,[248] increased cardiac-related hospitalizations and the prevalence of a preclinical indicator of heart failure.[249] [250] Short-term exposures have been associated with increases in cardiovascular-related hospitalization and, for those with heart disease, heart attacks.[251]

Mortality

Increases in air pollution have been associated with increased mortality. Jerrett determines that an increase of $PM_{2.5}$ in the ambient air of 0.2 $\mu g/m^3$ is associated with a 0.28% increase in non-injury deaths,[252] while the California Air Resources Board attributes an increase of 20 non-injury deaths per 100,000 people to the same increase in $PM_{2.5}$ concentrations.[253]

Cancer

Vehicle-related air pollution is associated with lung cancer risk,[254] and vehicle-related pollution is made up of a variety of recognized carcinogens. As a result, although the epidemiological literature contains few studies specifically on the relationship between cancer and vehicle-related pollution, cancer-risk methodologies are extremely common in assessing near-road health impacts. They are well established and widely accepted, and given the complexity of sorting out which specific ingredients in the soup can be said to cause certain health impacts, cancer-risk tools are thought to be helpful.

Other Health Effects

There has been less study on other health impacts, including effects on birth outcomes, male fertility, and non-asthma allergic reactions. Recent study has also associated living in proximity to freeways while pregnant with increased chances of autism in children.[255]

4.7.2 Existing Air Quality Conditions in the Study Area

Alameda County air quality is regulated under both the Federal Clean Air Act (CCA) and the California Clean Air Act (CCAA). Each of these Acts requires areas to have ambient concentrations of six pollutants (carbon monoxide (CO), diesel particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2)) below certain thresholds. An area that has ambient concentrations for all required pollutants below their attendant thresholds is determined to be in "attainment," or in compliance with each Act. If a pollutant threshold is exceeded once in a three-year period, the area is said to be in "non-attainment" for that pollutant.

Alameda County, as a whole, is in non-attainment for O_3 and $PM_{2.5}$ under the California Clean Air Act and O_3, $PM_{2.5}$ and PM_{10} under the Federal Clean Air Act. Alameda County is in attainment for CO, NO_2 and SO_2 under both the CCA and the CCCA. The Bay Area Air Quality Management District (BAAQMD) adopted an Ozone Strategy in 2005 to bring the region into attainment for O_3. BAAQMD is required to submit a plan to bring the region into attainment for $PM_{2.5}$ by December 2012.

As a result of its industrial past, its role as a center of trade through the Port of Oakland and its regional role as the crossroads for much of the Bay Area's transportation infrastructure, the City of Oakland experiences air quality that is worse, sometimes significantly worse, than the county average. This is especially true for the flatlands of East Oakland, where transportation and freight infrastructure, as well as the city's industrial and warehouse uses, are most heavily concentrated. International Blvd is the primary artery through East Oakland, and its neighboring communities have historically tolerated poor air quality and negative health outcomes.

The sections below review existing conditions along the International Blvd corridor with respect to air quality from both mobile (vehicle, rail) and stationary sources.

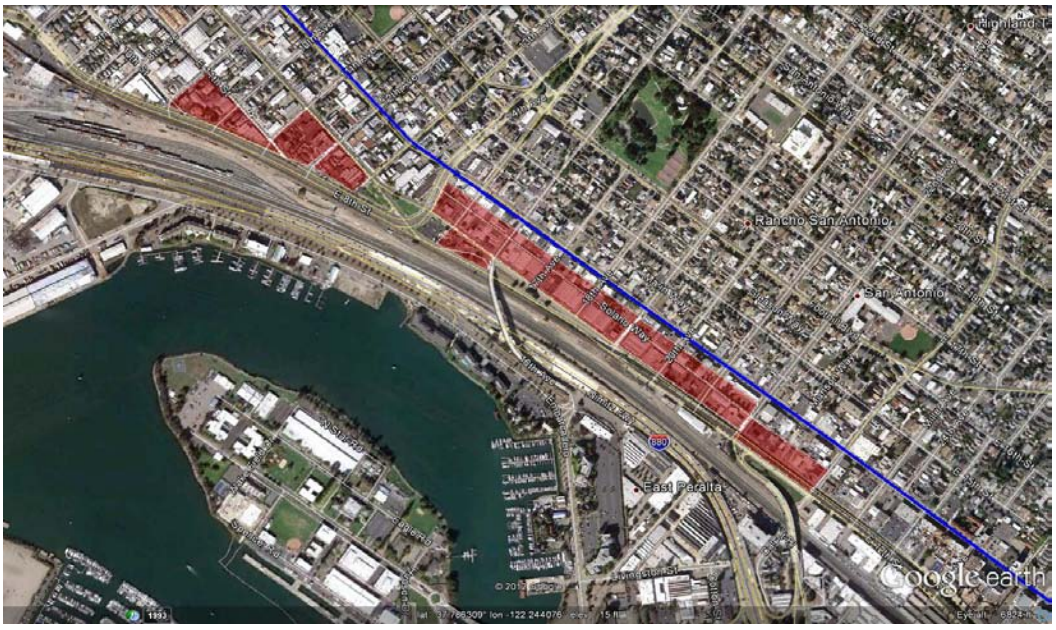
Mobile Sources of Pollutants: International Blvd, I-880 and Union Pacific

International Blvd is a busy local artery that is a primary thoroughfare for east-west travel through the City of Oakland. It is not, however, the largest source of mobile source pollutants for its adjacent communities. The most significant levels of mobile source emissions come from the I-880 freeway, which runs parallel to International Blvd from 13th Avenue to High Street. Along this 2.16-mile section, I-880 and International Blvd run alongside one another as close as 690 feet apart, and as far as 1,600 feet, before they diverge significantly as they continue eastward.

BAAQMD has established thresholds for pollution-related cancer risk, non-cancer health risk, and concentrations of $PM_{2.5}$ for the purposes of screening locations adjacent to sources of mobile pollutants.[256] While it is important to note that there is no established "safe" exposure to $PM_{2.5}$, these thresholds have been established to address health-related concerns in California's

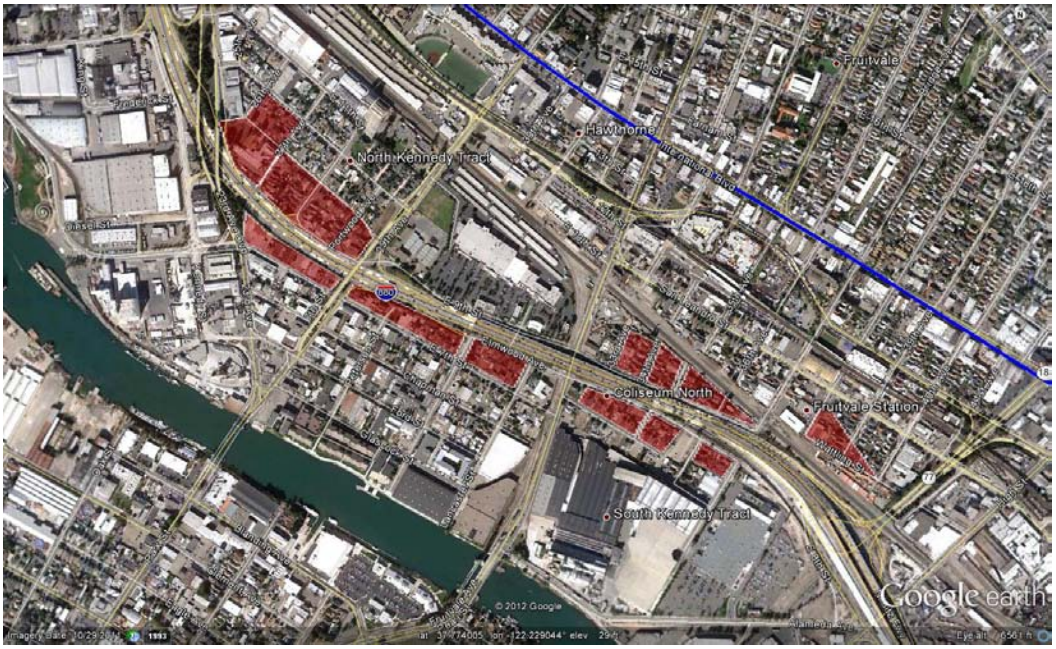
environmental review process. The maps below for the Eastlake and Fruitvale neighborhoods indicate those residential areas adjacent to I-880 that exceed BAAQMD's thresholds.

Figure 29. Modeled PM2.5 Concentrations in Exceedance of BAAQMD Thresholds in Eastlake Neighborhood



Source: Google Earth
Notes:
BRT Alignment shown in blue
Residential Areas Above BAAQMD Thresholds shown in red

Figure 30. Modeled PM2.5 Concentrations in Exceedance of BAAQMD Thresholds in Fruitvale Neighborhood

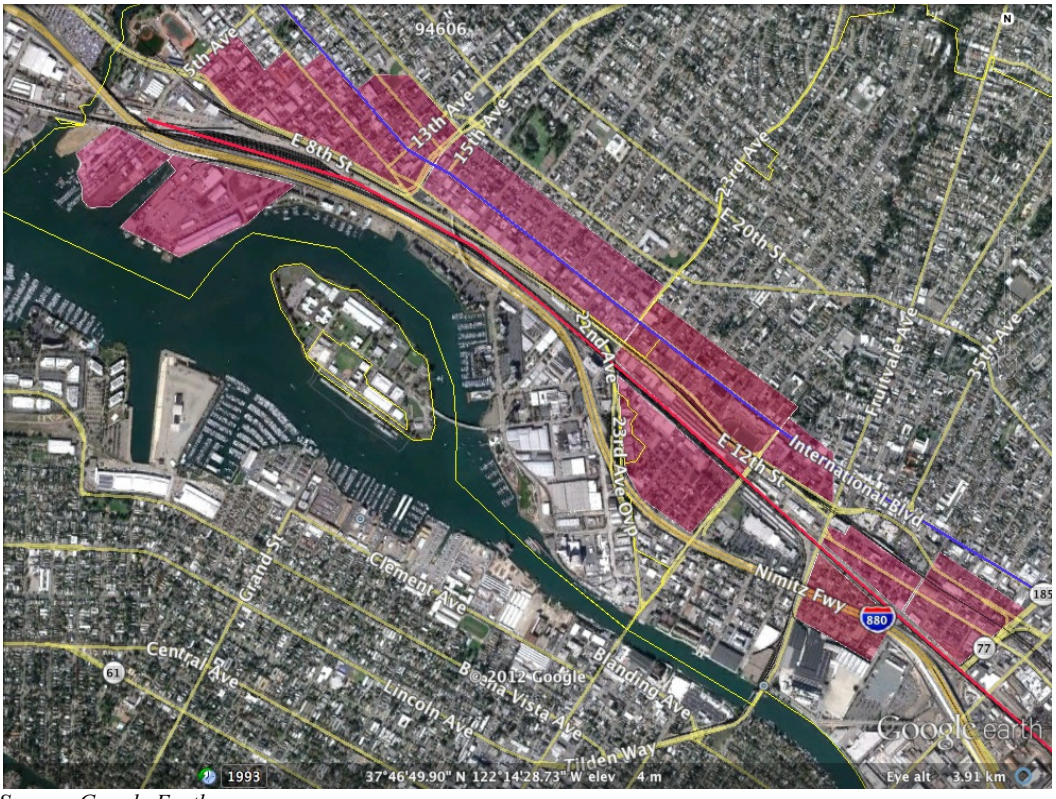


Source: Google Earth
Notes:
BRT Alignment shown in blue
Residential Areas Above BAAQMD Thresholds shown in red

Particulate matter and other pollutants related to emissions on I-880 do not as greatly impact Study Area residents east of Fruitvale, because I-880 diverges from International Boulevard and there are few residential areas along I-880 east of this.

Between I-880 and International Blvd runs the Union Pacific railroad right-of-way that accommodates both long-haul locomotives serving the Port of Oakland and Amtrak passenger service from the Central Valley and Sacramento. Locomotives are a significant source of pollution. The California Air Resources Board (CARB) has recommended that no sensitive uses, which include residential areas, be located within 1000 feet of rail yards. Health-protective guidelines issued by the CARB recommend that residences and other sensitive land uses not be sited within 1,000 feet of rail yards.[257] The map below indicates those residential areas within 1000 feet of the Union Pacific right of way. Analysis below will show that this is likely an unnecessarily wide buffer for the location of sensitive uses, but the proximity of residential areas near this right of way should be noted.

Figure 31. Neighborhoods Along UP Alignment Within 1,000 feet of Union Pacific Right of Way



Source: Google Earth
Notes:
BRT Alignment shown in blue
UP Alignment shown as red line
Residential areas within 1000 ft of UP Alignment shaded in red

Inventories of Mobile Source Pollutants: International Blvd, I-880 and Union Pacific

The following inventory of mobile source emissions for International Blvd was taken from the FEIR. The FEIR calculated emissions for the entire East Bay BRT alignment—from Berkeley to San Leandro—not only the International Blvd segment. The FEIR also used 2015 as a base year. The International Blvd segment is 6.8 miles long, making up approximately 47% of the length of the entire alignment.[4] While the International Blvd segment has the highest number of auto trips of any of the other segments, as a rough estimate of an emissions inventory, it is assumed that the International Blvd segment also carries 47% of the VMT. Both assumptions—2015 base year and the use of 47% of the total pollutants—likely produce slight *underestimations* of total mobile emissions along the alignment.

Table 34. Summary of 2015 Total Emissions: International Blvd

Pollutant	2015 Emissions (Pounds/Day)
$PM_{2.5}$	143
PM_{10}	231

[4] Note that the International Blvd segment used in this analysis is slightly shorter than the Study Area portion of the alignment.

ROG	420
CO	10,701
NO_x	2407
SO_2	21

Source: FEIR

The following inventory of mobile source pollutants for I-880 was compiled using the same emissions factors used in the FEIR for International Blvd (derived from EMFAC 2007) and traffic counts for December 2010 from Caltrans' Performance Management System (PeMS) for the 5.5-mile stretch of the I-880 that runs between 5th Avenue and 98th Avenue.

Table 35. Summary of 2012 Total Emissions: I-880

Pollutant	**2015 Emissions (Pounds/Day)**
$PM_{2.5}$	63
PM_{10}	105
ROG	893
CO	22,769
NO_x	5123
SO_2	44

Source: FEIR

The following inventory of train emissions is based on the following assumptions:

- An average of 20 passenger trains per day (Amtrak Capitol Corridor) and 20 freight trains;[258] [259]
- Each freight train has an average of 1.38 locomotives and is maintained at a non-stop average speed of 25 MPH through the 2.75 mile segment running from approximately 1st Avenue to 44th Avenue through the Eastlake and Fruitvale neighborhoods;
- For freight trains, a 2007 Base Year was used with emission factors from Union Pacific Railroad's *Toxic Air Contaminant Emissions Inventory and Dispersion Modeling Report for the Oakland Railyard, Oakland, California*;[260]
- Each Amtrak Capitol Corridor train was pulled by a single General Motors Electromotive Division (EMD) locomotive at a non-stop average speed of 25 MPH through the 2.75 mile segment with performance and emissions factors derived from CARB's *Diesel Particulate Matter Health Risk Assessment for the West Oakland Community*[261]

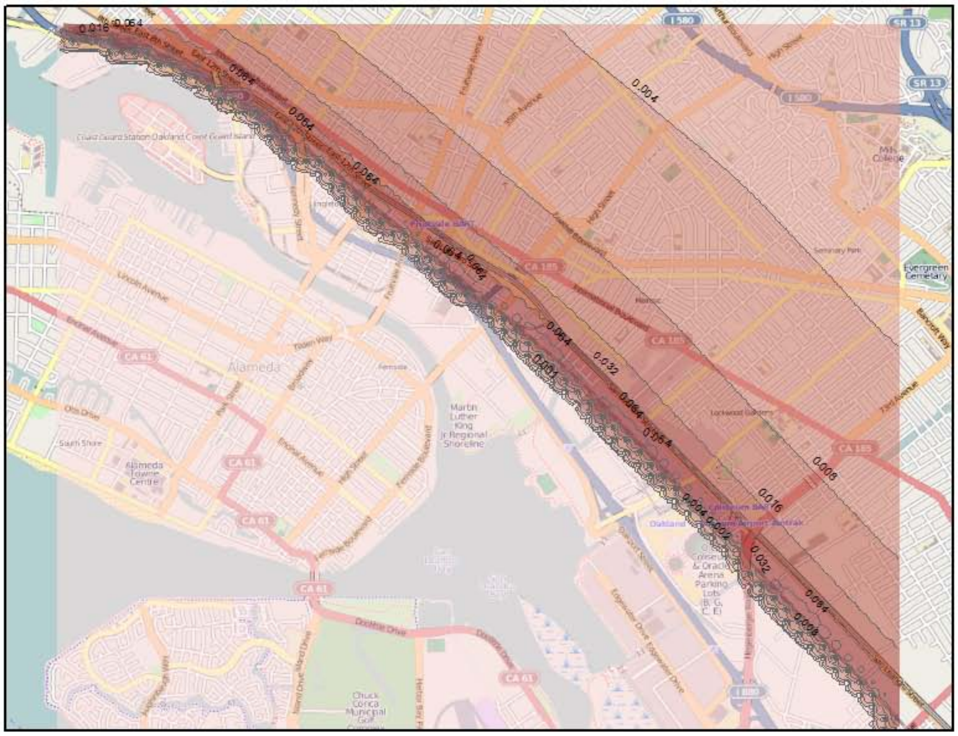
Table 36. Summary of Total Emissions: Rail

Pollutant	**2010 Freight Emissions (pounds/day)**	**2010 AmtrakEmissions (pounds/day)**
Diesel Particulate Matter	1.52	1.10
Nox		42.5

Source: FEIR

The map below combines the freight and Amtrak emissions inventory above and models likely dispersion of PM using a CALINE dispersion model.

Figure 32. Locomotive Particulate Matter Emissions Dispersion from CALINE Model



Notes:
4.7 MPS Wind Speed
Concentration Contours and values are in µg/m3added to ambient background

Figure 32 above shows (in red) the total geographical extent of PM dispersion, which is different than Figures 29 and 30 above, which show (in red) areas where PM thresholds are exceeded. As Figure 32 shows, PM emissions contributed by freight and Amtrak trains, while not substantial, slightly expand the range of residential areas that exceed BAAQMD's PM threshold when added to I-880 emissions. In the most extreme case (between 14th and 23rd Avenues) as much as an additional residential block eastward exceeds the threshold.

Ambient $PM_{2.5}$ and PM_{10} Concentrations. There are two BAAQMD air quality monitors along the International Blvd segment, at 67th Avenue and 98th Avenue. Neither of them monitor $PM_{2.5}$ or PM_{10}. The closest $PM_{2.5}$/PM_{10} monitor is in Berkeley, at 6th St and Camelia, approximately 6 miles from the intersection of 1st Ave and International Blvd. The Final EIR used the Berkeley monitoring station to characterize $PM_{2.5}$ and PM_{10} conditions for the LPA alignment. From 2005-2009, $PM_{2.5}$ 24-hour standards were exceeded on an average of three days per year.

Ambient CO Concentrations. The table below from the FEIR shows the results of a "worst case" simulation using existing CO concentrations at specific intersections selected for both traffic density and proximity to sensitive receptors. Four of the intersections are located along the International Blvd section of the alignment. None of the examined intersections violate either State or Federal 1-hour and 8-hour CO standards.

Table 37. Carbon Monoxide Concentrations at Specific Intersections Along LPA Alignment

Table 4.12-4. Carbon Monoxide Concentrations (Modeled for Existing Conditions)[1]

Intersection	Parts Per Million	
	1-hour	8-hour
Federal CO Standard	**35**	**9**
California State CO Standard	**20**	**9.0**
Shattuck Avenue and University Avenue (East)	4	2.8
Fulton Street and Bancroft Way	4	2.9
Adeline Avenue and Ashby Street	4	3.0
College Avenue and Claremont Avenue	4	2.8
Telegraph Avenue and 40th Street	4	2.9
Broadway and West Grand Avenue	4	2.9
Foothill Boulevard and Fruitvale Avenue	4	2.8
International Boulevard and Seminary Avenue	4	2.8
International Boulevard and 66th Avenue	4	2.9
International Boulevard and 73rd Avenue/Hegenberger Expressway	4	2.9
International Boulevard and 98th Avenue	4	3.0
East 14th Street and Davis Street/Callan Avenue	4	2.9

Notes:
[1] All concentrations include one- and eight-hour ambient concentrations of 3 ppm and 2.4 ppm, respectively.
Source: Alameda-Contra Costa Transit District, 2010.

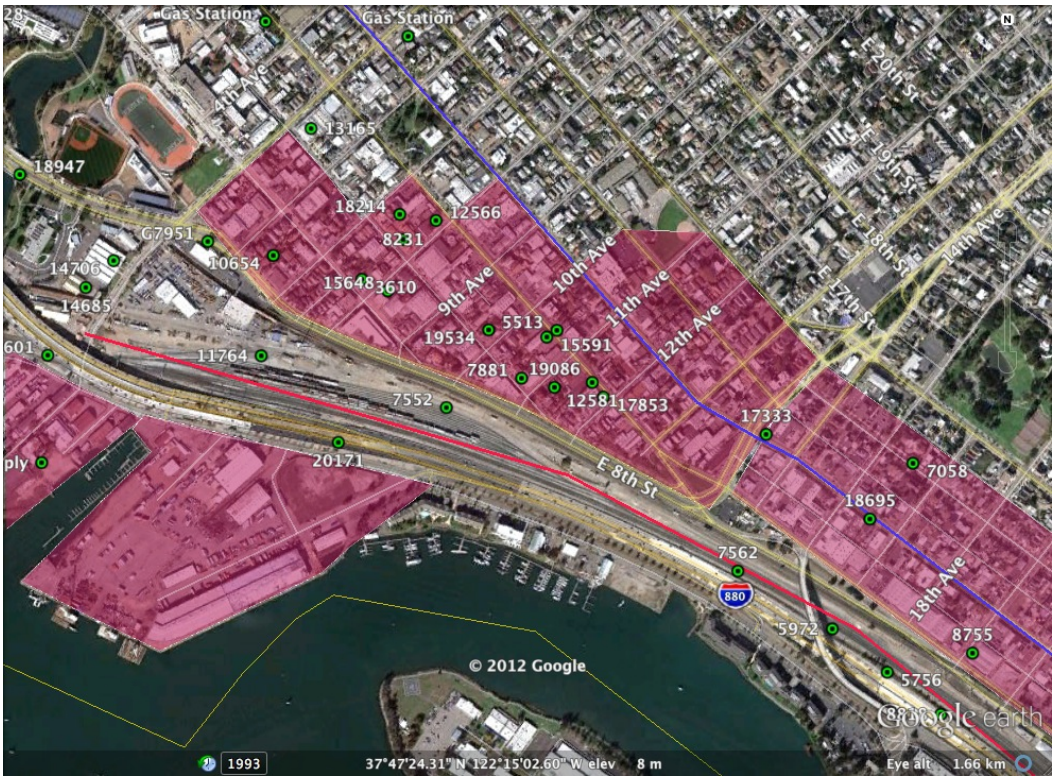
Ambient NO_x Concentrations. The FEIR presents data from the Oakland – International Monitoring Stations. For that period, that was not one episode where NO_x ambient air quality standards were exceeded.

Stationary Sources of Pollutants and Areas of Community Concern

The communities adjacent to the International Blvd segment of the East Bay BRT are located not only in close proximity to major transportation infrastructure and mobile emissions sources, but also to a variety of stationary sources of pollution. These include not only businesses that may contain or emit hazardous chemicals or pollutants (gas stations, factories, cleaners, auto-related uses), but also land use types, such as warehousing or manufacturing, that create demand for diesel trucks and other mobile sources on local streets.

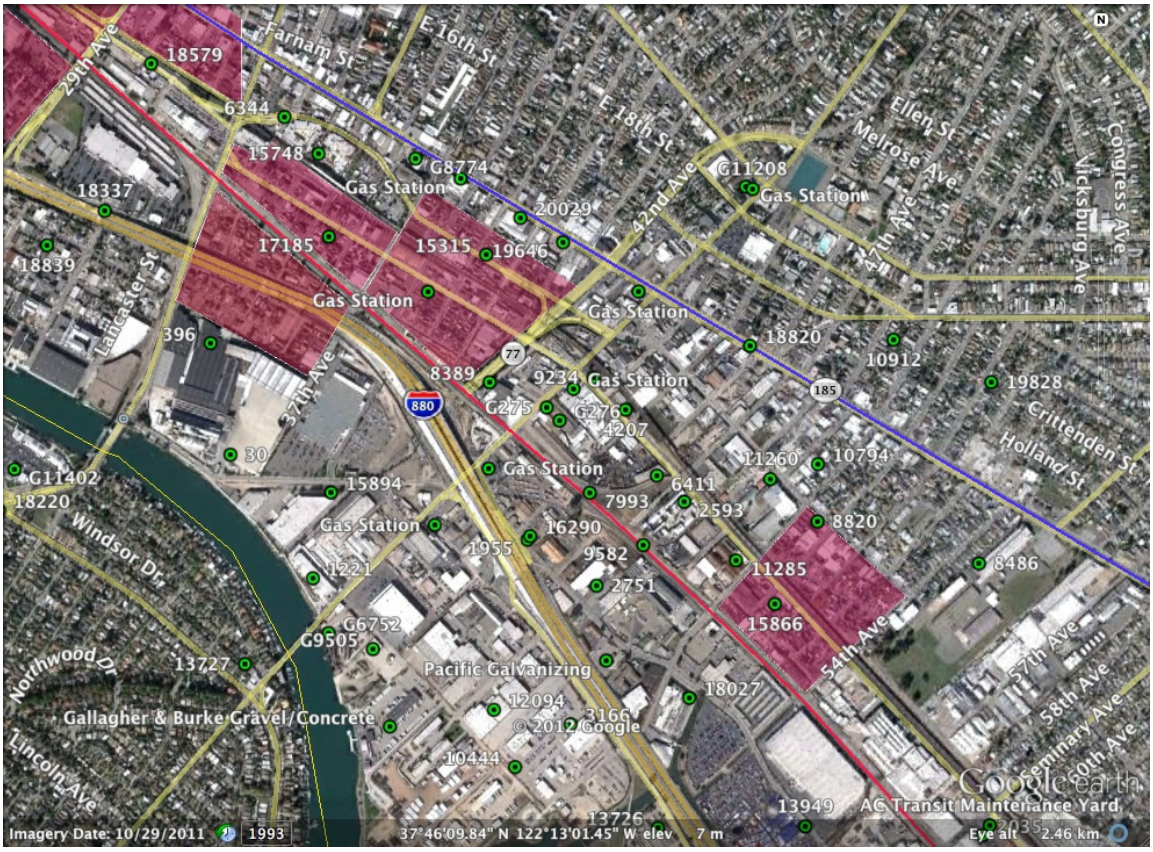
BAAQMD has compiled an inventory of stationary sources based in Google Earth for each of the nine Bay Area counties. The maps below highlight concentrations of stationary sources in two communities within the Study Area (Eastlake and Fruitvale).

Figure 33. Eastlake Neighborhood and Concentration of Auto-Related Stationary Sources



Source: Google Earth
Notes:
Auto-Related Stationary Sources shown in green
BRT Alignment shown in blue
UP Alignment shown in red
Residential Areas Within 1000 ft of UP alignment shown in red

Figure 34. Fruitvale Neighborhood and Concentration of Light Industrial Stationary Sources



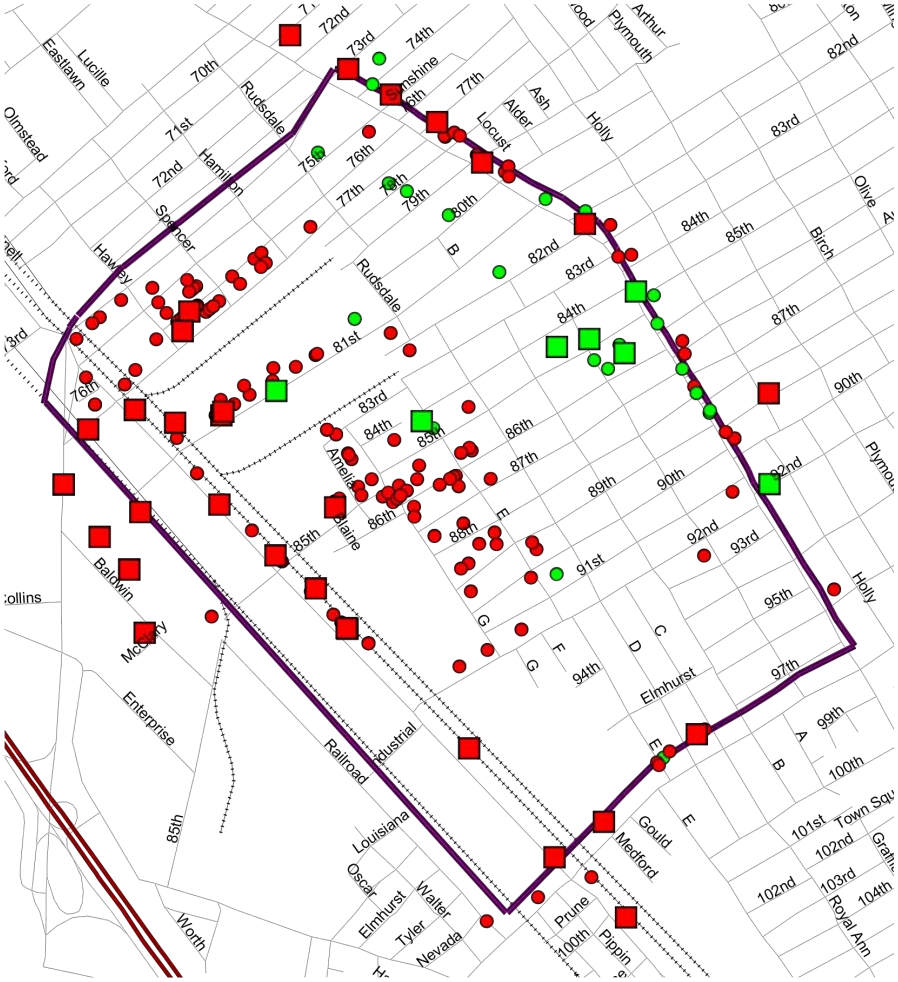
Source: Google Earth
Notes:
Auto-Related Stationary Sources shown in green
BRT Alignment shown in blue
UP Alignment shown in red
Residential Areas Within 1000 ft of UP alignment shown in red

As with mobile sources, BAAQMD has established thresholds for pollution-related cancer risk, non-cancer health risk, and concentrations of $PM_{2.5}$ for the purposes of screening locations adjacent to these stationary sources of mobile pollutants.[262] An examination of the more than 100 stationary sites located in communities alongside International Blvd and I-880 and UP rights of way included in the inventory revealed no stationary source that exceeded any of the three thresholds.[5] Again, it is important to note that there is no acceptable level of $PM_{2.5}$ exposure, therefore, if regulatory thresholds are not exceeded, it does not necessarily mean there are no potential health effects.

[5] There were a number of likely significant sources—an AC Transit maintenance yard, at least three concrete foundries,, that did not have values attached to any of the standards and instead directed viewers to "contact district staff" for more information. None of these were in close proximity to residential areas, however.

There are likely additional stationary sources that have not been captured in the BAAQMD inventory. In 2008, Communities for a Better Environment engaged in a "community-level inventory study of stationary and mobile sources in the Hegenberger Corridor," located along the International Blvd segment's eastern terminus.[263] What the study found was that there was significant underreporting of pollution sources in the area, as the following map from the report shows:

Figure 35. Stationary Sources and Sensitive Receptors in the Hegenberger Corridor



Notes:
Sensitive Receptors (such as residential areas, hospitals, daycare facilities, elder care facilities, elementary schools and parks) shown in green
Hazards shown in red
Squares: included in CARB Inventory
Circles: direct community observation

The only location along the corridor where community members expressed specific concerns about air quality in the International Blvd TOD Plan was at the intersection of 85th Avenue and International Blvd, which is consistent with CBE's study.[264]

4.7.3 Impacts of the BRT proposal on Air Quality and Related Health Outcomes

System-wide Air Pollution

The FEIR for the project summarizes expected concentrations of a variety of air pollutants along the entire LPA alignment. While the International Blvd segment was not itself uniquely analyzed, it is assumed that the direction, and magnitude, of air pollutant concentrations is consistent with the project as a whole.

Concentrations of all pollutants are shown to decline as a result of completing the BRT project (See Table 38). While the declines are not profound, they will contribute to other air quality improvements that are expected from new policies, including increased fuel efficiency, improved auto emissions standards, and cleaner truck and bus programs. At the same time, while reductions can be seen in all of the pollutants when compared to not building the BRT at all, these reductions likely do not reach levels that would lead to substantially cleaner air for communities along International Blvd. *Given the prominence of the I-880 freeway, the Union Pacific railway, recognized stationary sources, and other community-identified sources of air pollution, the BRT will make a small, but helpful, contribution to air quality*

Table 38. Air Pollutant Concentrations With and Without BRT 2015 and 2035

Scenario	VMT	ROG (ppd)[1]	NO_x (ppd)	PM_{10} (ppd)	$PM_{2.5}$ (ppd)	CO (ppd)	SO_x (ppd)
2015 No BRT	4,954,375	896	5,134	492	306	22,817	8
2015 BRT	4,943,059	894	5,122	490	305	22,765	8
BRT benefit	(11,316)	(2)	(12)	(2)	(1)	(52)	(0)
BRT benefit	(0.2%)	(0.2%)	(0.2%)	(0.4%)	(0.3%)	(0.2%)	(0%)
2035 No BRT	5,781,545	433	1,797	535	331	10,707	51
2035 BRT	5,739,366	430	1,784	531	329	10,629	51
BRT benefit	(42,179)	(3)	(13)	(4)	(2)	(78)	(0)
BRT benefit	(0.7%)	(0.7)	(0.7%)	(0.7%)	(0.6%)	(0.7%)	(0%)

Source: USDOT, AC Transit 2010[265]

[1] ppd=Lbs/day

Localized Air Quality Impacts: Project Construction and Vehicle Stopping/Starting

Over the life of the project, air quality impacts derive from the operations of the BRT and any attendant change in mode share from cars to BRT, the less polluting alternative. These impacts are, again, relatively minor, and are less significant at any particular location since they are spread along the length of the entire BRT alignment. However, there are two BRT-related activities that could produce localized air quality effects: construction of the system and air pollution emissions from buses as they stop and start at individual bus stops.

Construction Emissions. The primary sources of emissions related to construction are heavy machinery used in construction; vehicle trips from workers to and from construction sites; and additional vehicle emissions from cars traveling more slowly as a result of construction activity and lane closures. Construction emissions vary frequently, based on the nature of the work done on a particular day, the location of the work, the level of activity, and the weather. The FEIR classified construction emissions as either on-site emissions (those directly related to construction, such as heavy machinery and slowed traffic) or off-site emissions (those indirectly related to construction, namely, worker vehicle trips).

Unfortunately, the FEIR totaled construction emissions for the project as a whole and compared them to regional health-based thresholds for NO_x, $PM_{2.5}$ and PM_{10} from the Bay Area Air Quality Management District (BAAQMD). The FEIR did not measure potential pollution exposures for workers, pedestrians and residents in close proximity to specific construction sites. While true that specific project locations and staging areas have yet to be determined, the general characteristics of construction settings are known (International Blvd and other arterials) and a "typical" project area could have been estimated for purposes of localized analysis.

Table 39 below summarizes the regional emissions from construction activities, both on-site and off-site, and compares them to the BAAQMD regional thresholds. Again, there is no known acceptable level of exposure to PM, but these thresholds were developed with health protection in mind. These emissions are totaled for the project as a whole, so construction along the International Blvd alignment would result in fewer emissions. These emission totals are estimated after implementation of a variety of mitigations related to construction, including dust control, speed control, idling restrictions and machinery maintenance requirements.

Table 39. East Bay BRT Construction-Related Emissions, with Mitigations

	ROG (ppd)	NO_x (ppd)	PM_{10} (ppd)	$PM_{2.5}$ (ppd)
Total Construction Emissions	18	65	53	3
BAAQMD Threshold	54	54	82	54

Source: USDOT, AC Transit 2010[266]

The table above indicates that total NO_x emissions will exceed the BAAQMD threshold, even with mitigations. Again, it is not known exactly where these emissions will occur, so potential health impacts are difficult to assess. However, even short-term exposure to NO_x has been associated with airway inflammation in healthy people and increased symptoms for people with asthma. NO_x is also a precursor for ground level ozone (O_3). While $PM_{2.5}$ and PM_{10} emissions are quite low for the project as a whole, there is currently no established threshold for PM exposure under which no health effects can be guaranteed.

Construction must be well monitored and caution should be taken to minimize the use of heavy machinery near sensitive receptors and to place staging and maintenance zones to avoid areas where pedestrians, residents or other sensitive receptors may congregate.

Bus Stop Emissions. As buses stop, idle and accelerate out of bus stops, they can emit pollutants in higher concentrations at specific locations than when operating at standard speeds. Bus stops have been shown to have 1.6 – 3 times more emissions than areas adjacent to buses in motion.[267] Depending on the bus model and fuel type, these localized emissions can have health impacts.

The Draft Environmental Impact Report (DEIR) analyzed potential $PM_{2.5}$, PM_{10} and NO_x emissions at bus stops along the BRT route.[268] The DEIR estimated 250 Van Hool model buses per day at each bus stop and determined that $PM_{2.5}$, PM_{10} and NO_x concentrations would all increase in areas around bus stops.

PM_{10} concentrations would increase by 0.8 µg/m^3 over 2010 ambient concentrations and 0.5 µg/m^3 over expected 2025 ambient concentrations. While there is no acceptable level of PM_{10} exposure for human health, these additional PM_{10} emissions would not drive total PM_{10} emissions (i.e. ambient concentrations plus emissions from the buses) over the Federal Clean Air Act's 24-hour standard for 2010 or 2025. These additional emissions would drive total PM 10 emissions near bus stops over the California Clean Air Act's 24-hour standard.

$PM_{2.5}$ concentrations would increase by 0.8 µg/m3 over 2010 ambient concentrations and 0.5 µg/m3 over expected 2025 ambient concentrations. *These additional $PM_{2.5}$ emissions would drive total $PM_{2.5}$ emissions near bus stops over the Federal Clean Air Act's 24-hour standard in 2010 but would not surpass the Federal Clean Air Act's 24-hour standard in 2025. Again, despite the thresholds, there is no acceptable level of $PM_{2.5}$ exposure for human health.*

NO_x emissions from BRT would be higher near bus stops in 2025 than emissions from normal bus operation (i.e. non-BRT) along the corridor. The DEIR projects, however, that this increase in NO_x from BRT operations will be offset by the decrease in NO_x emissions from vehicles, as BRT decreases overall VMT along its alignment.

To address the DEIR's determination, the East Bay BRT projects can further reduce local PM_{10}, $PM_{2.5}$ and NO_x emissions by implementing certain operational practices. Indeed, many of these practices are consistent with BRT's stated operational approach.

Operation strategies that can reduce dwell time and stops at signals can reduce emissions. The East Bay BRT's control over traffic signal phasing will eliminate unnecessary brake-idle-accelerate cycles. BRT will also utilize an off-board fare system (i.e. a passenger buys a ticket at a kiosk before they board), which will reduce dwell times and attendant idling emissions. Boarding platform design and low-floor buses ease boarding for all passengers (particularly the elderly and disabled), which will also reduce dwell time.

The DEIR assumed the use of Van Hool model buses for the BRT system, and its analysis is based on that bus' performance. However, AC Transit has not, as yet, committed to a specific bus model for the BRT system, although staff has indicated a diesel-hybrid will be selected and that the most likely model in the short term will perform similarly to the Van Hool. Obviously, the air quality impacts of the system will depend on which bus model is ultimately selected and as bus technology improves, there would be opportunities to improve on the DEIR and FEIR's projections.

Summary of Health Impacts of BRT Related to Air Quality

The most common health impacts associated with long-term exposure to urban air pollutants relate to respiratory function in children, cardiovascular function, mortality and cancer. Residents of neighborhoods along the International Blvd segment of the East Bay BRT are currently exposed to a variety of sources of air pollution. While International Blvd itself is heavily traveled, the neighborhoods along the western end of the Study Area are exposed to higher levels of mobile source emissions due to their proximity to both I-880 and the Union Pacific rail right of way. These neighborhoods also contain significant concentrations of stationary sources, although nearly all of them do not appear to exceed health-based thresholds determined by

BAAQMD. A community-based study has shown, however, that agency-based inventories of hazardous sites can undercount actual sources.

The East Bay BRT project will likely have minor positive impacts on air quality in the Study Area. These air quality improvements will likely not in themselves result in significant health benefits for residents of neighborhoods along the International Blvd corridor. Communities along International Blvd would experience significantly greater health benefits from efforts to reduce VMT along I-880, reduce diesel train traffic (through either reduced trips or electrification of the line) along the Union Pacific rail line and a reduction of both agency-recognized and community-mapped stationary sources of pollution. Nevertheless, BRT will be a small step in the right direction and will contribute to efforts to improve air quality through controls on vehicle emissions, as well as land-use related efforts to decrease vehicle trips and trip distances.

4.7.4 Air Quality-Related Recommendations

To maximize the health benefits of improved transit service to air quality, the following are recommended actions:

1. Closely monitor construction-sites, and strictly enforce mitigations laid out in the FEIR, including potential penalties for contractors for violations, as well as incentives for superior compliance.
2. Develop and publicize an accessible system for community members to register complaints and concerns about construction activity.
3. Maximize BRT's control over traffic signals to minimize braking and idling.
4. Maximize BRT's off-board fare system to reduce dwell time and idling.
5. Ensure that the BRT system uses low-emissions buses.
6. In order to reduce vehicle miles traveled on I-880, coordinate with the Bay Area's Metropolitan Transportation Commission (MTC) and other metropolitan planning organizations (MPOs) around the state to Incentivize non-vehicle travel on a regional level.
7. Reduce diesel emissions from train traffic along the Union Pacific rail line (through electrification of rail)
8. Mitigate or eliminate emissions from stationary sources of air pollution within East Oakland residential neighborhoods.

4.8 SUMMARY OF IMPACTS ASSESSMENT

The health impacts of the proposed BRT Project (DOSL Alternative) mediated through the five health determinants for which analyses were done are summarized in Table 40 below.

Table 40. Summary of BRT Impacts on Health Determinants

Health Determinant	Impact of BRT	Magnitude	Severity	Strength of Evidence	Uncertainties and Qualifications
Mobility	+	Mod–Major	Minor	♦	Mobility will increase for the majority of the Study Area, but could potentially decrease for a very small proportion of the population in specific locations.
Access to Goods and Services	+	Mod-Major	Minor	♦	The relationship between access to goods and services and health outcomes is dependent on many factors (e.g., income and culture) in addition to transit resources.
Traffic Safety	+	Minor	Major	♦♦	Changes in pedestrian and bicycle activity are uncertain. Other factors related to traffic safety (e.g., speed) were not predicted.
Crime and Safety	+	Minor-Mod	Moderate	♦♦	Many other factors (e.g., law enforcement) contribute to perceptions of crime and crime rates than those that are relevant to BRT.
Air Quality	+	Minor	Moderate	♦♦♦	Given the regional scope of the FEIR analysis, local air quality impacts are uncertain.

Explanations:

- *Impact* refers to whether the proposal will improve health (**+**), harm health (**-**), or whether results are mixed (**~**).
- *Magnitude* reflects a qualitative judgment of the size of the anticipated change in health effect (e.g., the increase in the number of cases of disease, injury, adverse events): Negligible, Minor, Moderate, Major.
- *Severity* reflects the nature of the effect on function and life-expectancy and its permanence: High = intense/severe; Mod = Moderate; Low = not intense or severe.
- *Strength of Evidence* refers to the strength of the research/evidence showing a causal relationship between the effects of the proposal on the health determinants and health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = causal relationship certain. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

5 Recommendations

In addition to our general recommendation to approve the East Bay BRT Project, the following list is a set of recommendations that have the potential to improve the project's impacts on health. Recommendations are primarily directed to AC Transit, but there are several that involve action and attention by other departments or governing bodies in the city or region. As such, we have organized the recommendations below according to our perception of the responsible agency. We also encourage the Oakland City Council to advocate for the AC Transit suggestions, and to work with regional leaders and planners to facilitate implementation of the other recommendations included here.

5.1 Mobility and Access to Goods and Services Recommendations

AC Transit

4. Consider bringing an AC Transit office into East Oakland, where transit ridership is high. Community residents have expressed their need for easier access to AC Transit resources such as Clipper Card purchases.
5. Implement a locally sponsored shuttle that offers free rides to BRT stops to improve BRT accessibility and increase ridership. Cleveland's Downtown Trolley system currently sponsored by the Dollar Bank is an example of this kind of service.
6. Conduct public transportation education days at public schools along the BRT corridor to increase culture of generational awareness and buy-in for public transit
7. Provide free student BRT passes for students and senior to increase use and ownership

Other governing bodies

8. Facilitate the development of a full-service supermarket along International Blvd. City agencies (e.g., Planning and Public Health Departments) should work with community partners and developers to develop a set of incentives (e.g., tax credits, predevelopment assistance, or regulatory incentives) that attract grocery retailers to this area.
9. Align development in this area with community priorities as expressed in the International Blvd Transit-Oriented Development Plan, such as walkable neighborhoods; accessible social services; parks and green space, businesses that provide daily goods and services; entertainment, recreation, arts and culture; celebration of cultural diversity; inclusive mixed income housing; community facilities; more street lighting; improved trash collection and cleanup of illegal dumping; graffiti abatement; and increased police presence.

5.2 Traffic Safety Recommendations

AC Transit

13. Implement all pedestrian and bicycle upgrades outlined in the FEIR and project plans.
14. Ensure dedicated lanes are median running, as these have been shown to reduce cyclist-bus conflicts.

15. Ensure separated bike lanes are added along International Blvd.
16. Consider adding more bike lanes to adjacent corridors than are currently planned.
17. Address pedestrian environment deficiencies at intersections that have had high rates of pedestrian-vehicle and bicycle-vehicle collisions (see HIA report for specific locations).
18. Set a minimum 13-foot width requirement for sidewalks. This should include an 8-foot "clear" zone free of trees, furniture and other obstructions to pedestrians.
19. Conduct an in-depth study of signal timing at intersections along the BRT corridor. Re-time signals with leading pedestrian intervals, which give pedestrians several seconds to cross the street before motor vehicles are given a crossing signal. Time signals to allow pedestrians to cross at 3, rather than 4, feet per second.
20. Place additional flashing warning signs, high visibility crosswalks, and reduce motor vehicle speed limits in front of schools, senior centers, and libraries.
21. Ensure that enhanced pedestrian crossings are available at least every 600 feet along International Blvd.
22. To reduce conflicts between BRT buses and vehicles, limit BRT bus intersection speeds to 10 mph. Place additional warning signs and flashing signals at intersections where left-turn conflicts will occur to remind motorists not to turn against the signal.
23. Post 'No Trucks' signs to direct truck traffic away from 85th Ave, a designated local street. Strictly enforce use of nearby truck routes on 73rd Ave and 98th Ave to avoid conflicts between trucks, cars, bicycles, and pedestrians.
24. Implement the Neighborhood Traffic Management Program as proposed in the FEIR, including traffic calming measures, and involve community input in this process.

5.3 CRIME AND SAFETY RECOMMENDATIONS

AC Transit

1. Use safety ambassadors to patrol the streets and help keep them clean and safe near stations in hot spot areas for violent, property and quality of life crimes (see Crime and Safety section for specific hot spot locations).
2. Station "AC Transit contracted security guards" (as described in project FEIR) at stations and other areas that are within higher crime hot spots.
3. Ensure that "AC Transit-trained first responders" (listed as such in the FEIR) are stationed along this part of the BRT route, where crime is higher, and train additional first responders if necessary to provide coverage.
4. Make the presence of these security personnel more public to increase awareness about AC Transit security measures.
5. Implement median running transitways, which may promote the visibility of waiting passengers, clearly mark access points, and may reinforce the territory of the station as safe, thus keeping people safe from risks to personal security while waiting for the train.

6. Ensure full coverage of streetlights at all proposed stations, in intersections planned for improvements, and in other parts of the route where BRT-related projects are planned.
7. Work with Crime Prevention Councils to ensure station designs uphold the principles of Crime Prevention Through Environmental Design (CPTED): Natural Surveillance, Natural Access Control, Territorial Reinforcement, and Maintenance.
8. Create an education and PR campaign to highlight the benefits and safety of public transit and BRT.

Other governing bodies

9. Coordinate with other public agencies to ensure adequate street lighting throughout the length of the alignment (including where BRT-related improvements are not planned).
10. Limit permits for liquor stores near proposed stations and elsewhere along the BRT route.
11. Promote business development near proposed stops to ensure active uses near stations.

5.4 AIR QUALITY RECOMMENDATIONS

AC Transit

9. Closely monitor construction-sites, and strictly enforce mitigations laid out in the FEIR, including potential penalties for contractors for violations, as well as incentives for superior compliance.
10. Develop and publicize an accessible system for community members to register complaints and concerns about construction activity.
11. Maximize BRT's control over traffic signals to minimize braking and idling.
12. Maximize BRT's off-board fare system to reduce dwell time and idling.
13. Ensure that the BRT system uses low-emissions buses.
14. In order to reduce vehicle miles traveled on I-880, coordinate with the Bay Area's Metropolitan Transportation Commission (MTC) and other metropolitan planning organizations (MPOs) around the state to Incentivize non-vehicle travel on a regional level.

Other governing bodies

15. Reduce diesel emissions from train traffic along the Union Pacific rail line (through electrification of rail)
16. Mitigate or eliminate emissions from stationary sources of air pollution within East Oakland residential neighborhoods.

6 Monitoring

The following is an outline of a plan to track the impact of this HIA on decisions related to the East Bay BRT Project, and to measure the impact of the project on health determinants or outcomes. As part of monitoring, HIA and project stakeholders should evaluate the following questions over time:

- How has the project impacted taking public transit, walking biking and driving?
- How has the project impacted resident's ability/time to get to and from other places in the region?
- How has the project impacted pedestrian and bike environments and safety?
- How has the project impacted injuries from motor vehicle, pedestrian and bicycle accidents?
- How has the project impacted levels of safety, crime and violence?
- How has the project impacted air quality?
- How has the project impacted access to public and private goods and services?
- How has the project impacted any of these elements for vulnerable populations, including seniors, school-age people, and transit dependent people?

7 Conclusion

Through empirical analyses, this HIA found that the proposed East Bay BRT Project will offer numerous health benefits to Oakland communities. In summary, our findings are as follows:

- The East Bay BRT Project will provide enhanced transit access to jobs, schools, healthcare, healthy food, and other goods and services essential to health.
- Average commute times will decrease for those using public transit to get to work and residents may gradually shift away from relying on automobiles as their only mode of transportation.
- The BRT Project has the potential to significantly improve pedestrian and bicycle safety along International Blvd by reducing vehicle speeds and volumes and by implementing a variety of pedestrian and bicycle infrastructure upgrades.
- Crime may also be reduced with more eyes on the street due to increased ridership and economic investment along the BRT route.
- Finally, minor improvements to air quality are anticipated as drivers switch to using BRT.

While the proposed East Bay BRT Plan is likely to lead to numerous health benefits, there are several additional measures that can be taken to improve health in Study Area communities. Based on health impacts of the East Bay BRT Plan predicted in this HIA, HIP and our partners developed the recommendations listed in Section 6 of this report.

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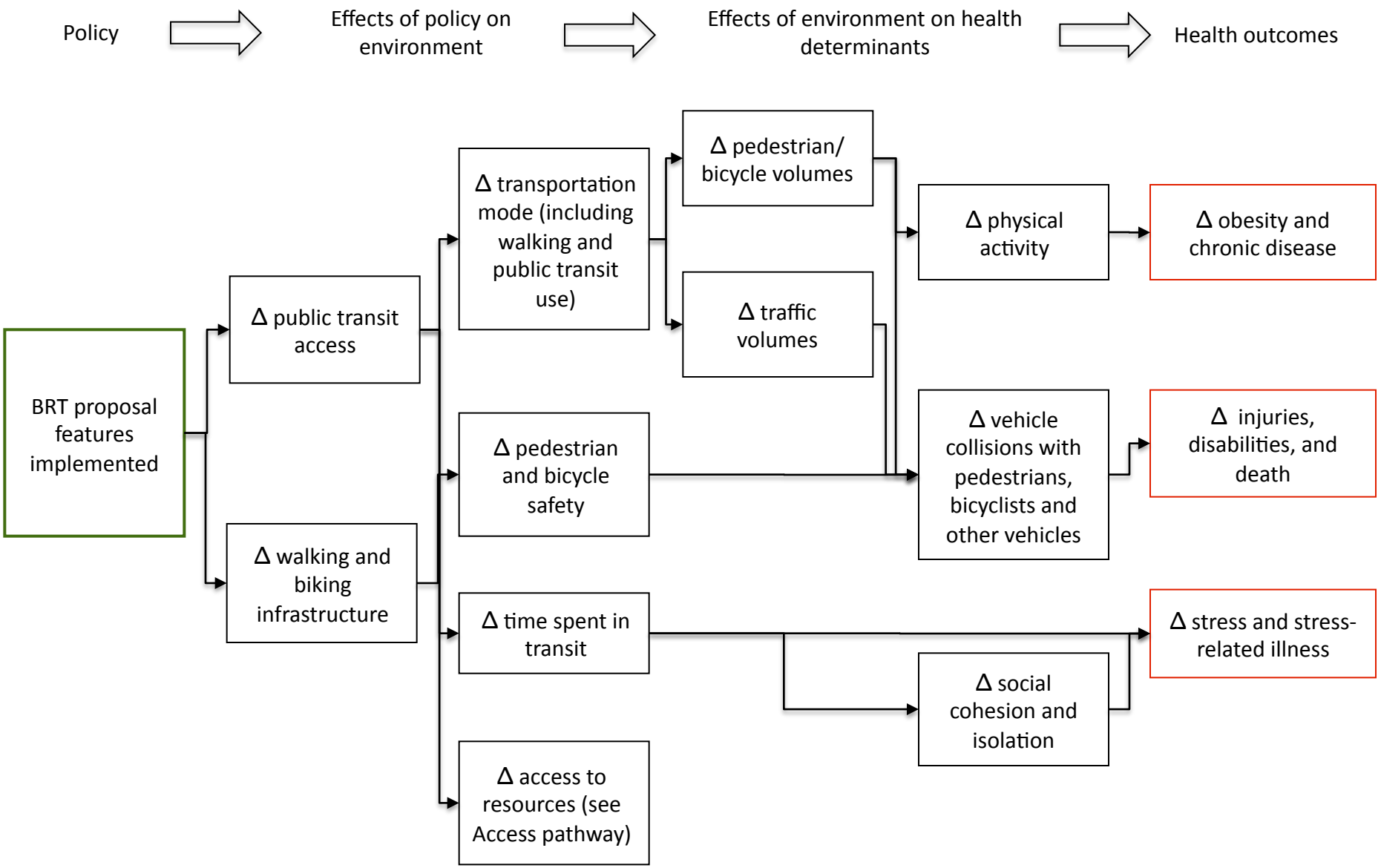
Appendix A. BRT Scope Pathway Diagrams

Scoping: Bus Rapid Transit and Health

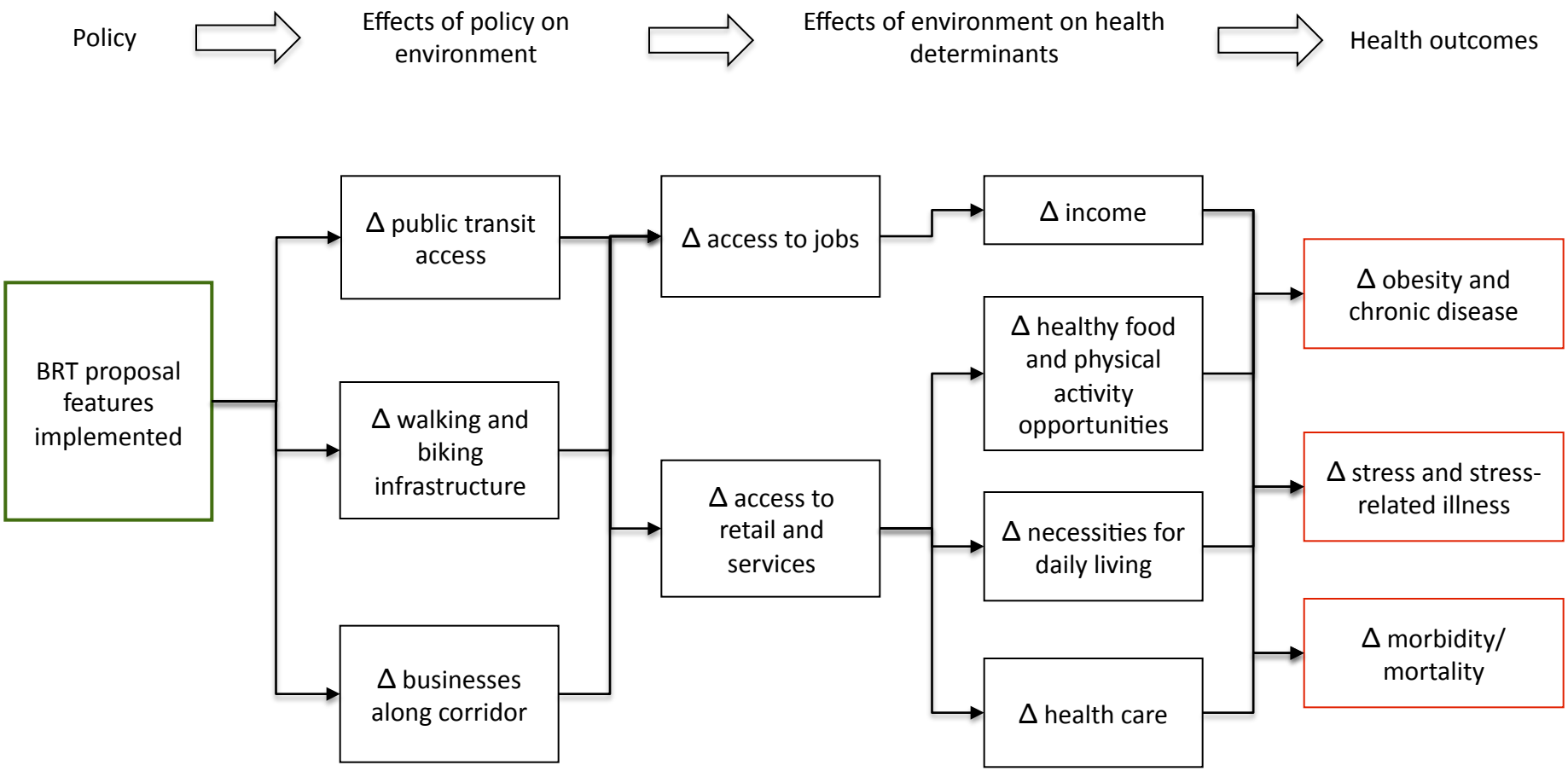
Proposed features:

- Median running transitways side running transitways
- Transit signal priority, new traffic signals, and transit-only signals
- Platform designs (single platform, center median stations at median running transitways; level/near level boarding at side running transitways)
- Station spacing
- Real-time traveler information
- Pedestrian access and safety improvements at stations
- Shelters that include extended canopies with amenities for comfort and convenience
- Lighting
- Bicycles allowed inside of buses
- Security features (e.g., closed circuit television and emergency phones)

Mobility

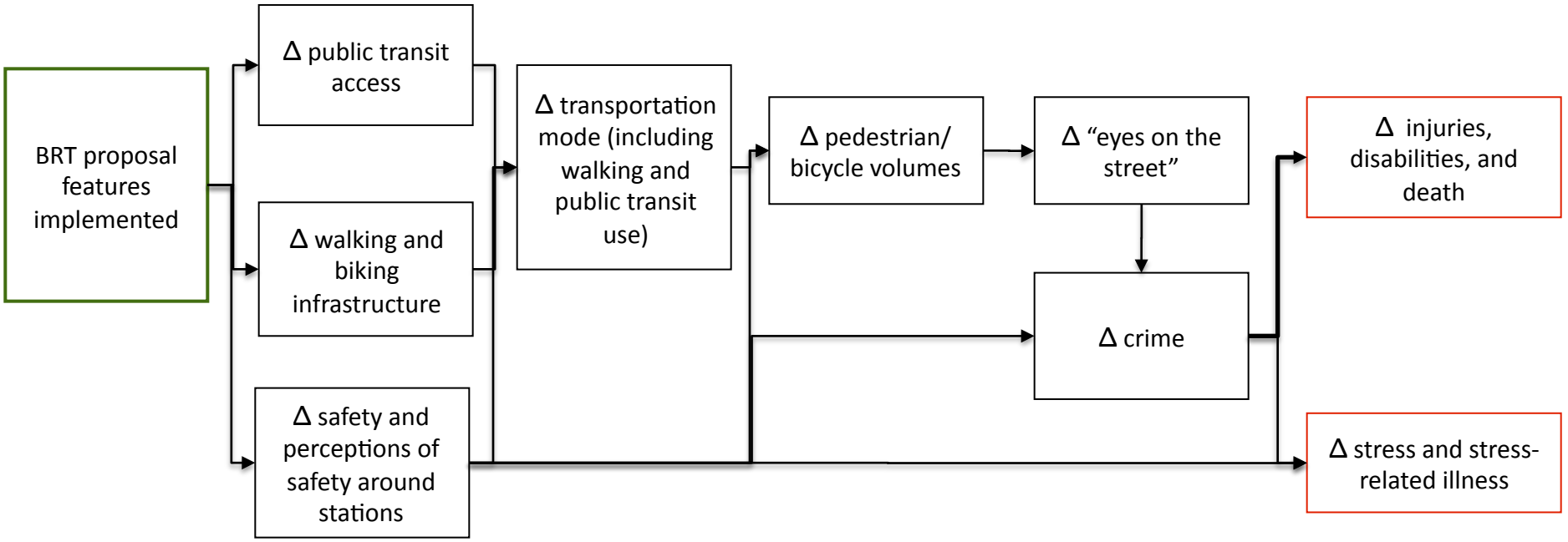

Policy
Effects of policy on environment
Effects of environment on health determinants
Health outcomes
BRT proposal features implemented
Δ public transit access
Δ walking and biking infrastructure
Δ transportation mode (including walking and public transit use)
Δ pedestrian and bicycle safety
Δ time spent in transit
Δ access to resources (see Access pathway)
Δ pedestrian/ bicycle volumes
Δ traffic volumes
Δ physical activity
Δ vehicle collisions with pedestrians, bicyclists and other vehicles
Δ social cohesion and isolation
Δ obesity and chronic disease
Δ injuries, disabilities, and death
Δ stress and stress-related illness

Access


Policy
Effects of policy on environment
Effects of environment on health determinants
Health outcomes
BRT proposal features implemented
Δ public transit access
Δ walking and biking infrastructure
Δ businesses along corridor
Δ access to jobs
Δ access to retail and services
Δ income
Δ healthy food and physical activity opportunities
Δ necessities for daily living
Δ health care
Δ obesity and chronic disease
Δ stress and stress-related illness
Δ morbidity/ mortality

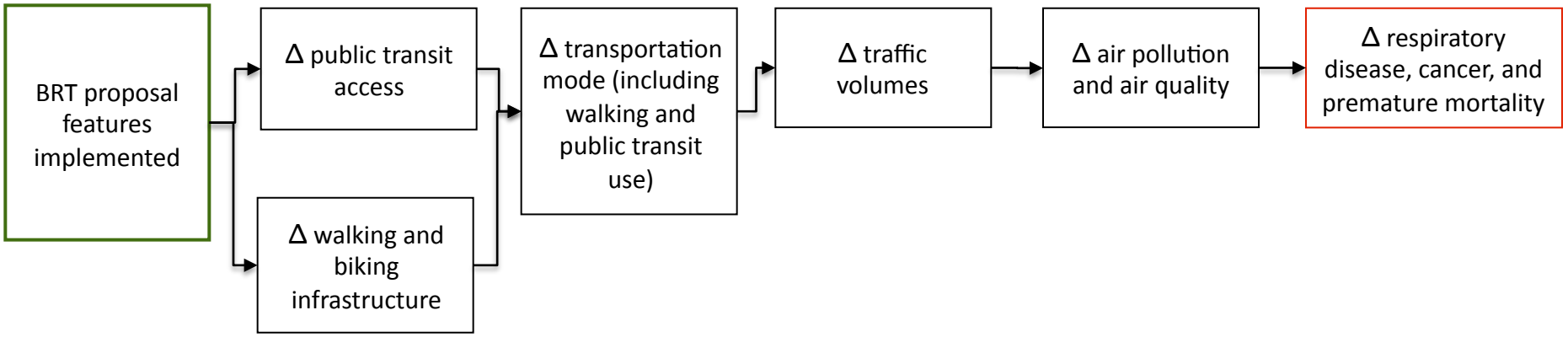
Crime

Policy ⇨ Effects of policy on environment ⇨ Effects of environment on health determinants ⇨ Health outcomes



Air Quality


Policy
Effects of policy on environment
Effects of environment on health determinants
Health outcomes


BRT proposal features implemented
Δ public transit access
Δ walking and biking infrastructure
Δ transportation mode (including walking and public transit use)
Δ traffic volumes
Δ air pollution and air quality
Δ respiratory disease, cancer, and premature mortality

Appendix B. BRT HIA Scope

Project:	Oakland BRT				
Health Determinant:	**Various (research questions relevant to multiple health determinants)**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
What is the transportation mode share for residents in the project area?	How will the project impact mode share in the project area?	Numbers/volume of people walking, biking, taking transit and driving to stations	Census, ACS; Travel survey	Quantitative; secondary data analysis	high
What is the transportation mode share in the communities adjacent to the project area?	How will the project impact mode share in in the communities adjacent to the project area?	Proportion of walking, biking, public transit, auto use	Census, ACS; Travel survey	Quantitative; secondary data analysis	high
What are current levels of transit use in the project area?	How will the project impact public transit use in the project area?	AC Transit Ridership		Quantitative; secondary data analysis	high
How many residents walk or bike to access public transit in the project area?	How will the project impact the number of people walking or biking to reach public transit in the project area?	AC Transit Ridership		Quantitative; secondary data analysis	medium
What are current traffic volumes in the project area and adjacent communities?	How will the project impact traffic volumes in the project area and adjacent communities?	Potential diversion of vehicle traffic to residential streets (does EIR look at this?)	EIR?	1) map vehicle travel patterns (suggestion from Joel)	high
Are there communities of concern (low mobility, the elderly, low income and minority) in the project area?	How will the project impact sensitive populations in the project area?	Counts and rates of population by sociodemographic characteristics (Students and seniors!!)	US Census	Quantitative; secondary data analysis	high
Health Outcomes					
What are current physical activity levels for residents in the project area and compared to larger geographic areas?	How will changes in the number of people walking impact physical activity levels for residents in the project area?	Rates of moderate physical activity	CHIS		

Project:	Oakland BRT				
Health Determinant:	**Various (research questions relevant to multiple health determinants)**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
What are current levels of chronic disease in the project area and in comparison to larger geographic areas?	How will the project impact chronic disease levels in the project area?	Counts and rates of asthma hospitalization and emergency department visits, diabetes hospitalization, chronic obstructive pulmonary disease (COPD) hospitalization, obesity	Office of Statewide Health Planning Inpatient Hospital Data; CHIS	Quantitative; secondary data analysis	
What are current rates of overweight and obesity in the project area and in comparison to larger geographic areas?	How will the project impact overweight and obesity rates in the project area?				
What are current levels of stress and stress-related illness in the project area?	How will the project impact stress levels for residents in the project area?	Subjective measures of stress using questions from Perceived Stress Scale or similar scale	Original	Quantitative and qualitative; community survey	low

Project:	Oakland BRT				
Health Determinant:	**Mobility**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
How far do residents currently walk to BRT stops?	How will the project impact the distance residents walk to BRT stops	Distance between stops; distance students walk (calc from schools); distance seniors walk (calc from senior centers)		1) Look at areas where stops will be located over 1/3 mile apart - are they densely populated areas? 2) Look at nearest stops to SCHOOLS - will students have to walk far? (Parents in cmty meeting were concerned about student safety if stations are not in front of schools where they can be supervised). 3) Compare farthest distance most residents would walk (1/6-mile) to another well-known distance as a point of reference (see Joel's email). 4) map pedestrian travel patterns (suggestion from Joel)	
How well do current buses accommodate mobility of disabled people and people with strollers?	How will the level boaridng offered by the project affect mobility of disabled people and people with strollers?	Time for disabled/stroller passengers to board, ease of boarding for these passengers	Case studies of other transit projects	Evidence from other transit projects offering level boarding? Interviews?	

Project:	Oakland BRT				
Health Determinant:	**Mobility**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
How much time do residents spend travelling in the project area?	How will the project impact the amount of time residents spend travelling in the project area?	Time spent traveling (all modes); Vehicle miles traveled. Vehicle congestion; Parking		Congestion: will BRT reduce lanes to one each way and thus lead to more travel time? Parking: will there be a reduction in parking (see BRT proposal for potential parking lot additions to make up for lost spaces on street), and if so, will this increase travel time?	
Health Outcomes					
What are current levels of social cohesion in the project area?	How will the project impact social cohesion levels in the project area?	Voting rates; residential mobility; counts of community centers, spiritual and religious centers, block party permits; social support reported by population		Quantitative; secondary data analysis	low

Project:	Oakland BRT				
Health Determinant:	**Access**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
Where do people living in the project area vicinity work (physical location and type of employment)?	How will the project impact where people can work (physical location and type of employment)?	Proportions of residents living within X distance/time Employment type for residents	Census	Qualitative; Will changes in employment opportunities be due to increased business investment on the BRT line, or to people being able to get to more within the same time?	medium
What is the current level of access to retail and services?	How will the project impact levels of access to retail and services?	Location, density and proximity to: banks/credit unions, grocery stores, local retail and retail centers		evaluate whether BRT attracts retail/business in case studies of other BRT projects (cmty member raised concern that businesses would never be drawn here); evaluate where residents currently go to access retail (do people go to places along proposed BRT line?)	

Project:	Oakland BRT				
Health Determinant:	**Access**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
What is the current level of access to public services?	How will the project impact level of access to public and private services?	Location, density and proximity to: parks, libraries, public schools, health clinics, day care centers, community centers, post offices, libraries		Look specifically at student access to schools - students are a major bus rider population	
Health Outcomes					
What are current levels of nutrition in the community?	How will the project impact nutrition levels (through better access to healthy food) for residents in the project area?	Rates of fruit and vegetable consumption	CHIS, California Department of Public Health (Network for a Healthy California);	Quantitative; secondary data analysis	
What are current levels of access to health care and medicine in the project area and in comparison to larger geographic areas?	How will the project impact access to health care and medicine for residents in the project area?	Counts of public health facilities within 1/2 mile of the BRT system; Distribution of public health facilities relative to population density; Proportion of hospital beds to population	CA Office of Statewide Health Planning and Development; CHIS; ACPHD's list of Community Clinics	Quantitative; secondary data analysis	

Project:	Oakland BRT				
Health Determinant:	**Access**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
What support is available for prenatal and infant care?	How will the project impact low birth weight and nutrition among women, infant, and children in the project area?	Counts and rates of low birth weights and childhood illnesses, levels of preventable childhood disease	CDC, Black Infant Health Program	Quantitative; secondary data analysis	low

Project:	Oakland BRT				
Health Determinant:	**Traffic Safety**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
How do the numbers of people walking and biking impact the number and severity of pedestrian and bicycle collisions with motor vehicles (m-v)?	How will changes in the numbers of people walking and biking impact the number and severity of pedestrian and bicycle collisions with motor vehicles?				
What is the quality of the pedestrian and bicyclist environment in the project area?	How will the project impact pedestrian and bike environments in the project area?	PEQI; BEQI	Original	Quantitative; primary data collection of PEQI and BEQI indicators using assessment tool	low (PEQI/BEQI)
How does the pedestrian environment impact the number and severity of pedestrian and bicycle collisions with motor vehicles?	How would pedestrian and bicycle infrastrauctuire changes impact the number and severity of pedestrian and bicycle collisions with motor vehicles?	Number and severity of collisions; for students specifically		Specifically analyze for student bus riders	

How do traffic volumes impact the number and severity of pedestrian and bicycle collisions with motor vehicles (m-v) and m-v/m-v collisions?	How will changes in traffic volumes due to the project impact the number and severity of pedestrian and bicycle collisions with motor vehicles and m-v/m-v collisions?	Locations and/or densities of motor-vehicle collisions with pedestrians and bicycles and collisions that resulted in injuries; for students specifically	SWITRS	Specifically analyze for student bus riders	

Health Outcomes

What are current injury/fatality rates from collisions with motor vehicles in the project area?	How will the project affect rates of injury from collisions between motor vehicles and pedestrian, bicyclists, or other motor vehicles in the project area?	Locations and densities of collisions between motor vehicles and other motor vehicles, pedestrians and bicycles that resulted in injury; for students specifically	SWITRS (from SafeTrec)	Quantitative; secondary data analysis; model equations reported in Accident Analysis & Prevention and the San Francisco Road Pricing HIA	

Project:	Oakland BRT				
Health Determinant:	**Crime and Safety**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
What are existing levels of crime and violence in the project area?	How will the project affect crime and violence in the project area? Evaluate for students specifically; gun violence and prostitution are particular concerns for community	Violent and non-violent crime counts and rates	crimespotting.org; case studies of other BRT projects	Quantitative; secondary data analysis; see case studies of other BRT projects and literature/case studies about street lighting to predict this plan's impact on crime; use case studies of other BRT projects and existing violence patterns in project area to predict BRT impacts on violence here; compare known crime hot spots (e.g., liquor stores) to proposed BRT station locations; look for evidence of BRT impact on prostitution in other locations	
What are perceived levels of safety, crime and violence in the project area?	How will the project affect perceived levels of safety, crime and violence in the project area? Evaluate for students specifically	Personal experience of crime or violence in the neighborhood; knowledge of residents impact by neighborhood crime or violence; comfortability going outside in daytime and nighttime	Original, case studies	Quantitative and qualitative; community survey; see case studies about the effect of street lighting on crime and crime perceptions. NOTE: could qualitatively connect any changes in perceptions of crime to whether that would affect whether people choose PT over cars (assuming one reason to use cars over PT is perception of greater safety from crime)	

Health Outcomes

What are current rates of injuries and fatalities from crime in the project area and compared to larger geographic areas?	How will the project impact injuries and fatalities from crime in the project area?	Crime data? Homicides? Hospitalization rates?			

Project:	Oakland BRT				
Health Determinant:	**Air Quality**				
Geographic Scope:	7-mile International Boulevard Corridor				
Existing Conditions Research Questions	**Impact Research Questions**	**Indicators**	**Data Sources**	**Methods**	**Priority**
What is current air quality in the project area?	How will the project impact air quality in the project area?	Number and severity of cumulative air quality issues at key sensitive receptors (i.e., schools, senior centers, medical facilities, intersection of 85th Ave and International Blvd) (and/or: proportion of households living within potential traffic-related air quality hazard areas); emissions of proposed BRT buses; emissions of idling cars IF increased congestion and vehicle idling is predicted	CalTrans AADT, etc.; Specs of proposed BRT buses (cleaner buses?)	Quantitative modeling; secondary data analysis	
Health Outcomes					
What are current levels of respiratory disease, cancer, and premature mortality in the project area and in comparison to larger geographic areas?	How will the project impact respiratory disease, cancer, and premature mortality levels in the project area?	Counts and rates of respiratory disease, cancer, premature mortality	CHIS, National Cancer Institute; California Center for Health Statistics	Quantitative; secondary data analysis	