The Gateway Cities Air Quality Action Plan

I-710 CORRIDOR PROJECT HEALTH IMPACT ASSESSMENT

November 2011

PREPARED FOR:

Gateway Cities Council of Governments and
ICF International

PREPARED BY:

Human Impact Partners (HIP)
304 12th Street, Suite 3B
Oakland, CA 94607
Contact: Jonathan Heller

Note: The results and recommendations contained herein are those of HIP, who incorporated input from many stakeholders. The results and recommendations are not endorsed by the Gateway Cities Council of Governments.

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Acronyms

µg/m^3	micrograms per cubic meter
AADT	annual average daily traffic
AASHTO	American Association of State Highway Officials
ADA	Americans with Disabilities Act
ADD	Attention Deficit Disorder
AFq	attributable fraction
AHRQ	Agency for Healthcare Research and Quality
AOI	area of interest
AQ	Air Quality
AQ/HRA	Air Quality and Health Risk Assessments
AQAP	Air Quality Action Plan
BMI	body mass index
BTS	Bureau of Transportation Statistics
CA EDD	California Employment Development Department
CAC	Corridor Advisory Committee
CADOE	California Department of Education
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CAS	collision avoidance systems
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CHIS	California Health Interview Survey
CHP	California Highway Patrol
CNEL	Community Noise Equivalent Level
CNG	compressed natural gas
CO	carbon monoxide

CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
county	Los Angeles County
CPI	Consumer Price Index
CVD	Cardiovascular disease
dB	decibel
dBA	A-weighted decibels
DPM	diesel particulate matter
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMS	Emergency Medical Services
EPA	U.S. Environmental Protection Agency
ER	Emergency room
ESWG	Environmental Subject Working Group
FARS	Fatality Analysis Reporting System
FBI	Federal Bureau of Investigation's
FHWA	Federal Highway Administration
FPPA	Farmland Protection Policy Act
GCCOG	Gateway Cities Council of Governments
GHGs	greenhouse gases
GIS	geographic information system
GP	General Purpose
GWP	global warming potential
haz mat	hazardous materials
HIA	Health Impact Assessment
HIP	Human Impact Partners
HOV	high-occupancy vehicle
HRAs	Health Risk Assessments
HUD	U.S. Department of Housing and Urban Development
I-	Interstate

ICTF	International Container Transfer Facility
ITS	Intelligent Transportation Systems
LA	Los Angeles
LAC	Local Advisory Committees
LACDPH	Los Angeles County Department of Public Health
LACHS	Los Angeles Community Health Services
LAFD	Los Angeles Fire Department
LAPD	Los Angeles Police Department
L_d	A-weighted daytime noise
L_{dn}	A-weighted day-night equivalent noise level over a 24-hour period
L_{eq}	equivalent average continuous noise level integrated over a period of time
L_n	A-weighted nighttime noise
LOS	Level Of Service
LPS	Locally Preferred Strategy
Metro	Los Angeles County Metropolitan Transportation Authority
mg	milligram
MI	Myocardial infarction
MIG	Moore Iacofano Goltsman, Inc.
mph	miles per hour
MSATs	Mobile Source Air Toxics
NCI	Neighborhood Completeness Indicator
NEPA	National Environmental Policy Act
NHTSA	National Highway Transportation Safety Administration
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
O_3	ozone
OEHHA	Office of Environmental Health Hazard Assessment
OR	odds ratio
OSHPD	Office of Statewide Health Planning and Development
PC	Project Committee

PE ROW	Pacific Electric Right-of-Way
PM	Particulate Matter
POLA	Port of Los Angeles
POLB	Port of Long Beach
ppm	part per million
PDIs	Pediatric Quality Indicators
PQIs	Prevention Quality Indicators
RFEI	Retail Food Environment Index
ROG	Reactive Organic Gases
RTIP	Regional Transportation Improvement Program
RTP	Regional Transportation Plan
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCIG	South Coast International Gateway
SCS	Sustainable Communities Strategy
SES	Socioeconomic status
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_X	sulfur oxides
SPA	Service Planning Area
SPUI	Single point urban interchange
SWITRS	Statewide Integrated Traffic Records System
TAC	Technical Advisory Committee
TEUs	twenty-foot-equivalent units
TNM	Traffic Noise Model
TSM/TDM	Transportation Systems Management/Transportation Demand Management
TWG	Technical Working Group
ultrafines	ultrafine particles
USDHHS	U.S. Department of Health and Human Services

USDOT	U.S. Department of Transportation
V/C	Volume to capacity
VHD	vehicle hours of delay
VMT	vehicle miles traveled
VOC	Volatile Organic Compounds
WHO	World Health Organization

1. Executive Summary

The Gateway Cities Air Quality Action Plan (AQAP) is a corridor-specific study requested by the I-710 Oversight Policy Committee in 2004. Funding for the AQAP has been secured and the study is now underway. It will assess how best to continue to improve air quality and public health by addressing both near-term and long-term measures for emissions reductions for all Gateway Cities. The Gateway Cities Council of Governments (GCCOG) is responsible for preparing the AQAP.

At the request of the I-710 Project Committee, this Health Impact Assessment (HIA) is one component that was added to the original scope of work for the AQAP. It is intended to assess the proposed I-710 Corridor Project alternatives and to evaluate selected health determinants to assess health outcomes linked to proposed actions of each alternative. At the time the AQAP was initiated (and subsequently the HIA), only draft I-710 technical studies were available. As such, the draft I-710 technical studies were used as resource material for input into this HIA.

For the purpose of context, the Los Angeles County Metropolitan Transportation Authority (Metro) and its funding partners are preparing the I-710 Corridor Project Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) to analyze alternatives for improving Interstate (I-) 710 from Ocean Boulevard in the City of Long Beach to State Route (SR-) 60, a distance of 18 miles. The purpose and need of the I-710 Corridor Project, as stated in the EIR/EIS Notice of Preparation, are to:

- Improve air quality and public health
- Improve traffic safety
- Address design deficiencies
- Address projected traffic volumes
- Address projected growth in population, employment, and economic activities related to goods movement.

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, as shown below in Table 1-1.

This executive summary briefly describes the screening and scoping processes of the I-710 HIA, and summarizes key findings and recommendations related to the six domains assessed in the HIA: mobility, air quality, noise, traffic safety, jobs and economic development, and access to neighborhood resources.

Table 1-1. The Steps of Health Impact Assessment

Screening	Determines the need and value of an HIA
Scoping	Determines which health impacts to evaluate, methods for analysis, and a workplan
Assessment	Provides: 1) a profile of existing health conditions 2) evaluation of potential health impacts
Recommendations	Provide strategies to manage identified adverse health impacts
Reporting	Includes: 1) development of the HIA report 2) communication of findings and recommendations
Monitoring	Tracks: 1) impacts on decision-making processes and the decision 2) impacts of the decision on health determinants

1.1 Screening

Screening, the first step of HIA, involves establishing the feasibility and value of an HIA for a particular decision-making context. A number of factors were taken into consideration in making the decision to conduct this HIA on the I-710 Corridor Project:

- Conditions related to the I-710 (e.g., air quality and traffic safety) are currently impacting the health of residents in the surrounding communities, and the proposed project has potentially significant health implications for these residents.
- There is a wealth of research, literature, and methods available to conduct this analysis. This includes the I-710 EIR/EIS, which analyzes the benefits, costs, and impacts of the alternative being considered, and thus contains a large amount of information that can be used as a starting point for analyzing health outcomes in the HIA.
- Residents near the I-710 and other stakeholders have vocalized their health-related concerns regarding the project and have called on decision-making bodies to conduct an HIA.
- Decision-making bodies associated with the I-710 Corridor Project voted in favor of conducting an HIA.

As a result of these factors, it was decided to conduct this HIA. Human Impact Partners led the I-710 HIA with support of a project team that consisted of Metro, GCCOG, ICF International, and Arellano and Associates.

The Project Team for the I-710 HIA was guided by input from the Gateway Cities Air Quality Action Plan I-710 Health Impact Assessment Technical Working Group (TWG), the Gateway Cities Air Quality Action Plan Technical Roundtable, the Gateway Cities Air Quality Action Plan Advisory Roundtable, and the Gateway Cities Environmental Committee. The GCCOG Transportation Committee and Board of Directors also participated in the preparation of the HIA.

The I-710 HIA will be used to inform the development of additional measures to further improve public health outcomes resulting from the I-710 Corridor Project alternatives and will be provided to the I-710 Corridor Project EIR/EIS Project Team upon completion. The decision, which has yet to be made, to include the results of the I-710 HIA in the I-710 Corridor Project EIR/EIS rests with the California Department of Transportation (Caltrans), lead agency for the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

1.2 Scoping

Scoping, the second step of HIA, involves determining which health determinants and impacts to evaluate, data sources and methods for analysis, and a workplan for completing the HIA.

The initial guidance for the I-710 HIA Scoping was provided by the I-710 Health Impact Assessment Technical Working Group, and subsequently the Gateway Cities Air Quality Action Plan Technical Roundtable, the Gateway Cities Air Quality Action Plan Advisory Roundtable, and the Gateway Cities Environmental Committee.

The goals of this HIA are to:

- Provide I-710 Corridor Project decision-makers and other stakeholders with positive and negative health effects, findings, and recommendations for alternatives being considered.
- Increase stakeholder participation and understanding of the I-710 Corridor Project.
- Identify community health concerns/issues within the Gateway Cities and their relationship to the I-710 Corridor Project.
- Provide a model for future transportation and infrastructure HIAs (including evidence and utility of conducting an HIA).
- Add value to the I-710 related analyses while utilizing the I-710 Corridor Project EIR/EIS technical data in the HIA to the greatest extent possible to reduce redundancy.

These goals set some parameters for the analysis. For example, the HIA analyzed only the alternatives being considered in the EIR/EIS and no other alternatives. These alternatives were:

- Alternative 1—No Build Alternative: This alternative consists of those transportation projects that are already programmed and/or committed to be constructed by or before the study's planning horizon year of 2035.
- Alternative 5A—Freeway Widening up to 10 General Purpose (GP) Lanes: The intent of Alternative 5A is to improve the I-710 mainline by widening the freeway to include ten lanes throughout the length of the corridor and modernizing its design. Alternative 5A also includes: the projects included in Alternative 1; Transportation Systems Management/Transportation Demand Management (TSM/TDM)/Transit/Intelligent Transportation Systems (ITS) improvements—including operational investments, policies, and actions aimed at improving goods movement—and passenger auto and transit travel; and arterial highway and I-710 congestion relief improvements including arterial highway improvements.

- Alternative 6A—10 GP Lanes plus Four-Lane Freight Corridor: Alternative 6A includes all the improvements from Alternative 5A with the addition of four separated freight movement lanes for exclusive use by conventional trucks from the ports (Ocean Boulevard) to the intermodal rail yards in Commerce and Vernon. This alternative is the Locally Preferred Strategy (LPS) that resulted from the prior I-710 Major Corridor Study plus additional design concept refinements.
- Alternative 6B—10 GP Lanes plus a Zero-Emission Four-Lane Freight Corridor. Alternative 6B includes all the improvements of Alternative 6A (described above) with the Freight Corridor restricted to trucks with zero tailpipe emissions. The Freight Corridor does not preclude future conversion to a fixed guideway (e.g., MagLev).
- Alternative 6C—10 GP Lanes plus a tolled Four-Lane Freight Corridor: Alternative 6C includes all the improvements of Alternatives 6A, but would toll trucks using the freight corridor.

The HIA used the same assumptions as, and much data from the draft I-710 technical studies. The HIA was completed before the draft EIR/EIS was completed, however, and not all the EIR/EIS data (e.g., noise and $PM_{2.5}$ modeling) was available. Therefore there are sections of the HIA that should be revisited when all the EIR/EIS data is available.

The following health determinants were selected for study:

- Mobility
- Air quality
- Noise
- Traffic safety
- Jobs and economic development
- Access to neighborhood resources

Pathway diagrams (examples shown in Figures 1-1 and 1-2) for each of these health determinants were developed to describe how the proposed project would impact health. Geographic boundaries were determined for each health determinant. Similar to the draft I-710 technical studies (i.e., the I-710 EIR/EIS), the HIA analyzed impacts in the year 2035 only. In addition to assessing impacts on the general population, impacts on vulnerable populations—including those defined by age, race/ethnicity, and/or income—were considered when stratified data was available.

The detailed scope is available in Chapter 3 of the report.

Figure 1-1. The Potential Health Impacts of the I-710 Corridor Project Mediated through Air Quality

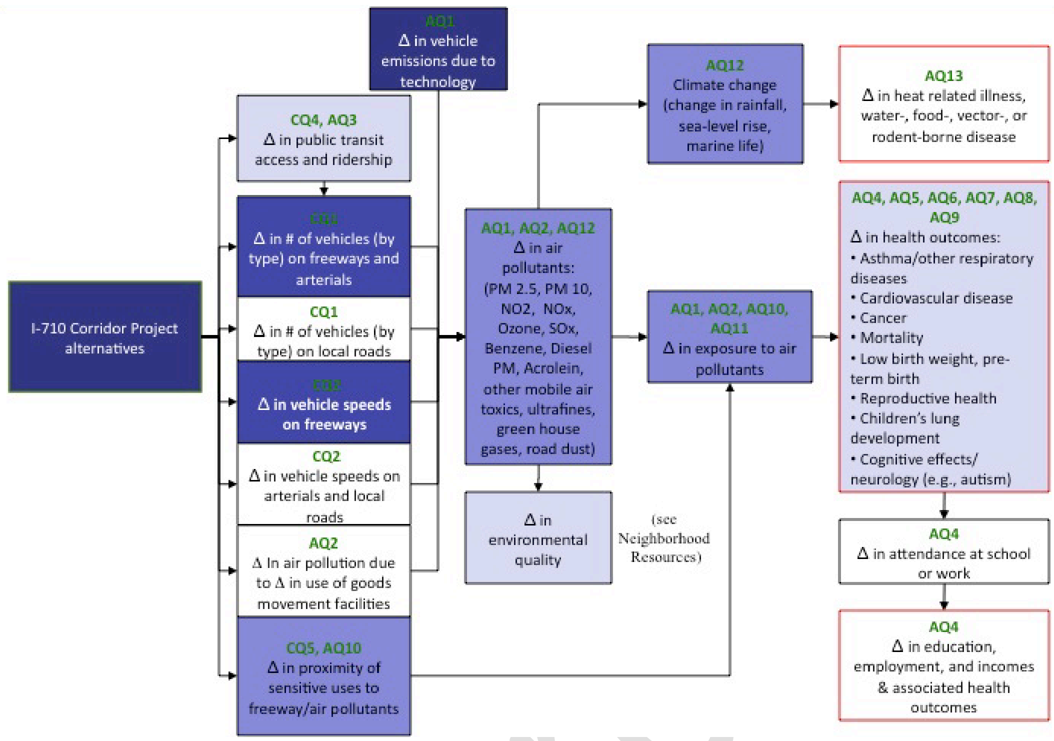
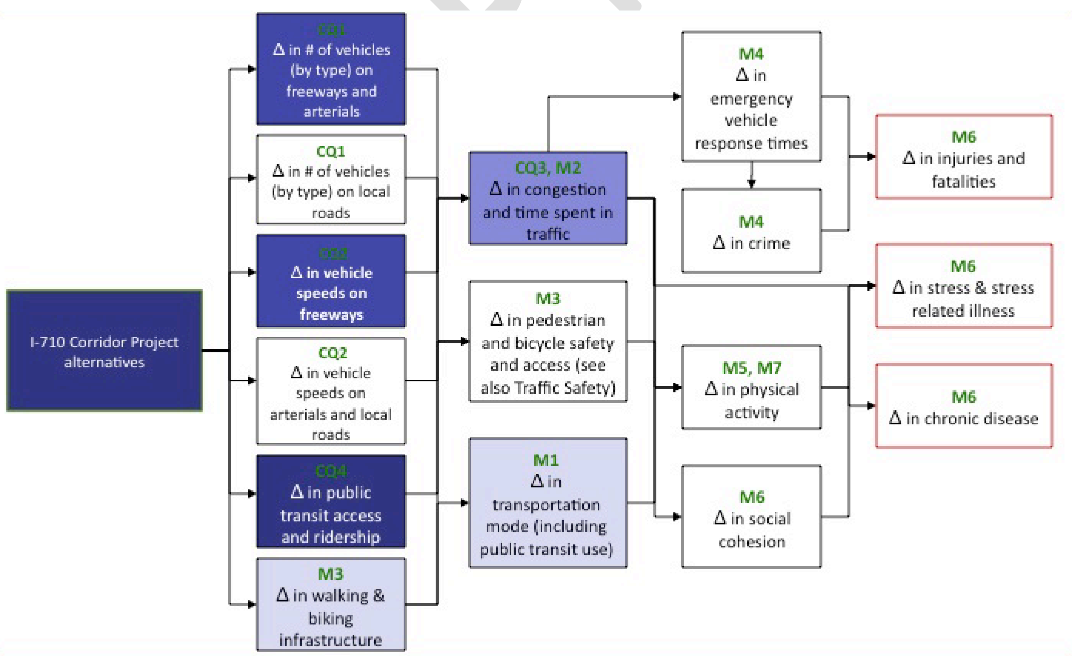


Figure 1-2. The Potential Health Impacts of the I-710 Corridor Project Mediated through Mobility



- Health impacts of stress include: poor mental health, increased inflammatory response, decreased immune response
- Health impacts of chronic disease includes: heart disease, diabetes, hypertension,
- Health impacts of delayed emergency response times include: stress, potential for survival and recovery

1.3 Assessment

Assessment, the third stage of HIA, involves profiling existing conditions and evaluating potential health outcomes. Scientific evidence found in the public health literature was reviewed to evaluate the relationships hypothesized in the pathway diagrams developed during scoping. Existing conditions data was collected from a number of sources, including documents being prepared for the EIR/EIS and other project-related documents (e.g., the Final I-710 Tier 2 Committee Report), the U.S. Census Bureau, the Los Angeles County Department of Public Health, the Office of Statewide Health Planning and Development, Metro, the Statewide Integrated Traffic Records System, and elsewhere. Using all this information, the proposed alternatives were then analyzed to understand how each would impact health.

One important caveat related to the Assessment findings in this HIA is that when analyzing effect levels for public health impacts, the transition from risk exposure to disease is complex and multifactorial. Many diseases are borne of multiple overlapping risk exposures, as well as social, economic, and environmental risk modifiers. Modifying factors are not distributed equally between all subpopulations. In addition, there is often a long delay between exposure and overt disease for many health determinants. This HIA investigates many health impacts and diseases but should not be construed as implying that the I-710 is or will be the only factor that determines health outcomes in the communities discussed.

Findings for each of the six health determinant assessed in the HIA are described in Section 1.4 below.

1.4 Findings and Recommendations

As described below and in greater detail in the full HIA report, the HIA finds that, compared to 2008 baseline, the alternatives under consideration are likely to lead to mixed health impacts:

- Health would likely improve under all the alternatives in terms of air quality impacts and as a result of an increase in the number of jobs available in the I-710 corridor.
- Negative health impacts related to noise will diminish the project's objective of improving public health.
- Project impacts on traffic safety are unclear; some improvements (e.g., separating trucks) would increase traffic safety, but overall increase in volume and speed under some alternatives could decrease safety.
- Based on changes in access to neighborhood resources, the health of some populations (i.e., those living further from the freeway) would be expected to improve, while other populations (i.e., those living closest to the freeway) would be expected to experience negative health impacts.
- Impacts from changes in mobility were not found to be health beneficial, and, as such, the proposed alternatives miss important opportunities to improve public health.

Findings and recommendations for each of the six analyzed health determinants are summarized briefly below.

Many of the issues addressed in the HIA are ongoing concerns in the LA region. It is critically important that implementation of the recommendations to improve conditions related to health outcomes be addressed on a regional scale, with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated public health objectives.

1.4.1 Mobility

Findings

Under all of the alternatives, automobile and truck traffic volumes on the freeway and arterials; speeds on the freeway, and, under some alternatives, on the arterials; vehicle miles traveled (VMT); and vehicle trips are likely to increase. The amount of these increases is dependent on the alternative. Although the EIR/EIS assumes the same public transit ridership for each alternative, the transportation literature indicates that mode share is likely to be dependent on traffic speeds and volumes, which differ between project alternatives. Traffic volumes and speeds are also likely to impact the use of active transportation—walking and biking—as a mode of transportation.

Scientific evidence in the public health literature firmly establishes the relationship between transportation mode choice and health. The health effects of mode choice are mediated through the following:

- Physical activity through active transport: Even small changes in physical activity rates resulting from changes in walking and biking would be likely to lead to changes in diabetes, heart disease, obesity, stress, mental illness, and longevity. Because higher traffic volumes on arterials and higher speeds on arterials and the freeway will reduce rates of walking and biking, Alternatives 6A/B/C are least likely to increase physical activity and positively impact these health outcomes. Alternative 5A is likely to have slightly better outcomes than Alternatives 6A/B/C because freeway speeds are lower. Because congestion may discourage driving, and thus raise the rate of transit use, Alternative 1 is likely to negatively impact physical activity and health the least of all the alternatives being considered. These impacts are likely to most affect children, the elderly, and disabled and lower-income people who have fewer opportunities to participate in sports or formal exercise programs.
- Social cohesion: Social connectivity helps manage stress, and is connected with longer lifespan and access to emotional and physical resources. Generally speaking, reductions in travel times and VMT and increases in walking/biking and public transit use will increase the amount of time one has with family, for social activities, and with neighbors. Because increases in travel speeds are likely to be offset by decreases in walking/biking, Alternatives 6A/B/C are unlikely to positively impact social cohesion. Negative impacts on social cohesion are more likely for Alternatives 1 and 5A than for Alternatives 6A/B/C because of longer commute times.
- Emergency response times: Under Alternatives 6A/B/C, emergency response times are likely to improve somewhat as a result of higher traffic speeds and will improve health outcomes associated with medical response. Under Alternative 5A, response times are likely to be similar to current levels because traffic speeds are similar. With lower roadway speeds, Alternative 1 is likely to result in

slightly longer response times, which would put more people at risk of poor outcomes in emergency situations. The impacts of these changes are likely to be minor.

As a result of these changes in active transport and social cohesion, levels of chronic disease (e.g., cardiovascular disease, diabetes) and mental illness (e.g., depression) are expected to stay the same or increase, and lifespan is expected to stay the same or decrease. Small changes in active transport could lead to significant changes in lifespan, chronic disease, and mental health, so this represents a significant lost opportunity to improve public health.

The health impacts of the proposed I-710 Corridor Project EIR/EIS alternatives mediated through mobility are summarized in Table 1-2.

Table 1-2. Summary of Predicted Mobility-Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Chronic disease (e.g., cardiovascular disease, diabetes) and decreased lifespan (primarily from changes in active transportation but also changes in social cohesion and stress)					
1	~/–	Potentially significant, non-quantifiable	Mod–High	♦♦♦	Project will have multiple impacts, some of which offset others.
5A					
6A					
6B					
6C					
Mental illness (e.g., depression; primarily from changes in active transportation, but also from changes in social cohesion and stress)					
1	~/–	Potentially significant, non-quantifiable	Mod–High	♦♦	Project will have multiple impacts, some of which offset others.
5A					
6A					
6B					
6C					
Negative health outcomes associated with delayed emergency response					
1	–	Minor	Mod–High	♦	Data in the literature is not conclusive regarding the impact of response time on health outcomes; emergency response time changes roughly estimated.
5A	~	Negligible			
6A	+	Minor			
6B	+	Minor			
6C	+	Minor			

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between mobility and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

Recommendations

To offset the negative health impacts associated with the reliance on driving as the primary mechanism for mobility, the alternatives being considered should include more concrete proposals and commitments to improve public transit, walkability, and bikeability. For example, public transit, walking, and biking infrastructure improvements proposed in the 2008 Regional Transportation Plan should be fully funded before the I-710 Corridor Project funding commitments are sought. Such proposals and commitments would help the project meet its stated objective of improving public health. A complete set of recommendations is contained in the main HIA chapters below; some key recommendations include:

Vehicle Travel

- Adopt or advocate for policies to reduce automobile and truck usage including, for example, by increasing use of the lowest emission rail technologies to transport freight and continuing to promote land use policies in the Gateway Cities that encourage higher density and mixed use development.
- Reduce and enforce speeds on targeted roadways using traffic calming for safety and to encourage bicycling and walking. Incorporate a bicycle and pedestrian plan (e.g., complete streets) into the project.
- For any alternative selected, fully fund and if necessary strengthen enforcement of truck route regulations.

Public Transportation

- In addition to public transit improvements that are proposed to be funded as part of Alternatives 5A and 6A/B/C, ensure the improved transit infrastructure in the Gateway Cities as described in the 2012 RTP and 2011 Gateway Cities Sustainable Communities Strategy (SCS) is funded and implemented.
- Evaluate options for dedicated bus lanes on targeted arterials to improve transit speed to make it more time-competitive with automobile and train trips.
- Support improvements of bus stops to make them safer, more accessible by foot, and more comfortable.
- Conduct an equity analysis to examine where transit will be most used and will have the greatest impact while serving those with the most need for transit options.

Walkability

- Ensure the improved walkability infrastructure in the Gateway Cities as described in the 2012 RTP and 2011 SCS is funded and implemented.

- In targeted areas, using physical engineered measures, reduce traffic speeds and volumes on streets with restaurants, stores, and services so that safety and walkability are improved. Examples include chicanes, lateral shifts, reduced lane width, pedestrian refuges, and narrower lane width.
- Support improvements in pedestrian infrastructure, including piano-key crosswalk striping and pedestrian count-down signals at signalized intersections.
- Assist in funding opportunities and/or direct project mitigation (as appropriate) that connects and/or creates pedestrian-friendly links between residential areas, transit-oriented neighborhoods/facilities, selected commercial and mixed use communities across and along the freeway, arterials, and the LA River (and Rio Honda Channel where appropriate). The cross-links or connectors should provide quality walking environments with access to existing or planned trails or other pedestrian networks.

<u>Bikeability</u>

- Ensure the improved bicycling infrastructure in the Gateway Cities as described in the 2012 RTP and 2011 SCS is funded and implemented.
- Create more bicycling routes and improve bicycling infrastructure beyond what is already proposed with the 2012 Regional Transportation Plan to offset increased traffic and volume associated with any alternative.

1.4.2 Air Quality

Findings

Los Angeles has the worst air pollution in the nation, primarily as a result of motor vehicle use. The I-710 is a major corridor linking the ports of Long Beach and Los Angeles to other major highways and communities in the region. Traffic flow on the I-710 is very high, and over 25% of vehicles are heavy-duty diesel trucks. Vehicle emissions impact air quality in the corridor communities and region, and contribute significantly to regional greenhouse gas emissions.

Scientific evidence in the public health literature firmly establishes the relationship between traffic-related air pollution and numerous negative health impacts. Traffic-related air pollutants known to impact health include the following:

- Criteria air pollutants: ozone, particulate matter (PM, including PM_{10}, $PM_{2.5}$, and ultrafines), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide, and lead.
- Mobile Source Air Toxics (MSATs): while there are hundreds of MSATs, the six most commonly studied are benzene, 1,3-Butadine, formaldehyde, acrolein, acetaldehyde, and diesel particulate matter (DPM).
- Greenhouse gases (GHGs) such as carbon dioxide (CO_2).

It is well documented that traffic is a significant source of most of these air pollutants. Other sources include, for example, maritime vessels and point sources such as refineries and warehouses. Research also suggests that low income and minority populations live closer to busy roadways and freeways, and thus are exposed to higher concentrations of air pollutants from vehicle emissions.

Health outcomes causally related to these pollutants include asthma and other respiratory diseases, cardiovascular disease, cancer, premature death, mortality, and preterm and low birth weight births. Furthermore, epidemiologic studies have consistently demonstrated that children and adults living in proximity to busy roadways have poorer health outcomes. Many studies supporting these findings have been conducted in southern California, and several have been specific to the I-710.

Although traffic volumes are assumed to increase significantly, because of cleaner fuels and more efficient technologies, under all the alternatives being considered in the I-710 Corridor Project, air quality in 2035 near the I-710 and in the region is predicted to improve. With reductions in emissions of and exposure to NO_2, CO, $PM_{2.5}$, and PM_{10} as well as the MSATs, asthma, mortality, cancer, cardiovascular disease, and low birth weight and preterm birth levels will decrease. These reductions in air pollution from the I-710 do not ensure that the region will meet $PM_{2.5}$ air quality standards. Also note that these conclusions are based on preliminary and incomplete data contained in an early version of the draft I-710 AQ/HRA technical study.

Due to increased population and vehicle usage, levels of regional GHGs are estimated to increase under all of the alternatives, but this is not expected to noticeably result in impacts to health in the I-710 corridor.

The health impacts of the proposed I-710 Corridor Project EIR/EIS alternatives mediated through air quality are summarized in Table 1-3.

Table 1-3. Summary of Predicted Air Quality–Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Asthma					
1					
5A					
6A	+	Odds ratio of 1.15 for every 10 μg/m^3 increase of annual average NO_2	High	♦♦♦	Final traffic analyses and air quality modeling were not available at the time of completion of this HIA; modeling results are not always accurate.
6B					
6C					
Mortality					
1					
5A					
6A	+	Estimates pending $PM_{2.5}$ modeling data	High	♦♦♦	Modeled estimates of mortality attributable to $PM_{2.5}$ were not available for this analysis. Magnitude is not estimated.
6B					
6C					
Cancer risk (from MSATs from the I-710 corridor)					
1		Minor			
5A		Minor			
6A	+	Minor	High	♦♦♦	Final traffic analyses and air quality modeling were not available at the time of completion of this HIA; modeling results are not always accurate.
6B		Minor			
6C		Not available			
Cardiovascular disease					
1					
5A					
6A	+	Magnitude not estimated	High	♦♦♦	Final traffic analyses and air quality modeling were not available at the time of completion of this HIA; modeling results are not always accurate.
6B					
6C					
Low birth weight and pre-term births					
1					
5A					
6A	+	Magnitude not estimated	Mod	♦♦	Final traffic analyses and air quality modeling were not available at the time of completion of this HIA; modeling results are not always accurate.
6B					
6C					

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between air quality and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

Recommendations

Although air quality is predicted to improve, because the issue is a primary concern of the community, there are steps that can be taken to further improve air quality and public health in the I-710 corridor. Many of the recommendations in this HIA can be implemented before the project is complete. A full set of recommendations is contained in the main HIA chapters below.

Research and Analysis

- Confirm the findings in this HIA with the final data from traffic modeling in the I-710 Corridor Project EIR/EIS and the Health Risk Assessment (HRA), including completing the particulate matter analyses.
- PM Analysis: The draft I-710 HRA does not provide a quantitative impact analysis of health impacts resulting from change in motor vehicle emissions of $PM_{2.5}$, PM_{10}, or Ultrafines, including impacts on mortality or childhood respiratory disease. A complete analysis of PM health effects, based on modeling, is recommended to better evaluate I-710 alternatives and strategies. This analysis is being completed as part of the AQAP.
- Ensure air quality modeling takes into account the distribution of air pollution in the presence of sound walls and the impacts of low noise road surfaces, if there are any.
- Fund a study to understand the most effective way to accelerate the adoption of zero emission technologies for trucks carrying freight under any alternative being considered for the I-710.

Goods Movement, Transportation, and Land Use Planning

- For any alternative, aggressively pursue policies that accelerate the use of zero emission trucks.
- Invest resources for planning and implementation of bike and walking infrastructure to improve walking and biking conditions, increase walking and biking mode share, and reduce vehicle trips.
- Support development and implementation of alternative transport of goods from the ports, such as lowest emission rail technology possible, in the I-710 corridor and beyond.
- Planning departments should ensure that all local land use planning improves the separation of residential and other sensitive uses from the goods movement infrastructure. All attempts should be made to move the goods movement infrastructure as close to the freeway as possible and to move sensitive uses away from the freeway and its associated traffic as well as away from the goods movement infrastructure. For example, 1) develop truck parking facilities and truck stops with services near the freeway and 2) pass city ordinances that would a) restrict potential land uses to reduce conflicts between sensitive receptors and air pollution-producing facilities and b) require new residential construction or uses to evaluate air existing pollution levels and mitigate if necessary before issuing permits.
- Develop a complete inventory of goods movement facilities (e.g., warehouses, transloading facilities) in the corridor in order to be able to understand the impacts that air pollution related to these facilities have on nearby receptors.

Air Pollution Emissions Reductions and Exposure Mitigations

- Aggressively apply a variety of truck emissions reductions strategies. Aggressively pursue strategies outlined by the Federal Highway Administration (FHWA) to reduce truck emissions through technology advancements and operations. Strategies include the implementation and use of filters and catalysts, the use of alternative "cleaner" fuel, increasing fuel efficiency, replacement of vehicle fleets, and reducing truck idling.
- Provide increased incentives for cleaner trucks, especially for local and small businesses that may not be able to afford truck upgrades/replacement.
- Increase vegetation known to reduce air pollutants (such as conifer trees) along the I-710.

Funding, Enforcing, and Strengthening Air Quality-Related Regulations

- Seek funding for mitigations for air quality impacts (e.g., providing safer and more accessible access to walking, biking, and transit to reduce individual automobile driving by mode shift) and treatment of air quality impacts (e.g., asthma case management programs); or, if Alternative 6C is adopted, use revenue from tolling for this purpose. Consider tolling (per truck or per volume of pollutants emitted) under all alternatives to provide revenue to fund mitigation strategies.
- If cleaner trucks or zero emission trucks are adopted as a strategy, ensure that proper regulatory and enforcement actions maintain emissions reduction goals over time and that such efforts are fully funded.
- Enforce and, if needed, strengthen regulations regarding truck emissions and consider funding truck emissions reduction programs.
- For any alternative selected, fully fund and, if necessary, strengthen enforcement of truck route usage as well as idling regulations. For example, truck routes should not be located near sensitive receptors such as parks, schools, and senior citizen facilities.

Post Build Out Monitoring and Mitigation

- After the project is completed, regularly monitor air quality at sensitive receptors such as schools, community centers, libraries, and senior facilities. If air pollutant levels rise above what is considered harmful to human health and this is attributable to the I-710 project, commit to retrofit these facilities (e.g., providing upgrades to building thermal performance and ventilation systems) to keep indoor air pollutant levels below that which is considered harmful to human health.
- After the project is completed, regularly monitor air pollution levels at parks and playgrounds. If air pollutant levels rise above what is considered harmful to human health and this is attributable to the I-710 project, commit to providing communities with new parks away from freeways.

If any alternative that includes zero emission trucks is adopted, policies and mechanisms must be put in place before construction begins to ensure that the freight corridor is used only by designated clean trucks. If such policies are not securely in place, there is the possibility that the freight corridor could be built and it is then found that implementing the zero emission truck policy is impossible, which would be detrimental to air quality and health. The communities neighboring the I-710 must have concrete assurances that zero emissions truck policies for the freight corridor will be implemented and enforced.

1.4.3 Noise

Findings

Scientific evidence in the public health literature firmly establishes the relationship between traffic-related noise and health. The health effects of noise from the I-710, truck traffic on arterials and local roads, and goods movement facilities in the communities near the I-710 include the following:

- Annoyance: Annoyance is related to several health effects associated with noise, including elevated blood pressure, circulatory disease, ulcers, and colitis. An estimated 22,000 and 35,000 people would currently report being highly annoyed by exposure to noise in the southern portion of the I-710 corridor (south of I-105). Estimated 2035 noise levels under all alternatives being considered in the EIR/EIS are well above the 50–55 A-weighted decibels (dBA) noise levels at which a causal effect of noise on annoyance has been well established.
- Sleep Disturbance: Sleep disturbance has been shown to begin in the 55–60 dBA range. An estimated 5,000 and 7,000 people would currently be expected to report high degrees of sleep disturbance as a result of noise exposure in the southern portion of the I-710 corridor (south of I-105). Estimated 2035 noise levels under all alternatives at night are likely to be above the range at which sleep disturbance begins. Health consequences of lack of sleep include fatigue, impaired endocrine and immune systems, and psychological effects.
- Cardiovascular disease: Estimated 2035 noise levels under all alternatives are in the range of levels at which noise has been shown to cause hypertension (L_{dn} = 70 dBA) and myocardial infarction (L_{dn} = 60 dBA).
- Cognitive impairment and academic achievement in children: Without mitigation, under all alternatives being considered, the number of schools with indoor noise levels well above the World Health Organization (WHO) recommended 35 dBA is highly likely to increase. There is significant evidence that many school age children will be at increased risk of attention span, concentration and remembering, and reading ability deficits. These are likely to result in significant impacts on lifespan, earning potential and the associated impacts on health of income, and prevalence of chronic and contagious disease as well as mental health issues.
- Hearing impairment: There is strong evidence that none of the alternatives being considered is likely to result in noise levels that would lead to hearing impairment. However, people with existing hearing impairment, for example, seniors experiencing hearing loss, will be impacted. Those populations will have more difficulty communicating with others as a result of higher noise levels.

The health impacts of the proposed I-710 Corridor Project EIR/EIS alternatives mediated through noise are summarized in Table 1-4.

Table 1-4. Summary of Predicted Noise-Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Annoyance					
1	–	Estimates pending noise modeling data from Caltrans	Low	♦♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Sleep disturbance					
1	–	Estimates pending noise modeling data from Caltrans	Mod–High	♦♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Cardiovascular disease (including hypertension and myocardial infarction)					
1	–	Estimates pending noise modeling data from Caltrans	High	♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Cognitive impairment and academic achievement					
1	–	Estimates pending noise modeling data from Caltrans	Mod–High	♦♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Hearing impairment					
1	~	None	Mod	♦♦♦	
5A		None			
6A		None			
6B		None			
6C		None			

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between noise and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

Recommendations

Caltrans has preliminarily identified locations for soundwalls near sensitive receptors along the I-710. This is a very important mitigation measure, but, as the Final I-710 Tier 2 Committee Report states, “Noise issues go beyond simply building more soundwalls.” In addition to building soundwalls the recommendations in the following areas would mitigate impacts of noise on health in the I-710 communities. A complete set of recommendations is contained in the main HIA chapters below.

Noise Analysis

- Complete the noise modeling for the I-710 Corridor Project EIR/EIS alternatives and use the results to quantitatively predict changes in annoyance and sleep disturbance and qualitatively assess changes in other health outcomes under the proposed alternatives.
- In the final noise report, describe existing and future noise levels using multiple measures, including separating daytime and nighttime noise, and measure ambient noise at additional sites.

Goods Movement, Transportation, and Land Use Planning

- All strategies to reduce the number of trucks should be implemented, including other alternatives for moving freight such as increasing on-dock rail using the lowest emission rail technologies feasible.
- Develop truck parking facilities and truck stops with services (e.g., restaurants, repair shops) near the freeway so that drivers do not need to drive farther into the communities and near sensitive uses.
- Pass city ordinances restricting potential land uses to reduce conflict between sensitive receptors and noise-producing facilities.
- Pass city ordinances requiring new construction or uses to evaluate noise levels and mitigate if necessary before issuing permits.
- As the Healthy Communities and Healthy Economies: A Toolkit for Goods Movement Report (Moore Iacofano Goltsman, Inc. (MIG) and ICF International 2009[326]) states, planning departments can:
  - “Review and approve applications for new land uses (such as new warehouses) for fit within the General Plan framework and define measures (such as setbacks or noise restrictions) that must be taken to deal with any adverse impacts
  - Negotiate voluntary restrictions on hours of operation and noise for existing facilities.”
- Use the Conditional Use Permit process to require goods movement related facilities to:
  - Post signage informing drivers of idling regulations and truck routes;
  - Require new facilities to locate loading docks and driveways as far away as possible from sensitive receptors; and
  - Use cargo handling equipment with noise mitigation technology (e.g., electric engines).

- Starting with existing residential streets that are walkable/bikeable, expand the network of safe walkable/bikeable streets in low-noise areas throughout the I-710 corridor to provide quiet and pleasant streets that can be used for active transportation and for physical activity.

<u>Noise Mitigations through Design</u>

- Construct sound walls in all locations in the corridor that are adjacent to a residential area, school, or park. For these soundwalls, use greening and aesthetic principles found in the project's Urban Design and Aesthetics Toolbox Report.
- Use low-noise (e.g., rubberized) road surfaces, evaluating alternative materials with regards to their effects on air quality.
- Work with acoustic scientists to design the freeway geometry so as to minimize noise, for example, by minimizing the number of inclines.
- Consider using variable tolling (e.g., congestion pricing) and/or changes to port gate hours to reduce variation of noise and peak noise periods.
- Create and fund a program that provides private property owners funding and technical assistance to augment acoustical insulation in private residences.

<u>Funding, Enforcing, and Strengthening Noise-Related Regulations</u>

- Use revenue from tolling to fund mitigations for noise impacts. Funds could be used, for example, for enforcement of truck routes, parking, idling regulations, and speed limits; installation of truck noise reduction technology; sound insulation at schools; and vegetative buffers between freeways and parks.
- For any alternative selected, fully fund and if necessary strengthen enforcement of truck route and parking regulations as well as idling regulations. For example, parking rules could prohibit trucks from parking adjacent to parks and other recreational facilities. Local jurisdictions could implement enforcement of the California Air Resources Board's (CARB's) idling regulations.
- Enforce and, if needed, strengthen regulations regarding truck noise (e.g., engine brake laws) and consider funding truck noise reduction programs.
- Enforce speed limits, considering photo-enforcement as a cost-effective means to limit noise.

<u>Post Build-Out Monitoring and Mitigations</u>

- After the project is completed, regularly monitor noise levels at schools, community centers, libraries, and senior facilities. If noise levels rise above what is considered harmful to human health and this is attributable to the I-710 project, commit to retrofitting these facilities (e.g., providing upgrades to windows and ventilation systems) to keep indoor noise below levels considered harmful by the WHO guidelines.
- After the project is completed, regularly monitor indoor noise levels in residences near the freeway and near goods movement infrastructure (e.g., train yards and warehouses). If noise levels rise

above what is considered harmful to human health and this is attributable to the I-710 project, retrofit to noise insulate either the residences (through windows and ventilation) or, if possible, noise producing equipment in goods movement facilities.

1.4.4 Traffic Safety

Findings

Scientific evidence in the literature firmly establishes the relationship between traffic volumes and speeds and the number and severity of collisions involving cars, trucks, and/or pedestrians and bicyclists. The literature also firmly establishes the links between many roadway and intersection improvements (including the separation of trucks and cars on freeways) and collisions. The literature can generally be summarized as follows:

- Automobiles: The number of collisions involving cars increases with vehicle volume and speed. Many roadway and intersection improvements reduce the number of car collisions. The severity of collisions involving cars increases with speed.
- Trucks: The number and severity of collisions involving trucks increase with vehicle volume and speed. Separation of trucks from cars decreases the number and severity of collisions. Other roadway improvements (e.g., at ramps) can reduce the number of truck collisions as well. Collisions involving trucks tend to be disproportionately severe.
- Pedestrians/bicyclists: The number of collisions between a vehicle and a pedestrian or bicyclist increases with the volume of pedestrians/bikes. These collisions tend to be disproportionately severe.

Based on these findings and on anticipated changes for each alternative being considered in the I-710 Corridor Project EIR/EIS, in the I-710 general purpose lanes and on the arterials near the I-710:

- Alternative 1 will lead to an increase in the number of collisions involving cars, but these are likely to be lower severity collisions. The number of collisions involving trucks will also increase and these are likely to be higher severity collisions.
- It is uncertain how the number and severity of collisions will change under Alternatives 5A and 6A/B/C because some anticipated changes (e.g., increases in volumes and speeds) would increase the number and severity of collisions while others (e.g., separation of cars and trucks, ramp improvements, intersection improvements) would decrease the number and severity of collisions.
- On arterials and other roads nearby, future growth in population and traffic volume will result in an increased frequency of vehicle–pedestrian/bicycle collisions, which are disproportionately severe, under all alternatives. Changes in pedestrian/bicycle volumes specific to each alternative may lead to differences in the number of such collisions.

In addition, the number of hazardous material incidents on the I-710 is expected to increase in proportion to truck volume. Infrequently, such incidents can be highly severe, but most often they are of low severity.

The health impacts of the proposed I-710 Corridor Project EIR/EIS alternatives mediated through traffic safety are summarized in Table 1-5.

Table 1-5. Summary of Predicted Traffic Safety–Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Non-Truck vehicle–vehicle fatalities and injuries					
1	–	Minor	High	♦♦♦	Relative impacts of roadway improvements compared to volume and speed changes uncertain
5A	?	Unknown			
6A	?	Unknown			
6B	?	Unknown			
6C	?	Unknown			
Truck–Auto fatalities and injuries					
1	–	Moderate	High	♦♦♦	Relative impacts of roadway improvements compared to volume and speed changes uncertain
5A	?	Unknown			
6A	?	Unknown			
6B	?	Unknown			
6C	?	Unknown			
Vehicle–Pedestrian/Bicycle fatalities and injuries					
1	–	Minor–Mod	High	♦♦	Changes in pedestrian and bicycle activity uncertain
5A		Minor			
6A		Minor			
6B		Minor			
6C		Minor			
Hazardous materials exposure from releases					
1	~/–	Negligible	Typically low, but infre-quently high	♦	High severity hazardous material spills are low probability events
5A		Negligible			
6A		Negligible			
6B		Negligible			
6C		Negligible			

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~). "?" indicates that the direction is uncertain.

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between traffic safety and the 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.

Recommendations

Causes of traffic collisions are complex and intertwined. The goals of vehicle-throughput efficiency and improved traffic safety, especially for non-motorized residents, can be at odds. The following recommendations would help mitigate the decreases in traffic safety that may result from changes in vehicle volumes and speeds on the freeway and arterials as well as increases in pedestrian and bicycle volumes on the arterials.

<u>Traffic Safety Analysis</u>

- Traffic safety experts should conduct an analysis of the impacts of the proposed I-710 improvements and the changes in volumes and speeds on collision rates using crash reduction factor methodology.
- Conduct further traffic modeling to determine vehicle speeds and trips taken on arterials to better understand the relationship between freeway expansion and traffic collisions in neighborhoods.

<u>Vehicles</u>

- Separate cars and trucks on the freeway under any alternative. This can be done through the freight corridor, as proposed in Alternative 6A/B/C, or through lane restrictions.
- Strictly enforce truck routes to keep them out of residential neighborhoods in order to reduce truck–pedestrian/bicyclist collisions.

<u>Walking and Bicycling Improvements</u>

- Supplement the intersection improvements outlined in the draft I-710 Corridor Project EIR/EIS with pedestrian-level improvements that increase their visibility and safety. Such improvements include, for example, clearly marked and protected crosswalks (e.g., with laddered crosswalks and pedestrian countdown signals).
- Starting with existing residential streets that are walkable/bikeable, expand the network of walkable/bikeable streets throughout the I-710 corridor to provide safe and pleasant streets that can be used for active transportation. This could include implementing "bicycle boulevards" (i.e., limited-access, low speed streets that have traffic calming features such as mid-block diverters with bicycle cut-outs) in local streets.
- Provide adequate facilities for pedestrians and bicyclists to cross the new single point urban interchanges (SPUIs) safely so that non-motorized transportation use is not discouraged.

1.4.5 Jobs and Economic Development

Findings

Income is one of the strongest and most consistent predictors of health and disease in the public health research literature, and health is inextricably linked to the availability and affordability of material resources. Because of this, the economic health of a region is an important indicator of the potential health of its residents.

Socioeconomic status (SES) has been extensively researched as a key factor that affects health. Scientific evidence in the public health literature firmly establishes the relationship between education, income, and occupational prestige or status, or “job control” and many health outcomes including lifespan, overall health, and chronic disease. In addition, unemployment has been shown to be a serious risk factor for both chronic disease and mental health.

All the alternatives being considered in the I-710 Corridor Project EIR/EIS assume that the Ports of Los Angeles and Long Beach will expand their operations to process approximately 42 million twenty-foot-equivalent units (TEUs) annually in 2035 (compared to approximately 13 million TEUs in 2008). In making this assumption, the EIR/EIS also therefore assumes that, under any alternative, the goods movement sector will grow the same (substantial) amount. The bulk of goods movement–related job growth is therefore assumed to be the same for all alternatives, and the differences between the alternatives in terms of job growth are limited to changes specific to each alternative. Because of this, the primary factors that inform this HIA’s impact analysis is the speed of moving freight, which may impact the cost of transported goods, and the location of future growth in the goods movement industry.

There are at least two competing hypotheses regarding impacts of the I-710 Corridor Project on the local economy in the study area and in the Gateway Cities:

- It is possible that Alternatives 5A and 6A/B/C will lead to economic growth along the corridor. As a result of decreased congestion and travel times, costs of business inputs may be lower, and the area may become more attractive to businesses for which these factors are important and thus improve commercial land values. On the other hand, under Alternative 1 congestion may increase the costs of doing business (e.g., by requiring the hiring of more truck drivers to move the same amount of goods) and may thereby hurt the local economy.
- It is also possible that, especially for Alternatives 6A/B/C, parts of the goods movement infrastructure (e.g., warehouses) may relocate farther from the ports to locations with cheaper land and less congestion (e.g., the Inland Empire). This could lead to decreased use of the goods movement facilities in the Gateway Cities and negative impacts on the local economy. Using this logic, Alternative 1, on the other hand, could make it more difficult for goods movement related business to move farther inland and thus keep businesses and jobs in the Gateway Cities. This may result in higher costs of doing business under Alternative 1, but an analysis of this is beyond the scope of this HIA.

Evidence suggests that total goods movement jobs will increase in the I-710 corridor because some industries, such as transloading facilities, are highly unlikely to move farther from the ports (Husing 2004[229]). Overall changes in terms of numbers, types, and locations of jobs are difficult to predict and have not been modeled elsewhere. Therefore, there is not enough information to make more specific predictions regarding the impact of the I-710 alternatives on the future economy, the costs of doing business, business locations, the costs of goods and services, or employment in the study area or in the Gateway Cities.

Alternative 6B may also potentially create and foster a new sector of jobs in the research, development, and manufacturing of zero emission technologies. The growth of this "green" industry may help to increase employment rates in the study area, assuming that the education and skills required for these jobs either match the education and skill base of the local population or that a significant investment in local job-training is made. Increased employment would likely result in health benefits (e.g., increased lifespan, reduced chronic disease, and improved mental health) for corridor residents.

Increased employment and economic development is likely to result in increased tax revenue that could be used for health-beneficial services and projects. It is unclear whether income to local governments would offset the increased costs of services required to support businesses as well as the costs of maintaining roads that deteriorate quickly due to high truck volumes.

The increase in jobs in the I-710 corridor would result in health benefits (e.g., increased lifespan, reduced chronic and communicable disease, and improved mental health) for corridor residents if employment for these jobs is sourced locally and if ample training opportunities are provided. The health impacts of the proposed I-710 Corridor Project EIR/EIS alternatives mediated through jobs and econcomic development are summarized in Table 1-6.

Table 1-6. Summary of Predicted Jobs-Related Health Impacts

<table>
<tr><th rowspan="2">Health Impact/ Alternative</th><th colspan="2">Impacts of Alternatives</th><th colspan="2">Health Outcome</th><th rowspan="2">Uncertainties</th></tr>
<tr><th>Impact</th><th>Magnitude</th><th>Severity</th><th>Strength of Causal Evidence</th></tr>
<tr><td colspan="6">Chronic disease (e.g., cardiovascular disease, diabetes) and decreased lifespan (e.g., from changes in income, employment, and access to health benefits)</td></tr>
<tr><td>1</td><td rowspan="5">+</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">High</td><td rowspan="5">♦♦♦</td><td rowspan="5">Distribution of new jobs between I-710 Corridor Communities and greater region uncertain.</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Mental Illness (e.g., depression; from changes in income and employment)</td></tr>
<tr><td>1</td><td rowspan="5">+</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">Mod–High</td><td rowspan="5">♦♦</td><td rowspan="5">Distribution of new jobs between I-710 Corridor Communities and greater region uncertain.</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Explanations:
Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).
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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between noise and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.</td></tr>
</table>

Recommendations

While job growth in the I-710 corridor is expected under all the alternatives, it is unclear how the alternatives will differentially impact the residents and businesses in the I-710 corridor from the perspective of jobs and economic development. The recommendations below would increase the number and quality of jobs available to local residents who currently face high unemployment rates.

Jobs and Economic Analysis

- Conduct economic research and modeling to determine how the proposed I-170 Corridor Project alternatives, through changes in traffic volumes and speeds, will impact local and regional costs of doing business and job growth. This analysis should include detailed information regarding geographic job distribution as well as a disaggregated analysis of income from new jobs.
- Conduct a cost-benefit analysis that details the benefits of the I-710 Corridor Project (e.g., business costs related to reduced congestion under some alternatives) and costs (e.g., construction). The analysis should include externalities such as potential changes in healthcare-related costs and potential impacts on business sectors unrelated to goods movement.

Local Job Tracking, Creation, and Training

- Measure and track the proportion of local jobs in each industry that are filled by local residents. This data would allow policymakers to make informed decisions regarding strategies to enhance and stimulate local economies.
- Through incentives, encourage businesses to locate in the I-710 corridor communities. Incentives may be in the form of tax breaks or credits or may be in the form of lower loan interest rates for potential small business owners, among others.
- Increase job-training opportunities for residents in the study area to better prepare the workforce for the employment opportunities in the region and reduce unemployment. Training should target jobs that pay a living wage and provide benefits such as health insurance.
- Encourage educational programs that prepare the local population for living wage jobs.

Green Jobs Tracking and Stimulus

- The green and sustainable technology jobs created locally (e.g., through Alternative 6B or projects at the ports) could be a strong source of employment, training opportunities, and improved health outcomes for residents in the study area. Opportunities in this relatively new industry should be encouraged to move into the I-710 Corridor Project study area regardless of the build alternative chosen, and government agencies and employers should be encouraged to train local workers in skills that will ensure that employers have a qualified labor pool and that will allow these new employees to succeed in this field.

1.4.6 Neighborhood Resources

Findings

Transportation planning research describes the trade-offs between a freeway's ability to increase mobility and move people and goods through an area and its negative impacts on "place-making." Access to a mix of public services and retail goods is important for health and quality of life, increasing walking and biking, possibilities for healthful and meaningful work, and interactions among neighbors while reducing daily vehicle trips and miles traveled as well as air and noise pollution. Scientific evidence in the public health literature establishes links between the following neighborhood resources and health: childcare, schools, libraries, parks, community centers, community gardens, post offices, banks, pharmacies, public art, food retail, and health care facilities.

The I-710 corridor communities currently have adequately complete neighborhoods, with access to a reasonable variety of resources, though some areas have more access to this variety than other areas. The I-710 Corridor Project is likely to impact neighborhood resources through changes in access to these resources, investment in the I-710 corridor communities, perceptions of environmental quality, and the usability of these resources, though these are difficult to predict. For example:

- As described in Chapter 6, "Mobility," none of the alternatives being considered is likely to increase walkability/bikeability, and, therefore, access to goods and services by this mode is likely to, at best, stay the same. Access to resources by car is likely to improve under Alternatives 6A/B/C, stay the same under Alternative 5A, and degrade under Alternative 1.
- Residential property values close to the freeway are likely to decrease (due to environmental factors) while those further away are likely to increase (due to faster commute times).
- Higher traffic volumes and/or an expanded freeway are unlikely to improve feelings of pride in one's neighborhood and social cohesion, though improvements described in the Urban Design and Aesthetics Toolbox may offset this somewhat.

These changes will impact different populations differently. Access to neighborhood resources will improve for some groups (e.g., those living farther from the freeway) and degrade for others (e.g., those living closest to the freeway). It is likely that physical activity, social cohesion, and neighborhood wealth as mediated through neighborhood resources will improve from some populations and degrade for others. As a result, health outcomes associated with these factors would be impacted. These health outcomes include:

- Chronic disease levels associated with physical activity (e.g., walking to goods and services), diet, access to needed services, and social cohesion;
- Mental health associated with physical activity and from changes in stress as a result of changes in social cohesion;
- Changes in lifespan associated with physical activity and social cohesion; and
- Changes in injury and fatality rates associated with changes in crime levels that could result from changes in social cohesion.

The health impacts of the proposed I-710 Corridor Project EIR/EIS alternatives mediated through access to neighborhood resources are summarized in Table 1-7.

Table 1-7. Summary of Predicted Health Impacts Related to Access to Neighborhood Resources

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Chronic Disease (e.g., cardiovascular disease, diabetes; from changes in physical activity, social cohesion, and stress)					
1	+/–	Potentially significant, non-quantifiable	Mod–High	♦ ♦	Changes in investment in communities difficult to predict.
5A					
6A					
6B					
6C					
Mental Illness (e.g., depression; from changes in physical activity, social cohesion, and stress)					
1	+/–	Potentially significant, non-quantifiable	Mod–High	♦	Changes in investment in communities difficult to predict.
5A					
6A					
6B					
6C					
Decreased Lifespan (e.g., from changes in physical activity, social cohesion and stress)					
1	+/–	Potentially significant, non-quantifiable	High	♦ ♦	Changes in investment in communities difficult to predict.
5A					
6A					
6B					
6C					
Injury and fatality (e.g., from crime)					
1	+/–	Potentially significant, non-quantifiable	Mod–High	♦	Changes in investment in communities difficult to predict.
5A					
6A					
6B					
6C					

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between access to neighborhood resources and the health outcome: ♦ = plausible but insufficient evidence; ♦ ♦ = likely but more evidence needed; ♦ ♦ ♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

Recommendations

The following recommendations would increase the likelihood that the I-710 Corridor Project results in positive health impacts mediated through changes in access to neighborhood resources.

Access to Neighborhood Resources

- Recommendations contained in Chapter 6, "Mobility," would help ensure that access to goods and services in the I-710 corridor is maximized; specifically those that describe improvements to walking and biking infrastructure.
- In order to at least partially offset any potential negative impacts on access to neighborhood resources, the I-710 Corridor Project could include additional improvements to existing neighborhood resources. For example, local jurisdictions could each be given funding as part of the project to invest in the neighborhood resources (e.g., libraries, schools, parks, community centers) that are likely to be impacted by the project.
- Adopt or advocate for policies to increase and maintain mixed income housing to ensure that low income communities will not be displaced and social cohesion harmed if economic growth does occur along the corridor.

Environmental Quality

- Recommendations contained in Chapter 7, "Air Quality," Chapter 8, "Noise," and Chapter 9, "Traffic Safety," including those related to future land use, would help ensure improvements to environmental quality. Improved perceptions of environmental quality are likely to follow actual improvements and lead to more investment in the corridor communities, improve social cohesion, increase physical activity, and lead to other neighborhood improvements.
- Fund and implement the recommendations contained in the Urban Design and Aesthetics Toolbox Report.

Public Investment

- Increase direct government investment in community infrastructure and services to ensure that people have access to the goods and services they need to live healthy lives and to improve social cohesion in local communities. Such investment could help attract private investment.

2. Introduction

The Gateway Cities AQAP is a corridor-specific study requested by the I-710 Oversight Policy Committee in 2004. Funding for the AQAP has been secured and the study is underway. It will assess how best to continue to improve air quality and public health by addressing both near-term and long-term measures for emissions reductions for all of Gateway Cities. The GCCOG is responsible for preparing the AQAP with administrative management and support from Metro.

At the request of the I-710 Project Committee, this Health Impact Assessment (HIA) is one component that was added to the original scope of work for the AQAP. It is intended to assess the proposed I-710 Corridor Project alternatives and to evaluate selected health determinants to assess health outcomes linked to proposed actions of each alternative. At the time the AQAP was initiated (and subsequently the HIA), only draft I-710 technical studies were available. As such, the draft I-710 technical studies were used as resource material for input into this HIA.

The Los Angeles County Metropolitan Transportation Authority (Metro) and its funding partners are preparing the I-710 Corridor Project EIR/EIS to analyze alternatives for improving the I-710 from Ocean Boulevard in the City of Long Beach to the SR-60, a distance of 18 miles. The purposes of the I-710 Corridor Project, as stated in the EIR/EIS Notice of Preparation, are to:

- Improve air quality and public health
- Improve traffic safety
- Address design deficiencies
- Address projected traffic volumes
- Address projected growth in population employment, and economic activities related to goods movement

This report describes the HIA process as well as the findings and recommendations of the HIA.

2.1 Introduction to Health Impact Assessment

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. An HIA analyzes health from a broad perspective by evaluating how a proposed project, plan, or policy affects these factors—often collectively referred to as “determinants of health”—and, in turn, how impacts of these factors are likely to positively or adversely influence health.

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. HIA is formally defined as a combination of procedures, methods, and tools that systematically judges the potential, and sometimes unintended, effects of a proposed project, plan, or policy on the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects (Quigley et al. 2006[379]).

There are six stages in a HIA process as shown in Table 2-1 (North American HIA Practice Standards Working Group 2010[347]).

Table 2-1. The Six Steps of Health Impact Assessment

Screening	Determines the need and value of a HIA
Scoping	Determines which health impacts to evaluate, methods for analysis, and a workplan
Assessment	Provides: 1) a profile of existing health conditions 2) evaluation of potential health impacts
Recommendations	Provide strategies to manage identified adverse health impacts
Reporting	Includes: 1) development of the HIA report 2) communication of findings and recommendations
Monitoring	Tracks: 1) impacts on decision-making processes and the decision 2) impacts of the decision on health determinants

2.2 The I-710 Corridor Project and Its Role in Goods Movement

There is a clear need to achieve the I-710 Corridor Project's purpose, described above. Although air quality has been improving, the Los Angeles basin still has some of the worst air quality in the country (American Lung Association 2011[9]) as a result of the goods movement it supports, other industrial sources of pollution, and automobile usage, made worse by its geographic features. According to the CARB, as a result of air pollution, the region suffers from thousands of premature deaths and hospitalizations, as well as approximately 1 million lost workdays. In addition, the I-710 is currently congested with a combination of goods movement traffic (35,000 truck trips per day on the I-710 originate at the Ports of Los Angeles and Long Beach (Powers 2006[373]); over 25% of the vehicles on the I-710 are medium- and heavy-duty trucks (Zhu et al. 2002[503]) and commuter traffic, and therefore has on average over one motor vehicle collision every day (California Highway Patrol 2009[69]). As a result of these and other health-related measures, for over a decade and in many forums, communities surrounding the I-710 have clearly expressed their concerns about both the current conditions and any future expansion of the freeway.

The I-710 is part of a goods movement network that includes:

- The Ports of Los Angeles and Long Beach, the largest ports in the United States;
- Intermodal facilities at which goods are moved from trucks onto trains;
- Rail yards, trains and railroads;
- Warehouses and transloading facilities at which goods are stored, moved from one container type to another (e.g., from 40 TEU to 53 TEU containers), and/or worked on (e.g., by finishing the manufacturing or by labeling with price tags); and

- Roads between these facilities.

In 2005, the ports moved over $215B worth and over 14 million TEUs of goods (Metro 2008[318]). Approximately 75% of the cargo that comes in through the ports leaves the Los Angeles area for destinations throughout the rest of the U.S. (Metro 2008[318]). Approximately 80% of the cargo that comes through the ports is moved with at least one truck trip:

- About 36% of goods are moved directly by trucks to local and regional destinations.
- About 24% of goods are moved by trucks to warehouses and transloading facilities before being reloaded on to trucks to final destinations (12%) or on to trucks to railroads (12%).
- About 20% of goods are moved by truck directly to intermodal facilities where they are loaded onto trains.

Aside from the current issues presented by the I-710, one of the main drivers of the current I-710 Corridor Project is the projected growth of goods movement through the ports over the next 25 years. In 2030, it is predicted that there will be over 70,000 truck trips per day on the I-710 (Powers 2006[373]). This increase in goods being moved would be accompanied by an equivalent increase in truck and railroad traffic, warehousing and transloading needs, and other goods movement–related infrastructure.

The Southern California Association of Governments (SCAG) is predicting the population in southern California to expand by about 2.2 million residents by 2035. This also significantly impacts future traffic volumes on I-710, other freeways, and other transportation facilities.

2.3 Screening

2.3.1 Screening Summary

Screening, the first step of HIA, involves establishing the feasibility and value of an HIA for a particular decision-making context. In making the decision to conduct this HIA on the I-710 Corridor Project a number of factors were taken into consideration:

- Conditions related to the I-710 (e.g., air quality and traffic safety) are currently impacting the health of local residents.
- The proposed project has potentially significant health implications for the very large number of residents in the local and surrounding communities.
- The proposed project may impact health positively and/or negatively through a variety of pathways, including through air quality, noise, mobility and access, traffic safety, jobs and economic development and neighborhood resources.
- There is a wealth of research, literature, and methodology available for this analysis. This includes the EIR/EIS which being developed for the project, which addresses some but not all of health impacts of the project, contains a large amount of information that can be used as a starting point for analyzing health outcomes;

- Residents near the I-710 and other stakeholders, including the LA County Public Health Department and the Environmental Protection Agency Region IX office, have vocalized their health-related concerns regarding the project and have called on decision-making bodies to conduct an HIA (see below for more detail);
- The I-710 Project Committee voted in favor of conducting an HIA (see below for more detail).

As a result of these factors, GCCOG decided to allocate funding to conduct this HIA as part of the AQAP effort.

2.3.2 Stakeholder Participation in the I-710 Corridor Project EIR/EIS related to HIA Screening

The I-710 Corridor Project was initiated in 1999, when the 27 cities of Southeast Los Angeles County identified the I-710 as a major problem for congestion in the region. In 2001 a *710 Major Corridor Study* was initiated to seek ways to make "transportation improvements" to the I-710 corridor, and a number of alternative strategies for improving the travel conditions along the corridor were proposed as part of this process. In March of 2005, Metro completed this study and proposed plans for the expansion of the freeway. An EIR/EIS of the proposed I-710 Corridor Project was initiated in 2007.

I-710 Corridor Project EIR/EIS Goals

The I-710 Corridor Project EIR/EIS goals, as outlined in its Purpose and Need Statement are to:

- Improve air quality and public health.
- Improve traffic safety.
- Address freeway design deficiencies.
- Address projected growth in traffic volumes.
- Address projected growth in population, employment, and economic activities related to goods movement.

Environmental Protection Agency EIR/EIS Scoping Comments

In a 2008 EIR/EIS Scoping Comment Letter to Caltrans, the Environmental Protection Agency Region IX (EPA) (a cooperating agency on the EIR/EIS) recommended that an HIA be conducted on the proposed I-710 Corridor Project:

> Low-income and minority communities are potentially experiencing more health impacts than would be predicted using traditional risk assessments. An HIA is a potential tool for examining this complex issue. HIAs look at health holistically, considering not only biophysical health effects, but also broader social, economic, and environmental influences. HIAs also explicitly focus on health benefits and the distribution of health impacts within a population. HIAs strive to anticipate potential impacts for decision-makers and to deliver a set of concrete recommendations targeted at minimizing health risks and maximizing benefits.
>
> EPA recently recommended that the Ports of Los Angeles and Long Beach consider development of port-wide HIAs. Given the magnitude and complexity of potential health impacts related to Port projects and the critical role the 1-710 Corridor serves accommodating freight traffic to and from the Ports, EPA

recommends that Caltrans partner with the Ports, the Army Corps of Engineers, the local health department and the local community to conduct an HIA which encompasses this project and all upcoming Port expansion projects. (EPA 2008a[149].)

Community Participation in the I-710 Corridor Project

In 2003 and 2004, community advisory committees (Tier I and II) were formed to discuss potential impacts of the I-710 Corridor Project on health, job and economic development, safety, noise, congestion and mobility, community enhancements, design concepts, environmental justice, and organization and process. These advisory committees determined that health should be the overriding consideration when designing the I-710 Corridor Project proposal, and that every action (of the I-710 Corridor Project) should be viewed as an opportunity for repair and improvement of the current situation. The fact that the I-710 is a corridor and that considerations should go beyond the freeway and infrastructure was also heavily stressed in the Tier II final report and recommendations.

In 2004, Metro and GCCOG created a new structure for continued community participation for the I-710 Major Corridor Study. The Community Participation Framework structure was designed to provide a wide variety of stakeholders—from the local level to subject area experts—the opportunity to weigh in on the scope and process of the I-710 Major Corridor Study.

I-710 Corridor Project EIR/EIS Community Participation Framework and the Health Impact Assessment

In a series of meetings between 2008 and 2010 the Environmental Subject Working Group (ESWG) of the Community Participation Framework explored, among a number of issues, links between air quality and potential project activities and public health outcomes. It also discussed the possibility of using an HIA as a way to measure the potential health impacts of the proposed project activities. As a result of requests by working group members, two presentations about HIAs were made to the ESWG. Additional presentations about HIAs were made in 2009 to Local Advisory Committees (LACs) and the Corridor Advisory Committee (CAC).

The following is a timeline of events related to the HIA and leading up the decision to conduct an HIA as part of the I-710 Corridor Project's AQAP:

- In April 2008, following a presentation about HIA to the ESWG, one of the members formally recommended that an HIA be conducted as a way to "ensure a comprehensive analysis that goes beyond a traditional EIR by fully addressing health consequences of all the impacts originally identified in the Tier 2 Report." A second recommendation that an HIA be included in the EIR/EIS was also made that month by an ESWG member.
- In May 2008 the Commerce LAC passed a motion to use HIA tools in the EIR/EIS as a more comprehensive way to analyze impacts on health.
- At a June 2008 CAC meeting, a request was made that an HIA be included in the I-710 Corridor EIR/EIS. In October the CAC passed a formal recommendation to the Project Committee (PC) to "implement the tools and methodologies presented for the HIA, specifically the 'pathways to health outcomes', and fund this effort."

- At the January 2009 PC meeting, the PC voted unanimously in favor of conducting an HIA. A motion was also unanimously approved to conduct the HIA under the umbrella of the AQAP.
- At the January 2010 PC meeting, a motion was made to have the HIA included in the EIR/EIS. The motion was approved by a 10 to 7 vote.
- In 2005, the GCCOG secured federal funding to conduct the AQAP. Subsequently in 2010, the AQAP scope of work was augmented to include the HIA and other studies requested by the CAC and the PC. In July 2010, a team led by ICF International and that included Human Impact Partners (HIP) was selected to conduct the AQAP; HIP was selected as a subconsultant to perform the HIA.

2.4 Use of the Results of this HIA

The I-710 HIA will be used to inform decision-makers and the public of the development of additional measures to further improve public health outcomes resulting from the I-710 Corridor Project. The HIA will be provided to the I-710 funding partners and Caltrans upon completion for potential inclusion into the I-710 environmental process (EIR/EIS). The decision to include the I-710 HIA in the I-710 Corridor Project EIR/EIS rests with Caltrans, the lead agency for the state and federal environmental regulations (e.g., CEQA and NEPA).

This report and its recommendations were drafted by HIP. HIP received extensive feedback on the report from GCCOG and Metro, but consensus was not reached on all the findings and recommendations. Futhermore, other stakeholders (see below) reviewed presentations regarding the HIA (but not the full report due to confidentiality issues regarding the data from the draft I-710 Corridor Project EIR/EIS) and provided feedback based on those presentations. Due to time constraints and the confidentiality issues, a complete review by stakeholders was not possible. After considering the input received, HIP developed this final HIA.

2.5 Stakeholder Engagement in the I-710 HIA Process

2.5.1 Stakeholder Engagement Summary

Meaningful and inclusive stakeholder participation in each stage of HIA is a goal and supports HIA quality and effectiveness (North American HIA Practice Standards Working Group 2010[347]). An HIA team should take reasonable and appropriate steps to identify, solicit, and utilize the expertise, including the community, needed to both identify and answer questions about potentially significant health impacts.

The I-710 HIA was led by Human Impact Partners with support of a project team that consisted of Metro, GCCOG, ICF International, and Arellano and Associates.

The Project Team for the I-710 HIA was guided by input from the Gateway Cities Air Quality Action Plan I-710 Health Impact Assessment Technical Working Group, the Gateway Cities Air Quality Action Plan Technical Roundtable, the Gateway Cities Air Quality Action Plan Advisory Roundtable, and the Gateway Cities Environmental Committee. These groups met periodically throughout the HIA process and provided input during the scoping phase (e.g., about the goals, pathway diagrams, research questions, methodology, and data sources), as well as during assesement, recommendations, and reporting (e.g., regarding the existing conditions and impact findings and recommendations). A complete listing of the members of these groups and meeting dates can be found below. These committees did not have access to the draft HIA document, but instead reviewed presentations about the content. Due to confidentiality issues regarding data from the draft I-710 Corridor Project EIR/EIS as well as time constraints, these committees were not able to fully review the HIA content, provide input, and come to consensus about the findings and recommendations.

The GCCOG Transportation Committee and Board of Directors also participated in the HIA preparation.

2.5.2 Stakeholder Participation in the Health Impact Assessment

The HIA Technical Workgroup

The HIA Technical Workgroup met on May 12, 2011; May 26, 2011; July 11, 2011; August 19, 2011; September 19, 2011; and October 3, 2011, and was composed of representatives from the following agencies and organizations:

- BP Lubricants USA
- City of Vernon Health and Environmental Control Department
- Los Angeles County Department of Public Health
- Metro
- Port of Long Beach
- Port of Los Angeles
- South Coast Air Quality Management District
- Southern California Association of Governments
- U.S. Department of Transportation, Maritime Administration
- EPA

Other participants at some meetings include BNSF Railways, the Pacific Marine Shipping Association, and California Council for Environmental and Economic Balance.

The AQAP Technical Roundtable

The Air Quality Action Plan Technical Roundtable met on July 13, 2011; August 10, 2011; September 14, 2011; October 12, 2011; and October 24, 2011, and was composed of representatives from the following agencies and organizations:

- BNSF Railways
- City of Compton Public Works, also an I-710 Technical Advisory Committee (TAC) member and SR-91/I-605/I-405 TAC member
- City of La Mirada Community Development

- City of La Mirada Public Works, also an I-5 Joint Powers Authority TAC member
- City of Long Beach Planning Department
- City of Long Beach Health and Human Services
- City of Lynwood Public Works, also an I-710 TAC member
- City of Vernon Health and Environmental Control Department
- City of South Gate Community Development
- Los Angeles County Department of Public Health
- Los Angeles County Regional Planning Department
- Port of Long Beach
- Port of Los Angeles
- South Coast Air Quality Management District
- Southern California Association of Governments
- TIAX, LLC
- U.S. Department of Transportation, Maritime Administration
- EPA

The AQAP Advisory Roundtable

The AQAP Advisory Roundtable met on July 14, 2011; August 11, 2011; September 15, 2011; October 13, 2011; and October 24, 2011 and was composed of individuals and representatives from the following agencies and organizations:

- BNSF Railways
- Breathe LA
- California Air Resources Board
- California State University, Long Beach
- City of South Gate
- Coalition for Clean Air
- Coalition for a Safe Environment
- Communities for a Better Environment
- East Yard Communities for Environmental Justice
- Express Transportation Services
- Future Ports

- Harold Tseklenis (resident of Downey), also an I-710 CAC member
- John Miller, Physician
- Legal Aid Foundation of Los Angeles
- Los Angeles County Department of Public Health
- Metro
- Long Beach Alliance for Children with Asthma
- Mothers of East LA
- Natural Resources Defense Council
- Our Lady of Lourdes Church
- Pacific Marine Shipping Association
- Port Community Advisory Committee, Port of Los Angeles
- Port of Long Beach
- Port of Los Angeles
- South Coast Air Quality Management District
- Southern California Edison
- Tri-Cities Regional Occupational Program
- UCLA School of Public Health
- Union Pacific Railway
- University of Southern California
- West Long Beach Neighborhood Association
- Vernon Chamber of Commerce
- Western States Petroleum Association
- U.S. Department of Transportation, Maritime Administration
- Long Beach Harbor Commission

The GCCOG Environmental Committee

The GCCOG Environmental Committee met on July 18, 2011; August 24, 2011; September 28, 2011; and October 26, 2011. The committee included representation from the two roundtables above and was composed of representatives from the following agencies and organizations:

- Vice Mayor, City of Southgate (Chair)
- California Air Resource Board

- City of Commerce City Manager
- City of Compton Public Works
- City of La Mirada Public Works
- City of Long Beach Health and Human Services
- City of Lynwood Public Works (AQAP Technical Roundtable representative)
- City of South Gate Community Development
- Coalition for Clean Air
- East Yard Communities for Environmental Justice (AQAP Advisory Roundtable representative)
- I-5 Joint Powers Authority
- Natural Resources Defense Council
- Office of LA County Board of Supervisor Mark Ridley-Thomas
- Office of LA County Board of Supervisor Gloria Molina
- Pacific Marine Shipping Association
- Port of Los Angeles
- Port of Long Beach
- South Coast Air Quality Management District

2.6 Assumptions and Limitations

The I-710 Corridor Project is a large-scale public works project with many aspects and components. Because of time and budget constraints for the HIA, existence of data and research done for the I-710 Project EIR/EIS, as well as the desire to ensure consistency with the project's EIR/EIS, the scope of the HIA analysis was constrained. As the HIA Technical Working Group put it, "The I-710 HIA does the best job possible with the limited data available; the process is up against real constraints, both in terms of data and schedule." Those constraints included the following:

- The HIA analyzed the alternatives being considered in the EIR/EIS and no other alternatives.
- The HIA used the same assumptions as, and much data from, the draft technical studies used to inform the I-710 EIR/EIS. For example, all alternatives considered, including the No Build Alternative, assumed that the ports would be fully built out and that proposed but unapproved transportation projects (e.g., new and expanded intermodal facilities) would not be built. The ports and others recognize that the ports could not fully build out under the No Build Alternative unless other freight movement build out occurs. As a result, modeled traffic estimates for the No Build Alternative may not match actual future traffic, along with all analyses based on those traffic models.

- The HIA authors had access to confidential information that was used to prepare the EIR/EIS. Draft technical studies were used to summarize existing conditions and to predict impacts in the HIA. When the EIR/EIS is released, all data used in the HIA will be publicly available.
- Not all the EIR/EIS data was available for the HIA because the HIA was completed before the draft EIR/EIS was completed. The timeline for the HIA was driven by the EIR/EIS process—findings from the HIA needed to be ready before the administrative draft (an internal draft that the funding partners review) of the EIR/EIS was complete. For example, $PM_{2.5}$ air quality modeling data and noise data were not available. The HIA notes where data was not available and recommends analyses to be done when the data is available.
- In order to avoid redundancy, the HIA relied on modeling and analyses conducted for the EIR/EIS, including traffic and air quality modeling.
- Some of the data used in the HIA for Alternatives 6A and 6B is not the final data that will be included in the EIR/EIS. Specifically, traffic, and air quality modeling data used in the HIA were from draft traffic and air quality technical studies that were later refined for the EIR/EIS, but the new data was not available in time for the HIA. It is believed that findings will not be very different using the new data, but this assumption should be checked when the final modeling data is available.
- Only very limited pieces of data were available for Alternative 6C, and this greatly limited the extent of analysis for this alternative.
- The HIA does not address impacts during the construction phase of the project given any of the suggested alternatives because these analyses are being covered in the EIR/EIS and the AQAP.
- Only impacts within the Gateway Cities are considered in the HIA. Impacts of increased truck volumes in other geographies (e.g., the San Fernando Valley) are not considered.
- Time constraints and other issues limited the ability to receive feedback on the draft HIA. A more thorough review and constructive discussion of the findings and recommendations would have strengthened the final HIA.

In addition, it should be noted that the HIA focuses specifically on the proposed alternatives for the I-710 corridor. The I-710 is just one piece of a larger goods movement puzzle. Decisions regarding port growth, economic development strategy, land use planning, and global trade will impact goods movement and, thereby, population health. Health will be affected by resulting environmental quality (e.g., air quality and noise), economic impacts (e.g., jobs and government revenue), and land use (e.g., locations of pollution sources with respect to receptors). The HIA authors believe that it is important to understand health outcomes of these many inter-related decisions—comprehensively and cumulatively—to ensure comprehensive solutions that provide the best health outcomes for current and future residents of the region. This HIA should be viewed as one component of the necessary analysis.

Lastly, when analyzing effect levels for public health impacts, the transition from risk exposure to disease is complex and multifactorial. Many diseases are borne of multiple overlapping risk exposures, as well as social, economic, and environmental risk modifiers. For example, cancer may result from a combination of genetic predisposition, environmental exposures, and individual behaviors such as smoking. Additional factors—such as poverty, lack of insurance, and chronic stress—may increase one's risk for cancer or cancer-related mortality. These modifying factors are not distributed equally between all subpopulations. In addition, there is often a long delay between exposure and overt disease for many health determinants. Solely monitoring health outcomes can be an ineffective strategy for establishing the public health interventions needed to address risk exposure and disease. This HIA investigates many health impacts and diseases but in no way implies that the I-710 currently or in the future will be the only factor that determines health outcomes.

3. Scoping

Scoping, the second step of HIA, involves determining which health impacts to evaluate, data sources and methods for analysis, and a workplan for completing the HIA. The HIA Technical Working Group worked with Human Impact Partners and the rest of the project team over the course of several meetings to:

- Set goals for the Health Impact Assessment
- Select a set of determinants of health on which the HIA would focus
- Select the alternatives being considered in the EIR/EIS that would be assessed in the HIA
- Set geographic and temporal bounds for the analysis
- Identify vulnerable populations that would be assessed in addition to the general population, if data is available
- Develop pathway diagrams for each of the health determinants

Human Impact Partners then developed a detailed scope, which consisted of a set of research questions for each pathway, indicators (i.e., measures that would be used to provide answers to the research questions), data sources, and research methods. The HIA TWG and project team reviewed the detailed scope and provided feedback that was then integrated.

The scoping materials were then presented to the AQAP Technical Roundtable, the AQAP Advisory Roundtable, and the GCCOG Environmental Committee. These groups discussed the scope in public meetings and also provided feedback via email.

The scoping materials were then provided to the GCCOG Transportation Committee and Board for review and approval. The final scope was approved by the GCCOG Board on September 7, 2011.

3.1 I-710 HIA Goals

The following goals were agreed upon by the AQAP HIA/TWG, Technical Roundtable, Advisory Roundtable, and the Gateway Cities Environmental Committee:

- Provide I-710 Corridor Project decision-makers and other stakeholders with positive and negative health effects, findings, and recommendations for alternatives being considered.
- Increase stakeholder participation and understanding of the I-710 Corridor Project.
- Identify community health concerns/issues within the Gateway Cities and their relationship to the I-710 Corridor Project.
- Provide a model for future transportation and infrastructure HIAs (including evidence and utility of conducting an HIA).
- Add value to the I-710 related analyses while utilizing the I-710 Corridor Project EIR/EIS technical data in the HIA to the greatest extent possible to reduce redundancy.

3.2 Overarching Parameters

3.2.1 Alternatives To Be Considered

- Alternative 1–No Build Alternative: This alternative consists of those transportation projects that are already programmed and/or committed to be constructed by or before the study's planning horizon year of 2035. Therefore, Alternative 1 represents future travel conditions in the I-710 corridor and is the baseline against which the I-710 alternatives are assessed. The No-Build Alternative is a requirement of the I-710 Corridor Project EIR/EIS effort. The proposed projects included in this alternative are based on SCAG's 2008 Regional Transportation Plan (RTP) as well as the 2008 Regional Transportation Improvement Program (RTIP) project list.
- Alternative 5A—Freeway Widening up to10 GP Lanes: The intent of Alternative 5A is to improve the I-710 mainline by widening the freeway up to ten lanes throughout the length of the corridor (including the freeway-to-freeway interchanges) and modernizing its design. Included in this alternative are redesigns of the freeway-to-freeway and arterial interchanges. Alternative 5A includes ten GP lanes. Also included in Alternative 5A are:
    - The projects included in the No Build Alternative.
    - TSM/TDM/ Transit/ITS improvements, including operational investments, policies, and actions aimed at improving goods movement, and passenger auto and transit travel; as well as reducing the environmental impacts of transportation for cities and operations in the I-710 Corridor Project study area, including improvements to transit in the I-710 corridor and implementation of ITS applications.
    - Arterial Highway and I-710 Congestion Relief Improvements, including the maximum arterial highway improvements that could be feasibly implemented in advance of any I-710 improvements. These would incorporate the major north/south and east/west arterial highways within the study area, as well as the study area intersections identified for the proposed project. The improvements will also address congestion relief projects, such as early action projects on I-710, by identifying existing freeway deficiencies causing bottlenecks, congestion, and safety problems.
- Alternative 6A—10 GP Lanes plus Four-Lane Freight Corridor: Alternative 6A includes all improvements from Alternative 5A (described above) with the addition of a separate four-lane freight corridor from the ports (Ocean Boulevard) to the intermodal rail yards in Commerce and Vernon. This alternative is the LPS that resulted from the prior I-710 Major Corridor Study plus additional design concept refinements. For the purpose of the technical analysis supporting the I-710 Corridor Project EIR/EIS, the freight corridor is being designed for the exclusive use of conventional heavy-duty trucks (5+ axles).
- Alternative 6B—10 GP Lanes plus a Zero-Emission Four-Lane Freight Corridor: Alternative 6B includes all the improvements of Alternative 6A (described above) with the freight corridor restricted to trucks with zero tailpipe emissions. In this alternative the design of the freight corridor will allow for possible future conversion as feasible (which may require additional environmental

analysis and approval) of a fixed-track guideway family of alternative freight transport technologies (e.g., maglev).

- Alternative 6C—10 GP Lanes plus a tolled Four-Lane Freight Corridor: Alternative 6C includes all the improvements of Alternatives 6A, but would toll trucks using the freight corridor.

3.2.2 Health Determinants

The following health determinants were selected for study and agreed upon by the HIA TWG and approved by the AQAP Technical Roundtable, Advisory Roundtable, and the Gateway Cities Environmental Committee:

- Air quality
- Noise
- Mobility
- Traffic safety
- Jobs and economic development
- Access to neighborhood resources

A more complete description of what is included in each of these categories can be found in the pathway diagrams and research questions below.

Decisions regarding other health determinants included:

- Water quality. Because there are regulations regarding water quality mitigations that the I-710 Corridor Project must follow and given the resource constraints for conducting the HIA, health outcomes related to water quality were de-prioritized.
    - Housing: The proposed I-710 Corridor Project improvement designs are estimated to displace only tens of residences according to the project leads, and housing displacement was therefore de-prioritized; this will be included in the I-710 Corridor Project EIR/EIS. Other aspects of housing (e.g., exposure to noise and access to neighborhood resources) are included in the determinants that will be addressed.
- Education: Proposed impacts on education are believed to be through environmental factors (e.g., air quality and noise) and not directly as a result of the freeway expansion; therefore, it was decided not to include education as an independent health determinant for analysis. Education-related outcomes will be addressed in the air quality and noise sections.
- Neighborhood safety: Impacts related to neighborhood safety have been integrated into other sections of the scope—including mobility, traffic safety, and neighborhood resources; therefore, it was decided not to include neighborhood safety as an independent health determinant for analysis.
- Social cohesion: Impacts related to social cohesion have been included in several other sections; therefore, it was decided to not include a separate section on social cohesion–related impacts.

- Other health determinants: Generally it was decided that impacts on all other determinants of health were too indirect to include in the HIA, given resource constraints. Other health determinants considered included disease vectors, poverty, racism, segregation, and political participation.

3.2.3 Time Boundaries

The HIA analyzed impacts in the year 2035 only. Other analyses (e.g., the EIR/EIS and other sections of the AQAP) cover construction impacts on air quality. Given the resource constraints on the HIA, other construction-related impacts were not included, though it was recognized that these impacts could have health impacts. This time frame is consistent with other regional transportation planning efforts.

3.2.4 Geographic Boundaries

Each health issue uses its own geographic boundaries, as detailed below. Generally and when possible, corridor specific statistics are compared with statistics for Los Angeles County (county) as a whole as well as statistics for the state of California and the U.S. as a whole.

3.2.5 Vulnerable Populations

In addition to the general population, the following vulnerable populations were considered when stratified data was available:

- Groups defined by age (e.g., young children (0–5), school children (6–17), seniors (65+))
- Groups defined by race/ethnicity (e.g., African American, Hispanic, Non-English speakers, and/or recent immigrants/foreign born populations)
- Groups defined by income (e.g., those living below the poverty line, those living below 200% of the poverty line, the lowest quartile or quintile of earners)
- Populations with existing health conditions (e.g., asthma, diabetes, cardiovascular disease [CVD], making them more susceptible to issues related to air quality or other impacts)

3.3 Common Questions (CQ)

3.3.1 CQ1

Existing Conditions Research Question

What are current vehicle volumes (including cars and medium- and heavy-duty trucks) on I-710, related freeways, and local roads?

Impact Research Question

What are predicted future vehicle volumes?

Indicators

- Heavy-duty truck traffic counts on the I-710
- Medium-duty truck traffic counts on the I-710
- Car traffic counts on the I-710
- Heavy-duty truck traffic counts on the I-110, I-605, I-405, SR-91, I-105, I-5, SR-60, I-10
- Medium-duty truck traffic counts on the I-110, I-605, I-405, SR-91, I-105, I-5, SR-60, I-10
- Car traffic counts on the I-110, I-605, I-405, SR-91, I-105, I-5, SR-60, I-10
- Heavy-duty truck traffic counts on ramps on/off the I-710
- Medium-duty truck traffic counts on ramps on/off the I-710
- Car traffic counts on ramps on/off the I-710
- Heavy-duty truck traffic counts on specific arterials
- Medium-duty truck traffic counts on specific arterials
- Car traffic counts on specific arterials
- Heavy-duty truck traffic counts on specific residential roads
- Medium-duty truck traffic counts on specific residential roads
- Car traffic counts on specific residential roads

Data Sources (same for all indicators)

- Draft I-710 Corridor Project EIR/EIS traffic studies
- Other reports/studies of local traffic conditions

Methods (same for all indicators)

- Review of EIR/EIS traffic model

3.3.2 CQ2

Existing Conditions Research Question

What are current speeds for vehicles (including cars and medium- and heavy-duty trucks) on the I-710, related freeways, and local roads?

Impact Research Question

What are predicted future vehicle speeds?

Indicators

- Speed vs. pollutant profile for different vehicles and different pollutants
  - Data Sources:
    - I-710 Corridor Project EIR/EIS traffic studies
  - Methods:
    - Review of EIR/EIS traffic model
- Traffic speeds at various times of day
  - Data Sources:
    - Draft I-710 Corridor Project EIR/EIS traffic studies
  - Methods:
    - Review of EIR/EIS traffic model
- Speed vs. collision severity profile for trucks and cars
  - Data Sources:
    - Other reports/studies of local traffic conditions
  - Methods:
    - Review of EIR/EIS traffic model

3.3.3 CQ3

Existing Conditions Research Question

What is the average VMT for people who live and/or work in the impacted areas? For trucks?

Impact Research Question

How would the proposed project impact the average VMT for people who live and/or work in the impacted areas? For trucks?

Indicators

- Average VMT per day for people who live in impacted areas
  - Data Sources:
    - SCAG (see 2008 Regional Transportation Plan and Pacific Electric Right-of-Way (PE ROW) / West Santa Ana Branch Corridor Analysis)
  - Methods:
    - Review results of EIR/EIS analysis; quantitative if possible

- Average VMT per day for trucks traveling on the I-710 and through impacted areas
  - Data Sources:
    - SCAG (see 2008 Regional Transportation Plan and PE ROW) / West Santa Ana Branch Corridor Analysis)
  - Methods:
    - Review results of EIR/EIS analysis; quantitative if possible
- Gross number and length of vehicle trips by vehicle type in the impacted area per day
  - Data Sources:
    - I-710 Corridor Project EIR/EIS traffic studies
    - SCAG
    - Other reports/studies
  - Methods:
    - Review results of EIR/EIS analysis; quantitative if possible

3.3.4 CQ4

Existing Conditions Research Question

What are the existing public transit routes and their associated use in the impacted areas?

Impact Research Question

How would the proposed project impact public transit routes, stops, and use?

Indicators

- Existing and planned transportation routes, transit routes/stops, bike routes, and pedestrian facilities
  - Data Sources:
    - METRO geographic information system (GIS) layer of transit (rail/bus) system
    - I-710 Intermodal Study
    - Metro
    - Metrolink: Bus service operators
    - Los Angeles County Municipal Bus service operators
  - Methods:
    - Qualitative (literature review and review of available statistics)

- Transit ridership
  - Data Sources:
    - METRO GIS layer of transit (rail/bus) system
    - I-710 Intermodal Study
    - Metro
    - Metrolink: Bus service operators
  - Methods:
    - Qualitative (literature review and review of available statistics)

3.3.5 CQ5

Existing Conditions Research Question

How do demographic characteristics of populations living within in the I-710 corridor compare to characteristics of people living in the county and in the whole of California? How have these been changing over time (the last 10 years)?

Impact Research Questions

How would demographics change?

Indicators:

- Population
- Income
- Unemployment rate
- Occupation
- Poverty rate
- Race/ethnicity
- Educational attainment
- Age
- Housing tenure (how long lived there, and rental or own)
- Overcrowding
- Car ownership
- Mode of transportation to work
- Commute time to work

- Data Sources:
  - Census data
  - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - PE ROW/West Santa Ana Branch Corridor Analysis
- Methods:
  - GIS

- How many residents would be displaced?
  - Indictors:
    - Number of residents displaced
  - Data Sources:
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - Methods:
    - GIS
- How many residents would be in closer proximity to the I-710?
  - Indicators:
    - Number of residents living within 150 and 300 meters (approximately 500 and 1,000 feet) of the edge of the I-710
  - Data Sources:
    - Census data
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - Methods:
    - GIS

3.3.6 CQ6

Existing Conditions Research Question

What sensitive receptor populations live in the I-710 corridor? Sites at which those people live, work, play, or go to school (e.g., children in schools and parks, seniors' homes, hospitals)?

Impact Research Question

How are these populations expected to change over time?

Indicators

- Number of residences (with age of housing), or people, within 150 meters (approximately 500 feet) of the edge of the I-710 and related roads and destinations
  - Data Sources:
    - Census data
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - Methods:
    - GIS
- Number of schools (and enrollment) and daycare centers within 150 and 300 meters (approximately 500 and 1,000 feet) of the I-710 and related roads and destinations
  - Data Sources:
    - California Department of Education (CADOE) or local school districts
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - Methods:
    - GIS
- Number of hospitals within 150 and 300 meters (approximately 500 and 1,000 feet)of the I-710 and related roads and destinations
  - Data Sources:
    - Office of Statewide Health Planning and Development (OSHPD) Facility Listings (December 31, 2009)—Hospitals
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - Methods:
    - GIS
- Number of parks within 150 and 300 meters (approximately 500 and 1,000 feet) of the I-710 and related roads and destinations
  - Data Sources:
    - SCAG land use database
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
  - Methods:
    - GIS
- Number of churches within 150 and 300 meters (approximately 500 and 1,000 feet) of the I-710 and related roads and destinations

- Data Sources:
  - I-710 Corridor Project EIR/EIS Community Impact Assessment
- Methods:
  - GIS

3.3.7 CQ7

Existing Conditions Research Question

What are existing disease outcomes for residents in the I-710 corridor compared to the county (broken out by demographic characteristics)?

Impact Research Question

See individual topic areas

Indicators

- Asthma prevalence
- Asthma attacks/symptomatic days
- Diabetes prevalence
- Obesity rates
- Cancer rates
- Cardiovascular disease (CVD) prevalence
- Stroke rates
- Myocardial infarction (MI) rates
- Hypertension prevalence
- Communicable disease rates
- Depression rates
- Average number of days of poor mental health
- Self-rated health
- Physical activity rates
- Injury rates
- Low birth weight birth rate
- Pre-term birth rate
- Mortality

- Asthma hospitalizations
- Diabetes hospitalizations
- Mental-health related hospitalizations
- Stress rates

Data Sources (same for all indicators)

- Los Angeles County Health Survey
- California Health Interview Survey (CHIS)
- I-710 Corridor Project EIR/EIS Community Impact Assessment
- Hospitalization records (define with International Statistical Classification of Diseases and Related Health Problems (ICD-9) codes)
- Los Angeles County Department of Public Health (LACDPH) (mortality records—ICD-10 codes)

Methods (same for all indicators)

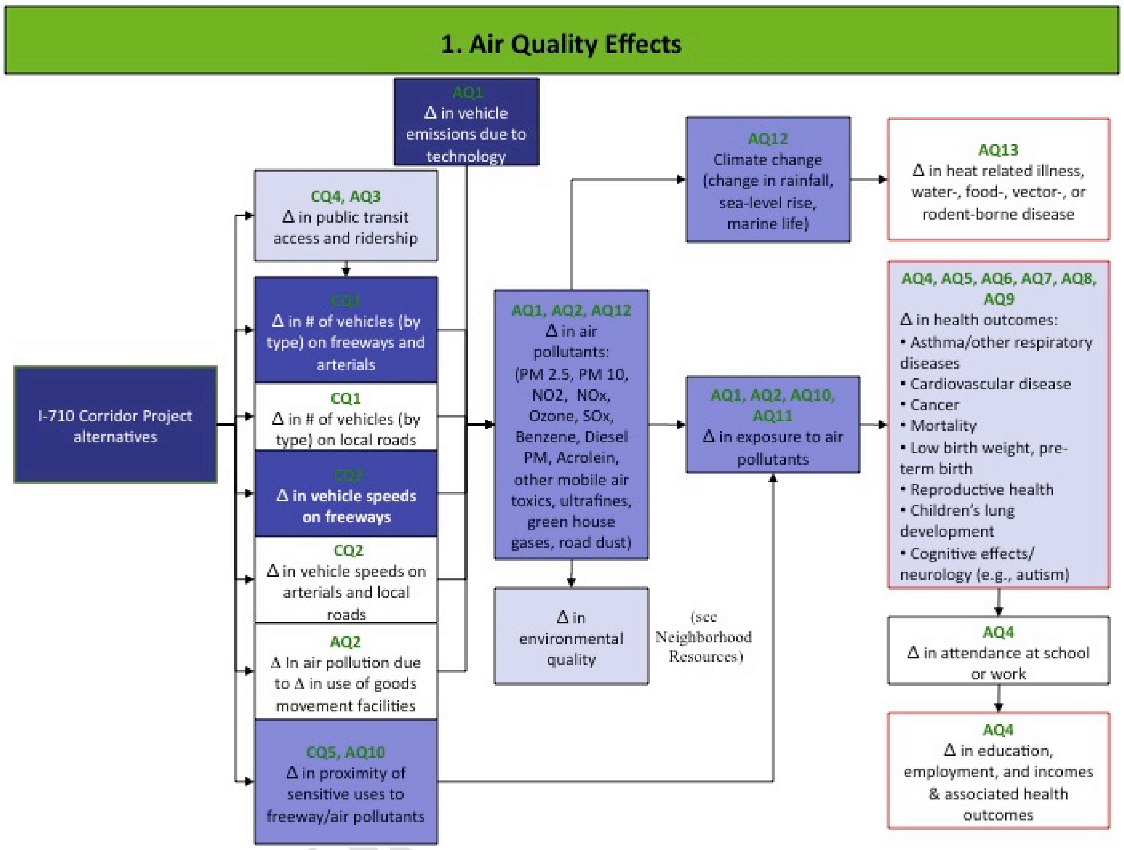
- Review and summary of the data sources above
- Potentially GIS

3.3.8 Note for Common Questions

The Los Angeles region has been the focus of a number of public health studies. In this analysis of health impacts, data from these studies was given more weight compared to studies focused on other locations.

3.4 Air Quality (AQ)

3.4.1 Pathway



3.4.2 Geographies of Interest

- 0–150 meters (approximately 0–500 feet) from the I-710 (upwind and downwind)
- 150–300 meters (approximately 500–1,000 feet) from the I-710 (upwind and downwind)
- Greater than 300 meters (approximately 1,000 feet) within the I-710 Corridor Project Study Area
- Los Angeles County and California (as comparison)

3.4.3 Research Questions

AQ1

Existing Conditions Research Question

What are the existing levels of air pollution emissions/exposures from traffic on I-710 in corridor communities and in the region? How do emissions/exposures (of which pollutants) for the different vehicles change with speed?

Impact Research Question

Based on the traffic model, how would the projected changes in traffic counts and speeds affect air quality in the corridor communities and the region? How would specific features of the proposals (e.g., position of truck lanes, zero emission trucks) impact air quality? How would emissions/ exposures (of which pollutants) for the different vehicles change over time?

Indicators

- Ambient level of Nitrogen Oxides (NO_X), Sulfur Oxides (SO_X), DPM, Particulate Matter ($PM_{2.5}$ and PM_{10}), ozone, benzene, acrolein, other mobile air toxics, and road dust at various locations in the community near the I-710
  - Data Sources:
    - Draft I-710 traffic studies
    - Draft I-710 AQ/HRA
    - CARB
    - South Coast Air Quality Management District (SCAQMD) State Implementation Plan (SIP) model predictions, inventories
    - SCAQMD ambient monitoring data
    - MATES III inventories and/or model predictions
    - Papers by Zhu et al. (see references)
    - Other Los Angeles AQ studies
  - Methods:
    - Review results of EIR/EIS AQ analysis
- Level of NO_2 emissions/exposures from the I-710
  - Data Sources:
    - Draft I-710 traffic studies
    - Draft I-710 Corridor Project EIR/EIS
    - AQ/HRA
    - CARB
    - SCAQMD SIP model predictions, inventories
    - SCAQMD ambient monitoring data
    - MATES III inventories and/or model predictions
    - Zhu et al. papers
    - Other Los Angeles AQ studies

- Methods:
  - Review results of draft I-710 AQ analysis
- Level of ultrafines (particles <100 nanometers in size) emissions/exposures from the I-710
  - Data Sources:
    - Draft I-710 traffic studies
    - Draft I-710 Corridor Project EIR/EIS
    - AQ/HRA
    - CARB
    - SCAQMD SIP model predictions, inventories
    - SCAQMD ambient monitoring data
    - MATES III inventories and/or model predictions
    - Zhu et al. papers
    - Other Los Angeles AQ studies
  - Methods:
    - Qualitative description
- Speed vs. pollutant profile for different vehicles and different pollutants (see Common Questions)
  - Data Sources:
    - Draft I-710 traffic studies
    - Draft I-710 Corridor Project EIR/EIS
    - AQ/HRA
    - Literature
  - Methods:
    - Qualitative description

AQ2

Existing Conditions Research Question

In addition to the I-710, what are other sources of air pollution occurring in corridor communities? Include both stationary sources (e.g., refineries) and other mobile sources (other freeways, rails).

Impact Research Question

How would the I-710 Corridor Project impact air pollution from other sources including rails, at warehousing, transloading, and intermodal facilities?

Indicators

- For each source of pollution, level of select pollutants emissions/exposures
  - Data Sources:
    - Draft I-710 AQ/HRA
    - CARB
    - SCAQMD SIP model predictions, inventories
    - SCAQMD ambient monitoring data
    - MATES III inventories and/or model predictions
    - Zhu et al. papers
    - Other Los Angeles AQ studies
  - Methods:
    - Qualitative description
- Number of households within 300 meters (approximately 1,000 feet) of warehouses/transloading facilities
  - Data Sources:
    - Cambridge Systematics report to SCAG, 12/3/09
  - Methods:
    - GIS

AQ3

Existing Conditions Research Question

What is the existing impact of public transit access and use on transportation mode choice and, therefore, air quality in corridor communities?

Impact Research Question

How would the proposed project be expected to impact transportation mode choice and thereby air quality?

Indicators

- Existing and planned transportation routes, transit routes/stops
  - Data Sources:
    - METRO GIS layer of transit (rail/bus) system
  - Methods:

    - Qualitative (literature review and review of available statistics)

- Transit ridership
  - Data Sources:
    - I-710 Intermodal Study
    - Metro; Metrolink: Municipal bus service operators
  - Methods:
    - Qualitative (Literature review and review of available statistics)

AQ4

Existing Conditions Research Question

What are current asthma rates and rates of other respiratory diseases, compared to the county? How many missed days of school and work are currently attributable to asthma in the impacted areas?

Impact Research Question

How would changes in air quality resulting from the proposed project be expected to impact asthma risk? How would changes in asthma rates be expected to impact missed school and work days? How would missed school and work days be expected to impact health outcomes related to education, employment, and income?

Indicators

- Asthma prevalence, hospitalizations
  - Data Sources:
    - Los Angeles County Health Survey
    - Hospital admissions data
    - CHIS
    - Draft I-710 AQ/HRA
  - Methods:
    - Model using odds ratios from HIP meta-analyses to obtain attributable risk
- Days of missed school due to asthma
  - Data Sources:
    - Local school districts
    - CARB
    - Literature

- Methods:
  - Qualitative
- Days of missed work due to asthma
  - Data Sources:
    - CARB
    - Literature
  - Methods:
    - Qualitative

AQ5

Existing Conditions Research Question

What are the mortality rates associated with air pollution in impacted areas compared to the county?

Impact Research Question

How would changes in air quality resulting from the proposed project be expected to impact mortality risk?

Indicators

- Mortality rates due to air pollution (including CVD, hypertension, stroke, etc.)
  - Data Sources:
    - Hospital admissions data
    - LACDPH mortality data (ICD-10 codes)
    - Draft I-710 AQ/HRA
  - Methods:
    - Modeling based on CARB 2008[88] (or 2002) study (Pittsburg and Port of Oakland HIAs) if $PM_{2.5}$ data is available from the draft I-710 AQ/HRA; otherwise, qualitative analysis

AQ6

Existing Conditions Research Question

What is the current cancer risk due to air pollution in the impacted areas, compared to in the county?

Impact Research Question

How would changes in air quality resulting from proposed project changes be expected to impact cancer risk?

Indicators

- Rates and risk of various types of cancer
  - Data Sources:
    - Draft I-710 AQ/HRA
  - Methods:
    - Qualitative description (e.g., about uncertainties in analysis, if any)

AQ7

Existing Conditions Research Question

What is the current prevalence of hypertension, CVD, and stroke in impacted areas compared to the county?

Impact Research Question

How would changes in air quality resulting from the proposed project be expected to impact the prevalence of hypertension, CVD, and stroke?

Indicators

- CVD prevalence and hospitalization
- Hypertension prevalence and hospitalization
- Stroke rates and hospitalization

Data Sources (the same for all indicators)

- Los Angeles County Health Survey; hospital admissions data

Methods (the same for all indicators)

- Qualitative (literature review and review of available statistics)

AQ8

Existing Conditions Research Question

What is the current number of low-birth weight babies and pre-term births, and the status of other reproductive and endocrine health measures in the impacted areas compared to in the county and California as a whole?

Impact Research Question

How would changes in air quality resulting from the proposed project be expected to impact low birth-weight, pre-term births, and other reproductive and endocrine health risk (associated with air quality)?

Indicators

- Low birth weight births
  - Data Sources:
    - Literature review
    - Hospital data
  - Methods
    - Qualitative (literature review and review of available statistics)
- Preterm births
  - Data Sources:
    - Literature review
  - Methods
    - Qualitative (literature review and review of available statistics)

AQ9

Existing Conditions Research Question

What is the current number of autistic people and people with other cognitive/neurological issues in the impacted areas compared to in the county and California as a whole?

Impact Research Question

How would changes in air quality resulting from the proposed project be expected to impact autism rates and rates of people with other cognitive/neurological issues?

Indicators

- Autism rates
  - Data Sources:
    - Literature review
  - Methods
    - Qualitative (literature review and review of available statistics)
- Rates of cognitive/neurological disorders
  - Data Sources:
    - Literature review
  - Methods
    - Qualitative (literature review and review of available statistics)

AQ10

Existing Conditions Research Question

How do demographic characteristics of populations living in proximity to air pollution sources compare to characteristics of people living outside proximate areas?

Impact Research Question

Would projected changes in air pollution exposure disproportionately impact people with social-, economic-, or education-related vulnerabilities?

Indicators

- See Common Questions section

AQ11

Existing Conditions Research Question

What is the current air quality at the sites at which sensitive receptors live, work, play, or go to school (e.g., children in schools and parks; seniors' homes, hospitals)? Include data on age of housing units and impact age has on indoor air quality; disease populations (e.g., diabetes) and any added sensitivity to air quality they may have.

Impact Research Question

How would the proposed project impact air quality for sensitive receptors at those sites?

Indicators

- Ambient air quality measurements at schools, hospitals, etc.
  - Data Sources:
    - I-710 Corridor Project EIR/EIS Community Impact Assessment
    - SCAQMD
    - Existing studies
    - EIR/EISs
  - Methods:
    - Qualitative (literature review and review of available statistics)

AQ12

Existing Conditions Research Question

What are existing levels of GHG emissions from traffic on the I-710? What is the existing contribution of GHG emissions from traffic on the I-710 to climate change?

Impact Research Question

How would the projected changes impact levels of GHG emissions and therefore climate change?

Indicators

- Level of CO_2 equivalent (CO_2eq) emissions from traffic on the I-710. Speed profile for CO_2 and different vehicles. For current and future trucks.
  - Data Sources:
    - Draft I-710 AQ/HRA
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Level of CO_2eq emission from other sources associated with the I-710 (e.g., warehouses)
  - Data Sources:
    - Draft I-710 technical studies (especially cumulative impact analysis)
  - Methods:
    - Qualitative (literature review and review of available statistics)

AQ13

Existing Conditions Research Question

What is the current prevalence of heat-related illness in the corridor compared to the county?

Impact Research Question

How would changes in greenhouse gas emissions and climate change from the proposed project impact heat-related illness?

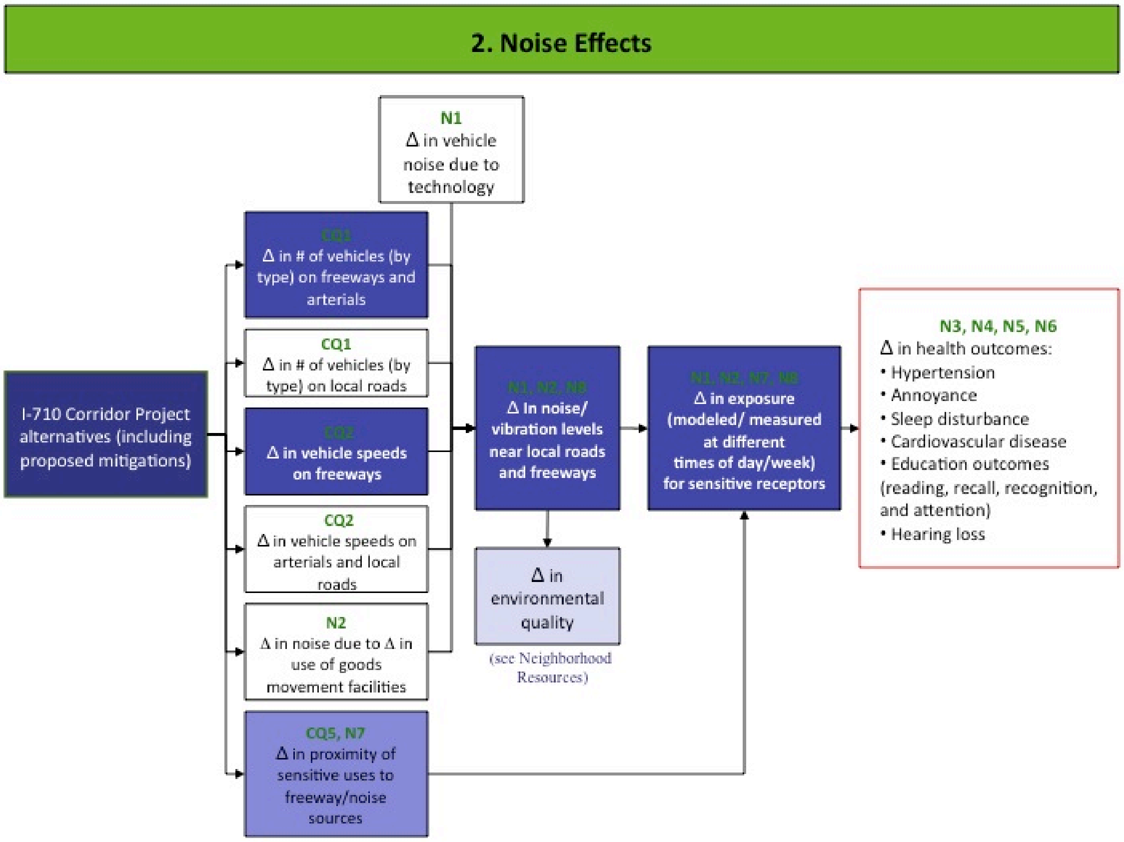
Indicators

- Heat-related illness
  - Data Sources:
    - California Department of Public Health
  - Methods:

– Qualitative (literature review and review of available statistics)

3.5 Noise (N)

3.5.1 Pathway



3.5.2 Geographies of Interest

- 0–150 meters (approximately 0–500 feet) from the I-710
- 150–300 meters (approximately 500–1,000 feet) from the I-710
- Greater than 300 meters (approximately 1,000 feet) within the I-710 Corridor Project Study Area
- Los Angeles County (as comparison)

3.5.3 Research Questions

N1

Existing Conditions Research Question

What are noise levels in impacted areas, measured at different times of day? Where are the existing sound barriers, and what type of barriers are they?

Impact Research Question

How would projected changes affect noise levels in the impacted areas? How would specific features of the proposals (e.g., position of truck lanes, zero emission trucks, sound barriers) impact noise?

Indicators

- Average daytime and nighttime (and weekday/weekend times) decibel readings at sites (including sensitive receptor locations) near the I-710, other major highways, on/off ramps, and selected arterials.
    - Data Sources:
        - I-710 Corridor Project EIR/EIS noise readings/contours or noise model
        - Caltrans studies
    - Methods:
        - Review results of draft I-710 Noise analysis
- Locations and heights of noise barriers on the I-710, other major highways, and on/off ramps
    - Data Sources:
        - draft I-710 Noise study
    - Methods:
        - Review results of draft I-710 Noise analysis

N2

Existing Conditions Research Question

What are other sources of noise (including rail) in corridor communities, how do they vary by time of day/week, and what is their contribution to existing levels of noise in the impacted areas?

Impact Research Question

How would the I-710 Corridor Project impact other noise sources, including rail, local roads, and warehousing, transloading, and intermodal facilities? How would changes in these sources, in addition to project changes, cumulatively be expected to impact noise?

Indicators

- Locations of other noise sources in the community
- Average daytime and nighttime decibel estimates near these locations

Data Sources (the same for all indicators)

- EIRs/EISs (Ports PierPASS project EIR/EIS)
- Rail/intermodal facility EIRs/EISs
- South Coast International Gateway (SCIG)/ International Container Transfer Facility (ICTF) expansion EIR/EIS (forthcoming)

Methods (the same for all indicators)

- Qualitative
- GIS

N3

Existing Conditions Research Question

Based on modeling data, what is the current prevalence of annoyance, sleep disturbance, and cognitive impairment in the impacted areas?

Impact Research Question

How would projected changes in noise affect modeled levels of these outcomes?

Indicators

- Percent highly annoyed
  - Data Sources:
    - draft I-710 Noise study
  - Methods:
    - If noise data is available from the draft I-710 Noise study, model percent highly annoyed based on decibel levels near traffic and other noise sources to estimate the population at risk for health problems due to noise (Miedema and Oudshoorn 2001[325]); otherwise, qualitative analysis
- Percent of people whose sleep is disturbed
  - Data Sources:
    - Draft I-710 noise study readings/contours or noise model
  - Methods:

  - If noise data is available from the EIR/EIS, model sleep disturbance using Miedema study; otherwise, qualitative analysis

- Cognitive impairment based on noise
  - Data Sources:
    - Draft I-710 noise study readings/contours or noise model
  - Methods
    - Qualitative (literature review and review of available statistics)

N4

Existing Conditions Research Question

What is the current prevalence of hypertension and myocardial infarction in impacted areas compared to the county?

Impact Research Question

How would changes in noise resulting from the proposed project be expected to impact the prevalence of hypertension and myocardial infarction?

Indicators

- Rates of hypertension and MI
  - Data Sources:
    - Los Angeles Community Health Services (LACHS), hospital discharge diagnosis data
    - Van Kempen 2002 meta-analysis for hypertension
    - Babich meta-analysis for MI
  - Methods:
    - Qualitative (literature review and review of available statistics)

N5

Existing Conditions Research Question

What are the current levels of academic achievement (standardized tests, reading comprehension) for children in the impacted areas?

Impact Research Question

How might the projected changes in noise affect school achievement? How might changes in school achievement affect health outcomes?

Indicators

- Average test scores for children (broken out test scores by race/ethnic enrollment and eligible for free and reduced price meals)
  - Data Sources:
    - Local school districts
  - Methods:
    - Qualitative (literature review and review of available statistics)

N6

Existing Conditions Research Question

What are the current levels of hearing impairment in the impacted areas?

Impact Research Question

How might the projected changes in noise affect hearing impairment?

Indicators

- Number of hearing impaired people
  - Data Sources:
    - Literature review
  - Methods:
    - Qualitative (literature review and review of available statistics)

N7

Existing Conditions Research Question

How do demographic characteristics of populations living in proximity to noise sources compare to characteristics of people living outside proximate areas?

Impact Research Question

Would projected changes in noise exposure disproportionately impact people with social-, economic-, or education-related vulnerabilities?

Indicators

- See Common Questions section

N8

Existing Conditions Research Question

What is current noise level at the sites at which sensitive populations live, work, play, or go to school (e.g., children in schools and parks, seniors' homes, churches, hospitals, disease populations, and any added sensitivity to noise)?

Impact Research Question

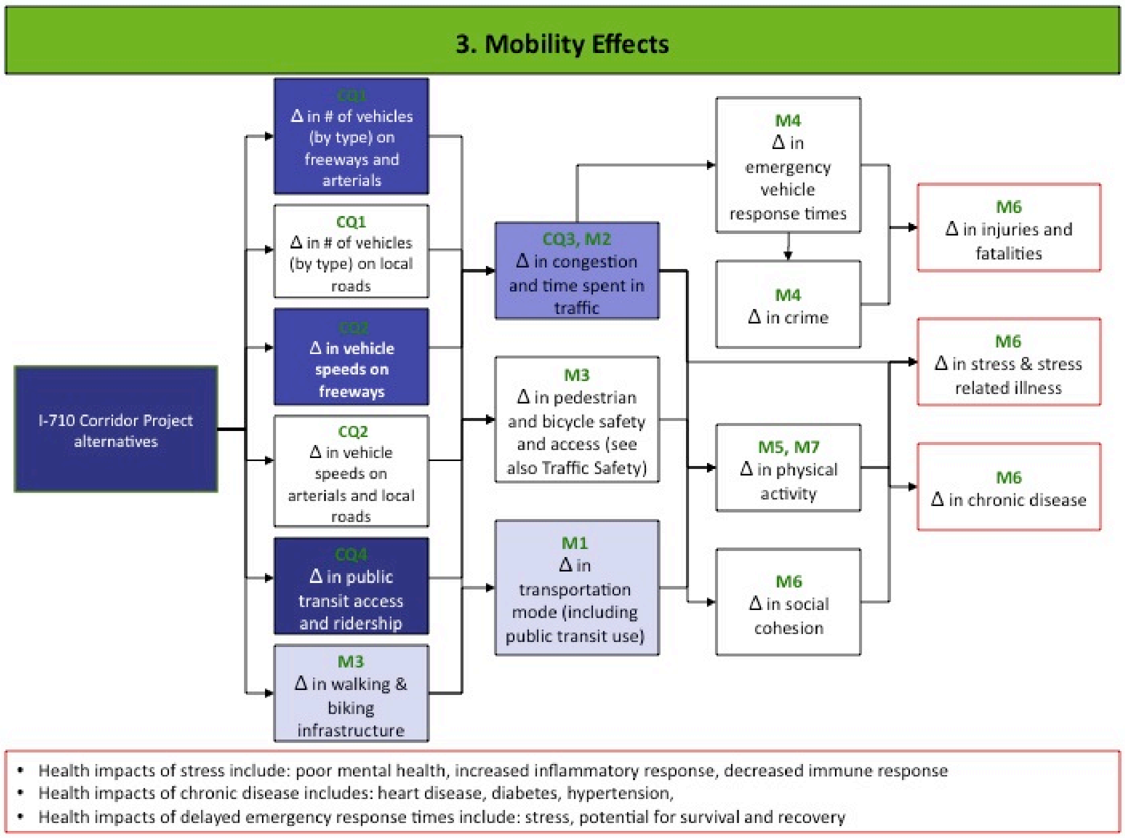
How would the proposed project impact noise for sensitive receptors at those sites? How would soundproofing in schools or other buildings impact existing ventilation or air conditioning systems (and potentially increase other health impacts)?

Indicators

- Average daytime and nighttime decibel readings (or modeled levels)
  - Data Sources:
    - draft I-710 Noise study
    - Caltrans noise studies
  - Methods:
    - Qualitative (literature review and review of available statistics)

3.6 Mobility (M)

3.6.1 Pathway



3.6.2 Geographies of Interest

- I-710 Corridor Project Study Area

3.6.3 Research Questions

M1

<u>Existing Conditions Research Question:</u>

Which modes of transportation do residents use to get to work in impacted areas? What are current travel times to work for residents who live in the impacted areas?

Impact Research Question:

How would proposed changes impact mode of travel to work? What impact would these changes have on traffic measures? How would the proposed project impact the travel times for people who live and/or work in the impacted areas?

Indicators:

- Mode Share for residents to work in the impacted area (by race, age, income, etc.)
  - Data Sources:
    - U.S. Census
    - Draft I-710 traffic studies
    - SCAG (see 2008 Regional Transportation Plan and PE ROW / West Santa Ana Branch Corridor Analysis)
  - Methods:
    - Review results of EIR/EIS analysis
- Access to motor vehicles by household and household size
  - Data Sources:
    - U.S. Census
    - Draft I-710 traffic studies
    - SCAG (see 2008 Regional Transportation Plan and PE ROW / West Santa Ana Branch Corridor Analysis)
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Commute time for residents who live in the area
  - Data Sources:
    - U.S. Census
    - Draft I-710 traffic studies
    - SCAG (see 2008 Regional Transportation Plan and PE ROW / West Santa Ana Branch Corridor Analysis
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Travel times for segments of the I-710
  - Data Sources:

- Draft I-710 traffic studies
- SCAG (see 2008 Regional Transportation Plan and PE ROW / West Santa Ana Branch Corridor Analysis)
- California Department of Transportation (Caltrans) database

- Methods:
  - Review results of EIR/EIS analysis
  - Quantitative if possible

M2

Existing Conditions Research Question:

What are the current congestion conditions, VMT, time spent driving, and speeds on roads in defined geographies at various times in the day and week?

Impact Research Question:

How would the proposed project impact congestion conditions on the freeway and arterials streets at various times in the day and week? How would the proposed project impact speeds on roads in the impacted areas, VMT, and time spent driving?

Indicators:

- Screenline volume/capacity (vehicle demand compared to the available roadway capacity)
  - Data Sources:
    - Draft I-710 traffic studies
    - SCAG (see 2008 Regional Transportation Plan and PE ROW / West Santa Ana Branch Corridor Analysis)
  - Methods:
    - Review results of draft EIR/EIS analysis
    - Quantitative if possible
- Traffic speeds at various times of day (see Common Questions section)
  - Data Sources:
    - Draft I-710 traffic studies
    - SCAG, Bureau of Transportation Statistics (BTS) travel time index (http://www.bts.gov/publications/national_transportation_statistics/html/table_01_64.html)

- Methods:
  - Review results of EIR/EIS analysis
- Annual delay per traveler (or vehicle-hour delay)
  - Data Sources:
    - Texas Transportation Institute (http://mobility.tamu.edu/ums/congestion_data/tables/national/table_4.pdf)
  - Methods:
    - Quantitative if possible (see http://mobility.tamu.edu/ums/report/appendix_a.pdf)
- VMT—See Common Questions

M3

Existing Conditions Research Question

What is the status of walkability and bikeability in impacted areas?

Impact Research Question

How would the proposed project impact the quality of the environment for pedestrians and bicyclists in the impacted areas?

Indicators

- Traffic volume on streets used by pedestrians
  - Data Sources:
    - Los Angeles Department of Transportation Traffic Volumes Book
    - Metro
    - I-710 Intermodal study
    - SCAG
    - Metrolink
    - Bus service operators: focus group
    - City of Long Beach Livability Study
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Ratio of miles of bike lanes and paths to miles of road
  - Data Sources:
    - GIS shape files from Caltrans or local transit authority

    - Long Beach Bicycle Master Plan
  - Methods:
    - Qualitative (literature review and review of available statistics)

M4

Existing Conditions Research Question

What are current emergency vehicle response times in impacted areas?

Impact Research Question

How would project proposals impact congestion and speeds for emergency response vehicles? How might these changes impact crime rates in impacted areas?

Indicators

- Average response times for emergency vehicles (medical, police, and fire)
  - Data Sources:
    - Police, fire, and medical departments
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Crime rates
  - Data Sources:
    - Police departments
  - Methods:
    - Qualitative (literature review and review of available statistics)

M5

Existing Conditions Research Question

What are the current rates of physical activity for populations living in the impacted areas? What are the health impacts of these activity levels (e.g., CVD, mental health, diabetes)?

Impact Research Question

How would projected changes in travel times, VMT, and mode of transportation impact rates of physical activity for these populations? What are the health impacts of projected changes in levels of physical activity?

Indicators

- Number of days physically active at least one hour (typical week) for adults and children
  - Data Sources:
    - Los Angeles County Health Survey
    - Cohen's RAND study on parks and physical activity in Los Angeles
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Percent of adults/children that participate in recommended levels of physical activity
  - Data Sources:
    - Los Angeles County Health Survey
    - School data
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Rates of obesity (body mass index)
  - Data Sources:
    - Los Angeles County Health Survey
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Morbidity and mortality from heart disease
  - Data Sources:
    - Los Angeles County Health Survey
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Morbidity and mortality from diabetes
  - Data Sources:
    - Los Angeles County Health Survey
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Hospital visits with a depressive disorder diagnosis
  - Data Sources:

   - Los Angeles County Health Survey
- Methods:
   - Qualitative (literature review and review of available statistics)

M6

Existing Conditions Research Question

What are the other potential health impacts of a lack of mobility? (Does a lack of mobility lead to increased stress? Does stress from a lack of mobility lead to CVD or aggression? Does lack of mobility impact social cohesion? Does congestion impact emergency vehicle services and therefore injury and fatality rates?)

Impact Research Question

How would the changes in traffic impact other health impacts related to mobility and congestion (e.g., how would injury rates from crime change)?

Indicators

- Average medical, police, and fire emergency response times
  - Data Sources:
    - Police, fire, and medical departments
  - Methods:
    - Qualitative (literature review and review of available statistics)
- Percent of residents reporting higher than average levels of stress (LACHS has entries for "avg days of poor mental health in past month", "diagnosed depression" and "frequent mental distress")
  - Data Sources:
    - Los Angeles County Health Survey
  - Methods:
    - Qualitative (literature review and review of available statistics)

M7

Existing Conditions Research Question

How many hours of physical activity do children currently get?

Impact Research Question

How would children's physical activity levels change as a result of the proposed project (e.g., walking to school, park use)?

Indicators

- Amount of physical activity or a measure of physical fitness
- Body mass index

Data Sources (same for all indicators)

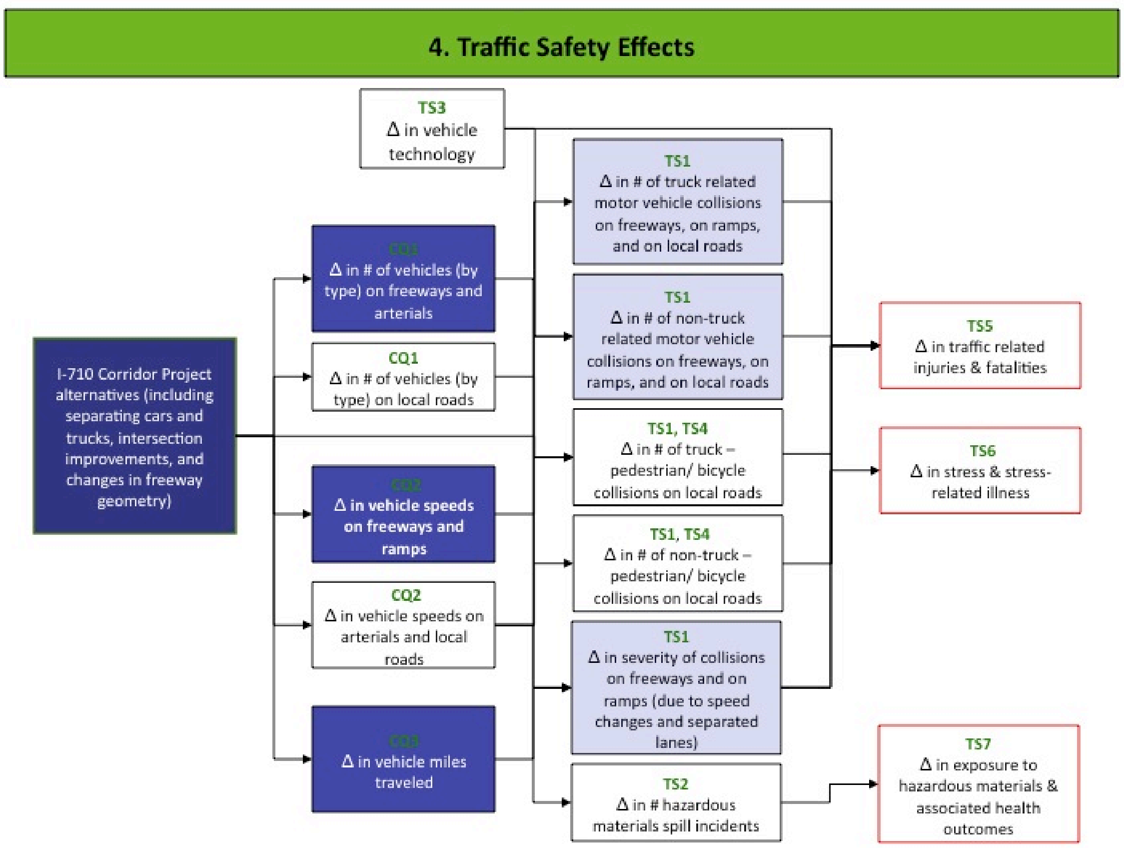
- LACDPH
- Fitness program

Methods (same for all indicators)

- Qualitative (literature review and review of available statistics)

3.7 Traffic Safety (TS)

3.7.1 Pathway



3.7.2 Geographies of Interest

- I-710 Corridor Project Study Area
- Los Angeles County

3.7.3 Research Questions

TS1

Existing Conditions Research Question

How many truck and non-truck motor vehicle–motor vehicle and motor vehicle–pedestrian/bicycle collisions occur annually in the impacted areas? (Separate analysis for on freeway, on ramps, and on local roads.)

Impact Research Question

How would changes in traffic volumes, VMT and speeds, separating car and truck lanes, freeway geometry, and intersection improvements impact the number and severity of truck and non-truck motor vehicle–motor vehicle and motor vehicle–pedestrian/bicycle collisions?

Indicators

- Number of truck-related motor vehicle–motor vehicle collisions, broken out by location (highway or city streets)
- Number of non-truck-related motor vehicle–pedestrian/bicycle collisions
- Number of truck-related motor vehicle–pedestrian/bicycle
- Number of non-truck-related motor vehicle–pedestrian/bicycle
  - Data Sources (for all 4 indicators above):
    - Statewide Integrated Traffic Records System (SWITRS)
    - Draft I-710 traffic studies
  - Methods (for all 4 indicators above)
    - Review results of draft EIR/EIS analysis
    - GIS
    - Qualitative (literature review and review of available statistics)
- Speed vs. collision severity profile for trucks and cars (see Common Questions)
  - Data Sources:
    - SWITRS
    - Draft I-710 traffic studies
  - Methods
    - Qualitative analysis of pedestrian collisions using Loukaitou-Sideris
    - Use expert analysis of proposed interchange design

TS2

Existing Conditions Research Question

How many hazardous materials incidents occur on the I-710 each year? What are the impacts of these incidents on infrastructure and on health?

Impact Research Question:

How would changes in traffic volumes, VMT, and speeds, separating car and truck lanes, freeway geometry, and intersection improvements impact the number of hazardous materials incidents? How would they impact infrastructure and health of surrounding communities?

Indicators

- Number of incidents per year
- Amount of material released annually

Data Sources (same for all indicators)

- Incidents Reports Database (USDOT Pipeline and Hazardous Materials Safety Administration)
- California Highway Patrol
- California Emergency Management Agency

Methods (same for all indicators)

- Qualitative (literature review and review of available statistics)

TS3

Existing Conditions Research Question:

What are existing vehicle sizes and technologies related to traffic safety (e.g., air bags)?

Impact Research Question

How would changes in vehicle size and technology impact collision rates and rates of injury/fatality?

Indicators

- Vehicle sizes and technologies

Data Sources

- Literature review

Methods

- Qualitative (literature review and review of available statistics)

TS4

Existing Conditions Research Question

How do students get to school?

Impact Research Question

How would the project impact routes to schools? Is there evidence of higher pedestrian injury in schools closer to the I-710 or other freeways?

Indicators

- Locations of schools in corridor study area
- Number of students who walk/bike to school
- Number of pedestrian injuries close to schools near the I-710

Data Sources (same for all indicators)

- SWITRS
- Local school districts
- CADOE

Methods (same for all indicators)

- GIS

TS5

Existing Conditions Research Question

What is the current rate (or number) of injuries and fatalities from motor vehicle accidents in the corridor? (Broken out by pedestrian, bicycle, and vehicle.)

Impact Research Question

How would changes in traffic, VMT, separating car and truck lanes, freeway geometry, and intersection improvements due to the proposed project impact the rate (or number) of injuries due to motor vehicle accidents in the corridor? How would changes in traffic speed and freeway design due to the project impact the severity of collisions/ injuries from motor vehicle accidents on freeways and on ramps?

Indicators

- Number of pedestrian injuries from collisions
- Number of bicycle injuries from collisions
- Number of bicycle fatalities from collisions

- Number of pedestrian fatalities from collisions
- Number of injuries from motor vehicle–motor vehicle collisions

Data Sources (same for all indicators):

- SWITRS
- Draft I-710 traffic studies

Methods (same for all indicators):

- Qualitative analysis of number of pedestrian accidents and fatalities using Loukaitou-Sideris
- Qualitative (literature review and review of available statistics)
- Qualitative analysis using SWITRS data and analysis above
- Qualitative analysis based on number of collisions

TS6

Existing Conditions Research Question

What are current levels of stress and stress-related illness related to motor vehicle accidents in the corridor?

Impact Research Question

How would changes in traffic, VMT, separating car and truck lanes, freeway geometry, and intersection improvements due to the proposed project impact stress and stress-related illness in the corridor?

Indicators

- Percent of residents reporting higher than average levels of stress (LACHS has entries for "avg days of poor mental health in past month," "diagnosed depression," and "frequent mental distress")
  - Data Sources:
    - Los Angeles County Health Survey
  - Methods:
    - Qualitative (literature review and review of available statistics)

TS7

Existing Conditions Research Question

What are the health outcomes associated with past hazardous material spills?

Impact Research Question

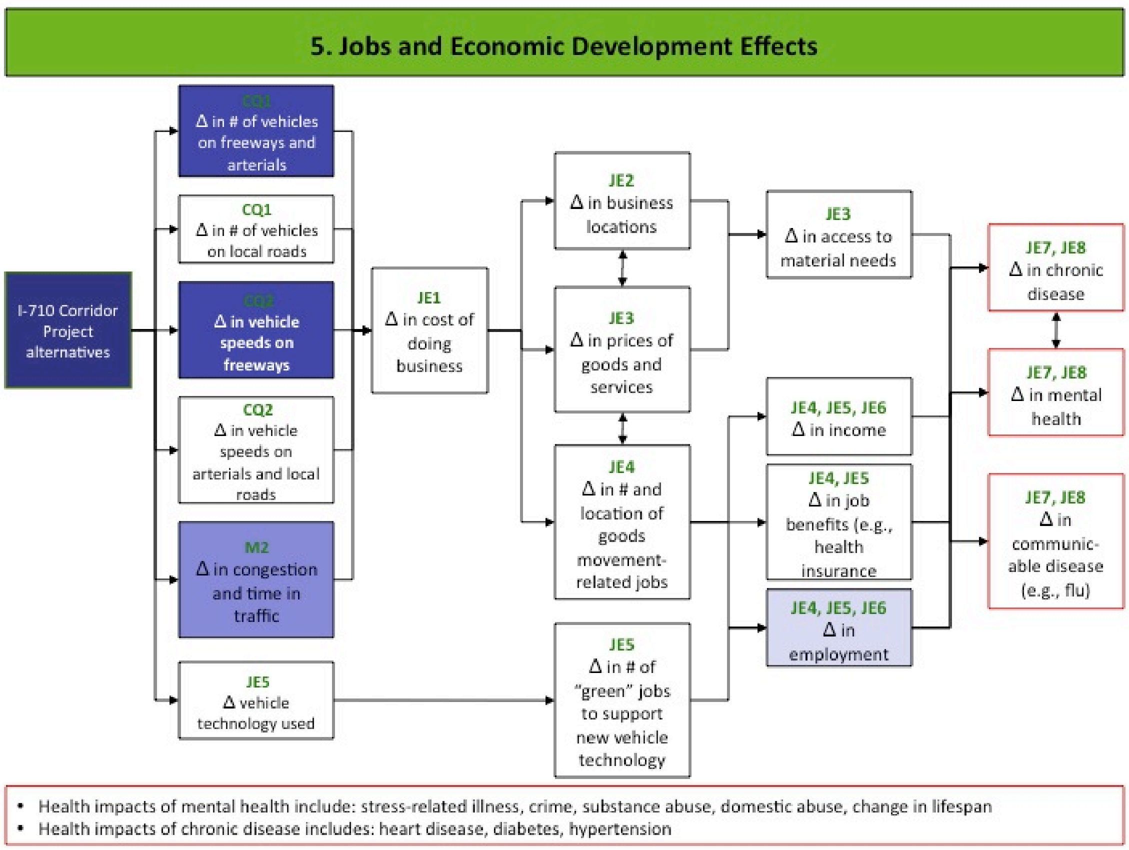
How would the change in the number of hazardous material spills impact health outcomes?

Indicators

- Qualitative description of hazardous material spills and health outcomes, if any
  - Data Sources:
    - California Emergency Management Agency
  - Methods:
    - Qualitative (literature review and review of available statistics)

3.8 Jobs and Economic Development (JE)

3.8.1 Pathway



3.8.2 Geographies of Interest

- I-710 Corridor Project Study Area, where possible
- Los Angeles County or state-level indicators

3.8.3 Research Questions

JE1

Existing Conditions Research Question

What are the current major, relevant inputs into the cost of doing business in the region? (Include, for example, property values, travel time, environmental concerns.)

Impact Research Question

How would the costs of doing business change as a result of the proposed project?

Indicators

- Commercial property values
  - Data Sources:
    - California Association of Realtors
    - I-710 community profiles and draft property impacts and relocation study
    - Caltrans interview
  - Methods:
    - Qualitative (literature review, review of available statistics)
- Annual delay for trucks or VMT for trucks
  - Data Sources:
    - I-710 traffic studies
  - Methods:
    - Qualitative (literature review, review of available statistics)
- Perceptions of environment of business community
  - Data Sources:
    - Focus groups/surveys
  - Methods
    - Qualitative (literature review, review of available statistics, focus groups, or interviews with businesses)

JE2

Existing Conditions Research Question

What businesses are currently choosing to locate in the I-710 corridor?

Impact Research Question

How would the proposed project impact the choice of business location?

Indicators

- Business location by industry type
  - Data Sources:
    - California Association of Realtors
    - I-710 Corridor Project EIR/EIS community profiles
  - Methods:
    - Qualitative (literature review, review of available statistics, focus groups or interviews with businesses)

JE3

Existing Conditions Research Question

What are the costs of goods and services available locally? How does this impact access to these goods and services?

Impact Research Question

Would the proposed project impact cost of goods and services: (1) as inputs for other businesses, and (2) consumer goods available to residents locally and in the region? Would changes in costs impact access to these goods and services?

Indicators

- Consumer price index
  - Data Sources:
    - Bureau of Labor Statistics, California Department of Industrial Relations
  - Methods:
    - Qualitative (literature review, review of available statistics)

JE4

Existing Conditions Research Question

How many and what types of jobs (including wages, benefits, types, skill sets necessary, safety hazards, leave policies) does the goods movement industry currently offer? How many and what types of jobs do goods movement industries currently provide residents in which parts of the city, county, region, state?

Impact Research Question

How would the proposed project impact the number and types of goods movement jobs available? How would the proposed project impact the number and types of goods movement jobs offered to residents in the corridor?

Indicators

- Number of goods movement jobs, by category
  - Data Sources:
    - California Employment Development Department (CA EDD)
    - U.S. Census
  - Methods:
    - Qualitative (literature review, review of available statistics)
- Number of jobs, by income
  - Data Sources:
    - CA EDD
    - U.S. Census
  - Methods:
    - Qualitative (literature review, review of available statistics)
- Number of jobs, by educational level required
  - Data Sources:
    - CA EDD
    - U.S. Census
  - Methods:
    - Qualitative (literature review, review of available statistics)
- Proportion of goods movement jobs held locally
  - Data Sources:
    - Port of Los Angeles
    - Port of Long Beach
    - U.S. Census
  - Methods
    - Qualitative (literature review, review of available statistics)

- Net job loss/growth: compare projected rise in jobs (in goods movement, retail, etc.) to industries projected to decline (manufacturing, construction)—stratify by educational attainment level required
    - Data Sources:
        - CA EDD
        - U.S. Census
    - Methods:
        - Qualitative (literature review, review of available statistics)

JE5

Existing Conditions Research Question

How many and what types of jobs related to alternative vehicle technologies are currently available in the corridor and region?

Impact Research Question

How would the proposed project impact the number and types of jobs related to alternative vehicle technologies available? How would the proposed project impact the number and types of such jobs offered to residents in the corridor?

Indicators

- Number of alternative vehicle technology jobs by category
    - Data Sources:
        - CA EDD
        - U.S. Census
    - Methods:
        - Qualitative (literature review, review of available statistics)
- Number of jobs by income
    - Data Sources:
        - CA EDD
        - U.S. Census
    - Methods:
        - Qualitative (literature review, review of available statistics)

- Number of jobs by educational level required
  - Data Sources:
    - CA EDD
    - U.S. Census
  - Methods:
    - Qualitative (literature review, review of available statistics)

JE6

Existing Conditions Research Question

What is the current level of unemployment in corridor communities?

Impact Research Question

How would the proposed project impact levels of employment?

Indicators

- Percent unemployment, underemployment, and those no longer seeking work
- Number of jobs needed to fulfill unemployment
- Number of jobs needed to bring employment rate to parity with the county level (will be a greater number than above)

Data Sources (same for all indicators)

- U.S. Census
- City estimates

Methods (same for all indicators)

- Qualitative (literature review, review of available statistics)

JE7

Existing Conditions Research Question

What are the current rates of major diseases (CVD, mental health, premature mortality, infectious diseases, others) related to income and employment?

Impact Research Question

How would the proposed project impact rates of major diseases related to income and employment?

Indicators

- Health outcome data
  - Data Sources:
    - LACDPH
    - I-710 Corridor Project EIR/EIS community profiles
  - Methods:
    - Qualitative (literature review, review of available statistics)

JE8

Existing Conditions Research Question

What are the rates of diseases related to access to goods and services?

Impact Research Question

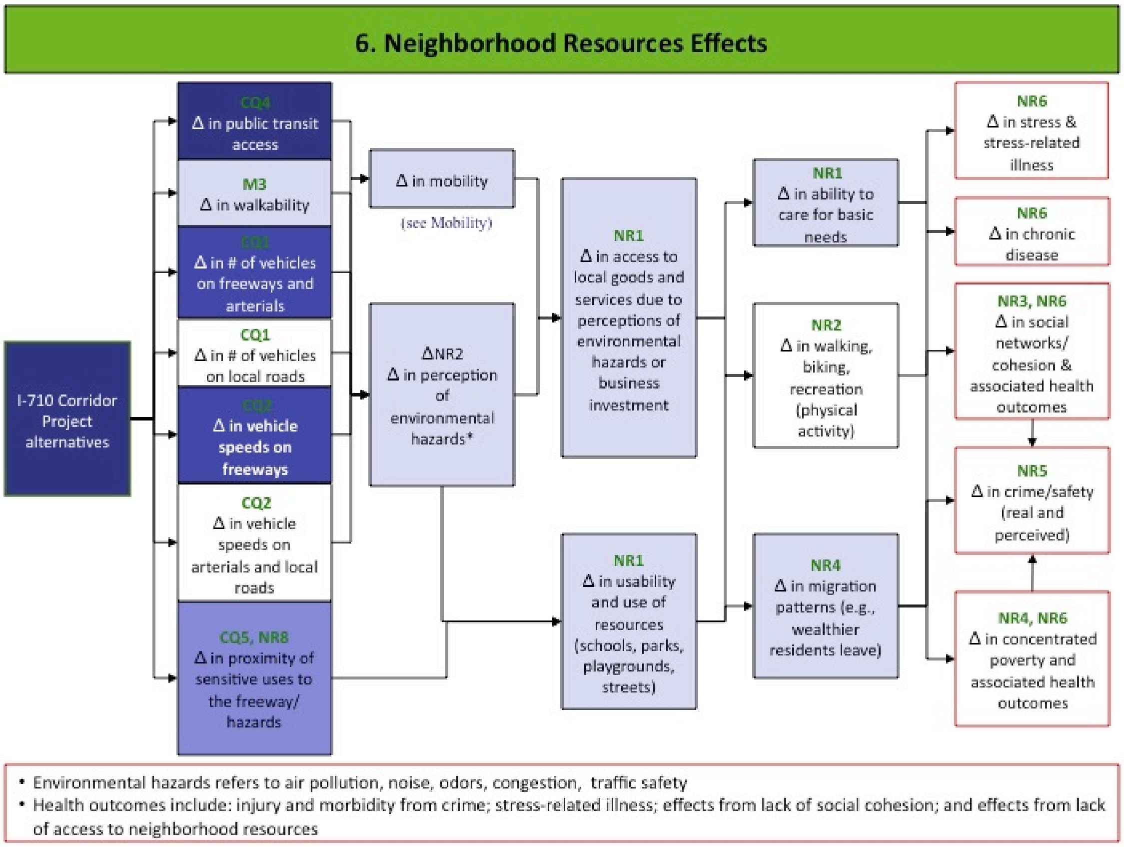
How would the rates of these diseases change as a result of the proposed project?

Indicators

- Health outcome data
  - Data Sources:
    - LACDPH
    - I-710 Corridor Project EIR/EIS community profiles
  - Methods:
    - Qualitative (literature review, review of available statistics)

3.9 Neighborhood Resources (NR)

3.9.1 Pathway



3.9.2 Geographies of Interest

- I-710 Corridor Project Study Area

3.9.3 Research Questions

NR1

<u>Existing Conditions Research Question</u>

What public and private resources (e.g., parks, libraries, schools, health clinics, day care centers, community centers, post offices, banks, grocery stores, local retail) are available? Do residents perceive a lack of necessary public or private resources in their neighborhoods? If so, which resources do residents feel are important?

Impact Research Question

Would projected changes result in real or perceived changes in necessary neighborhood resources (including displacement or proximity of environmental hazards to resources)?

Indicators

- Neighborhood completeness index (SFDPH)
  - Data Sources:
    - Chamber of Commerce, neighborhood associations, business directories, etc.
    - I-710 community profiles and draft property impacts and relocation study
  - Methods:
    - Qualitative (literature review and review of available statistics and focus groups/surveys)
- Proportion of population within 0.5 mile of healthcare facilities
  - Data Sources:
    - Chamber of Commerce, neighborhood associations, business directories, etc.
    - I-710 Corridor Project EIR/EIS community profiles and draft property impacts and relocation study
  - Methods:
    - GIS mapping

NR2

Existing Conditions Research Question

Do residents perceive environmental hazards in their neighborhoods associated with the freeway? If so, which hazards are a problem? Do environmental hazards cause residents to avoid certain outdoor activities (e.g., walking, visiting parks, routes to schools)?

Impact Research Question:

Would projected changes due to the proposed project result in changes to perceptions of environmental hazards? Would projected changes in environmental hazards change residents' outdoor activities or use of neighborhood resources?

Indicators

- Perceptions of the environmental quality
  - Data Sources:
    - Focus groups/survey

- Methods:
  - Qualitative analysis of how these perceptions impact social cohesion, collective efficacy, use of resources

NR3

Existing Conditions Research Question

What is the nature of existing social cohesion in the impacted areas? What social spaces do people identify as being important?

Impact Research Question

How would projected changes to the neighborhood population and resources impact social cohesion? Would the proposed project change the cohesiveness of neighborhoods? Do residents think the changes resulting from the freeway would affect social cohesion?

Indicators

- Perceptions of social cohesion
- Objective measures: counts of community centers, parks, churches, community and neighborhood organizations, churches; voting records

Data Sources (same for all indicators)

- Focus groups/surveys

Methods (same for all indicators)

- Qualitative (literature review and review of available statistics and focus groups/surveys)

NR4

Existing Conditions Research Question

Is there concentrated poverty in the study area as compared to the county? What are the trends in poverty levels over time? What is the relationship between home prices and proximity to the freeway?

Impact Research Question

Would changes in environmental hazards, social cohesion, or neighborhood resources be expected to change migration patterns and increase poverty in the study area as compared to the county or region? How would home prices be impacted by the proposed project alternatives?

Indicators

- Poverty rate
  - Data Sources:

  - Census
  - I-710 Draft Community Impact Assessment
  - PE ROW/West Santa Ana Branch Corridor Analysis
- Methods:
  - GIS
  - Qualitative (literature review and review of available statistics)

- Home prices
  - Data Sources:
    - I-710 Draft Community Impact Assessment
    - Real estate data
  - Methods:
    - GIS
    - Qualitative (literature review and review of available statistics)

NR5

Existing Conditions Research Question

What are current conditions of neighborhood safety in the impacted areas (violent crime rates, citizen neighborhood safety commissions)?

Impact Research Question

How would changes in the social environment, concentrated poverty, and neighborhood resources impact neighborhood safety (violent crime rates, neighborhood safety commissions)? How would changes in neighborhood safety impact use of resources, such as parks?

Indicators

- Violent crime rates
  - Data Sources:
    - Los Angeles Police Department (LAPD)
    - I-710 Draft Community Impact Assessment
  - Methods:
    - Qualitative (literature review and review of available statistics)

NR6

Existing Conditions Research Question

What are the current rates of major diseases (CVD, mental health, premature mortality, self-rated health, others) related to social cohesion, concentrated poverty, and neighborhood resources (including those mediated through stress)?

Impact Research Question

How would the proposed project broadly impact rates of major diseases related to social cohesion and neighborhood resources?

Indicators

- Health outcome data
  - Data Sources:
    - LACDPH
  - Methods:
    - Qualitative (literature review and review of available statistics)

NR7

Existing Conditions Research Question

What are the current rates of physical activity for populations living in the impacted areas?

Impact Research Question

How would projected changes in travel times, time spent outdoors, and mode of transportation impact rates of physical activity for these populations?

Indicators

- Number of days physically active at least one hour (typical week) for adults and children
  - Data Sources:
    - Los Angeles County Health Survey
    - Deb Cohen's RAND study on physical activity
    - City of Long Beach Livability Study
  - Methods:
    - Qualitative (literature review and review of available statistics)

- Percent of adults/children who participate in recommended levels of physical activity
  - Data Sources:
    - Los Angeles County Health Survey
    - School data
  - Methods:
    - Qualitative (literature review and review of available statistics)

NR8

Existing Conditions Research Question

How do demographic characteristics of populations living in proximity to environmental hazards compare to characteristics of people living outside proximate areas?

Impact Research Question

How would perceived changes in environmental hazards vary by proximity to hazards and the demographic characteristics of these populations?

Indicators

- See Common Questions section

Notes for Neighborhood Resources

"Environmental hazards" refers to air pollution, noise, odors, congestion, and traffic safety.

4. History of the I-710 Corridor Communities

The American Association of State Highway Officials (AASHTO) Standing Committee on the Environment recognizes that a basic awareness of the history and past actions that shaped a region is crucial to understanding how a proposed project may impact residents:

> In some cases, when a community was originally impacted, environmental regulations (NEPA, etc.) were not in place, so past impacts might not have been identified to the degree they now would be. For instance, highway projects that were built in the 1950s and 1960s might not have addressed even severe community impacts, such as major disruptions to access, barrier effects, increases in noise, and degradation of aesthetics. A new transportation project that affects the same community might seem to have a minor direct impact. However, the analysis should take into consideration past impacts that were not addressed. (Grant et al. 2008[204])

To help build this awareness, a brief history of the communities surrounding the I-710 has been provided here.

4.1 Turn of the Century: Birth of the Streetcar Suburbs

Even before private automobiles were introduced in the early 1910s and 20s, Los Angeles had already begun developing its characteristic sprawling, low-density form and associated land use. As the population of Los Angeles exploded from around 6,000 residents in 1880 to over 100,000 at the turn of the century, land syndicates—partnerships between speculators, realtors, and trolley operators—competed to build housing (Wachs 1984[472]). The Los Angeles basin became scattered with "streetcar suburbs" that offered single-family homes surrounded by open space, connected to the growing downtown by a trolley system.

Many of these suburbs were heterogeneous in terms of race and socioeconomic status. Deed restrictions prohibiting certain groups were common, yet low-income people and minorities still carved out residential enclaves in many of these suburbs. This was especially prevalent in the working-class suburbs, such as the neighborhoods that flourished in the area between Downtown and the Los Angeles Harbor, now bisected by the I-710.

The completion of the Southern Pacific rail line in the 1880s helped spur growth in manufacturing industries concentrated in the area south of Downtown LA, which necessitated a readily available labor force (Jones & Stokes 2001[244]). In the early decades of the 20th century, neighborhoods like Compton, South Gate, Lynwood, and Bell Gardens became havens where primarily White, Mexican-American, and Chinese-American blue-collar workers could secure affordable housing (Nicolaides 1999[344]). In many of these suburbs, houses were owner-built, allowing residents to use "sweat equity" to construct homes and providing owners with a measure of stability and self-sufficiency. Because many of these neighborhoods were not incorporated until the late 1950s and 60s, there were lax building regulations and few municipal services, both of which resulted in lower housing prices. It is estimated that by the 1930s about 90% of residents in working-class Bell Gardens were homeowners, a figure that was roughly twice the county and national rates (Nicolaides 1999[344]).

4.2 The 1920s: The Goods Movement Industry and the Birth of the Automobile Culture

Investments in infrastructure at the Ports of Los Angeles and Long Beach enhanced shipping capacity and helped fuel the era of rapid growth that Los Angeles experienced in the early decades of the 20th century. In 1912, Southern Pacific completed a wharf facility that linked the ports to its expansive rail network (Jones & Stokes 2001[244]).

Modernization of the ports coincided with the opening of the Panama Canal in 1917, which improved cargo routes between the Pacific and Atlantic oceans. As the southern-most seaport in North America, the ports became a natural docking point. Industries supporting this global goods movement system thrived; by the early 20th century there were approximately 20,000 laborers employed in the port's shipyards (Jones & Stokes 2001[244]). The region's importers, exporters, construction businesses, fisheries, and canneries flourished.

Private automobiles changed the way of life during this period and helped shape the future development of the region. Between 1919 and 1929, the number of automobiles registered in the county increased from 141,000 to 777,000, and the ratio of residents to cars dropped from 9:1 to roughly 3:1 (Wachs 1984[472]). It was during this period that traffic congestion first became an issue. A group of residents, industries, and policymakers united to develop the region's first transportation plans, and in the early 1920s, the city of Los Angeles debated two visions: *A Major Traffic Street Plan*, which outlined the need for wide, fast-moving streets to accommodate the rise in private vehicles and industries, and *A Report and Recommendations on a Comprehensive Rapid Transit Plan for the City of Los Angeles*, which called for updating the trolley cars, the construction of elevated rail lines, and a feeder bus system (Jones 2008[245]).

The Major Traffic Street Plan passed almost unanimously in 1924. Ridership on the city's trolley system peaked in the early 1920s, and, by the 1930s, many of the main trolley routes were dismantled (University of Southern California 2002[462]). The trolley from Los Angeles to Long Beach continued to operate amidst falling ridership levels. When it was discontinued in 1961, it was the last trolley system running in the region (University of Southern California 2002[462]).

4.3 1940s: Disinvestment Amidst Increasing Racial Segregation

Working-class neighborhoods that were dependent on public transit were impacted by the end of the trolley system but also by other policies and practices. Starting after the Great Depression, residents in more exclusive, predominantly White communities had gained access to new financial products from the Home Owners' Loan Corporation, allowing recipients to improve their property or become first-time homebuyers. In contrast, the minority, working-class communities were systematically "redlined" by banks, suppressing new investments in the neighborhoods.

Simultaneously, the region experienced major changes as the country prepared for World War II. The local shipbuilding industry ballooned, at one point employing as many as 90,000 workers. Between 1942 and 1965, nearly 600,000 African-Americans came to Los Angeles from the South (Soja et al. 1983[419]). They settled throughout southern Los Angeles, but particularly in areas such as Compton, Florence, Willowbrook, and Watts. Table 4-1 shows population growth in the corridor over this period, and reveals a large population rise in some neighborhoods, such as Compton (196%) and Lynwood (135%).

Table 4-1. I-710 Corridor Study Area, General Population by City, 1960–2000

City	Incorporated	1940	1950	1960	1980	2000
		Pop.	Population (% Change)	Population (% Change)	Population (% Change)	Population (% Change)
Bell	1927	11,264	15,430 (36%)	19,450 (26%)	25,450 (31%)	36,664 (44%)
Bell Gardens	1961	--	--	26,467	34,117 (29%)	44,054 (29%)
Bellflower	1957	--	--	45,909	53,441 (16%)	72,878 (36%)
Carson	1968	--	--	38,059	81,221 (113%)	89,730 (10%)
Commerce	1960	--	--	9,555	10,509 (10%)	12,568 (20%)
Compton	1888	16,198	47,991 (196%)	71,812 (50%)	81,347 (13%)	93,493 (15%)
Cudahy	1960	--	--	--	18,275	24,208 (32%)
Downey	1956	--	--	82,505	82,602 (0%)	107,323 (30%)
East Los Angeles	--	--	--	104,270	110,017 (6%)	124,283 (13%)
Huntington Park	1906	28,648	29,450 (3%)	29,920 (2%)	45,932 (54%)	61,348 (34%)
Lakewood	1954	--	--	67,126	74,654 (11%)	79,345 (6%)
Long Beach	1897	164,271	250,767 (53%)	344,168 (37%)	361,355 (5%)	461,522 (28%)
Lynwood	1921	10,982	25,823 (135%)	31,614 (22%)	48,409 (53%)	69,845 (44%)
Maywood	1924	10,731	13,292 (24%)	14,588 (10%)	21,810 (28%)	28,083 (1%)
Paramount	1957	--	--	27,249	36,407 (34%)	55,266 (52%)
Signal Hill	1924	3,184	4,040 (27%)	4,627 (15%)	5,734 (24%)	9,333 (63%)
South Gate	1923	26,945	51,116 (90%)	53,831 (5%)	66,784 (24%)	96,375 (44%)
TOTAL		273,073	438,341	971,379	1,158,154	1,466,409

Source: Los Angeles Almanac 2011[289].

During the postwar era, working-class suburbs became increasingly homogeneous and segregated. Returning White veterans were given greater access to education and housing in the new subdivisions around the country; however, such benefits were routinely denied to veterans of color (Katznelson 2005[248], Lui et al. 2006[300]). Many of the remaining White residents in southern LA region who could afford to do so moved out to newer subdivisions. Homeowners and business owners in the minority neighborhoods were systematically denied funding for improvement projects, and there were few incentives for outsiders to invest their money in the communities. These formerly thriving, self-sufficient neighborhoods became increasingly depressed (Avila 2004[17]).

4.4 1950s–60s: Urban Renewal, Freeway Building

Proponents of urban renewal argued that cities needed to take action to revitalize their central business districts and surrounding low-income neighborhoods. With the goal of eliminating blight, newly formed redevelopment agencies were enabled to use federal funds and raze private property in the name of progress. Although the 1949 Housing Act was founded under the premise of providing “safe, sanitary housing” for slum residents, in practice the legislation often harmed low-income neighborhoods. From

1949 to 1960, 838 projects were initiated nationwide. Four units of low-income housing were destroyed for each one built, resulting in a 90% net decrease in low-income housing stock around the country. Hundreds of thousands of people were displaced from their homes and communities (Halpern 1995[213]).

Also in the 1950s, local traffic congestion had intensified to unbearable levels in part due to the swelling population (Modarres 1998[330]). Even though the previous Major Traffic Street Plan had been derailed by lack of funding during the depression and war years, in 1940 the city constructed the Arroyo Seco Parkway (now I-110), the first freeway in California. In 1956, the Federal-Aid Highway Act provided funding to construct a 40,000-mile interstate highway system, allowing Los Angeles traffic planners to begin to implement their plans.

Urban renewal legislation provided a convenient method to amass land for freeway building projects. Poorer, minority communities in Los Angeles were disproportionately affected by freeway building projects (Mohl 2002[331]). Residents and businesses living in the path of the freeways were required to leave. The community disruption experienced during the construction of these freeways is credited with exacerbating racial and social tensions. (Avila 2004[17], Jones 2008[245]).

4.5 1970s–Today: Continued Decline as Global Trading Accelerates

After the mid-1960s, white flight from working-class neighborhoods in Los Angeles accelerated to “near total abandonment” (Soja 1994[418]) and many African Americans who could afford to do so migrated away. As businesses and social institutions shut their doors, many of the remaining residents lived in conditions of concentrated poverty. Latinos and other immigrant groups filled in the gaps left by the exodus in neighborhoods. Los Angeles has become a predominantly a Latino city over the last four decades.

Economic trends also had a dramatic influence on Los Angeles during this period. As the nation entered into a period of recession and deindustrialization in the 1970s and 1980s, manufacturing industries shed thousands of jobs that paid high wages to low- and mid-skill workers. Los Angeles was not as hard hit by these trends; it added approximately 250,000 manufacturing jobs in the 1970s and 1980s (Soja 1994[418]). However, many of these jobs paid less and carried fewer benefits than the jobs that had been lost elsewhere. Reflecting these trends, the city’s median income for full-time male workers fell from a two-decade high of $35,270 in 1973 to a low of $30,500 in 1989. During this same period the proportion of male full-time workers earning less than $20,000 nearly doubled, reaching 25% (Ong 1993[352]). Poverty rates grew at a faster pace than that of the country over the 1970s–80s and reached 15% in 1989 (Ong 1993[352]). These trends were exacerbated by the large influx of lower-skilled immigrant groups, who are more likely to occupy jobs with the worst pay and working conditions.

Los Angeles has also been changed by globalization and increasing foreign trade. Free trade policies stimulated an upsurge of manufacturing industries overseas. Adjusted for inflation to 2005 dollars, the value of goods traded internationally increased 19-fold from 1951 to 2008, from $152 billion to $3,076 billion dollars (U.S. Census Bureau 2011a[455]). As one of only two West Coast ports equipped to handle the newer and larger cargo ships, the Port of LA/Port of Long Beach (POLA/POLB) was ideally positioned to become a leader in the global goods movement industry.

In 1930, railroads dominated the freight transport industry, and trucks handled only 2–3% of goods moved nationally (Weingroff 2011[477]). By the 1940s, this figure had grown to slightly more than 10% of all goods moved by truck. Early proponents of the interstate highway system did not predict that rail transport would give way to trucking as the dominant form of freight service. In fact, the early planners explicitly mentioned that there was no need for "… special highway facilities for the accommodation or encouragement of long-distance trucking," adding that, "… all the evidence amassed by the highway planning surveys… would seem to forecast a future shortening rather than a lengthening of highway-freight hauls." (Weingroff 2011[477])

This forecast underestimated the allure of trucking, which allowed for more flexible transportation than rail freight, particularly after the interstate highways were completed. Today, trucking is by far the most common form of freight transport. The Federal Highway Administration estimated that in 2008, approximately 9% of all goods were transported by rail, compared to 62% of goods moved by truck (FHWA 2009[185]). These trends are reflected in the neighborhoods around the I-710 today, where trucks and warehouses have become ubiquitous fixtures of the landscape.

4.6 Freeway Opposition Nationally and in LA

When construction on the I-710 drew to a close in 1975, it represented 23 out of 718 linear miles of freeways built throughout Los Angeles between the 1940s and 1970s (Brodsly 1981[53]). During the height of the freeway building era in the 1960s, construction was responsible for displacing over 62,200 housing units annually, possibly affecting as many as 200,000 people a year (Mohr 1998[332]).

However, not all the freeways envisioned by transportation planners were actually built. By the 1960s, people began organizing to stop projects in their neighborhoods. Groups like the Eastside Citizens Committee Against the Freeway and the Freeway Fighters had unsuccessfully fought the extension of the Pasadena Freeway, but other communities delayed and suspended projects (Avila 2008[18]). Confronted with freeway revolts in cities around the country, the federal government's position on freeway building began to change. In the late 1960s, the U.S. House Committee on Public Works acknowledged that impacts had been disproportionately borne by low-income and minority communities, admitting that displacement was "… particularly serious in the big city black ghettos where the supply of housing is inadequate and relocation beyond the confines of the ghetto is severely limited by racial segregation." (Mohr 1998[332])

These national trends played out in the case of the I-710. While the southern stretch of the freeway from Long Beach to I-10 was completed, in South Pasadena more wealthy homeowners waged a campaign to stop the construction of the 4.5-mile stretch of the road that would have cut through their city. The battle over the "South Pasadena Gap" continues, with many continuing to oppose the most recent proposal to complete the freeway via underground tunnels.

4.7 The I-710 Corridor Today

In the 1980s and 1990s, the Gateway Cities subregion lost significant numbers of industrial jobs and many associated local jobs. In the aerospace industry alone, an estimate 18,000 jobs were lost between

1992 and 1997, and job growth occurred in industries paying lower wages (Drayse et al. 1998[123]). Increasingly, goods movement has become a major employment sector in the region.

Today, the communities surrounding the I-710 defy generalization—the area is a diverse patchwork of cities and neighborhoods, each with unique cultural and socioeconomic characteristics. More information about these communities can be found in the Community Impact Assessment chapters of the I-710 EIR/EIS. It is clear that these communities have had a dynamic and complex history, one that is important to consider when moving forward with any proposed freeway or development project.

5. Demographics

5.1 Introduction

It is important to understand the demographics of a neighborhood, as they are a reflection of the policies and trends that have come before and represent an opportunity to adjust policies for the future to address inequities, neighborhood quality, and health. Below the literature about the relationship between demographics and health is reviewed and then specific information about the population near the I-710 is provided in Sections 5.1.1 and 5.2 through 5.9.

The demographic characteristics of a neighborhood are shaped by a complex set of economic, political, social, and physical forces. Examples of these forces include economic development policies that impact businesses' decisions to locate in an area and determine the kinds of jobs available to local residents, market trends that shape employment opportunities and housing costs, housing policies that facilitate or impede the development and preservation of residences of difference sizes and affordability ranges, real estate and loan practices that promote or discourage racial segregation, and social networks that impact residents' decisions to stay near friends and family. For more details about historical development patterns that have shaped demographic patterns in communities along the I-710 corridor, please see the short history of the communities living in the I-710 Corridor in Chapter 4.

Regardless of the economic, political, social, and physical forces, race/ethnicity and income have proven links to health in and of themselves that are in part due to neighborhood environments. After adjusting for individual-level socioeconomic status, a review found that all but two of the 25 reviewed studies reported a statistically significant association between at least one measure of neighborhood socioeconomic context and health outcomes including mortality, infant/child health, chronic diseases among adults, mental health, and health behaviors (Pickett and Pearl 2001[363]).

In the US, many people of color experience a wide range of serious health issues at higher rates than do whites, including breast cancer, heart disease, stroke, diabetes, hypertension, respiratory illness, and pain-related problems. On average, African Americans, Native Americans, Pacific Islanders, and some Asian American groups live shorter lives and have poorer health outcomes than whites. According to the Centers for Disease Control and Prevention, African American men in the U.S. die on average 5.1 years sooner than white men (69.6 vs. 75.7 years), while African American women die 4.3 years sooner than white women (76.5 vs. 80.8 years). People of color are likely to be less wealthy, less educated, and more likely to live in segregated communities with underfunded schools, insufficient services, poor transportation and housing, and higher levels of exposure to toxic and environmental hazards (California Newsreel 2008[71]).

For individuals, income is one of the strongest and most consistent predictors of health and disease in the public health research literature (Yen and Bhatia 2002[496]). Nationally, individuals with the lowest average family incomes ($15,000–$20,000) are three times more likely to die prematurely as those with higher family incomes (greater than $70,000). It has also been shown that every additional $12,500 in household income buys one year of life expectancy (up to an income of $150,000). Poorer adults are also three times as likely to have a chronic disease that limits their activity, twice as likely to have diabetes, and nearly 50% as likely to die of heart disease (California Newsreel 2008[71]). Additionally, being low-income is also a risk factor for low birth weight babies, for injuries or violence, and most cancers; and children in low-income families are seven times as likely to be in poor or fair health as compared to high-income families (California Newsreel 2008[71]; Yen and Syme 1999[497]). The relationship between income and health is mediated though nutrition, employment conditions, parenting resources, leisure and recreation, housing adequacy, neighborhood environmental quality, community violence, and stress.

Factors that contribute to people living in poverty include low levels of education, inadequate job skills, unemployment or underemployment, low wages, and language barriers. Poverty imposes many difficult issues on residents and families, including living in overcrowded and substandard housing, overpaying for housing, and inadequate income to provide for basic necessities such as food, clothing, and health care (City of Long Beach 2005[107]).

Recent research in Los Angeles has reported that the impacts of environmental hazards on communities vary by demographics. Specifically, researchers report patterns indicating that communities with high proportions of lower-income residents and populations of color bear significantly greater cumulative environmental burdens than predominantly white and more affluent communities (Su et al. 2009[426]). Studies have also shown that, overall, individuals who live in poor, disadvantaged neighborhoods have inferior health outcomes (Prentice 2006[374]).

The sections below contain basic demographic information about the population near the I-710. Apendices A, B, and C include all the health data collected for the HIA, which is referred to in the existing conditions sections of individual chapters on health determinants (Chapters 6 through 11).

5.1.1 The I-710 HIA Study Area

The HIA study area focuses on the population living within 1 mile of the I-710. As shown in Figure 5-1, census tracts within the 1-mile boundary of the I-710 are included in the study area, and for the purposes of the HIA have been divided into four groups. The first two groups (A and B in the figure) consist of all tracts whose centroids fall within a 1-mile buffer of the existing freeway. The second two groups (C and D in the figure) consist of tracts that intersect a 150-meter buffer surrounding the existing freeway.

Each set of groups is then subdivided into upwind and downwind groups based on whether the majority of the tract falls on the eastern or western side of the freeway, respectively. In other words, the prevailing upwind groups include tracts adjacent to the south–north flow of traffic, i.e., the east side of the freeway. The prevailing downwind groups include tracts adjacent to the north–south flow of traffic, or the west side. The resulting four groups are:

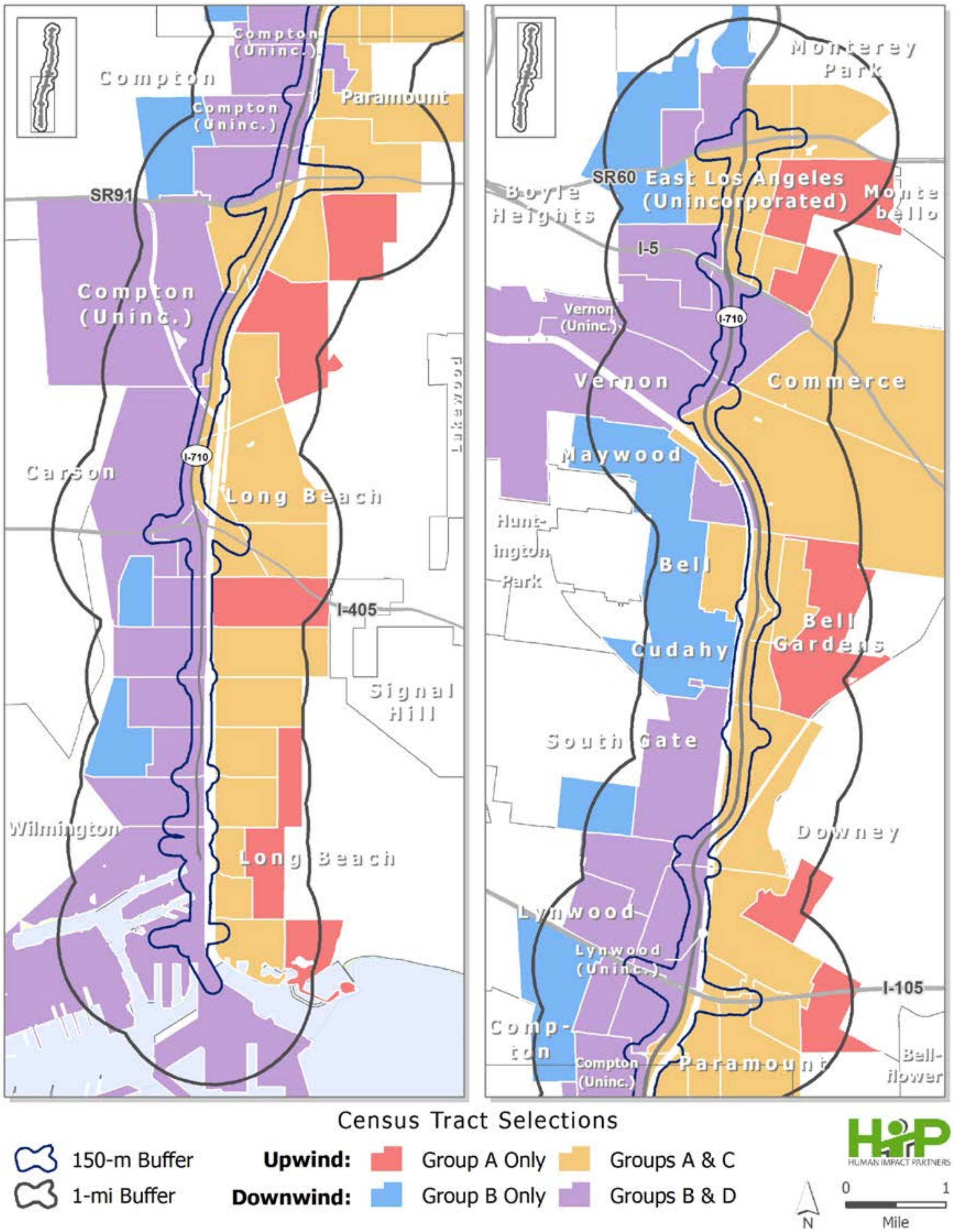
- Census tracts with centroids within 1 mile of the freeway on the upwind side (Group A)
- Census tracts with centroids within 1 mile of the freeway on the downwind side (Group B)
- Census tracts with centroids within 150 meters (approximately 500 feet) of the freeway on the upwind side (Group C)

- Census tracts with centroids within 150 meters (approximately 500 feet) of the freeway on the downwind side (Group D)

Two additional tracts were added to Group A because, although their centroids do not fall within the 1-mile buffer, they are large industrial tracts that have a significant portion of their area within the 1-mile buffer and intersecting the 150-meter buffer.

Available data on the demographic characteristics of the population living within the 1 mile study area was collected by census tract or by zip code. Zip codes were assigned to study area census tracts based on the tract centroid.

Figure 5-1. I-710 Corridor Project Study Area Groups



5.2 Population Estimates and Projections

An aggregation of data from the 2005–2009 American Community Survey of the U.S. Census shows that the population in the 1-mile buffer zone around I-710 is approximately 508,283.

Populations in areas throughout the county are projected to grow substantially by 2035. As shown in Table 5-1, the percent change in the population in the county from 2008 to 2035 is higher than in many of the cities along the I-710 corridor, apart from Paramount and Signal Hill, which have higher growth projections than in the county.

Population growth should be considered when assessing the potential health impacts of the I-710 Corridor Project, because the magnitude of current health conditions and potential impacts of the project could be increased as a result of the growing population in areas along the corridor.

Table 5-1. Population Estimates and Projected Change from 2008 to 2035

Area	2003	2008	2035 Projected	% Change (2008–2035)
LA County	10,034,571	10,451,707	12,338,620	18%
Gateway Cities	2,069,480	2,124,092	2,364,194	11%
Bell	38,421	38,762	40,028	3%
Bell Gardens	45,821	46,356	47,958	3%
Boyle Heights[1]	NA	NA	NA	NA
Carson	95,503	100,050	115,059	15%
City of Commerce	13,266	13,487	13,667	1%
Compton	97,404	99,146	100,451	1%
Cudahy	25,541	526,204	29,765	14%
Downey	112,184	114,784	126,300	10%
Huntington Park	64,177	66,067	76,184	15%
Lakewood	82,672	83,728	84,435	1%
Long Beach	483,752	497,721	572,614	15%
East LA	332,970	347,694	390,183	12%
Lynwood	72,738	73,491	74,539	1%
Maywood	29,269	29,662	30,334	2%
Paramount	57,490	59,190	72,781	23%
Signal Hill	10,451	11,237	13,324	19%
South Gate	100,782	103,748	120,154	16%
Vernon	95	95	95	0%
Wilmington[1]	NA	NA	NA	NA

Source: Metro 2010[319].

[1]The Community Impact Assessment does not present growth trends specific to Boyle Heights or Wilmington

5.3 Age

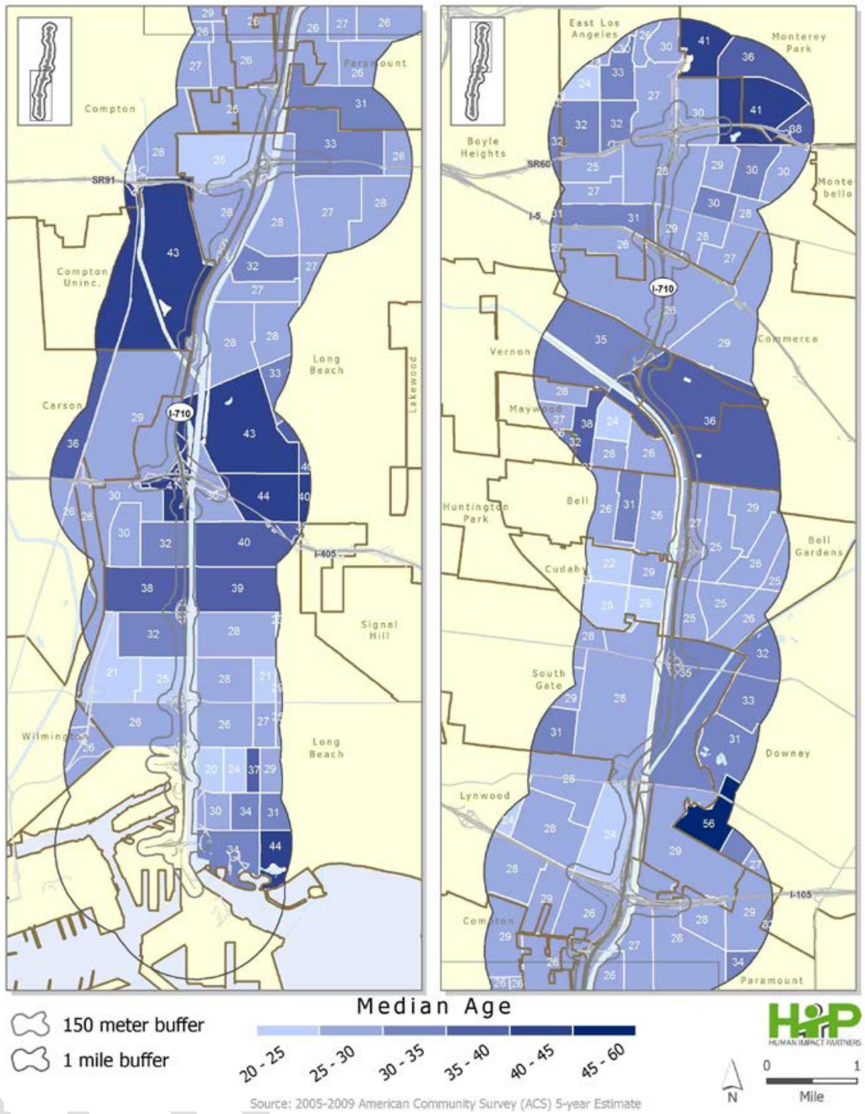
The median age of residents living within 1 mile of the I-710 is approximately five years younger than the median age for the county overall. Looking more closely at the four groups within the study area, the residents on the downwind (east) side of the freeway have a lower median age than those on the upwind (west) side.

Table 5-2. Median Age (in years)

LA County	Entire Study Area	1 Mile West	1 Mile East	150 Meters West	150 Meters East
34.6	29.6	30.4	28.6	30.0	29.3
Source: U.S. Census Bureau 2010[454].					

Figure 5-2 shows the median age across census tracts that lie within the I-710 1-mile study area. Actual median age values are overlain on top of the age categories, which are shaded from light (younger) to dark (older). The majority of the census tracts in the study area have a median age of 25–30 years. There are several pockets of younger-leaning census tracts. Out of the 13 tracts (31%), 4 that have a median age of 20–25 years have portions of their areas within 150 meters (approximately 500 feet) of I-710. There are clusters of census tracts with higher median ages in Long Beach, unincorporated Compton, and Monterey Park. The census tract with the oldest median age is in Downey, where the median age is 56 years.

Figure 5-2. Median Age Distribution of the I-710 Corridor Project Study Area



5.4 Race and Ethnicity

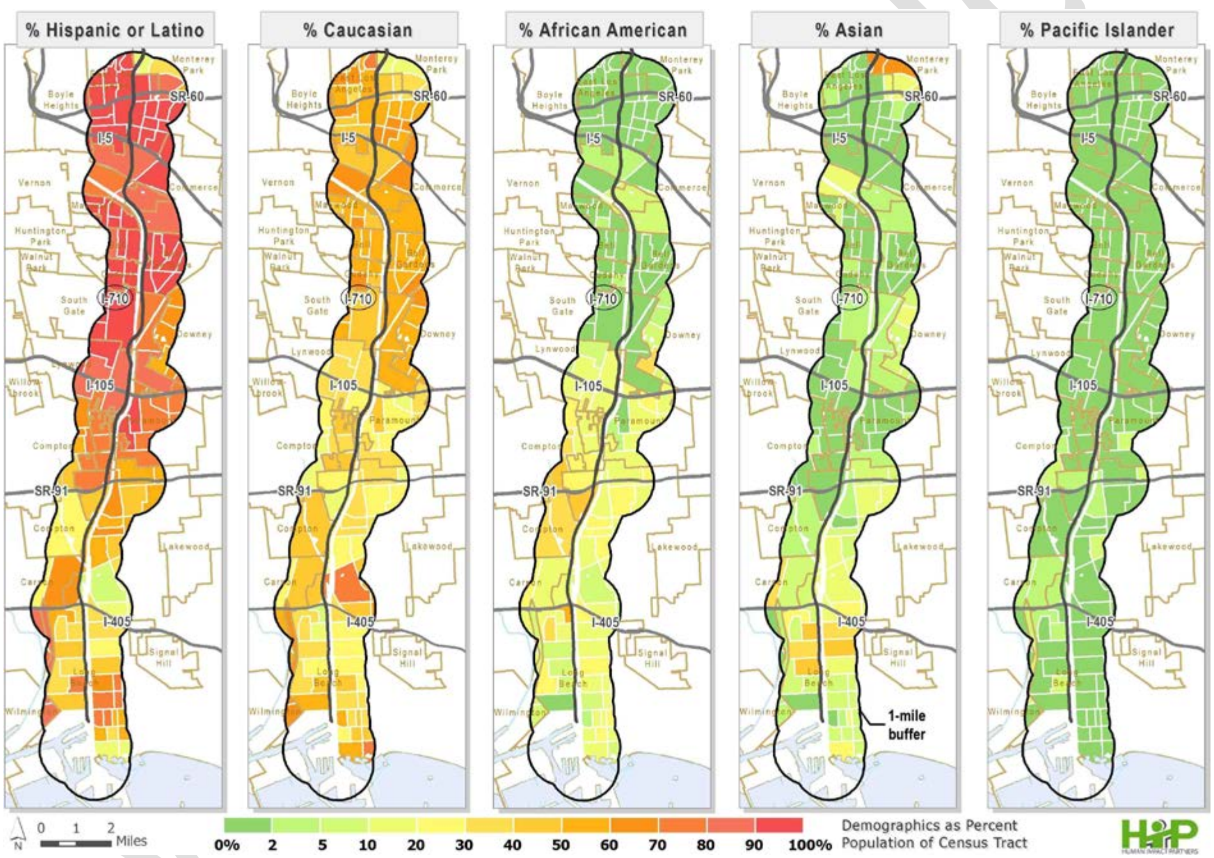
The study area includes a diverse group of residents. Table 5-3 shows that the percent of Latino/Hispanic residents in the study area is significantly higher than in the overall county (27.5%). The percent of African Americans in the study area is also higher than in the county. There are lower percentages of Caucasian, Asian, and Pacific Islander residents in the study area compared to the county.

Table 5-3. Race and Ethnicity of the Population

	LA County	1-Mile Study Area
Latino or Hispanic	46.5%	74.0%
Caucasian	51.1%	44.8%
African American	8.7%	9.4%
Asian	13.0%	6.7%
Pacific Islander	0.5%	0.2%

Figure 5-3 contains a series of maps that show the percentage of residents of different racial or ethnic groups for each census tract within 1 mile of the I-710.

Figure 5-3. Race and Ethnicity within 1 Mile of the I-710



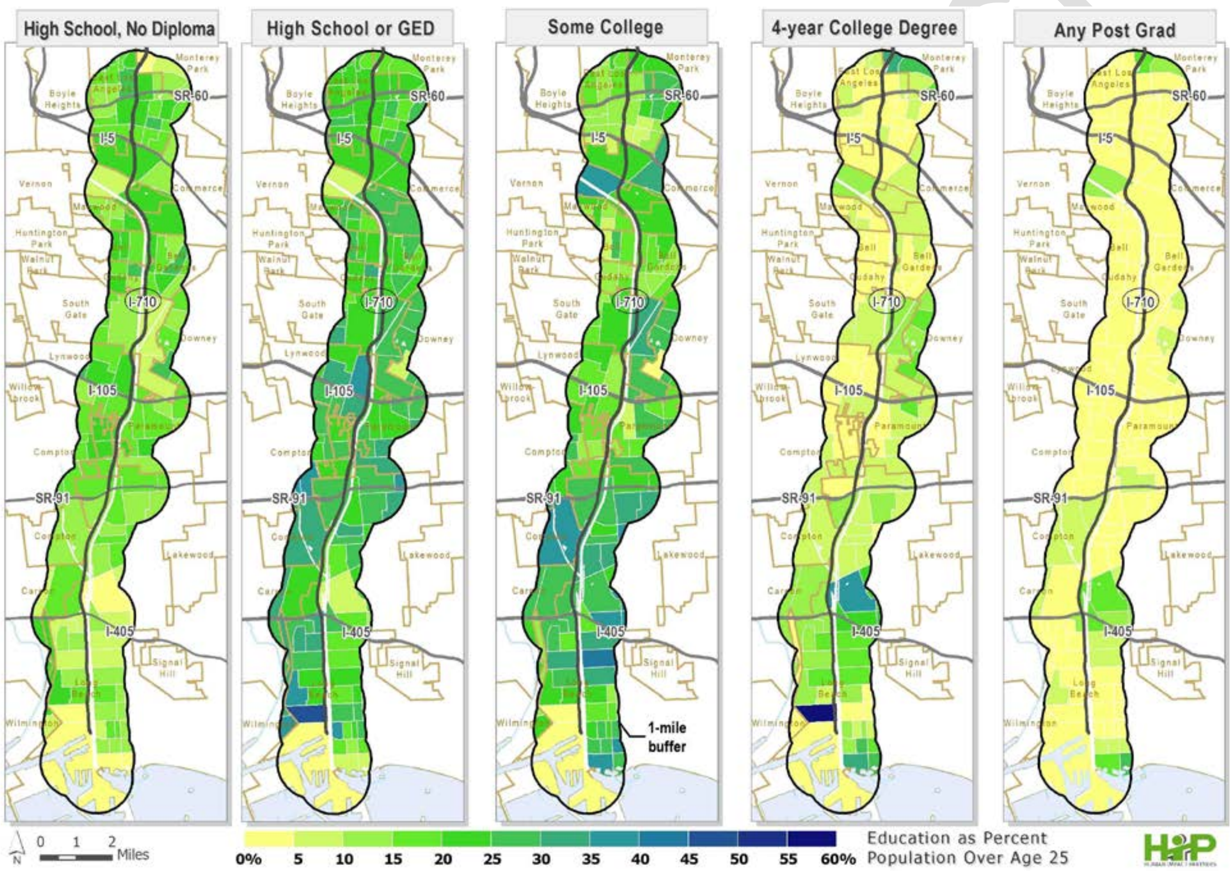
The majority of census tracts in the study area have a high percentage of Latino/Hispanic residents. The concentration of Hispanic/Latino residents is higher towards the northern end of the study area (except for a relatively higher concentration in downtown Long Beach). The same is true for the Caucasian population. The opposite pattern, however, is true for African Americans, Asians (except for Monterey Park), and, to a lesser extent, Pacific Islanders, where the tracts with higher concentrations of residents of these races/ethnicities appear to be located in the southern end of the study area.

5.5 Educational Attainment Distribution

Data from the 2005–2009 U.S. Census American Community Survey shows that a higher percentage of the population living in the study area (85.96%) are high school graduates compared to the overall population in the county (73.59%).

Figure 5-4 displays a series of maps that show increasing levels of educational attainment for adults ages 25 or older. For these maps, darker shading indicates a higher percentage of residents with the noted educational attainment.

Figure 5-4. Maximum Education Level Attained (persons aged over 25 years) Within 1 Mile of the I-710



The maps show that for most of the census tracts in the study area, approximately 10–25% of residents do not have a high school diploma or General Education Development (GED) certificate, that 20–35% have a high school diploma, and 20–35% have some college education.

The highest concentration of residents with 4-year college degrees is located in areas surrounding the I-710/I-405 interchange, Downey, and Monterey Park. There are only a handful of census tracts where more than 5% of residents have post-graduate degrees.

5.6 Socioeconomic Status

According to the 2005–2009 American Community Survey of the U.S. Census, measures of socioeconomic status (SES)—including the rate of residents living below the federal poverty level, median household income, and unemployment—all indicate that residents living in census tracts 1 mile from the I-710 can be considered on average of lower SES than those in the county overall.

Table 5-4. Measures of Socioeconomic Status (SES) [1]

Indicator	LA County	I-710 Corridor Project Study Area
Poverty Rate (per 1,000 population)	154.43	207.20
Median Household income	$60,073	$44,189
Unemployment	5.05%	6.73%
Source: U.S. Census Bureau 2010[454].		

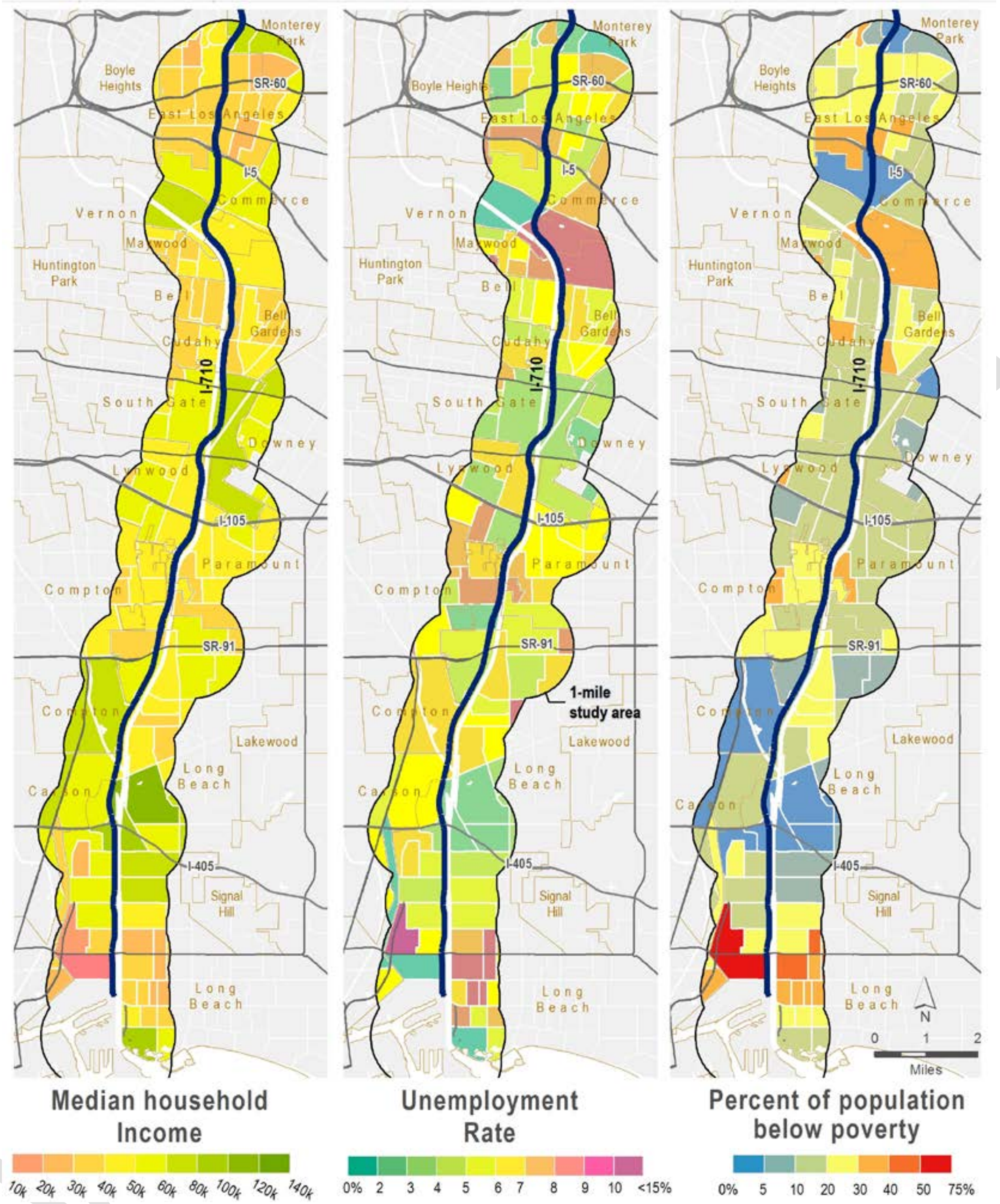
Figure 5-5 displays a series of maps that show median household income, unemployment, and residents living below the poverty level within 1 mile of the I-710.

Median household income is shown to be lowest within the census tracts in downtown Long Beach (excluding those with direct shore access), Westside Long Beach, and East Los Angeles. Household income trends higher in the area east of Carson (which includes the Virginia Country Club and surrounding homes), Compton, and Downey. There are clusters of household income groups, in part because of patterns in land value, differential rental rates among neighborhoods, and differences in zoning (e.g., areas for detached single-family homes versus high-density apartment buildings). See property value data in Section 5.7 below.

According to the 2005–2009 U.S. Census American Community Survey, unemployment rates within the study area are mixed, with much more variability throughout the study area compared to income. There are relatively low unemployment rates in Long Beach, north of I-405, South Gate, and Downey. Meanwhile, there are high levels of unemployment in Downtown Long Beach and parts of Compton.

[1] It should be noted that these estimates are an average from 2005–2009, and therefore do not reflect recent economic or other current trends.

Figure 5-5. Measures of SES within 1 Mile of the I-710



In the third map, “below poverty” is defined as below the Federal Poverty Level, which is different for each type of family unit. The distributions shown in this map appear to follow, in most cases, fairly closely with the median household income map. The southern end of the study area (with the exception of downtown Long Beach), Downey, and Monterey Park appear to have relatively low proportions of poverty compared to the middle-western side of the freeway.

5.7 Property Value

The average assessed value of residential property parcels in the study area census tracts is an estimated $147,820 less (about 40%) than the average value of a residential parcel in the county overall.[2] The average assessed value of commercial property parcels in the study area is less than half of the average value of commercial properties in the county. Both industrial and manufacturing property parcels in the study area have lower average assessed values than in the county as well. However, industrial parcels on the upwind side of the freeway are on average assessed at a higher value than those in the county, and manufacturing parcels in each of the individual study areas are all assessed at higher values than the average value for manufacturing parcels in the county.

Table 5-5. Average Assessed Value of Property Parcels

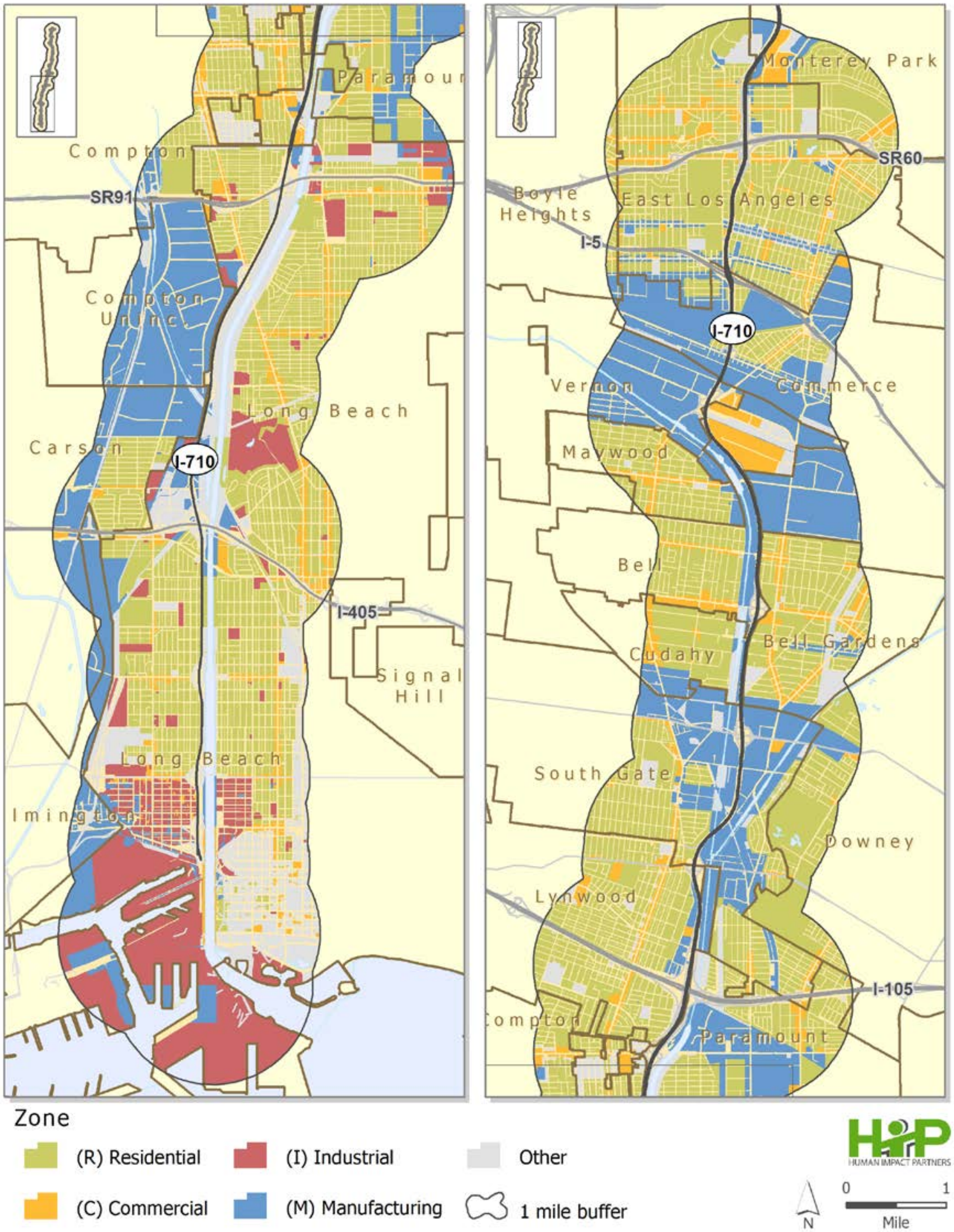
Zone Type	LA County	Entire Study Area	1 Mile West	1 Mile East	150 Meters West	150 Meters East
Residential	$364,865	$217,045	$232,371	$191,740	$241,537	$186,318
Commercial	$1,123,993	$410,689	$424,487	$333,997	$554,509	$294,525
Industrial	$1,019,397	$844,717	$1,733,625	$561,335	$1,811,436	$544,064
Manufacturing*	$1,141,465	$1,019,278	$1,358,186	$1,359,203	$1,457,436	$1,422,124

Source: Los Angeles County Office of the Assessor 2011.

*Individual study area groups have values that are all higher than the entire study area average because (as can be seen in Figure 5-1) the selected census tracts (for each of the four individual groups) that encompass largely manufacturing areas extend farther beyond the 1-mile study area boundary than the more residential tracts. Selection of manufacturing parcels for the study area included only those parcels within the study area, whereas selection for of the four study area groups included parcels within tracts whose centroids fell within the 1 mile buffer, but may extend beyond it - which is especially the case for more manufacturing tracts.

[2] Assessed value of property parcels was calculated by adding the parcel land value to the parcel's improvement value. The assessed value of a parcel is used to determine property tax.

Figure 5-6. Property Parcels by Zone Code Within 1 Mile of the I-710



5.8 Emergency Room Visits

Among the most commonly used measures of health are rates of hospitalization, and data on emergency room (ER) visits are routinely collected and reported.

Table 5-6 shows that the crude rates[3] (per 100 residents) for ER visits within the study area are higher than those in the county overall, and that for the downwind (west) side of the study area these rates are slightly higher than in the state.

Table 5-6. Emergency Room Visits, Crude Rates per 100 Residents

California	LA County	1 Mile West	1 Mile East	150 Meters West	150 Meters East
31	29	31	33	31	34
Source: Office of Statewide Health Planning and Development 2009[72].					

In 2009 there were nearly three million ER visits from patients in the county. For 82% of these visits (2.45 million), patients were treated and released. However, nearly 18% of the visits led to patients being admitted to the hospital after visiting the ER, which is higher on average than the combined percentage for all other counties in California, and for the state as a whole.

Approximately 84% of ER visits from residents living in zip codes within 1 mile of the I-710 ended up with patients being treated in the ER and then released. Approximately 16% of led to patients being admitted to the hospital.

For more detail about ER visits and other hospitalization or health outcome data discussed in other chapters of the HIA, see Appendices A, B, and C attached.

5.9 Summary of Demographic Data

The demographics of the study area can be briefly summarized as follows:

- Residents living within 1 mile of the I-710 are slightly younger than residents of the county overall. However, the age of the population within the study area census tracts fluctuates, with no consistent pattern within the areas surrounding the freeway.
- There is a significantly higher percentage of Latino/Hispanic residents within 1 mile of the I-710 than in the county overall. Concentrations of Hispanic and Caucasian residents increase in the northern portion of the study area, while the concentrations of African American, Asian, and Pacific Islander residents decrease in this direction.
- The census tracts in the central portion of the study area tend to have higher proportions of residents who have a high school diploma or some college experience, but not a 4-year degree. The highest concentration of college graduates is in Downtown Long Beach. Education levels on average are lower on the west side of the freeway compared to the east side.

[3] Crude rates are not adjusted for age, race or any other demographic characteristic that may vary by area.

- Measures of SES—including poverty, median household income, and unemployment—indicate that the study area has lower SES than the county. SES varies throughout the study area, but portions of the study area that generally fall within lower extremes of SES are Downtown Long Beach and East Los Angeles, while portions that are at the higher end of SES are Mid-Long Beach (adjacent to the freeway), Compton, Downey, and Monterey Park.
- Residential and commercial property parcels are assessed at significantly lower average values in the study area compared to the county.
- The rate of ER visits among the population living within 1 mile of the I-710 is higher than that in the county. Rates of ER visits among the population living within 1 mile of the I-710 on the downwind (east) side are higher than for residents living within 1 mile on the upwind (west) side of the I-710.

6. Mobility

6.1 Introduction

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 (EPA 2001a[143]).

The mobility analysis considered the effects of the I-710 Corridor Project on traffic generation, vehicle speeds, public transportation access and ridership, and walking and biking infrastructure.

6.1.1 Background: The Relationship between Mobility and Health

The term mobility encompasses several distinct concepts, each with its own connections 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 (what means—e.g., 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 (Acheson 1998[3]). 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 Neighborhood Resources chapter.

Caltrans' mission is to "Improve mobility across California," with a strategic mobility goal to maximize transportation system performance and accessibility (Caltrans 2011a[75]). Caltrans promotes the value of a multi-modal system for mobility, recognizing bicycle, pedestrian, and transit modes as integral elements of the transportation system and views all transportation projects as opportunities to improve safety, access, and mobility for all travelers in California (Caltrans 2008[73]).

There are many types of transportation-related improvements (including land use changes) that can lead to mobility enhancements. Table 6-1 shows the effects of common projects on transportation system indicators. Roadway widening, while beneficial to auto level of service (LOS; a measure used to determine the effectiveness of elements of transportation infrastructure by categorizing traffic flow with driving conditions), can serve to increase vehicle mode share and vehicle miles traveled per household while decreasing the pedestrian quality environment and reducing neighborhood completeness. Other transportation projects have been evaluated below for their effect on various transportation system indicators.

Table 6-1. Typical Effects of Common Urban Transportation Projects on Transportation System Indicators

	Auto Level of Service (LOS)	Vehicle Mode Share (VMS)	Vehicle Miles Traveled (VMT) per Household	Pedestrian Environmental Quality	Neighborhood Completeness
Surface Light Rail or Bus Rapid Transit	Lower	Lower	Lower		
Roadway Widening	Higher	Higher	Higher	Lower	Lower
Pedestrian or Bicycle Facilities	Lower, if loss of vehicle lane	Neutral or Lower	Neutral or Lower	Higher	Higher
Increased Residential Density	Typically lower	Lower	Lower		Higher
Transit Oriented Development	Typically lower	Lower	Lower		Higher
Big Box Retail	Lower	Higher	Higher	Lower	Lower
Source: Bhatia et al. 2007[43].					

This chapter provides an assessment of the potential health effects, positive or negative, mediated through mobility, of the proposed I-710 Corridor Project Alternatives; specifically covering the effects of local road and freeway conditions, access to public transportation, the walking and biking environment, and their indirect effects on health.

Impacts of Roads and Freeways

Accessing daily needs and vital resources including employment, schools, and goods and services is essential for health. Dominant low-density land use patterns have resulted in the personal automobile becoming the primary means of accessing daily needs. Older and denser urban areas typically have a diverse mix of uses and encourage more non-motorized and public transportation options. Driving has replaced active types of transportation, such as walking and biking, decreasing daily physical activity. Lack of physical activity is associated with many diseases including heart disease, hypertension, stroke, diabetes, obesity, osteoporosis, depression, and some types of cancer (Killingsworth and Lamming 2001[256]). Regular walking and biking have been shown to reduce mortality by 22% and 28%, respectively (WHO Europe 2011[488]; Andersen et al. 2000[12]; Hamer and Chida 2008[214]), and physical inactivity was estimated to be responsible for over 200,000 deaths per year in 1996 (Centers for Disease Control and Prevention [CDC] 1996[93]). Research has demonstrated that each additional hour spent in a car per day is associated with a 6% increase in the likelihood of obesity, while each hour walked per day has been associated with a 4.8% reduction in the likelihood of obesity (Frank et al. 2004[190]).

Low-income residents face additional challenges imposed by the cost of car ownership. Households in automobile-dependent communities devote more than 20% of household expenditures to transportation (more than $8,500 annually), while those in communities with more accessible land use and more multi-modal transportation systems spend less than 17% (less than $5,500 annually) (McCann 2000[309]). Residents in low-income communities are less likely to own a car and three times less likely to have a grocery store within their neighborhood (Morland et al. 2002[335]; Vallianatos et al. 2002[466]). Low-income parents identify transportation difficulties, such as high cost and inaccessibility, as a significant barrier to obtaining routine medical care for themselves and their children. It has been demonstrated that improving walkability can help achieve equity objectives, including a fair distribution of public resources for non-drivers, financial savings and improved opportunity for lower-income people, increased accessibility to people who are transportation disadvantaged (e.g., who may not have access to a car), and improved basic access (Litman 2004[286]).

Roads with high volumes, significant delay, and increased traffic can increase time spent in a car and decrease the likelihood of active transportation (i.e., using physical activities like walking and biking as a means of transport). For example, the risk of pedestrian injuries may discourage pedestrian activity and negatively impact physical activity levels. One study found that three factors—traffic volume, traffic speed and the separation between pedestrians and traffic—explained 85% of the variation in perceived safety and comfort for pedestrians (Landis et al. 2000[272]).

Traditional vehicle Level of Service analysis looks at the worst possible hour of the day, valuing the speedy movement of cars over other forms of transportation. A summary of the relationship between different transportation indicators, including LOS, and health / environmental outcomes is shown in Table 6-2. As seen below, increasing LOS does not reduce traffic injuries, air pollution, CO_2 emission, noise, or physical activity. Furthermore, LOS does not account for modal shift, or people deciding to shift from driving to other ways to get around.

Measures that more accurately assess the relationship between transportation and health are vehicle miles traveled, vehicle mode share, and neighborhood completeness. Three of these indicators will be used in this section.

Table 6-2. Relationship between Transportation Indicators and Health/Environmental Outcomes

Indicator	Traffic Injury Rate Reduction	Air Pollution Reduction	CO_2 Emissions Reduction	Noise Reduction	Access to Goods and Services	Physical Activity	Social Equity	Social Cohesion
Vehicle Level of Service (Increase)	-	-	-	-	+/-	-	+/-	+/-
Vehicle Miles Traveled (Reduction)	+	+	+	+	+/-	+	+/-	+
Vehicle Mode Share (Reduction)	+	+	+	+	+/-	+	+	+
Neighborhood Completeness (Increase)	+/-	+	+	+/-	+	+	+/-	+
Source: Bhatia et al. 2007[43].								

Mitigations for automobile LOS and traffic—such as intersection widening, increased number of lanes, and reduced time for the walking phase of a traffic signal—often prove deleterious to other indicators for health. Expanding roadways in particular has been shown to lead to more driving and more reliance on cars. In fact, some cities in California intentionally limit streets in commercial districts to LOS E and F, because slower traffic speeds have been found to improve the economic health of local businesses, which benefit from passing vehicles noticing their shops. Slower speeds also reduce barriers to bicycling and walking, and reduce the severity of collisions (Great Communities Collaborative 2007[205]).

Impacts of Transportation on Physical Activity

Transportation and land use patterns can have beneficial effects on health by encouraging physical activity and walking for leisure (Frank et al. 2004[190]). Physical activity can prevent obesity, diabetes, and heart disease, reduce stress, improve mental health, and promote longevity (PolicyLink 2002[365]; Task Force on Community Preventive Services 2001[433]). Physical activity, even in modest amounts, can reduce mortality rates. 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 “complete” 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 (Handy 1996[215]; Li et al. 2005[280]; Ewing and Kreutzer 2006[177]; Frank et al. 2004[190]). 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 (Ewing and Kreutzer 2006[177]; Li et al. 2005[280]; Frank et al. 2004[190]).

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:

- People who commute by bicycle 3 hours per week are 28% less likely to die from any cause than non-cyclists (Andersen et al. 2000[12]; WHO Europe 2011[488]).
- 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 (Hamer and Chida 2008[214]; WHO Europe 2011[488]).
- Saelens has shown that people walk on average 70 minutes per week longer in pedestrian-oriented neighborhoods (Saelens et al. 2003[400]).
- 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 (Frank et al. 2004[190]).
- 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 Centers for Disease Control and Prevention's (CDC's) recommended amount of physical activity (30 minutes a day, five times a week) (Besser and Dannenberg 2005[41]).
- 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 (Weinstein and Schimek 2005[479]).
- 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 (CDC 2002a[94]; Li et al. 2005[280]; Transportation Alternatives 2006[442]).

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 (Leyden 2003[278]).

Impacts of Public Transportation

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 (EPA 2003a[146]).
- 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 (Babisch et al. 2005[21]; Stansfield et al. 2005[422]; London Health Commission 2003[287]).
- Workers with access to public transit are more likely to walk, bike, and take public transit to work than those without (Hefferman 2006[221]).

- 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 (Berkman and Syme 1979[38]; Poortinga 2006[368]). 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 (Bailey 2004[22]). Taking public transportation aids in decreasing isolation and encourages what city-planning advocate Jane Jacobs referred to as “casual contact from unplanned social interactions” (Jacobs 1993[234]).
- 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 (Bailey 2007[23]).

Impacts on Emergency Vehicle Response Times

Emergency response time describes the timeframe in which emergency services are delivered to a patient. Impacts of emergency response time on health include the following:

- 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%) (Blackwell and Kaufman 2002[46]).
- A separate study identified a survival benefit when response time was less than 4 minutes for patients with intermediate or high-risk mortality (Pons et al. 2005[367]).
- 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% (American Heart Association 1996[7]).

A recent study (Trowbridge et al. 2009[445]) 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 the 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.

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 (Meislin et al. 1999[314]). For example, the Los Angeles Fire Department (LAFD) calculates response time using the following: 911 answer time by police representative, transfer of call to LAFD, answer time by LAFD, initiation of dispatch by LAFD, actual dispatch of call by LAFD, turnout time of LAFD unit, and response time by LAFD unit (Kahn pers. comm. [505]).

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 (American Heart Association 2000[8]). Shortening response time could decrease morbidity and improve survival for many types of illness and injury (Blackwell and Kaufman 2002[46]). Reducing traffic congestion would likely lead to shorter response times.

During the Scoping phase of this HIA, it was hypothesized that emergency (i.e., police) response times may impact crime rates. For example, if police are not able to respond to crimes quickly due to traffic congestion or other factors, criminal activity may be encouraged. A search of the literature revealed no evidence supporting this hypothesis and, therefore, crime rates are not considered further in this chapter.

Impacts of Transportation on Social Cohesion

Social cohesion describes one's social networks and involvement with friends and relatives. As defined by Caltrans, community cohesion, a similar concept, is the degree to which residents have a sense of belonging to their neighborhood, a high level of commitment to the community, or a strong attachment to neighbors, groups, and institutions, usually as a result of continued association over time.

Support, perceived or provided, from neighbors, friends, and family can buffer stressful situations, prevent damaging feelings of isolation, and contribute to a sense of self-esteem and value. Socially isolated people die at two or three times the rate of people with a network of social relationships and sources of emotional and instrumental support (Brunner 1997[56]). In the landmark Alameda County Study, those with fewer social contacts had twice the risk of early death, even accounting for other factors including income, race, smoking, obesity, and exercise (Berkman and Syme 1979[38]). 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 (Surface Transportation Policy Project 2004[429]).

Transportation can support or hinder social networks and community cohesion by affecting access and interactions among members within a community. For example, investments in pedestrian facilities or traffic calming not only encourage more short walking and bicycling trips within a community but also provide settings for social interaction. Taking public transportation helps decrease isolation and encourages casual contact from unplanned social interactions (Jacobs 1993[234]). Conversely, driving takes time away from other health-positive activities, such as community involvement or time with family.

Impacts of Transportation on Stress

When people face challenging events or conditions that they feel exceed their resources for coping, they are said to experience stress. As a Robert Wood Johnson Foundation Issue Brief on the subject of stress and health (Egerter et al. 2011[126]) indicates, exposure to stress has been repeatedly implicated in many health outcomes, including:

- Some evidence suggests that stressful experiences during pregnancy may increase a woman's risk of delivering her baby preterm (before 37 completed weeks of gestation); chronic exposure to stressful conditions during childhood or as an adult before becoming pregnant may increase the risk of preterm birth as well. This elevated risk can have long-lasting effects for the baby: preterm birth is a powerful risk factor not only for infant mortality and cognitive, behavioral, and physical problems in childhood, but also for serious chronic disease—including heart disease, hypertension, and diabetes—later in life.
- During childhood and adolescence, stress appears to increase risk of poorer mental and physical health. For example, research examining a range of individual and family stressors such as family disruption and conflict, parents' mental health problems, and financial strain indicates that children and adolescents exposed to higher levels of stress have increased risks of being overweight and/or obese even after considering other factors such as age, racial or ethnic group, parents' weight or family income. In addition, a growing body of evidence links stressful childhood experiences with increased risk of serious adult health problems including heart disease and diabetes.
- Among adults, exposure to work-related and other stressors has been linked in multiple studies with cardiovascular illness such as coronary heart disease and heart attacks, as well as with cardiovascular disease risk factors.

Driving to work is a significant cause of stress for many people, so reduced commuting time could lead to decreased stress levels (BBC 2000[34]). Highway congestion has been associated with elevated blood pressure among car or bus drivers (Wener et al. 2006[482]). Some studies have looked specifically at "commute impedance," such as traffic jams and road construction. Researchers have concluded that traffic impedance is associated with higher blood pressure, more self-reported "tense" and "nervous" feelings, more self-reported colds and flu, and more days at the hospital (Wener et al. 2006[482]).

6.1.2 Established Transportation Standards and Health Objectives

A number of established regulations and transportation plans are designed to ensure fair and equitable implementation of transportation projects. Chapter 3.0 of the I-710 Corridor Project EIR/EIS describes some of the regulatory environment pertaining to the I-710 corridor area, including regulations imposed by the Council on Environmental Quality (CEQ) Regulations, the Code of Federal Regulations (CFR), the National Environmental Policy Act (NEPA), and the Farmland Protection Policy Act (FPPA). Transportation master plans, bicycle and/or pedestrian plans, and other community development documents describe how land should best be used and detail the availability of facilities and financing for community development. Finally, the Healthy People health objectives established by the U.S. Department of Health and Human Services provide science-based national objectives for improving the health of all Americans. These benchmarks were most recently established in 2010 with benchmarks for 2020. Further guidance and recommendations applicable to the I-710 Corridor Project are discussed below.

Federal Policy Goals and Regulatory Standards

U.S. Department of 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.

Healthy People 2020

The U.S. Department of Health and Human Services (USDHHS) establishes National objectives related to physical activity. By 2020, the following objectives should be achieved:

- Increase the number of adults who engage in regular, preferably daily, moderate physical activity for 30 minutes per day.
- Increase the proportion of adults who engage in aerobic physical activity of at least moderate intensity for at least 150 minutes/week, or 75 minutes/week of vigorous intensity, or an equivalent combination.
- Require children to engage in vigorous or moderate physical activity
- Increase the proportion of trips made by walking for children and adolescents aged 5 to 15 years (trips to school of 1 mile or less).
- Increase the proportion of trips made by walking for adults aged 18 years and older (trips of 1 mile or less).
- Increase the proportion of trips made by bicycling for adults aged 18 years and older (trips of 5 miles or less).
- Increase the proportion of trips made by bicycling for children and adolescents aged 5 to 15 years (trips to school of 2 miles or less).

Centers for Disease Control and Prevention (CDC)

The CDC recommends that adults engage in:

- 75 minutes (1 hour and 15 minutes) a week of vigorous intensity aerobic physical activity (i.e., running, swimming, walking, bicycling, dancing, and doing jumping jacks);
- Or 150 minutes (2 hours and 30 minutes) a week of moderate intensity;

- Or an equivalent combination of moderate and vigorous intensity aerobic activity; the vigorous and moderate activity should be either in a single-session or accumulated in multiple sessions, each lasting at least 10 minutes.
- Muscle-strengthening activities (i.e., doing push-ups, sit-ups, lifting weights and climbing stairs) on 2 or more days a week.

State of California and Regional Policies and Standards

Governors Environmental Goals and Policy Report (2003)

The 2003 Governors Environmental Goals and Policy Report includes the following goal:

- Provide the public with a transportation network that increases mobility choices—including public transportation, walking, and biking—and allows equitable access to jobs, community services and amenities.

Caltrans Strategic Plan 2007–2012 (2007)

Caltrans, as assigned by the FHWA, directs that full consideration should be given to the safe accommodation of pedestrians and bicyclists during the development of federal-aid highway projects (23 CFR 652). It further directs that the special needs of the elderly and the disabled must be considered in all federal-aid projects that include pedestrian facilities. When current or anticipated pedestrian and/or bicycle traffic presents a potential conflict with motor vehicle traffic, every effort must be made to minimize the detrimental effects on all highway users who share the facility. Furthermore, Caltrans has the stated public goal of maximizing transportation system performance and accessibility, and two relevant near-term goals:

- By 2012, increase intercity-rail ridership by 28% on state-supported routes.
- By 2012, reduce single occupancy vehicle commute trips by 5%.

Local Standards and Guidance

Below are two examples of local standards and statements related to mobility. A comprehensive review of all such policies is beyond the scope of the HIA.

- Metro's mission states "Metro is responsible for the continuous improvement of an efficient and effective transportation system for Los Angeles County." Its 2009 Adopted Long Range Transportation Plan: "Focus on the development of public policy and adoption of appropriate regulatory standards and targeted funding to develop more safe, connected and walkable pedestrian environments that promote non-motorized transport as a viable alternative for an increasing share of trips made by residents and visitors of Los Angeles County."
- City of Long Beach Bike Plan: "Make bicycling safer, more convenient and more enjoyable for all types of bicyclists, transportation and recreation related, with a goal to increase bicycle use by 5% by the year 2020; encourage more people to bicycle for transportation to promote an attractive and

healthy transportation option, which will reduce traffic, congestion, air pollution and noise pollution; develop an economical transportation option that promotes social equity."

6.2 Existing Conditions for Mobility

6.2.1 Mode of Travel

In California, from 1990 to 2000, total vehicle miles traveled increased nearly 93% to 300 billion. The state's population grew by 33% over the same period (Road Information Program 2001[395]). Reliance on automobiles and number of miles driven per person is influenced by a number of factors including population density and urban design. The County of Los Angeles is the second largest urban area in the United States and is well known for having considerable traffic. Much of this can be attributed to the large population size; however, the population is also heavily reliant on automobiles for transportation. Los Angeles County has a large and comprehensive system of freeways including High Occupancy Vehicle lanes that facilitate automotive travel. Data from the U.S. Census Bureau's American Community Survey shows that 72.2% of residents in the county drive an automobile to get to work. Census data also indicates residents living within 150 meters (approximately 500 feet) or 1 mile of the I-710 study corridor area use automobiles to get to work at similar rates. Carpooling is the second most widely used means of transportation for travel to work, followed by public transportation, and then other modes including walking, bicycling, and taxicab.

As shown in Table 6-3, residents in the I-710 Corridor Project study area report a higher share of carpooling to work than residents of LA County. Public transportation utilization is also somewhat higher in the study area. The share of residents walking and using other means of transportation is similar across geographies.

Table 6-3. Percent of Population Using Various Modes of Transportation to Work

Population	Drove Alone	Carpool	Public Transit	Walked	Taxi, Motorcycle, Bicycle, or Other Means	Worked at Home
Within 150 Meters of Freeway	71.8%	15.9%	7.6%	2.4%	2.1%	2.4%
Within 1 mile of Freeway	70.0%	15.5%	8.9%	2.8%	2.3%	2.4%
LA County	72.2%	11.6%	7.0%	2.8%	2.1%	4.3%
California	73.0%	12.0%	5.1%	2.8%	2.3%	4.8%
Source: U.S. Census Bureau 2010: 2005–2009 American Community Survey 5-Year Estimates[454].						

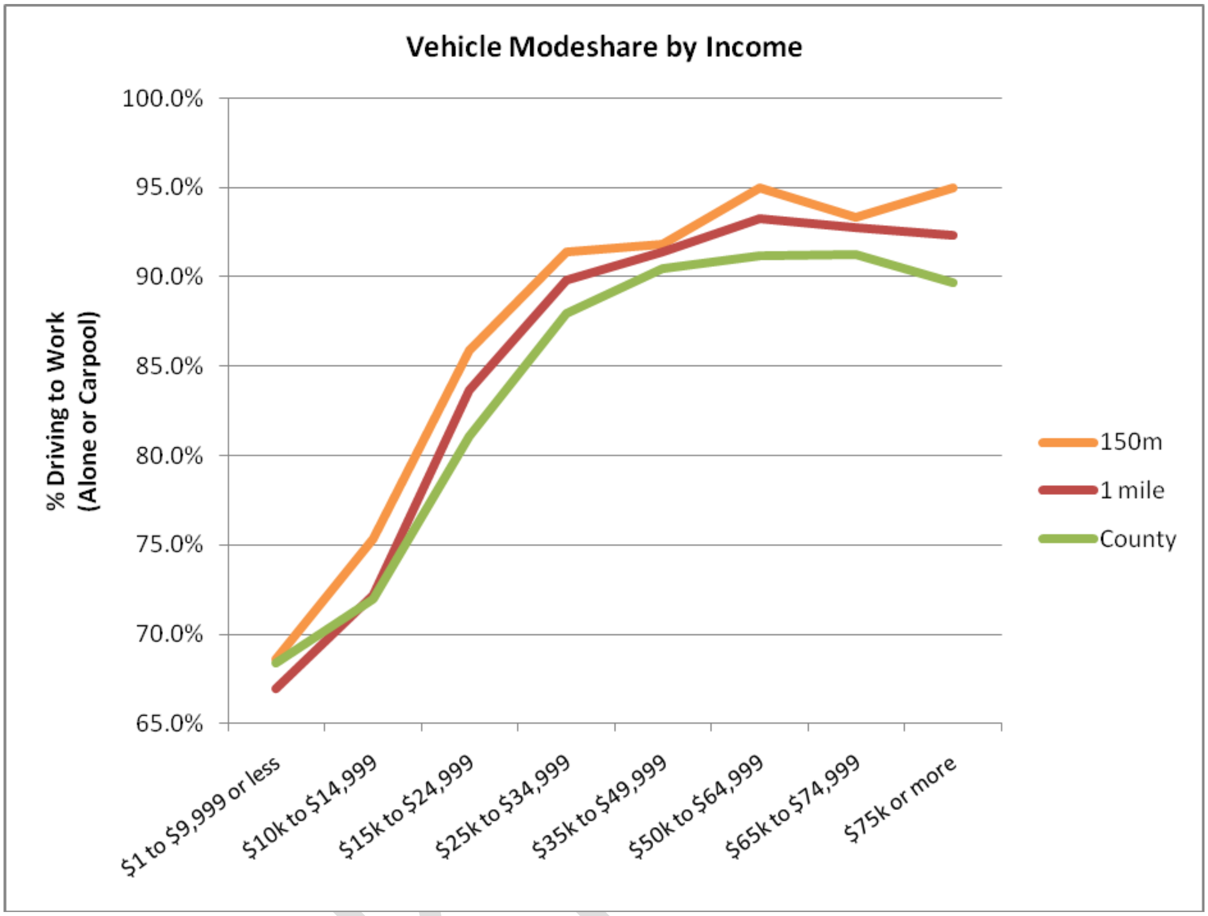
Table 6-4 shows the commuting patterns for residents in the transit corridor expansion study area by proximity and income. Approximately 90% of residents at higher levels of income ($35,000 or more) indicate that they drive alone or carpool as their primary mode of transportation to work. As shown in Figure 6-1, those at higher levels of income drive more than those residents earning $25,999 and less, who were more likely to use public transportation. Geographic proximity to the I-710 correlates with higher rates of driving (alone or in a carpool); those residents closest to the I-710 drive at higher rates than the county average.

Those residents at lower levels of income indicate a higher utilization of public transportation, walking, bicycling, and other means of travel. Mode share of walking at the county level is significantly higher than that of the study area for all levels of income, ranging from two to five times higher depending on income.

Table 6-4. Mode of Transportation by Income and Proximity to I-710

Income Range	% Car, Truck, or Van, Alone or Carpooled				% Public Transportation				% Walked				% Taxicab, Motorcycle, Bicycle, or Other Means				% Worked at Home			
	150 meters	1 mile	LA County	California	150 meters	1 mile	LA County	California	150 meters	1 mile	LA County	California	150 meters	1 mile	LA County	California	150 meters	1 mile	LA County	California
$1 to $9,999 or less	68.6	67.0	68.4	74.6	14.0	16.3	13.4	7.9	6.1	6.1	13.4	6.4	5.2	5.2	3.5	3.7	6.1	5.5	7.2	7.5
$10k to $14,999	75.3	72.2	72.0	78.1	14.5	16.2	15.9	9.1	3.9	5.4	15.9	4.5	3.6	3.7	3.0	3.1	2.7	2.5	4.5	5.2
$15k to $24,999	85.9	83.7	81.1	83.4	8.2	9.8	10.2	6.6	2.0	2.5	10.2	3.4	1.9	1.9	2.4	2.6	2.0	2.1	3.1	4.0
$25k to $34,999	91.4	89.8	87.9	88.0	4.1	5.0	4.8	3.9	1.6	1.6	4.8	2.2	1.4	1.7	1.8	1.9	1.5	1.8	3.5	3.9
$35k to $49,999	91.8	91.4	90.5	89.7	4.3	4.4	3.4	3.5	1.3	1.5	3.4	1.7	1.0	1.4	1.3	1.6	1.5	1.3	3.2	3.5
$50k to $64,999	95.0	93.2	91.2	89.9	2.0	3.0	2.7	3.4	0.6	0.8	2.7	1.4	0.1	0.0	1.3	1.6	2.4	2.9	3.7	3.8
$65k to $74,999	93.3	92.8	91.2	89.7	4.7	3.7	2.5	3.5	1.1	1.2	2.5	1.2	0.0	1.7	1.1	1.6	0.8	0.7	4.2	3.9
$75k or more	95.0	92.3	89.7	87.1	2.6	3.4	2.0	3.8	0.6	0.9	2.0	1.4	0.7	1.7	1.7	2.0	1.1	1.7	5.3	5.7
Source: U.S. Census Bureau 2010: 2005-2009 American Community Survey 5-Year Estimates[454].																				

Figure 6-1. Driving to Work (alone or carpool) by Income and Proximity to I-710 Mainline



6.2.2 Commute Times

Commute trips comprise approximately 20–25% of all trips. The average commute time for residents living in the county is 29.0 minutes. Those living within 1 mile of the corridor have a similar average commute time of 28.8 minutes, while those living the closest have a commute time of 28.1 minutes. The average commute time for Californians is somewhat shorter, 26.5 minutes. Table 6-5 provides the percentage of residents by commute times in the study area by proximity and mode. The percent of public transportation trips taking 60 minutes or more far exceeds that of any other mode. Driving yields the highest percentage of trips in the 30–34 minute range, while taxicab, motorcycle, bicycle, and walking have the lowest average associated time. Proximity to the I-710 appears to have little correlation with travel time by mode of transportation.

Table 6-5. Commute Travel Time by Proximity and Mode

Method of Travel	Placement	Minutes								
		<10 (%)	10–14 (%)	15–19 (%)	20–24 (%)	25–29 (%)	30–34 (%)	35–44 (%)	45–59 (%)	60 or more (%)
All Modes	150 meters	7.9	11.6	15.5	15.6	7.2	18.8	6.8	6.5	10.1
	1 mile	7.1	11.2	15.2	15.8	6.7	19.1	7.2	7.3	10.3
	LA County	8.8	11.6	13.9	14.2	5.6	17.3	7.5	9.2	11.8
Drive	150 meters	7.3	12.2	16.7	16.7	7.6	18.9	6.7	6.6	7.3
	1 mile	6.6	11.6	16.4	17.1	7.4	19.3	7.3	7.0	7.2
	LA County	8.4	12.0	14.8	15.0	6.1	17.3	7.7	9.2	9.6
Carpool	150 meters	6.9	11.2	15.2	14.4	6.3	20.0	8.7	6.1	11.2
	1 mile	6.4	11.3	15.2	14.6	6.0	21.3	7.4	7.5	10.3
	LA County	6.6	10.6	13.5	14.0	5.4	18.6	8.1	9.7	13.5
Public Transportation	150 meters	1.7	3.1	7.5	8.4	5.2	18.3	8.0	9.0	38.8
	1 mile	1.7	3.4	5.2	8.5	3.6	17.6	9.7	12.1	38.2
	LA County	1.3	3.0	5.8	7.8	3.0	20.9	8.0	13.1	37.0
Taxicab, motorcycle, bicycle, walked, or other means	150 meters	31.1	17.0	12.1	15.2	6.1	14.1	1.0	1.4	2.0
	1 mile	25.7	19.4	16.1	14.0	5.0	12.9	1.6	2.6	2.9
	LA County	31.1	19.5	14.7	11.8	2.7	10.2	2.5	2.8	4.7
Source: U.S. Census Bureau 2010: 2005–2009 American Community Survey 5-Year Estimates[454].										

6.2.3 Travel by Automobile

Access to Motor Vehicles by Household

Vehicle availability, as determined by whether residents report access to one or more vehicles, appears to be fairly consistent across geographical proximities to the I-710. As seen in Table 6-6, 8.5% of residents within 150 meters (approximately 500 feet) of the I-710 corridor do not have access to any vehicles while that percentage increases to 10.6 for an area of 1 mile from the corridor.

Table 6-6. Vehicle Availability by Proximity

Vehicles Available	150 Meters (%)	1 Mile (%)	LA County (%)	California (%)
None	8.5	10.6	8.8	3.5
1	24.8	26.3	24.8	19.9
2	35.4	33.1	35.5	40.0
3	31.3	29.9	30.9	36.5
Source: U.S. Census Bureau 2010: 2005–2009 American Community Survey 5-Year Estimates[454].				

Screenline Volume/Capacity

Volume to capacity (V/C) is a measure that reflects mobility and the quality of travel for automobile drivers. It compares roadway demand by measuring vehicle volumes with roadway supply, or carrying capacity. The draft I-710 Traffic Impact Analysis Report includes PM period V/C ratios obtained from the SCAG travel demand model for 137 separate local arterial roadway segments within the study area. Evening peak period volumes are used to represent the most critical peak condition for the corridor (URS 2010[464]).

Approximately 38% (54 of 137) of the roadway segments currently experience V/C ratios approaching 0.90 ≤ V/C <1.0 or exceeding V/C ≥1.0 of existing capacity. A V/C ratio above 1.00 predicts that the facility will fail, unable to discharge the demand arriving at the section and leading to delays (FHWA 2007[183]). See Table 6-18 for more on V/C ratios and how they compare with future scenarios.

Annual Delay per Traveler and Vehicle Miles Traveled

Speed and delay were computed as part of the EIR/EIS. Delay is the difference between the actual travel time and travel time that would be experienced if a person traveled at the legal speed limit. This measure is reported as person-hours of delay.

An analysis of vehicle hours of delay (VHD) and VMT was prepared for the I-710 Corridor Project. See Table 6-17 for a comparison of VMT and VHD for the No Build and the project build alternatives.

The 2008 SCAG Regional Transportation Plan calculated the following person-hours of daily delay in the SCAG region:

- 3.9 million vehicle-hours of daily delay
- 5.7 million person-hours of daily delay
- 15 minutes of daily delay per capita during peak commute periods
- 35.5 million vehicle miles traveled per day

Vehicle Travel Speeds

Vehicle travel speeds were calculated as part of the EIR/EIS based on the traffic flows for various segments of the I-710 Corridor Project Study Area. Average travel speeds were calculated for the I-710 by weighting the predicted and observed speed by segment length for the different build alternatives. Currently, 2008 baseline travel speeds range from AM speeds of 40.9 miles per hour (mph) to mid-day speeds of 50.4 mph. The heaviest traffic volumes are in the PM period from 3–7 p.m., with an observed 2008 baseline speed of 30.8 mph. See Table 6-14 for complete baseline vehicle speeds.

6.2.4 Public Transportation and Non-Motorized Transportation

Currently, 8.9% of the corridor study area population takes public transit in order to commute to work. This is more than the county average of 7.0%, or the state average of 5.1%. Local and county public transportation is provided by Metro and various city municipal transit lines. Complete routes and ridership information is summarized in the Multimodal Review Report for the EIR/EIS.

Public Transportation Routes and Ridership

Metro provides both local bus service and light rail service (called Metro Rail) in the I-710 Corridor Project study area. The subregional and municipal bus service operators provide local bus service operates at least six routes from southeast Los Angeles County to downtown Los Angeles, and there are a total of 13 routes that provide east-to-west service and 12 routes that provide north-to-south service. Metro Rail services are provided via the Metro Blue Line and Green Line, which run throughout the I-710 Corridor Project study area. More details are included in the URS Multimodal Review in that document's Section 2.0, "Existing Multimodal Systems." Some of these transit lines have high ridership.

Figure 6-2 shows the density of transit stops in the study area. Downtown Long Beach has the highest density. Major roads (e.g., arterials, some of which carry extensive amounts of truck traffic) throughout the area are also well served. Other areas (e.g., Vernon, which has a very small population) appear to be much less well served by the MTA.

A sampling of morning travel speeds for four transit options are provided in Table 6-7. Average speed is calculated from the Metro timetables for a given route for travel between 8 and 9 a.m. The speed associated with rail travel is significantly faster than that of two Metro bus options. For comparison, the average travel speed on the I-710 during the same time period is 40.9 mph.

Table 6-7. Average Speed for Public Transit Options

	Distance (Miles)	Time (Minutes)	Average Speed
Blue Line Light Rail	9.0	16	36.1 mph
Green Line Light-Rail	7.5	10	44.8 mph
Metro Bus Route 60	11.1	51	13.1 mph
Metro Bus Route 260	10.7	46	14.0 mph
Source: Metro 2011a: Metro time tables; calculated for travel between 8 and 9 a.m[320].			

Factors that determine public transit use include driving times, cost of driving (e.g., gas prices) and transit, socioeconomic factors, residential and employment density (e.g., headways, proximity to and accessibility of transit stops), parking (e.g., at destinations, park and ride), and safety (Taylor and Fink n.d. [436]).

According to Final I-710 Tier 2 Committee Report (Tier 2 Community Advisory Committee 2004[437]), "alternative transportation has been an underdeveloped asset in the corridor, especially mass transportation, bicycle and pedestrian options." While the 2009 Long Range Transportation Plan for the county calls for improvements to public transportation routes and facilities, recent budget cuts have threatened to actually reduce bus service. *LA Weekly* reports that Metro is eliminating 305,000 hours of service, impacting low-income workers in the outskirts of Los Angeles most (Wilson 2011[493]). *The New York Times* comments that the coming cuts will make existing long bus rides even longer (Medina 2011[313]). Furthermore, the elimination of some bus routes will require passengers to pay for each connection, doubling or sometimes tripling their costs. This would disproportionately affect transit-dependent low-income individuals who spend a higher percentage of their income on transportation. It would also increase the amount of time spent commuting and decrease time available to spend with family, resulting in increased stress and chronic disease outcomes.

Pedestrian Routes and Access

The 2002 Metro on-board survey revealed that 93% of all bus and train passengers walk to their transit stops, and 94% walk to their final destinations from transit. According to the 2009 Long Beach Transportation Plan, nearly all trips within the county, regardless of purpose, include a non-motorized component. Almost 9% of all the trips within the county are exclusively pedestrian trips, and about half of these are walking trips to and from home to work. Thus, all non-motorized transport modes should connect to an efficient, aesthetically pleasing, and safe pedestrian system that enable a person to successfully complete a trip. Streetscape development in Los Angeles County has created less than optimal pedestrian environments and conditions found within the corridor are typical of the region.

Pedestrian facilities within the study area include sidewalks, walkways, and crosswalks. Pedestrian access is also provided via the Los Angeles River Trail and the Rio Hondo Trail.

Conditions for pedestrians vary widely in the I-710 Corridor. Many communities, as shown in Figures 6-3 and 6-4, have sidewalks and vegetation as well as traffic calming features (such as the speed bumps in Figure 6-4) that support pedestrian activity. Figure 6-5 shows an intersection farther away from the I-710 in Paramount that is pedestrian friendly, with crosswalks and pedestrian crossing signals.

Other areas in and near the I-710 corridor have features that currently discourage walking. The figures below show some examples of these, including the following:

- Sidewalks on busy arterials with high volumes of truck traffic. Though there is a buffer between the sidewalk and the road, driveway cuts are a hazard and lighting is not at pedestrian scale (Figure 6-6).
- Narrow sidewalks with impediments and trucks parked near them in commercial areas (where, for example, a public transit user may need to walk to get to work) (Figures 6-7 and 6-8).
- Highly exposed and unprotected freeway crossings (Figure 6-9).
- Intersections with poorly marked crosswalks, no pedestrian signals, and high volumes of truck traffic (Figures 6-10 and 6-11).
- Walkable residential neighborhoods bordered by busy arterials that can discourage walking between neighborhoods (Figure 6-12).

Figure 6-2. Transit Stop Density in the HIA Study Area

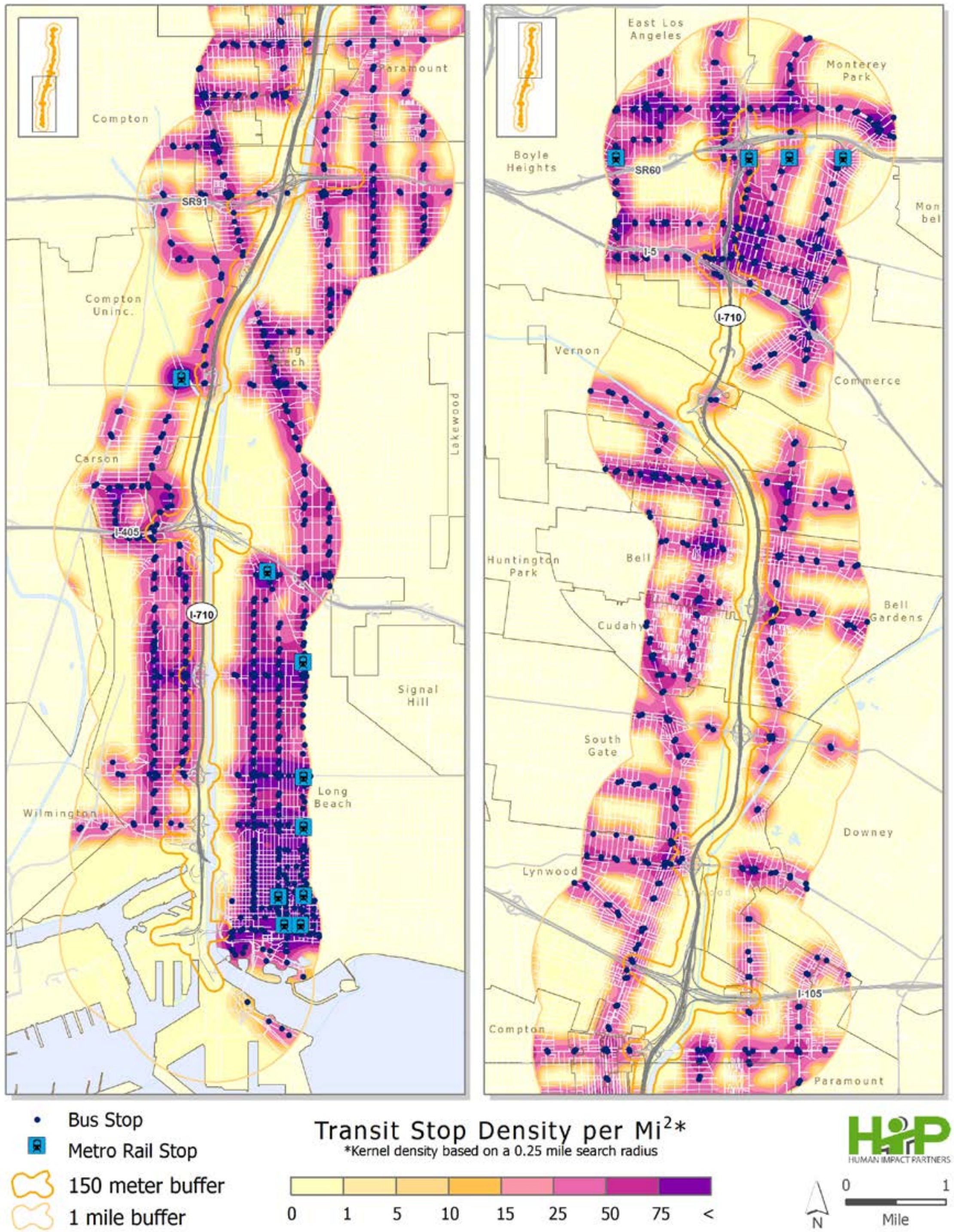


Figure 6-3. A Residential Neighborhood near the I-710 That Provides a Pleasant Pedestrian Environment

Figure 6-4. A Residential Neighborhood near the I-710 That Provides a Pleasant Pedestrian Environment, Including Speed Bumps

Figure 6-5. An Example of an Intersection in Paramount that Provides Some Safety Features for Pedestrians, Including a Well-Marked Crosswalk and Pedestrian Crossing Signals

Figure 6-6. A Sidewalk on a Busy Arterial with High Volumes of Truck Traffic and Little Protection for Pedestrians

Figure 6-7. A Sidewalk in a Commercial Area with Impediments (Fire Hydrant, Tree, and Street Sign) as well as Truck Parking

Figure 6-8. A Sidewalk at a Bus Stop that is Narrow and Has Many Impediments to Walking

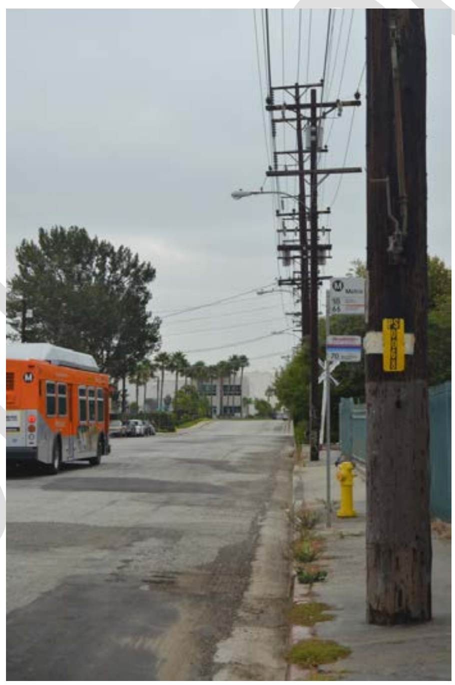


Figure 6-9. Pedestrians Using an Unprotected Sidewalk on an Arterial Crossing the Freeway

Figure 6-10. An Intersection in a Commercial Neighborhood with Poorly Marked Pedestrian Crosswalks, No Pedestrian Signals, and Impediments in the Surrounding Sidewalks

Figure 6-11. A Second Example of an Intersection in a Commercial Neighborhood with Poorly Marked Pedestrian Crosswalks, No Pedestrian Signals, Impediments in Surrounding Sidewalks, as well as High Volumes of Truck Traffic

Figure 6-12. A Google Map View of Walkable Residential Neighborhoods Separated from Each Other by Atlantic Avenue, a Busy Arterial with High Truck Volumes Just East of the I-710

A safe and inviting pedestrian environment can encourage walking and public transit use while unsafe and unappealing environments have been shown to discourage pedestrian activity.

Bicycle Routes and Access

Bicycle travel is accommodated in the I-710 Corridor through the use of designated bikeways and existing roadways. Class 1 Bikeways provide a completely separated right-of-way for the exclusive use of bicycles and pedestrians, with cross-flow by motorists minimized. Class 2 Bikeways provide a striped lane for one-way bike travel on a street or highway. Class 3 Bikeways provide for shared use by pedestrian or motor vehicle traffic.

Table 6-8 shows the ratio of length of bike lanes to length of road. In the county, there are 4.24 miles of bike lane for every 100 miles of road. In the I-710 Corridor Project study area, there are 3.3 miles of bike lane for every 100 miles of road. In the area 150 meters (approximately 500 feet) to either side of the center of the I-710, there are 2.19 miles of bike lane for every 100 miles of road.

Table 6-8. Ratio of Bike Routes to Motor Vehicle Routes

Area	Miles of Motor Vehicle Routes (Miles)	Miles of Bike Routes (Miles)	Miles of Bike Lane per 100 Miles of Road
Los Angeles County	31,720.5	1,344.8	4.2
1-mile buffer	1125.6	37.2	3.3
150-meter buffer	166.7	3.6	2.2
Source: Analysis of LA Metro Bicycle Route Map Spatial Data			

Existing bike trails are shown in Figure 6-13. Although there is a network of bikeways within the study area, not all are usable, quality bike routes. Many of the Class 3 Bikeways are often poorly marked, and do little to decrease speed or traffic volume, both of which influence perceived safety of bicycling. In a survey preformed by Alta Transportation Consulting for the Long Beach Bicycle Master plan, the primary reason for not riding a bicycle more is the lack of bikeways, while many potential bicyclists cite the fear of traffic as one of their main barriers to riding a bicycle in an urban community. Additional comments concerning constraints of the existing bicycle infrastructure included importance of access to activity centers, bicycle parking, and safety issues. 27% of survey respondents wanted to see things such as signal detectors sensing bicycles, wider curb lanes, and a variety of other improvements (City of Long Beach 2001[106]).

While not specific to the study area, the 2009 LA Bike Count Report notes a significant percent of riders riding on the sidewalk (22–29%) (Los Angeles Bicycle Coalition 2009[290]). This indicates a clear lack of perceived safety, which would likely benefit from increased bicycle lanes and routes. The Final I-710 Tier 2 Committee Report recommends providing a comprehensive bicycle and pedestrian network that provides connectivity throughout the area. The report further recommends providing for bike lanes and sidewalks in all aspects of arterial improvements to the I-710, establishing an east–west connection across the freeway, and providing new bike and pedestrian trails along the Los Angeles River Corridor.

The 2006 Metro Bicycle Transportation Strategic Plan identified a list of gaps in the inter-jurisdictional bikeway network to provide guidance for planners on where connectivity is needed. These gaps provide the opportunity for on-street or-off street accommodations and include completion of the river bike paths, rails-with-trails, or on-street connectors between two facilities or communities. While many gaps may be short, missing segments of a larger system, they all have a large impact on usage and safety (Metro 2006[316]). A total of 53 gaps were identified for the county, 5 of which are in the I-710 Corridor Project study area. These are listed in Table 6-9.

In general, bike facilities are inadequate throughout the study area, with the exception of Long Beach, which has taken steps to improve bikeability, including adding marked bike routes and traffic calming.

Figure 6-13. Identified Bikeways in the HIA Study Area

Table 6-9. Gaps in the Inter-Jurisdictional Bikeway Network

Gap	Name	Jurisdiction	Location	Description (From/To)	Constraints	Proposed By
25	Ocean Boulevard	LA City/ Long Beach	Harbor Area	Connection between Harbor Bike Lanes and LA River terminus	Vincent Thomas Bridge	LA City/ Stakeholders
27	Connector to LA River Path	LA City/ Wilmington	Anaheim Street or other corridor	Connection between Figueroa and Long Beach/LA River	Route not identified	Stakeholder Meeting
34	Connector	LA County/ Carson	Los Angeles River near Del Amo Boulevard	Connection between LA River path and Compton path terminus	Route not identified	Stakeholder Meeting
42	Carson Boulevard	Long Beach/ Lakewood	Carson Boulevard	Connector between LA River and Carson Boulevard bike path	Urban arterial	Stakeholder Meeting
43	Willow	Long Beach/ Signal Hill	Willow Street	Connection between LA River and San Gabriel River	Urban Arterial	Stakeholder Meeting
Source: Metro 2006[316].						

6.2.5 Emergency Response Times

The locations of emergency facilities in the I-710 Corridor study area were mapped in Section 6.2 of the Community Impact Assessment (see Appendix H of that report for emergency/community services maps).

There is no data available for any of the Gateway Cities emergency response entities; the following discussion from the City of Los Angeles is used here as an example because of the availability of data and high volume of calls received. Data specific to the I-710 corridor was not available from local emergency response facilities. The LAFD reports that from July to September 2008, the response time for benchmark incidents was 86% within 5 minutes when LAFD was the first resource on the scene at life-threatening Emergency Medical Services (EMS) incidents, and 89% within 8 minutes when LAFD was the first paramedic on the scene at life-threatening EMS incidents (Los Angeles Fire Department 2008[297]). This calculation defines response time as starting with receipt of the call by dispatch and ending with arrival at the scene; it does not account for the time from the call to the administration of medical care to the patient.

6.2.6 Health Outcomes Associated With Mobility

Physical Activity for Adults and Children

People of all ages who are physically active are healthier, less likely to develop many chronic diseases, and have better aerobic fitness than those who are physically inactive. Participating in regular physical activity can lead to improved cardiorespiratory (aerobic) fitness and muscular strength, bone health, cardiovascular and metabolic health biomarkers, favorable body composition (percentages of muscle, bone, and fat), and reduced symptoms of depression (CDC 2011a[97]).

According to the 2007 Los Angeles County Health Survey, approximately 47% of adults and 62% of children in the county do not meet recommended CDC guidelines for physical activity, with more than 36% of adults and more than 15% of children engaging in minimal to no physical activity. Rates of physical activity in the study area are similar to those in the county.

Table 6-10. Percentage of People Who Do Not Meet Physical Activity Guidelines, 2007

	LA County	All Census Tracts in Study Area	1 Mile West	1 Mile East	150 Meters West	150 Meters East
Adults	46.9%	46.7%	43.0%*	50.9%*	42.0%*	54.0%*
Children	62.4%	61.6%*	62.2%*	60.9%*	66.3%*	58.5%

* Indicates the estimate is statistically unstable (relative standard error > 23%) and therefore may not be appropriate to use for planning or policy purposes

Source: Los Angeles County Department of Public Health 2007a[293].

One of the barriers to meeting physical activity guidelines is having access to places to be physically active. In the county, more than 80% of parents rate their community as a pleasant place to be physically active for their children, and almost 80% say their child has a safe place to play that is easily accessible. Figures for the study area are similar, with the exception of people who live within 150 meters (approximately 500 feet) east of the I-710, who are more likely to say that their child has an easily accessible safe place to play.

Table 6-11. Parents' Evaluation of Places for Children To Be Physically Active, 2007

	LA County	All Census Tracts in Study Area	1 Mile West	1 Mile East	150 Meters West	150 Meters East
Safe place for child to be physically active	83.4%	82.4%	87.3%	77.5%	87.2%	76.0%
Park, playground or other safe place for child to play easily accessible	79.8%	80.3%	80.7%	79.9%	90.3%	79.4%

Source: Los Angeles County Department of Public Health 2007a[293].

Obesity

Table 6-12 indicates that, according to the 2007 Los Angeles County Health Survey, levels of obesity and being overweight are higher in the study area than in the county.

Table 6-12. Rates of Chronic Conditions for Adults, 2007

	LA County	All Census Tracts in Study Area	1 Mile West	1 Mile East	150 Meters West	150 Meters East
Obesity	22.2%	31.2%	29.1%	34.0%	26.3%	32.1%
Overweight	35.9%	38.7%	41.8%	34.6%	46.1%	33.4%
Ever Diagnosed with Heart Disease	7.7%	6.2%	8.2%*	3.9%*	9.1%*	no data
Ever Diagnosed with Hypertension	24.7%	21.2%	20.1%	22.5%	25.6%	22.2%*
Ever Diagnosed with High Cholesterol	29.1%	27.1%	29.3%	24.6%	36.5%	23.7%*
Ever Diagnosed with Diabetes	8.7%	12.4%	11.6%*	13.3%*	14.4%*	15.8%*
Ever Diagnosed with Depression	13.6%	9.1%*	7.6%*	10.8%*	7.6%*	9.2%*

* Indicates the estimate is statistically unstable (relative standard error > 23%) and therefore may not be appropriate to use for planning or policy purposes

Source: Los Angeles County Department of Public Health 2007a[293].

Table 6-13. Hospitalization Rates (per 100,000), 2008

	State of California	LA County	1 Mile West	1 Mile East	150 Meters West	150 Meters East
Hypertension	35.56	52.63	57.74	65.66	59.03	66.43
Angina without procedure	25.15	29.06	36.09	42.68	36.54	43.26
Diabetes, short term complication	48.51	45.31	59.71	72.84	61.14	78.48
Diabetes, long term complication	108.23	137.23	212.15	223.45	213.17	232.14
Uncontrolled Diabetes	11.98	18.79	29.53	32.83	30.69	33.57

Source: California Office of Statewide Health Planning and Development 2009[72].

Heart Disease

As shown in Table 6-12, current rates of hypertension and heart disease in the I-710 corridor are similar to rates in the county, as reported in the 2007 Los Angeles County Health Survey. Rates shown in the table are not statistically different and confidence intervals of measures overlap significantly. Table 6-13 reports current rates of hospitalizations for cardiovascular diseases. Rates of hospitalization for hypertension are similar in the study area and the county, but these rates are higher than rates in the state. Rates for angina (without procedure) are higher in the study area than in the county, and county rates are higher than state rates.

Diabetes

As shown in Tables 6-12 and 6-13, diabetes rates are higher in the study area than in the county according to the Los Angeles County Health Survey, and diabetes-related hospitalizations (for short-term complications, long-term complications, and uncontrolled diabetes) are higher in the study area than the county or the state according to the OSHPD.

Depression

Rates of having been diagnosed with depression are 13.6% at the county level. Data in the study area is statistically unstable, and it is therefore not possible to compare levels of depression near the I-710 with those in the county.

Stress

No data related to stress levels of residents living near the I-710 is available. However, drivers in the Los Angeles region and in the Gateway Cities have especially long work trip travel times compared to people elsewhere in the country. Los Angeles was ranked by the U.S. Census as having the fourth highest percentages of people with “extreme” commutes of longer than 90 minutes per day (5%) (U.S. Census Bureau 2005[453]). Census data also shows that 20% of those living in the larger Los Angeles region commute more than 45 minutes each way to work. Long commutes, as noted above, have been linked to higher stress levels.

6.3 Assessment of I-710 Corridor Project on Mobility

The EIR/EIS uses the SCAG 2008 RTP Travel Demand Model to determine travel demand forecasting for 2035. According to the SCAG 2008 RTP Travel Demand Model, study area work-person trips are distributed as follows:

- Auto person trips: 83% (94% single-occupancy vehicles, 6% high-occupancy vehicles [HOV])
- Transit person trips: 10%
- Non-motorized trips: 7%

Each alternative analyzed in the EIR/EIS uses the above mode share distribution. The travel demand forecasting thus assumes that neither changes in future conditions (e.g., increasing congestion under baseline conditions) nor roadway capacity changes will influence mode share. Substantial transportation research, however, suggests that alternative conditions could significantly influence travel demand and mode share. The model forecasts a high work-trip transit mode share of 10%, compared to a 4% work trip transit share for the overall SCAG region and compared to existing conditions in the county (7%) and near the freeway (7.6%).

6.3.1 Impacts on Vehicle Travel

Travel Trips

Travel by auto is the predominant mode of transportation in the I-710 Corridor Project study area (83% of all person trips for the study area). Assuming a constant mode share for automobile travel, the number of auto trips will increase under each alternative being considered.

An additional consideration primarily affecting auto travel is the tolling impacts of Alternative 6C. According to a presentation by InfraConsult to the I-710 Project Committee, the traffic impacts of tolling the freight corridor are notably different than Alternatives 6 A/B (e.g., with no tolls). Alternative 6C would shift approximately 6% of daily truck traffic off the I-710 and shift approximately 25% of daily truck traffic from the freight corridor to the general purpose lanes. Trucks would be shifted off the I-710 and onto other freeways and arterial roads, resulting in considerable changes to the traffic conditions. Because full modeling results for Alternative 6C were not available before the HIA was completed, the analysis of this alternative is not comprehensive and a more comprehensive analysis is recommended when the data is available.

Vehicle Speeds

Vehicle speeds between proposed alternatives differ significantly. As shown below in Table 6-14, under Alternative 1 vehicle speeds on the freeway will be significantly decreased. Alternative 5A will result in higher average speeds compared to 2008 levels by 2.36, 1.22, and 6.1% respectively, for the AM, mid-day, and PM time periods. Alternatives 6A and 6B would result in significantly increased speeds at all times of day, ranging from a mid-day increase of 12.1% to a PM increase of 20.8%. Data regarding vehicle speeds was not available for Alternative 6C; however, a comparison of build alternatives performed by InfraConsult shows a marked decrease in truck volumes for Alternative 6C over 6A/6B in the GP lanes. Therefore, additional increases in speeds can be expected for vehicles traveling in the I-710 GP lanes under the tolling alternative.

Table 6-14. Average Vehicle Speeds on General Purpose Lanes by Alternative

	2008 Baseline	Alternative 1 No Build (mph and % Change over Baseline)	Alternative 5A (mph and % Change over Baseline)	Alternative 6A/6B (mph and % Change over Baseline)	Alternative 6C
AM (6 a.m.–9 a.m.)	41 mph	37 (-9.7%)	42 (2.4%)	48 (16.6%)	Unavailable but likely higher than 6A/6B
Mid-day (MD) (9 a.m.–3 p.m.)	50 mph	48 (-5.4%)	52 (1.2%)	56 (12.1%)	Unavailable but likely higher than 6A/6B
PM (3 p.m.–7 p.m.)	31 mph	28 (-8.1%)	33(6.1%)	37 (20.8%)	Unavailable but likely higher than 6A/6B
Source: Analysis of Environ post processed traffic flow data.					

Traffic Volumes in General Purpose Lanes

Traffic volumes on the I-710 also vary considerably depending on time of day and project alternative. PM traffic volumes are the highest, followed by AM volumes. As shown in Table 6-15, truck traffic volumes in the GP lanes increase substantially under Alternative 5A and slightly less under Alternative 1. Under Alternatives 6A/B, truck volumes increase, but much more modestly. Auto volumes increase modestly under Alternative 1, an intermediate amount under Alternative 5, and most under Alternatives 6A/B.

Table 6-15. Traffic Volume on I-710 General Purpose Lanes, Percent Change from 2008

Build Alternative	Auto Volume	Truck Volume in General Purpose Lanes
AM Travel		
1	0.1%	101.2%
5A	5.0%	134.1%
6A/B	13.5%	46.4%
MD Travel		
1	12.0%	42.4%
5A	24.0%	54.1%
6A/B	32.9%	13.6%
PM Travel		
1	3.3%	32.6%
5A	33.0%	51.7%
6A/B	40.2%	2.9%
Source: URS 2010[464].		

An analysis was also preformed of traffic volumes on arterial streets. A full list of individual streets used in this analysis can be found in the Final Traffic Analysis Report of the EIR/EIS. The total percent change in volume, as averaged over all analyzed streets, is shown in Table 6-16. Auto volumes for Alternative 1 are anticipated to increase by 8.45% while they will increase under Alternatives 5A and 6A/B by 7.74 and 8.35%, respectively.

Truck volumes on arterials will increase substantially under Alternative 1 (43.76%). Under Alternatives 5A and 6A/B truck volumes will increase less, but still significantly (37.89 and 38.02%, respectively).

Table 6-16. Arterial Street Volumes by Alternative, Percent Change Compared to 2008

	Alternative			
	1	5A	6A/B	6C/D
Auto	8.45%	7.47%	8.35%	Unavailable
All trucks	43.76%	37.89%	38.02%	Unavailable
Source: URS 2010[464].				

Vehicle Miles Traveled and Vehicle Hours of Delay

VMT and VHD were calculated in the EIR/EIS for some of the project alternatives. As shown in Table 6-17, auto VMT on the freeways and total VMT (freeways + arterials and other roads) would increase the most under Alternatives 6A/B and the least under Alternative 1. Total truck VMT (freeway plus arterials and other roads) would be the same for all alternatives, but the ratio between freeway miles and non-freeway miles changes for the alternatives proposed.

2008 Baseline VHD data was not available, so a comparison with existing conditions is not possible. Alternative 1 would result in the most VHD. Alternatives 5A and 6A/B would result in a smaller delay on the I-710.

VHD and VMT had not been assessed for Alternative 6C at the time the HIA was completed.

Table 6-17. Daily Vehicle Miles Traveled and Vehicle Hours of Delay

	Daily Auto VMT (% Increase over 2008 Baseline)	Daily Truck VMT (% increase over 2008 Baseline)	Vehicle Hours of Delay (VHD)
Freeways			
2008 Baseline	38.5 M	3.6 M	Data unavailable
2035 Alternative 1	40.9 M (+6.2%)	5.0 M (+38.9%)	1.53 M
2035 Alternative 5A	41.5 M (+7.8%)	5.1 M (+41.7%)	1.52 M
2035 Alternative 6A/B	41.9 M (+8.8%)	5.2 M (+44.4%)	1.48 M
2035 Alternative 6C	Data unavailable	Data unavailable	Data unavailable
Arterials/Other			
2008 Baseline	32.5 M	1.6 M	
2035 Alternative 1	35.9 M (+10.5%)	2.2 M (+37.5%)	
2035 Alternative 5A	35.6 M (+9.5%)	2.1 M (+31.25%)	
2035 Alternative 6A/B	35.5 M (+9.2%)	2.0 M (+25.0%)	
2035 Alternative 6C	Data unavailable	Data unavailable	

Source: URS 2010[464].
Numerical and percent changes based on actual, not rounded values. M = Million.

Volume to Capacity Ratios

As discussed earlier, volume to capacity ratios provide an indicator of mobility and quality of travel. A V/C ratio above 1.00 predicts that the facility will not be able handle the traffic demand, leading to significant delays (FHWA 2007[183]). A total of 137 arterial roadway segments in the I-710 Corridor Project study area were evaluated for V/C; 39.4% of roadway segments for which V/C ratios had been calculated exceed 0.90 V/C for the 2008 baseline. For both Alternative 1 and Alternative 5A, the percentage of segments approaching or exceeding 0.90 V/C rises to 47.4%. Alternative 6A/6B returns the percentage back to 2008 baseline conditions with 39.4% of segments approaching or exceeding 0.90 V/C. It is likely that the V/C for Alternative 6C will result in even fewer segments with V/C exceeding 0.90 ≤ V/C on the mainline, however, at the expense of V/C on other roadways.

Table 6-18. Volume to Capacity Ratios for Segments of the I-710

Major Arterial Roadway Segments Approaching or Exceeding (0.90 ≤ V/C) in 2035 Build Alternative Analysis					
	2008 Baseline Conditions	Alternative 1	Alternative 5A	Alternative 6A/B	Alternative 6C
North–south	24/74 (24 of 74 segments exceed 0.90 ≤ V/C)	28/74	28/74	19/74	Unknown
East–west	30/63	37/63	37/63	35/63	Unknown
Percent	39.4%	47.4%	47.4%	39.4%	Unknown
Source: Draft I-710 traffic analysis (URS 1010[464]). V/C ratios obtained from 2008 SCAG RTP travel demand model.					

6.3.2 Impacts on Public Transportation Mode Share and Travel Times

Public Transit Usage

Improvements to existing transit service are described in Section 3.1 of the Multimodal Review and are based on the Metro 2008 Long Range Transportation Plan. These proposed improvements include additional routes, parking structures, and other miscellaneous capital and operational improvements in the study area. The following projects are included for all alternatives being considered:

- Alameda Corridor, LA/LB Ports to approximately Washington Boulevard, Los Angeles Blue Line downtown Long Beach to 7th Street / Metro Center in downtown Los Angeles, operational improvements to existing line
- 1st Street parking structure near Blue Line terminus in Long Beach
- Los Angeles Eastside Corridor/ Pasadena Gold Line Eastside Extension, Union Station to Pomona/Atlantic in East Los Angeles
- Green Line, miscellaneous capital and operational improvements to existing line
- Exposition Light Rail—Phase I to Venice-Robertson Station, Phase II to Santa Monica
- Bus Service Improvements, miscellaneous operational improvements to existing system (approximately 20% increase in service levels)
- Atlantic Avenue Metro Rapid Bus: The Atlantic Avenue Metro Rapid service operates along Atlantic Avenue from the Long Beach Transit Mall to east Los Angeles and Pasadena Long Beach Boulevard
- Metro Rapid Bus: This route follows Long Beach Boulevard from the Long Beach Transit Center to downtown Los Angeles
- Bus improvements associated with the Metro and Caltrans HOT lanes demonstration project, Fastlanes, on I-110 and I-10, with implementation planned by the end of 2011

For Alternatives 5A and 6A/B/C, the following improvements are also proposed:

- 25% transit service level increase within study area
- Additional bus shuttles to/from the Blue/Green Lines
- Expanded Metrolink service (if possible; freight traffic volumes may not allow this)
- Expanded high speed bus service between Los Angeles and Orange Counties

These improvements are assumed to result in a 20% increase in overall study area rail ridership, yielding a decrease of 7,600 auto trips in the peak period in the study area; as well as a 27% increase in overall study area bus transit, yielding a decrease of 18,500 auto trips daily in the study area.

Increased park-and-ride utilization is predicted in the Multimodal Review Final Report for the I-710 Corridor Project EIR/EIS in Section 3.1 based on operational improvements on the Blue Line and the Green Line. The Multimodal Review notes that ridership increases resulting from proposed improvements to rail and bus system capacity could be constrained by less than proportional increases to park and ride facilities. Based on the preliminary forecast study, it is estimated that approximately 2,500 new parking spaces would be required in the I-710 Corridor Project study area to support the potential increase in rail ridership. These additional parking spaces would be built under Alternatives 5A and 6A/B/C.

The SCAG 2008 RTP Travel Demand Model provides a forecast of the year 2035 travel for the I-710 Corridor Project study area by mode share. The model assumes transit person trips to be 10% in the study area, higher than current levels. As stated above, each build alternative analyzed in the EIR/EIS uses these same mode share assumptions; mode share is not stratified by build alternative to reflect changing congestion conditions in the corridor or improvements to transit service.

The transportation literature indicates that, in reality, mode share is likely to be dependent on traffic speeds and volumes, which differ between project alternatives. The Downs-Thomson effect (Downs 1962[122]; Thomson 1977[440]; Abram and Hunt 2001[2]) is the hypothesis that highway capacity improvements may ultimately increase overall congestion and travel times. An immediate effect of capacity expansion is a shift from transit to private vehicle use by some travelers. Downs-Thomson states this reduction in transit ridership leads to raises in transit fares or service reduction, resulting in further decreased patronage due to increased inconvenience of transit. Simulation modeling of the Downs-Thomson effect showed that long-term reductions in transit ridership can be induced by increases in highway capacity without any change in transit fares. Modeling in the EIR/EIS has not taken this effect into account.

Increased public transit service proposed under Alternatives 5A and 6A/B/C would likely increase public transit ridership and offset some of the shift away from public transit that results from decreased congestion. However, budget cuts for public transit currently being implemented will make it difficult to provide this additional service on an ongoing basis and to reach the increased public transit usage predicted in the SCAG model under any of the project alternatives being considered.

Based on this data, Alternatives 1 and 5A are likely to result in the highest public transit ridership levels. Alternative 1 will likely have higher ridership due to traffic congestion; Alternative 5A will have higher ridership due to a combination of congestion and increased transit service. It is likely that transit mode share for Alternatives 6A/B/C will be the lowest (lower than current levels) due to improvements in travel speeds on roadways. Travel by motor vehicle under Alternatives 6A/B/C will become more attractive and thus divert riders from transit.

Public transit ridership is dependent on many other factors aside from traffic volumes and speeds, such as land use patterns and density, the price of gas, and availability of alternative choices. These other factors will influence ridership under all the alternatives and make quantitatively predicting changes in ridership difficult for a corridor of this size without more data.

Table 6-19. Transportation Mode Share Existing Conditions and Assumptions for the EIR/EIS Alternatives

	2005–2009 Census Survey			2035 Study Area Assumptions
	150 meter buffer	1 mile buffer	Los Angeles County	
Auto	87.6%	85.5%	83.8%	83%
Public transportation	7.6%	8.9%	7.0%	10%
Non-motorized trips	4.6%	5.3%	9.2%	7%

Sources: U.S. Census Bureau 2010: 2005-2009 American Community Survey 5-Year Estimates[454]; EIR/EIS Multimodal Review Final Report

Public Transit Travel Times

Although the Multimodal Review does not present data regarding trip times for transit, the following assumptions can be made:

- Rail transit times will stay relatively constant. Additional trains could potentially reduce peak headway, but, aside from that, travel times would be unaffected. The Multimodal Review notes that increased Metrolink service may not be possible due to increased freight traffic. The I-710 Railroad Goods Movement Study predicts that the anticipated increase in goods movement and passenger trains reaches beyond the efficient capacity of freight rail lines and that additional tracks will need to be constructed to accommodate passenger train growth, which may be limited by Right-of-Way constraints.
- Bus commute times should improve with increased vehicle speeds and reduced hours of delay resulting from any of Alternatives 5A, and 6A/B/C. Increases in service levels and increased capacity will also decrease bus wait times.

6.3.3 Impacts on Walkability and Bikeability

The Multimodal Review Final Report for the I-710 Corridor Project EIR/EIS states that "Roadway improvements planned will likely incorporate pedestrian and bicycle facility enhancements during construction activities which will increase attractiveness for those facilities once construction is complete." Similarly, the Community Impact Assessment Executive Summary states, "the I-710 Corridor

Project build alternatives would improve local streets by constructing new curbs, gutters, and striping, and would result in changes in access." However, no actual improvements are proposed or specified.

There is significant research suggesting that higher traffic volumes and speeds negatively impact perceptions of safety and the attractiveness of walking/biking as an alternative to using motorized transport and are likely to reduce walking and biking on streets (CDC 2002a[94]; Li et al. 2005[280]). As mentioned above, cyclists in the area state that the primary reason for not riding a bicycle more is the lack of bikeways, and many potential bicyclists cite the fear of traffic as one of their main barriers to riding a bicycle in an urban community. Under all alternatives being considered, traffic volumes on arterials are predicted to increase. This will likely lead to decreased speeds on arterials under Alternative 1, as many of these roads are already congested, but, under Alternatives 5A and 6A/B/C, intersection changes to increase automobile LOS are planned and could offset any reduction in speed from increased volumes.

Future changes in active transportation will depend on many factors in addition to traffic volume and speed and perceptions of safety, which are discussed below. These other factors include land use patterns and density and availability of alternative choices for transportation. Current rates of active transport in the study area are very low, but the reasons for this and the reasons people walk and bike are not clear. Without a better understanding of these factors, it is not possible to quantify the extent to which changes in traffic will impact active transportation rates. (For example, it may be that those who do walk or bike currently have no alternative choices. If that is the case, changes in traffic volume or speed are unlikely to impact that choice. Others with more options or more local destinations may be able to alter their transportation mode.) Therefore, only general statements can be made regarding impacts on walkability and bikeability.

For Alternative 1, traffic volumes increase the most but traffic speeds decrease, so the impact on the pedestrian/bicyclist environment is uncertain. Increased congestion would also likely make walking or biking more time-competitive, increasing the number of pedestrians and bicyclists on the street, and increasing the social acceptance as walking/biking is paired with transit as a viable transportation alternative. Overall, the impact on walking and biking would still likely not be positive.

Alternatives 5A and 6A/B/C will result in lower traffic volumes on arterials but also higher vehicle speeds compared to Alternative 1. The negative impacts on walking and biking of increased speeds and increased truck volumes are likely to offset any positive increases in walking and biking as a result of infrastructure improvement under these alternatives. Walking and biking rates under these alternatives are likely to be lower than Alternative 1. Under Alternatives 6A/B/C, as discussed above, public transit usage may also decrease, further reducing pedestrian activity. In addition, under Alternatives 6A/B/C, the proposed freight corridor would place truck traffic into the area currently occupied by overhead electricity cables between the current I-710 GP lanes and the LA River. This area is just opposite the LA River from the major bike route in the corridor, which also runs along the river. Noise and air pollution from the trucks will degrade the environmental quality of this bike path and may discourage use.

The new interchange proposed under Alternatives 5A and 6A/B/C in Maywood at Slauson Avenue is predicted to bring increased traffic to Slauson Avenue, which currently is bordered by residential uses. This increased traffic flow is likely to decrease walkability and bikeability in Maywood.

6.3.4 Impacts on Emergency Vehicle Response Times

According to the Community Impact Assessment, only one emergency facility will be directly affected by the I-710 Corridor Project: Fire Station #4, located at 4350 Bandini Boulevard (City of Vernon). The station is located in a zone that is primarily industrial. This property would be acquired and relocated under the I-710 Corridor Project build alternatives. The new station would be placed at a site similar in size and where existing service/response times can be maintained, and would be in operation prior to demolishing the existing station.

Emergency response times may be impacted by the proposed project alternatives based on changes in vehicle volumes and speeds on arterials and the freeway. Under Alternative 1, increases in traffic volumes and lower speeds are likely to reduce emergency vehicle response times somewhat. Alternative 5A will have higher traffic volumes, with slightly higher speeds on the arterials and freeway. Emergency response times are likely to be similar to those in 2008. Alternatives 6A/B/C will be similar to Alternative 5A with the exception that vehicle speeds on the freeway will be higher, which will allow for faster response times because of improved mobility and less congestion.

6.3.5 Summary of Changes to Mobility

Table 6-20 summarizes the impacts of the alternatives on the mobility indicators described above.

Table 6-20. Summary of Impacts on Mobility Indicators

Mobility Indicator	Alternative			
	1	5A	6A/B	6C
Traffic speed	⇓⇓⇓	⇔	⇑⇑	⇑⇑
Traffic volume—general purpose lanes	⇑	⇑⇑	⇑⇑	⇑⇑
Truck traffic volume—arterials	⇑⇑⇑	⇑⇑	⇑⇑	⇑⇑
Automobile VMT	⇑	⇑	⇑⇑	⇑⇑
Truck VMT	⇑⇑	⇑⇑	⇑⇑	⇑⇑
VHD	⇑⇑	⇑	⇓	⇓
V/C	⇑⇑	⇑⇑	⇔	⇔
Non-motorized travel mode share	⇔/⇓	⇔/⇓	⇔/⇓	⇔/⇓
Public transit mode share	⇔/⇑	⇔/⇑	⇔/⇓	⇔/⇓
Automobile mode share	⇓	⇔	⇑	⇑
Emergency response times	⇓	⇔	⇑	⇑

6.3.6 Impacts on Mobility Associated Health Outcomes

Impacts on Health through Active Transport

Under all the alternatives being considered, increases in automobile and truck VMT and lack of increases in walking and biking create additional barriers to active transportation and access to local recreational areas. Even small increases in physical activity rates would be likely to lead to decreases in diabetes, heart disease, obesity, stress, and mental illness, and are likely to increase longevity (PolicyLink 2002[365]; Task Force on Community Preventive Services 2001[433]).

Alternatives 6A/B/C are least likely to increase physical activity and positively impact these health outcomes. Alternative 5A is likely to have slightly better outcomes than Alternatives 6A/B/C. Alternative 1 would be likely to negatively impact physical activity and health the least of all the alternatives being considered in the EIR/EIS.

Walking tends to be particularly accessible as a form of physical activity for children, elderly, disabled, and lower-income people who have fewer opportunities to participate in sports or formal exercise programs. These populations will be negatively impacted significantly by these changes.

Impacts on Health through Social Cohesion

As described above, social connectivity helps manage stress, and is connected with longer lifespan and access to emotional and physical resources.

Increased average travel speeds and increases in VMT in Alternatives 6A/B/C would have opposite impacts on commute times, yielding an unclear impact on time available for family and social activity. A lack of an increase in walking/biking and public transit use in these alternatives is likely to not improve social interaction either (Putnam 2001[378]). As a result, that social cohesion under Alternatives 6A/B/C will not improve and the potential health benefits of cohesion will not be realized.

Alternative 5A would result in higher VMT and a small increase in travel speeds, likely leaving people with longer commutes and reducing time available for social interaction. In addition, a lack of increased walking/biking would not improve social cohesion, although increased public transit usage under this alternative may offset that somewhat. Negative impacts on social cohesion are more likely for Alternative 5A than for Alternatives 6A/B/C, with negative health outcomes associated with the lack of such cohesion.

The addition of an on-/off-ramp at Slauson Avenue under Alternatives 5A and 6A/B/C has the potential to impact social cohesion in Maywood significantly by reducing the ability of those living on the north and south sides of Slauson Avenue to interact, potentially dividing this community in two. Conversely, removal of ramps at Wardlow Road (in Alternatives 6A/B/C only) has the potential to increase social cohesion by reducing traffic on those arterials.

Alternative 1 would likely have similar impacts as 5A. Lower traffic speeds would lead to longer commutes, further impacting cohesion negatively, although increased active transport could offset this impact.

Impacts on Stress and Stress-Related Illness

As described above, impacts on both physical activity levels and community cohesion can impact stress levels. In addition to these changes in stress levels, commuting and traffic congestion can also impact stress, with longer commutes and increased congestion leading to more stress. Stress can lead to poor pregnancy outcomes, poorer physical and mental health in childhood, and cardiovascular disease in adults.

Under Alternative 1, a lack of improvement in physical activity levels and in social cohesion would, at best, not improve stress levels. Longer commute times and increased congestion would negatively impact stress. In comparison, Alternative 5A would be less likely to increase physical activity but likely to not impact social cohesion as negatively. Alternative 5A would lead to less congestion. Alternatives 6A/B/C would be least likely to improve physical activity but least likely to impact social cohesion negatively. They would also offer the least congestion. Because it is not possible to quantify how these factors impact stress, it is difficult to predict how stress overall would be impacted under these different alternatives or to predict how health outcomes would be impacted.

Impacts on Injury and Fatality through Changes in Emergency Response Times

As described above, emergency response times under 8 minutes is a recognized goal that improves survival for those with cardiac arrest, and faster response times lead to better survival statistics generally. In 2008, more than 85% of the time response times by the LAFD were below this.

Emergency response times under Alternatives 6A/B/C are likely to improve and will further improve health outcomes associated with emergency medical response. Under Alternative 5A, response times are likely to be similar to current levels. Alternative 1 is likely to result in longer response times, which could put more people at risk of poor outcomes in emergency situations.

Mobility and Poverty

Low-income populations who live closest to the freeway drive disproportionately more than those who live farther from the freeway. Those individuals spend a higher percentage of their income on transportation-related costs, with vehicle ownership being one of the most costly types of transportation. For example, 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 (Benedict et al. 2006[36]).

Improvements to the freeway could induce more car dependence within this vulnerable population, decreasing financial resources available for health care and basic needs, decreasing community cohesion, and increasing stress and related chronic diseases. Public transportation, on the other hand, 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 (Bailey 2007[23]). 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 (American Public Transportation Association 2011[10]).

Summary

As Table 6-21 shows, all alternatives under consideration are unlikely to lead to positive health impacts as a result of changes in mobility, and would thus diminish the project's objective of improving public health.

Table 6-21. Summary of Predicted Mobility-Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Chronic disease (e.g., cardiovascular disease, diabetes) and decreased lifespan (e.g., primarily from changes in active transportation, but also including changes in social cohesion and stress)					
1	~/–	Potentially significant, non-quantifiable	Mod–High	♦ ♦ ♦	Project will have multiple impacts, some of which offset others.
5A					
6A					
6B					
6C					
Mental Illness (e.g., depression; primarily from changes in active transportation, but also from changes in social cohesion and stress)					
1	~/–	Potentially significant, non-quantifiable	Mod–High	♦ ♦	Project will have multiple impacts, some of which offset others.
5A					
6A					
6B					
6C					
Negative health outcomes associated with delayed emergency response					
1	–	Minor	Mod–High	♦	Data in the literature is not conclusive regarding the impact of response time on health outcomes; emergency response time changes roughly estimated
5A	~	Negligible			
6A	+	Minor			
6B	+	Minor			
6C	+	Minor			

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between mobility and the health outcome: ♦ = plausible but insufficient evidence; ♦ ♦ = likely but more evidence needed; ♦ ♦ ♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

6.4 Recommendations

The issues identified in this analysis of mobility—notably that higher traffic volumes on arterials and higher speeds on the arterials and freeway will reduce active transport use—are multi-factorial and both the issues and the recommendations put forward are ubiquitous throughout the region. Although some of the I-710 Corridor Project Alternatives achieve the purposes of addressing projected traffic volumes and growth in population and economic activities related to goods movement, these strong regional forces still result in an increase in traffic volume on arterials, and active transport through walking and biking in the corridor will remain a challenge. Therefore, it is critically important that implementation of the recommendations to encourage active transport be addressed on a regional scale, with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. Improvements proposed under Alternatives 5A and 6A/B/C may increase ridership, but the expansion of the freeway and higher vehicle speeds are likely to counter progress in that area. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated objective of improving public health. Recommendations have been listed below by subject.

6.4.1 Vehicle Travel (Trucks and Automobiles)

- Adopt or advocate for policies to reduce automobile and truck usage including:
  - Increasing use of the lowest emission rail technologies feasible to transport freight;
  - Increasing use of public transportation and walking and biking as a mode of transport for non-commute trips;
  - Continuing to promote land use policies in the Gateway Cities that encourage higher density and mixed use development.
- Reduce and enforce speeds on targeted roadways using traffic calming for safety and to encourage bicycling and walking. Incorporate a bicycle and pedestrian plan (e.g., complete streets) into the project.
- For any alternative selected, fully fund and if necessary strengthen enforcement of truck route regulations.

6.4.2 Public Transportation

- In addition to public transit improvements that are proposed to be funded as part of Alternatives 5A and 6A/B/C, ensure the improved transit infrastructure in the Gateway Cities as described in the 2012 RTP and 2011 Gateway Cities Sustainable Communities Strategy (SCS) is funded and implemented.
- Evaluate options for dedicated bus lanes on targeted arterials to improve transit speed to make it more time competitive with automobile and train trips.

- Support improvements of bus stops to make them safer, more accessible by foot, and more comfortable.
- Conduct an equity analysis to examine where transit will be most used and will have the greatest impact while serving those with the most need for transit options.

6.4.3 Walkability

- Ensure the improved walkability infrastructure in the Gateway Cities as described in the 2012 RTP and 2011 SCS is funded and implemented.
- In targeted areas, using physical engineered measures, reduce traffic speeds and volumes on streets with restaurants, stores, and services so that safety and walkability are improved. Measures that compel drivers to slow down and decrease traffic volumes can increase safety for children, pedestrians, bicyclists, and motorists alike. Examples include chicanes, lateral shifts, reduced lane width, pedestrian refuges, and narrower lane width.
- Support improvements in pedestrian infrastructure, including piano-key crosswalk striping and pedestrian count-down signals at signalized intersections.
- Increase the number of sidewalks that are easily accessible by people in wheelchairs through removal of obstructions, abrupt changes in level, excessive cross lopes, and overhanging obstructions, and ensure they are wide enough for safe travel. Also ensure compliant curb ramps at intersections.
- Assist in funding opportunities and/or direct project mitigation (as appropriate) that connects and/or creates pedestrian-friendly links between residential areas, transit-oriented neighborhoods/facilities, selected commercial and mixed use communities across and along the freeway, arterials, and the LA River (and Rio Honda Channel where appropriate). The cross-links or connectors should provide quality walking environments with access to existing or planned trails or other pedestrian networks.

6.4.4 Bikeability

- Ensure the improved bicycling infrastructure in the Gateway Cities as described in the 2012 RTP and 2011 SCS is funded and implemented.
- Create more bicycling routes and improve bicycling infrastructure beyond what is already proposed with the 2012 RTP to offset increased traffic and volume associated with any build alternative.

7. Air Quality

7.1 Introduction

The I-710 is a major corridor linking the Ports of Long Beach and Los Angeles to other major highways and communities in the region. The average traffic flow on the I-710 is approximately 12,180 vehicles/hour. Over 25% of these vehicles are heavy-duty diesel trucks; this represents one of the highest proportions of truck traffic on an urban freeway in the region (Zhu et al. 2002[503]). Vehicle emissions, especially emissions from diesel trucks, impact air quality regionally and in nearby communities adjacent to the roadway. Traffic on the I-710 also contributes significantly to regional greenhouse gas emissions (Ewing and Kreutzer 2006[177]).

The purpose of this chapter is to evaluate the cumulative impacts of air quality on the health of community residents along the I-710 corridor. Port and rail operations, related industrial land use in the area, and traffic on and near the surrounding freeways all contribute cumulatively to potential air quality impacts on residents along the I-710 corridor.

As discussed in Chapter 2, “Introduction,” there are several limitations to this analysis, including that some of the important data being modeled in the draft I-710 AQ/HRA and needed for the HIA were not available at the time the HIA was completed. This limits the findings discussed here.

7.1.1 Air Pollutants and Health

The quality and cleanliness of air directly impacts human health, and poor air quality or polluted air has numerous negative health impacts. Some sources of air pollution are natural, such as wildfires, but many are human-made, especially in urban areas. Common sources of air pollutants include transportation-related exhaust, industrial activity, and technology improvements (EPA 2011b[161]).

Criteria Health Pollutants

The EPA has identified six criteria air pollutants as being harmful to human and environmental health: ozone, PM, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead (EPA 2010a[155]).

Ozone (O_3)

Ozone is a gas found naturally in the environment. It is present in both the Earth’s upper atmosphere as well as at ground level (EPA 2010b[156]). Ozone has both beneficial and harmful effects on the environment and human health depending on where it is located and in what quantities. Ground level ozone is generally thought of as harmful to the environment and health and is created by a chemical reaction between oxides of nitrogen and volatile organic compounds (VOCs) in the presence of sunlight. Motor vehicles produce chemicals that contribute to ozone development and the result is a general haze, which is commonly referred to as smog.

Short-term health impacts from exposure to ozone include chest pain, coughing, throat irritation, congestion, and worsening lung ailments such as emphysema and asthma. Long-term health impacts include permanent lung damage and other respiratory diseases. In a study examining the health impacts of ozone in 50 cities Bell et al. (2007[35]) found that elevated levels of ozone result in a range of 0.11 – 0.27 % total daily mortality. Additionally, the WHO reports that there is an increased risk of dying of between 0.2 and 0.6% for each increase in 10 micrograms per cubic meter ($\mu g/m^3$) in ozone (smog) (WHO 2003[484]).

A Southern California study on ozone followed children for 5 years. Those children who played three or more sports in a high ozone community showed a 3.3 times higher risk of having asthma than those who did not play sports, but still lived in a high-ozone community (Peters et al. 1999[362]).

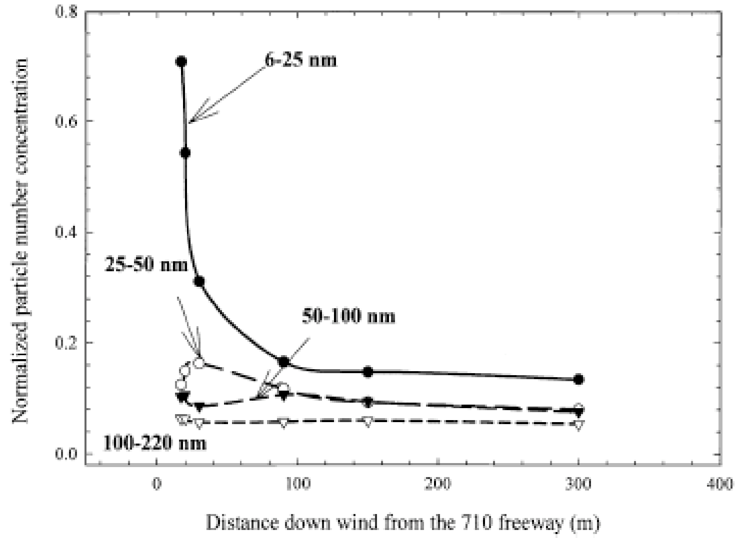
While ozone has known health impacts, stronger epidemiologic evidence exists for other criteria pollutants such as PM and NO_X. Health impacts resulting from changes in ozone will not be considered further in this HIA.

Particulate Matter (PM)

PM is a criteria pollutant known to be harmful to human health (WHO 2003[484]). It comes in a variety of sizes, most notably PM_{10}, $PM_{2.5}$, and ultrafines (≤ 0.1 microns [µm]). In the case of automobile emissions, PM largely is the byproduct of combustible materials in fuel. These particles are then released into the air and can contribute to air pollution and “haze” (visibility). They can also penetrate into residences, impacting indoor air quality (Zhu et al. 2005[502]). PM can contribute to negative health outcomes. $PM_{2.5}$ and ultrafines, being of very small sizes, are easily absorbed into respiratory tracts. Inhalation of $PM_{2.5}$ has direct public health consequences and is associated with the onset of respiratory illness and also exacerbates other existing conditions such as cardiac-related illness (EPA 2011c[162]). The EPA states that PM exposure has been associated with numerous health concerns such as respiratory irritations (coughing and difficulty breathing), decreased lung function, aggravated asthma, development of bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with existing heart and lung disease (EPA 2011c[162]).

Zhu et al. (2002[503]) examined ultrafine particles along the I-710 between August and October of 2001 and found that people closer to the freeway have higher exposures to ultrafine particles, and that fine PM concentrations remain high near the freeway, suggesting that there may be disproportionate exposure and subsequent health outcomes near the freeway.

Figure 7-1. PM Concentration as a Function of Distance from the I-710



Source: Zhu et al. 2002[503].

In California alone, PM was estimated to be responsible for 9,300 deaths, 16,000 hospital visits, and 600,000 asthma attacks each year (Sharp and Walker 2002[413]). According to the CARB, attaining California PM standards is estimated to annually prevent 6,500 premature deaths (3% of all deaths); 4,000 hospital admissions for respiratory disease; 3,000 admissions for cardiovascular disease; 2,000 asthma-related ER visits; 400,000 cases of lower respiratory symptoms (such as cough) in children; 400,000 cases of upper respiratory symptoms (runny nose, itching eyes) in children; 8,000 cases of chronic bronchitis; 500,000 cases of respiratory illness (colds and flu); and 350,000 asthma attacks (CARB 2004[81]).

$PM_{2.5}$

$PM_{2.5}$ is a fine PM (with dimensions of 2.5 microns, where a micron is one-millionth of a meter). $PM_{2.5}$ can be composed of many substances, including automobile emissions, largely due to burning fuels such as gasoline (CARB 2005c[84]). Once $PM_{2.5}$ leaves its original source, because it is so small, it gets carried through the air. The airborne nature of $PM_{2.5}$ makes it easy to inhale into respiratory systems as well as contribute to "haze" in the air, obstructing visibility.

Even short-term exposure to $PM_{2.5}$ has been found to be harmful to human health, increasing hospital admission and ER visits for cardiovascular diseases and respiratory diseases, non-fatal heart attacks, premature death in people with heart and lung disease, and lung function changes, especially in children and people with lung diseases such as asthma (EPA 2001b[144]).

Reducing the National Ambient Air Quality Standards for $PM_{2.5}$ by 1 milligram cubed (mg^3) from 15 to 14 is estimated to result in 1,900 fewer premature deaths, 3,700 fewer non-fatal heart attacks, and 2,000 fewer emergency room visits for asthma each year, nationwide (Dockery et al. 1993[121]).

In the southern coastal areas of California, researchers found an association between income (lower) and non-white racial status with significantly higher rates of $PM_{2.5}$ exposure (specifically $PM_{2.5}$ from chromium and diesel) (Marshall 2008[306]).

PM_{10}

PM_{10} is a fine PM similar to $PM_{2.5}$ in composition but with larger dimensions (10 microns). Because of its larger particle size and weight, PM_{10} is less airborne, and is found to be less directly harmful to human health than $PM_{2.5}$. However, PM_{10} is still a health concern, and several studies have examined the health impacts of PM_{10} in the Los Angeles region. These studies have found there to be:

- Seasonal variations and diurnal trends in particle numbers in the Los Angeles region (Singh et al. 2006[416]);
- Associations between PM_{10} and childhood respiratory health outcomes such as slowed lung growth and asthma exacerbation (Kunzli et al. 2003[268]); and
- Associations between exposure to air pollutants such as PM_{10} and hospital admissions for cardiopulmonary illness in Los Angeles from 1992–1995 and that day-to-day increases in PM_{10} are associated with increases in cardiovascular illness (Linn et al. 2000[284]).

Ultrafines

Ultrafines are a fine PM with the certain dimensions of 0.1 or less microns. Ultrafines are similar to $PM_{2.5}$, in that they are dangerous to human health because they are small in size and airborne, making them easily inhalable. However, ultrafines are even smaller than $PM_{2.5}$, and when inhaled they impact a larger surface area of lung tissue, thus posing increased health hazards.

Combustion is the major source of ultrafines, and on-road vehicles contribute to approximately 43% of observed ultrafines (CARB 2003[80]). DPM, coming from diesel engines, is often found in the size of 0.1 micron or less, making it an ultrafine particulate matter. More than 90% of particles in diesel exhaust are ultrafines (Balmes 2011[25]) and, as discussed in the AQAP, emissions from heavy-duty diesel trucks are a significant source of ultrafines.

The most effective control technology is the combination of a diesel particle filter and oxidation catalyst (Herner et al. 2011[223]). However, use of diesel particle filters alone, which would effectively filter out all solid particles from exhaust, would not affect ultrafines that are formed after emissions are exhausted from tailpipes and may in certain cases increase the total particle number emissions by nucleating (i.e., starting the formation of) some chemical species (Maricq 2007[303], Geller et al. 2005[198], Herner et al. 2011[223]). As the use of such filters increases, continued attention is being paid to the near-roadway levels of ultrafines.

Less is known about the health impacts ultrafines have on humans than on other particulate matter, and the CARB advises against using other PM to infer health impacts from ultrafines. However, studies in mice indicate that ultrafines can lead to atherosclerosis (Araujo et al. 2008[15]) and asthma flares (Li et al. 2010[279]). Several studies conclude that specific health concerns attributable to ultrafine particulate matter include mortality from respiratory disease and cardiovascular disease, and exposure to ultrafines is known to induce cellular damage (a precursor to cancer). Easy inhalation of ultrafines due to their small particle size may pose even greater health concerns for vulnerable populations with existing health concerns (such as obstructive pulmonary disease), compromising lung and circulatory function (CARB 2003[80]).

Similarly, the EPA's recent policy assessment (EPA 2011l[171]) finds that "the currently available evidence is suggestive of a causal relationship between short-term exposures to UFPs and cardiovascular and respiratory effects," but that "evidence is inadequate to infer a causal relationship between short-term exposure to UFPs and mortality as well as long-term exposure to UFPs and all outcomes evaluated."

Several studies have also been completed in the Southern California region to better understand qualities of ultrafines and the impacts that they have on air pollution and human health. Zhu et al. (2002[503]) found that ultrafine particle number concentrations measuring 300 meters (approximately 1,000 feet) downwind from the I-710 were indistinguishable from background concentrations (Zhu et al. 2002[503]).

A subsequent study of the I-10 in west Los Angeles concluded that elevated pre-sunrise hours of ultrafine particle number concentrations extended at least 1,200 meters from the freeway and did not reach background concentrations until a distance of 2,600 meters (approximately 8,500 feet) downwind and 600 meters (approximately 1,969 feet) upwind (Hu et al. 2009[225]). The researchers associated these elevated pre-sunrise concentrations over a wide area with a nocturnal surface temperature inversion, low wind speeds, and high relative humidity that allows for the buildup of pollutants over larger distances. This suggests that elevated concentrations of air pollution from busy freeways in this area may extend farther than originally determined by the CARB and the SCAQMD. This can have potentially huge effects on nearby communities, as the nighttime and pre-sunrise times of the day are when people are most likely in their residences. These studies also indicate that dispersion of ultrafines is very much affected by meteorological data.

In a small study, Zhu et al. (2005[502]) also explored indoor air quality concentrations of locations near the I-405 in Los Angeles to examine the ratio of indoor/outdoor particulate matter (Zhu et al. 2005[502]). Levels of ultrafines were found to be highly contingent on existing ventilation systems and ranged from a high of 0.6/0.9 (indoor/outdoor) to a low of 0.1/0.4, suggesting that living near freeways has indoor air quality implications and that research should be conducted to further understand these implications.

In addition to outdoor and indoor exposure to ultrafine particulate matter and other pollutants, there is some evidence that suggests elevated levels of exposure to harmful air pollutants are found while in vehicles driving along freeways. Zhu et al. (2007[501]) studied the specific microclimate of in-vehicle exposure to ultrafine particles while traveling along highways in Los Angeles (including the I-710) (Zhu et al. 2007[501]). They conclude that a 1-hour vehicle commute is equivalent to 10 hours of ultrafine particulate matter exposure in clean urban background environments away from freeways.

A more complete study of ultrafine particles related specifically to the I-710 is currently underway as part of the Gateway Cities AQAP. This information, when available, will be beneficial to understanding the health impacts of ultrafines in the I-710 corridor communities.

Carbon Monoxide (CO)

CO is a gas developed through combustion. The majority of CO in the U.S. is in urban areas from vehicle emissions. CO is very harmful to human health and is known to inhibit transfer of oxygen to vital organs via the blood. Short-term exposure to CO can cause chest pain, especially for persons with existing heart conditions. At high levels, CO causes death (EPA 2011d[163]).

Nitrogen Oxides (NO_X)

NO_X are highly reactive gases, the most common being NO_2. NO and NO_2 convert between one another depending on environmental conditions including the presence of sunlight. NO_2 is primarily attributable to transportation-related emissions, power plants, and off-road emissions. NO_2 contributes to the formation of ground level ozone and is also harmful to human health. The EPA reports that short-term exposure to NO_2 contributes to adverse respiratory health concerns such as airway inflammation and asthma, and has been found to lead to increased visits to emergency departments and hospital admissions (EPA 2011e[164]).

Concentrations of NO_2 have been found to be 30–100% higher in areas within 50 meters of roadways. In the U.S., 16% of residential housing units are located within 300 feet (approximately 90 meters) of a major highway, railroad, or airport and are likely to be minority and/or low-income, putting these populations at disproportionate risk for NO_2 exposure and subsequent negative health impacts (EPA 2011e[164]).

In a meta-analysis conducted on the impacts of NO_2 on childhood asthma, Chen (2011[104]) found that for a 10 $\mu g/m^3$ increase in NO_2, the pooled effect measure for asthma prevalence was 1.150 using a fixed effects model, and 1.156 using a random effects model. For asthma hospitalization, these figures were 1.027 and 1.041, respectively (Chen 2011[104]).

Findings from studies examining existing levels of NO_2 and associated health outcomes in the Southern California LA regions include the following:

- An association between air pollution and asthma using data from the Southern California Children's Health Study. Findings included a statistically significant association between asthma incidence and measured outdoor residential exposure to NO_2 with a hazard ratio of 1.29 (Jerrett et al. 2008[238]).
- An association between pollutants and cardiopulmonary illness–related hospitalization in the LA metropolitan area. This study concluded that high NO_2 pollution (seen in autumn and winter months) increases the risk of cardiopulmonary illness–related hospitalization in LA (Linn et al. 2000[284]).

Sulfur Oxides (SO_X)

Sulfur oxides (SO_X) are highly reactive gases, the most common being sulfur dioxide (SO_2). The majority of SO_2 is a result of fuel combustion from power plants and other industrial facilities. Transportation, including on-road vehicles, also contributes to SO_2 pollution (EPA 2011f[165]).

SO_2 is strongly linked to respiratory health concerns in humans. Even short-term exposure to SO_2 can result in respiratory irritation and asthmatic symptoms. The EPA also reports that short-term exposure can result in increased emergency department and hospital admissions for respiratory illness, especially among children, older adults, and asthmatics (EPA 2011f[165]).

While SO_X has known health impacts, stronger epidemiologic evidence exists for other criteria pollutants such as PM and NO_X. Health impacts resulting from changes in SO_X will not be considered further in this HIA.

Lead

Lead is no longer used in vehicle fuels; however, it is commonly found in air, soil, and water. Negative health outcomes associated with lead include behavioral problems, learning disabilities, seizures, and death (EPA 2011g[166]). Children are most vulnerable to toxics such as lead because they have small but quickly growing bodies, especially those under 6 years of age (EPA 2011h[167]). Adults can also have health consequences from lead exposure, including reproductive problems, high blood pressure and hypertension, nerve disorders, memory and concentration problems, and muscle or joint pain.

Current fuel standards do not permit leaded fuels, and thus lead will not be considered further in this HIA.

Greenhouse Gases and Health

Global climate change is a serious threat to the health and wellbeing of the planet and all its existing life forms, including humans. Greenhouse gases, by contributing to climate change, may increase heat-related illness (i.e., illnesses such as heat stroke that result when a body's temperature control system is overloaded) and death, health effects related to extreme weather events, health effects related to air pollution, water-borne and food-borne diseases, and vector-borne and rodent-borne disease (Knowlton et al. 2007[262]; Canadian Public Health Association 2007[78]; EPA 1997[138]).

Transportation is a primary source of excess greenhouse gas emissions (CO_2 in particular), which are the major contributors to global climate change. In the U.S., transportation energy use is concentrated on highways, totaling over 80% of total transportation energy use in 2006 (U.S. Department of Energy 2011[458]). Also in 2006, 61% of the total transportation energy use was from light-duty vehicles (cars, light trucks, and motorcycles).

Carbon Dioxide (CO_2)

The EPA has identified excess CO_2 as being harmful to human health (EPA 2009a[151]). CO_2 is a greenhouse gas found naturally in our environment and is essential to the health and wellbeing of the planet. However, in excess, CO_2 is harmful and contributes to global climate change.

The burning of fossil fuels is a major contributor to CO_2, and in 2004 CO_2 emissions from fossil fuel combustion comprised 81% of total greenhouse gas emissions (California Energy Commission 2006[68]). CARB has reported that transportation-related CO_2 emissions account for 38% of net CO_2 in California, and 36% is directly from on-road vehicles. There is great potential to reduce the total greenhouse gas emissions in California by reducing on-road vehicle CO_2 emissions.

Other Air Pollutants

Mobile Source Air Toxics (MSATs)

MSATs are air pollutants emitted from human-made sources such as highway vehicles and non-road equipment but are not regulated as criteria air pollutants with ambient air quality standards under the Clean Air Act. Many MSATS are known or suspected to cause cancer or other serious health and environmental effects (EPA 2011i[168]). Humans are exposed to MSATs through air, food, water, soil, and touch. The Federal Highway Administration finds that 90% of the excess cancer risk in the Los Angeles area is attributable to mobile sources (FHWA 2003[179]). There are hundreds of MSATs but six are commonly analyzed in Health Risk Assessments (HRAs): benzene, 1, 3-Butadine, formaldehyde, acrolein, acetaldehyde, and DPM.

Benzene

The EPA states:

> Benzene is found in the air from emissions from burning coal and oil, gasoline service stations, and motor vehicle exhaust. Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings. Reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing fetus have been observed in animal tests. Increased incidence of leukemia (cancer of the tissues that form white blood cells) have been observed in humans occupationally exposed to benzene. EPA has classified benzene as a Group A, human carcinogen. (EPA 2000a[140].)

1, 3-Butadine

The EPA states:

> Motor vehicle exhaust is a constant source of 1,3-butadiene. Although 1,3-butadiene breaks down quickly in the atmosphere, it is usually found in ambient air at low levels in urban and suburban areas. Acute (short-term) exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Epidemiological studies have reported a possible association between 1,3-butadiene exposure and cardiovascular diseases. Epidemiological studies of workers in rubber plants have shown an association between 1,3-butadiene exposure and increased incidence of leukemia. Animal studies have reported tumors at various sites from 1,3-butadiene exposure. EPA has classified 1,3-butadiene as carcinogenic to humans by inhalation. (EPA 2009b[152].)

Formaldehyde

The EPA states:

> Formaldehyde is used mainly to produce resins used in particleboard products and as an intermediate in the synthesis of other chemicals. Exposure to formaldehyde may occur by breathing contaminated indoor air, tobacco smoke, or ambient urban air. Acute (short-term) and chronic (long-term) inhalation exposure to formaldehyde in humans can result in respiratory symptoms, and eye, nose, and throat irritation. Limited human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer. Animal inhalation studies have reported an increased incidence of nasal squamous cell cancer. EPA considers formaldehyde a probable human carcinogen (Group B1) (EPA 2000b[141]).

Acrolein

The EPA states:

> Acrolein is primarily used as an intermediate in the synthesis of acrylic acid and as a biocide. It may be formed from the breakdown of certain pollutants in outdoor air or from the burning of organic matter including tobacco, or fuels such as gasoline or oil. It is toxic to humans following inhalation, oral or dermal exposures. Acute (short-term) inhalation exposure may result in upper respiratory tract irritation and congestion. No information is available on its reproductive, developmental, or carcinogenic effects in humans, and the existing animal cancer data are considered inadequate to make a determination that acrolein is carcinogenic to humans (EPA 2009c[153]).

Acetaldehyde

The EPA states:

> Acetaldehyde is mainly used as an intermediate in the synthesis of other chemicals. It is ubiquitous in the environment and may be formed in the body from the breakdown of ethanol. Acute (short-term) exposure to acetaldehyde results in effects including irritation of the eyes, skin, and respiratory tract. Symptoms of chronic (long-term) intoxication of acetaldehyde resemble those of alcoholism. Acetaldehyde is considered a probable human carcinogen (Group B2) based on inadequate human cancer studies and animal studies that have shown nasal tumors in rats and laryngeal tumors in hamsters (EPA 2000c[142]).

Diesel Particulate Matter (DPM)

DPM is a complex mixture of organic and inorganic gases, compounds, and particles found to be harmful to human health. DPM is emitted from vehicles using diesel fuel and is commonly seen in older heavy-duty trucks. The smaller the particulate matter, the more harmful to human health, as particles are more easily absorbed into the lungs. DPM is frequently found as fine particulate matter (<2.5 µm, see $PM_{2.5}$ summary above) and as ultrafine particulate matter (<0.1 µm, see ultrafine summary above). Short-term exposure to DPM is likely to cause physical irritations and respiratory inflammations, while long-term exposure is associated with cancer risk, asthma, and mortality (EPA 2002[145]; EPA n.d. [172]).

Volatile Organic Compounds (VOC)/Reactive Organic Gases (ROG)

VOC-emitted gases, also known as reactive organic gases, are found both outdoors and indoors. In outdoor environments, VOCs are a precursor to smog, as chemicals react with nitrogen oxides and ozone and contribute to ambient air pollution. Chemicals found in VOCs contribute to both short- and long-term health impacts such as “eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans.” (EPA 2011j[169])

While VOCs have known health impacts, stronger epidemiologic evidence exists for other pollutants. Health impacts resulting from changes in VOCs will not be considered further in this HIA.

7.1.2 Sources of Air Pollution

The EPA classifies air pollutants as coming from four primary sources: mobile (vehicles on roadways), point (large, stationary, identifiable sources), biogenic (natural sources), and area (smaller sources within an area), with mobile and point human-made pollutants contributing to poor air quality. Mobile sources include cars, trucks, trains, and airplanes. Point sources include factories and power plants. This HIA recognizes that there are many types of mobile sources including off-road mobile sources (such as rail and maritime). Given the scope of this HIA, traffic-related mobile sources impacted by the I-710 expansion are emphasized.

Mobile (Traffic) Source Emissions of Air Pollution

Transportation is one of the primary air polluters in the United States. Transportation-related pollutants include CO, hydrocarbons, NO_X, PM, air toxics, and greenhouse gases—all of which have been found to be harmful to human health. Nationally, cars and trucks account for 77% of the carbon monoxide, 56% of the nitrogen oxide, 25% of directly emitted PM, and 47% of the VOC in the air (EPA 2011k[170]). The well-documented health effects of pollution from traffic and truck-related sources include asthma and other respiratory diseases, cardiovascular disease, lung cancer, pre-term and low birth weight births, and premature death (Bailey et al. 2004[24]).

Auto Traffic

Although auto emissions have improved with changes in vehicle efficiency, fuels, and emissions controls, the cumulative impact of automobile emissions is still significant, representing an important share of air pollutants in the U.S., and an important source of air pollution hot spots. Vehicle exhaust adversely affects lung function and is related to cardiovascular disease, cancer, and mortality, and can exacerbate numerous other health conditions such as asthma, allergies, and chronic obstructive pulmonary disease (WHO Europe 2005[487]; Environment and Human Health 2006[135]).

Truck Traffic

Heavy-duty trucks used to deliver goods via freeways and local arterial roadways are exorbitant polluters, especially older diesel trucks. Port construction, operations, and related activities (including trucks, trains, and ships) have historically contributed to harmful air pollution in surrounding areas. Diesel exhaust from trucks is composed of a mixture of gases and particles such as carbon monoxide, nitrogen compounds, sulfur compounds, and many other toxic and/or carcinogenic compounds such as formaldehyde, acetaldehyde, acrolein, and benzene (Cole et al. 2004[113]; CARB 2008[88]). Approximately 80–95% of particles in DPM are less than 1 micron in size making them easily inhaled deeply into lungs (Cole et al. 2004[113]). Other air pollutants from diesel engines at ports and along freeways that can affect human health include VOCs, NO_X, and SO_X (Bailey et al. 2004[24]).

Health impacts from diesel trucks include acute bronchitis, heart and lung disease, asthma, and other respiratory symptoms. The CARB identified diesel engine exhaust as a carcinogen in 1999 and estimated that diesel pollution from trucks and buses alone was estimated to be responsible for 4,500 premature deaths in California in 2008 (CARB 2006b, Union of Concerned Scientists 2008[461]).

As technology advances, both diesel trucks and fuels have become more efficient. In 2001, the “2007 Highway Rule” was finalized by the EPA. This rule stipulates that beginning with the 2007 model year, harmful pollutants from heavy-duty highway vehicles were to be reduced by more than 90% by using ultra-low sulfur diesel and more efficient engines (EPA 2011a[160]).

Idling trucks have also been highlighted as a source of air pollution because they produce emissions that contribute to negative health outcomes such as cancer, premature death, and other acute and chronic conditions (CARB 2008[88]). Heavy-duty diesel trucks can emit up to 95 grams of CO, 57 grams of NO_X, and 2.6 grams of PM_{10} per hour (EPA 1998[139]), and are often located near low-income residential neighborhoods (Pacific Institute 2006[354]). Reducing idling-related emissions is especially important in high truck-trafficked areas, because greater numbers of idling trucks will have a cumulative effect on air pollutants. Reduced truck idling is mandated by the CARB.

Public Transit

Public transit, in general, is a more efficient way to travel, as more people ride per vehicle producing much fewer emissions per passenger-mile than from individual autos. However, historical use of diesel engines has made buses a major mobile source polluter. Buses (including school buses), similarly to heavy-duty trucks, have historically been diesel consumers, emitting harmful diesel-related emissions and impacting environmental and human health. As technologies advance, vehicle fleets are being replaced with more efficient engines and alternative fuel technologies such as electric and hybrid vehicles as they become more popular and economical. This will lead to a reduction in the emissions from transit buses across the nation. Metro's buses in the county are all powered by compressed natural gas (CNG), as are many local and municipal buses and other city vehicles.

School Buses

School buses, similarly to public transit buses, have historically used diesel engines contributing to air pollution especially inside buses, and near schools when idling disproportionately poses a health risk to children. Children are more susceptible to health implications from school bus exhaust because they breathe 50% more air for their body weight than adults (EPA 2003b[147]). Most school buses in the I-710 Corridor Project study area are now powered by CNG.

Maritime Emissions of Air Pollution

Air pollutants, including diesel engine exhaust, have important maritime sources as well. In a 2006 study, Singh et al. examined the change in air quality during the 2002 union workers strike at the Port of Long Beach (Singh et al. 2006[416]). During this strike, there were fewer trucks both on the freeway and arterials, and approximately 200 cargo ships were idling off the coast, upwind of Long Beach. There were also significant changes in weather during the strike period. The study found statistically significant increases in NO_X and CO during the strike period, but no significant differences in PM_{10}. The research suggests that the increase in NO_X and CO was due to the idling cargo ships.

Point Source Emissions

Point source polluters, also known as stationary polluters, can be extremely detrimental to human health, especially for those residing or working near the point source. Point source polluters are identifiable locations and/or facilities whose emissions contribute to air pollution. Point sources include factories, refineries, warehouses, and other industrial activity. Point source polluters are both major and minor sources of air pollutants. Major sources are those which emit pollutants over a major threshold set by the EPA, and minor sources emit fewer pollutants than the major source threshold (EPA 2010c[157]).

Potential major point source emitters include:

- Industrial goods movement locations including the Port of Long Beach, Intermodal facilities (the ICTF and the Hobart Railyard) where containers are moved between truck and rail, transloading facilities where goods are moved from one container type to another;
- Warehouses and distribution centers; and
- Factories, refineries, or other processing facilities.

7.1.3 Inequities in Proximity to Roadway Air Pollutants

For most air pollutants, exposure is proportional to the proximity to the pollutant sources. Research suggests that low income and minority populations live in greater proximity to busy roadways and freeways, and thus are exposed to higher concentrations of air pollutants from vehicle emissions. Sheppard et al. (1999) found that California's low-income children of color were disproportionately more likely to live in high traffic areas, including near highways and freeways (Gunier et al. 2003[211]). Also, in California, African-Americans, Asians, and Latinos, as well as children of color, are more likely to live close to major highways and suffer more pollution and resultant public health problems, as well as increased cancer risk (Morello-Frosch et al. 2002[334]; Gunier et al. 2003[211]). Moreover, Pastor et al. (2009[359]) found that there are patterns of environmental disparities by race and income for those living along major roadways in Long Beach and Riverside, in Southern California (Pastor and Tran 2009[359]). They conclude that African Americans, Latinos, and Asian Pacific Islanders and persons having lower per capita income are generally more likely to be near major roads.

Many of California's persons of color and low-income populations continue to live near highways and freeways. Whereas vehicle emissions are often thought of as mobile source emissions, the California Environmental Justice Advisory Committee asserts that these highways and freeways act as a stationary source of emissions for residents in these communities, exposing them to disproportionate amounts of air pollutants from vehicle emissions (Environmental Justice Advisory Committee 2008[136]).

Vulnerable Populations and Sensitive Receptors

The CARB states that:

> Sensitive individuals refer to those segments of the population most susceptible to poor air quality (i.e., children, the elderly, and those with pre-existing serious health problems affected by air quality). Land uses where sensitive individuals are most likely to spend time include schools and schoolyards, parks and playgrounds, daycare centers, nursing homes, hospitals, and residential communities (sensitive sites or sensitive land uses). (CARB 2005a[82].)

Persons who are more likely to be susceptible to negative health outcomes associated with air pollutant exposure are older adults, children, and infants, and people with existing heart and respiratory illness. Older adults may be at more risk to the harmful health effects associated with air pollutants because of existing or undiagnosed heart or respiratory weakness or disease (American Lung Association 2011[9]). Children are at higher risk of these negative health outcomes largely because their lungs and other respiratory organs are still developing as well as their potential for increased exposure due to higher physical activity levels than adults (American Lung Association 2011[9]).

In addition, California law (2003) prohibits school construction within 500 feet of busy roadways (CARB 2006a[85]), and both the CARB and SCAQMD recommend that schools and other sensitive receptors not be located near roadways (CARB 2005a[82]; SCAQMD 2005a[403]). SCAQMD adds that there is a health protective factor for both children and school employees when schools are located at least 1,000 feet from roadways.

7.1.4 Air Quality and Health Outcomes

There are many negative health outcomes associated with poor air quality. Health outcomes include asthma and other respiratory diseases, cardiovascular disease, cancer, preterm and low birth weight births, premature death, and mortality.

Air Quality, Asthma and Other Respiratory Diseases

Air quality and respiratory diseases such as asthma have been found to be associated with poor air quality (Chen 2011[104]; Peters et al. 2004[361]; Weinmayr et al. 2010[478]). By age 18, children exposed to higher levels of $PM_{2.5}$, NO_X, and elemental carbon (products of fossil fuel combustion, especially diesel) are five times more likely (7.9% vs. 1.6%) to have underdeveloped lungs (80% of normal) compared to teenagers living in communities with lower pollutant levels (CARB 2006b[86]).

Evidence specific to the Southern California region includes the following:

- A recent study by Perez, et al. (2009[360]) examined goods movement and local burden of childhood asthma in Southern California. They found that approximately 9% of all childhood asthma cases in Long Beach and 6% in Riverside were attributed to traffic proximity, on the accepted assumption that living within proximity to busy roads induces new-onset asthma. Thus, the researchers concluded that heavy traffic corridors in this area are responsible for a large preventable burden of childhood asthma (Perez et al. 2009[360]).
- Using data from the Los Angeles Children's Health Survey, McConnell et al. (1999[310]) found that an increase of 20 parts per billion of average ozone levels was associated with an 83% increase in school absences resulting from acute respiratory illness (McConnell et al. 1999[310]).

As referenced above, there is some data from Southern California indicating that those who are more physically active in areas with poor air quality are more likely to suffer from asthma (Peters et al. 1999[362]).

Air Quality and Cardiovascular Disease

Air pollutants, including ozone and particulate matter, are causal factors for cardiovascular mortality and respiratory disease and illness (CARB 2007[87]). Particulate matter from roadway vehicles exacerbates cardiovascular disease, leading to hospital visits and premature death (EPA 2001a[140]).

Evidence specific to the Southern California region includes the following:

- In a Los Angeles study, researchers found that an increased exposure of 10 µg/m^3 of $PM_{2.5}$ resulted in a carotid intima-media thickness (thickness of artery walls) increase of 5.9% (Kunzli et al. 2005[267]).
- A Los Angeles study found that in times and areas with stagnant air (fall and winter) there are more likely to be higher concentrations of CO, PM_{10}, and/or NO_2, and there was an increase in hospitalizations for cardiopulmonary illness (Linn et al. 2000[284]).

Air Quality and Cancer

Several studies, including two meta-analyses, have concluded that occupational exposure to diesel engine exhaust increases the risk of lung cancer (Bhatia et al. 1998[42]; Lipsett and Campleman 1999[285]). In 1999, the State of California concluded that diesel engine exhaust is a carcinogen, and a 2000 California risk assessment attributed 70% of the cancer risk from air pollution to diesel engine exhaust (CARB 2000[79]). On-road diesel trucks represent the largest emission source of diesel engine exhaust PM in the state (CARB 2006b[86]).

Air Quality and Birth Outcomes

A number of recent studies have examined the relationship between exposure to air pollution and preterm birth and low birth weight. Both preterm births and low birth weight are a significant health concern to infants as they are highly correlated to physical and mental disabilities and infant mortality (CDC 2010[96]; Paneth 1995[356]; CDC 2002b[95]).

Preterm Births

Recent studies show that air pollutant exposure and proximity to air pollutants increases risk for preterm births. Evidence specific to the Southern California region includes the following:

- A 2003 study conducted in Los Angeles County, in which researchers found that those living closest to distance-weighted traffic density (living close to heavy traffic roads and thus having higher exposure levels to motor vehicle emissions) have an 8% increase in risk of pre-term birth (Wilhelm and Ritz 2003[489]). This same study finds that the risk of term preterm birth increased by 11% for each 1 part per million (ppm) increase in annual average background CO concentration. Additionally, stronger associations were found for women whose third trimester was during fall and winter months, lived in areas with high levels of background air pollution, and lived in lower socioeconomic areas.

- In a study conducted in California's South Coast Air Basin, Wilhelm and Ritz (2005[490]) found that pregnant women in their first trimester living near air monitoring stations measuring CO had a 4–8% increase in risk for preterm birth for every 1 ppm increase in CO and that pregnant women living within a mile of air monitoring stations were at 27% increased risk of having a preterm birth as a result of increased exposure to high CO (defined as equal to or greater than 75th percentile of study sample). Low socioeconomic areas with high traffic-related exposure were also found to have higher odds (up to 30%) of preterm delivery as compared to those who lived in less trafficked areas (Wilhelm and Ritz 2005[490]).
- Ritz et al. (2007[391]) subsequently conducted a case-control survey study in Southern California to analyze air pollution effects on pregnancy outcomes. They found that pregnant women who were exposed to $PM_{2.5}$ and CO in their first trimester had associated increased risk of preterm births (10–29% and 20–25%, respectively). Additionally, pregnant women exposed to CO levels of 0.91 ppm and above during their last six weeks of pregnancy had increased odds of preterm birth (3–33%) (Ritz et al. 2007[391]).

Low Birth Weight

Air pollutant exposure during pregnancy has been found to be associated with low birth weight. Since the 1990s several studies have inquired about the relationship between air pollution (including $PM_{2.5}$, PM_{10}, coarse PM*, CO, NO_2 and ozone) and low birth weight (Glinianaia et al. 2004[202]; Morello-Frosh et al. 2010[333]; Peters et al. 2004[361]).

When examining research in southern California, evidence shows that several air pollutants are associated with risk for low birth weight. Evidence specific to the Southern California region includes the following:

- In a study conducted in the Southern California South Coast Air Basin, Wilhelm and Ritz (2005[490]) found that pregnant women living within a mile from air monitoring stations were at 12% increased risk of having a low birth weight baby per 1 ppm increase in CO during the third trimester (Wilhelm and Ritz 2005[490]). Similarly for PM_{10}, there was a 48% increased risk of having a low birth weight baby as a result of increased exposure to PM_{10} (averaging greater than 44.0 $\mu g/m^3$ for those within a 1-mile radius of the air monitoring station) during the third trimester.

Birth Defects

Birth defects have also been found to be associated with air pollutants. Evidence specific to the Southern California region includes the following:

- Ritz et al. (2002[393]) found a dose-response effect for second-month exposure to CO and ozone and resulting cardiac ventricular septal defects (CO) and aortic artery and valve defects, pulmonary artery and valve anomalies, and conotruncal defects (ozone).

* Where coarse particle exposure was defined as the difference in ambient exposures for respirable and fine particles (PM_{10} - $PM_{2.5}$)

Air Quality, Premature Death and Mortality

Poor air quality is associated with premature death (defined as dying before one's average life expectancy). The WHO estimates that air pollution causes approximately 2 million premature deaths worldwide each year (WHO 2011[486]). The WHO also estimates that there is an increased risk of dying of between 0.2 and 0.6% for each increase in 10 µg/m^3 in ozone (WHO 2003[484]). Specifically in relation to the presence of particulate matter, average life expectancy is decreased by 1.5 years when you compare cities at the highest and lowest PM levels (Brunekreef et al. 1997[55]).

In addition to premature death, poor air quality is associated with mortality. Mortality rates from respiratory illness in the most air-polluted cities compared to the least air-polluted cities are 1.26 times higher (Dockery et al. 1993[121]). The EPA states that there is a 1–8% increased risk of mortality for every 50 µg/m^3 of PM$_{10}$ and a 1–3.5% increase in mortality for every 25 µg/m^3 of PM$_{2.5}$ (EPA 2008b[150]).

Evidence specific to the Southern California region includes:

- Jerrett et al. (2005[239]) found that there was a 1.17 relative risk of all-cause mortality associated with an increase of 10 µg/m^3 in PM$_{2.5}$.(Jerrett et al. 2005[239]), and
- Ostro et al. (2006[353]) found PM$_{2.5}$ levels to be associated with mortality. Specifically, a 10 µg/m^3 change in 2-day average PM$_{2.5}$ concentration corresponded to a 0.6% increase in all-cause mortality (Ostro et al. 2006[353]).

Air Quality and Neurological Health Outcomes

Many air pollutants have neurotoxic or immunotoxic properties (EPA 2010d[158]), suggesting they may impact risk of autism or other neurological health outcomes. A 2006 study showed that there may be a moderate increased risk of autism associated with exposure to ambient air pollution (including air pollution from DPM) (Windham et al. 2006[494]). In a more recent study, Volk et al. (2011[469]) found that living near a freeway was associated with autism (odds ratio of 2.22 during third trimester of pregnancy exposure). Evidence related to these health outcomes is currently not as strong as evidence relating to the other health outcomes described above.

7.1.5 Health Effects of Roadway Proximity

Epidemiologic studies have consistently demonstrated that children and adults living in proximity to freeways or busy roadways have poorer health outcomes (Brunekreef et al. 1997[55]; Delfino 2002[120]; Health Effects Institute Panel on the Health Effects of Traffic-Related Air Pollution 2009[219]; Lin et al. 2002[282]).

Evidence specific to the Southern California region includes the following:

- In a low income population of children in San Diego, children with asthma living within 168 meters (approximately 550 feet) of high traffic flows were more likely than those residing near lower traffic flows to have more medical care visits for asthma (English et al. 1999[132]).

- In a study of Southern California school children, living within 75 meters (approximately 245 feet) of a major road was associated with an increased risk of lifetime asthma, prevalent asthma, and wheeze (McConnell et al. 2006[311]).
- In a study conducted in 12 Southern California communities, children who lived with 500 meters (approximately 1640 feet) of a freeway had reduced growth in lung capacity relative to those living farther than 1,500 meters (approximately 4,920 feet) from the freeway (Gauderman et al. 2004[196]).
- Specifically in Southern California (with specific focus on the I-710), Jerrett et al. (2005[239]) found that the relative risk of lung cancer and heart disease was 1.25–1.60 times higher for those near heavy trafficked roadways with high emissions as compared to the greater Los Angeles region (Jerrett et al. 2005[239]).
- Also, in a study conducted in 12 Southern California communities, children who lived within 500 meters (approximately 1640 feet) of a freeway had reduced growth in lung capacity relate to those living farther than 1,500 feet (approximately 4,920 feet) from the freeway (Gauderman et al. 2004[196]).

7.1.6 Established Air Quality Standards and Health Objectives

State of California and Federal standards

California and Federal air quality standards for ambient air quality of air pollutants are shown in Figures 7-2 and 7-3.

Figure 7-2. State of California and Federal Ambient Air Quality Standards, as of September 2010

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[1]		Federal Standards[2]		
		Concentration[3]	Method[4]	Primary[3,5]	Secondary[3,6]	Method[7]
Ozone (O_3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 $\mu g/m^3$)		0.075 ppm (147 $\mu g/m^3$)		
Respirable Particulate Matter (PM10)	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		—		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		35 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	15.0 $\mu g/m^3$		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 μg/m3)	Gas Phase Chemiluminescence	53 ppb (100 $\mu g/m^3$) (see footnote 8)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.18 ppm (339 $\mu g/m^3$)		100 ppb (188 $\mu g/m^3$) (see footnote 8)	None	
Sulfur Dioxide (SO_2)	24 Hour	0.04 ppm (105 $\mu g/m^3$)	Ultraviolet Fluorescence	—	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)[9]
	3 Hour	—		—	0.5 ppm (1300 $\mu g/m^3$) (see footnote 9)	
	1 Hour	0.25 ppm (655 $\mu g/m^3$)		75 ppb (196 $\mu g/m^3$) (see footnote 9)	—	
Lead[10]	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 $\mu g/m^3$	Same as Primary Standard	High Volume Sampler and Atomic Absorption
	Rolling 3-Month Average[11]	—		0.15 $\mu g/m^3$		
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 $\mu g/m^3$	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence			
Vinyl Chloride[10]	24 Hour	0.01 ppm (26 $\mu g/m^3$)	Gas Chromatography			

See footnotes on next page ...

For more information please call ARB-PIO at (916) 322-2990 California Air Resources Board (09/08/10)

Source: CARB 2011a[90].

Figure 7-3. State of California and Federal Ambient Air Quality Standards Continued

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.

8. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010). Note that the EPA standards are in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national standards to the California standards the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

9. On June 2, 2010, the U.S. EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. The EPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010. The secondary SO_2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by EPA. Note that the new standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the new primary national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

10. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

11. National lead standard, rolling 3-month average: final rule signed October 15, 2008.

more information please call ARB-PIO at (916) 322-2990 California Air Resources Board (0S

Source: CARB 2011a[90].

Other Regulations and Control Efforts

Heavy-Duty Trucks

In 2005, California began regulating idling for diesel-fueled vehicles, including heavy-duty trucks (CARB 2005b[83]) in order to "reduce public exposure to diesel particulate matter and other air contaminants by limiting the idling of diesel-fueled commercial motor vehicles." Regulations include limiting commercial idling to no more than 5 minutes, especially within 100 feet of residential areas. This regulation has several limitations and exceptions but is a first step to reduce idling-related emissions. In 2005, several amendments were made, including an automatic shutdown after 900 seconds of continuous idling and exhaust control mechanisms (CARB 2005b[83]).[*]

The Ports of Los Angeles and Long Beach approved the San Pedro Bay Ports Clean Air Action Plan in 2006, stipulating a plan to reduce pollution by a minimum of 45% within 5 years, including a clean truck program strategy (Port of Los Angeles 2006[369]). The strategy is progressive in that it requires that by January 1, 2012, all trucks not meeting the 2007 Federal Clean Truck Emissions Standards will be banned from the Los Angeles Port. The Port of Los Angeles reports that within the first year of implementation, the program was successful in reducing port truck emissions by 70%, and that, by 2012, estimated reduction emissions will be more than 80% (Port of Los Angeles 2011[370]).

Public Transit

The Metro Clean Fuel Program is an example of a commitment to reducing air pollution through the replacement of older less clean and fuel-efficient buses. Metro's Clean Fuel Program has all of its 2,600 buses powered by CNG. According to Metro, the new CNG buses are 97% cleaner than the diesel buses they replaced, and they reduce cancer-causing particulate matter by 98%, carbon monoxide by 80%, and greenhouse gases by over 20%. Long Beach Transit also has gas/electric hybrid busses in their bus fleet (Metro 2007[317]).

School Buses

There are several efforts being made in California to reduce pollution from school buses, including the School Bus Idling Airborne Toxic Control Measure and a funded program to retrofit currently in-use buses to meet emissions guidelines (CARB 2009[89]; CARB 2011b[91]). In Southern California, the SCAQMD adopted a Clean On-Road School Buses Rule in 2006 that mandates that all new school buses are alternative fuel-based and that existing school buses are retrofitted to be in accordance with the CARB-approved control devices and standards (EPA 2010e[159]).

7.2 Existing Conditions Related to Air Quality

Los Angeles has the worst air pollution in the nation, primarily as a result of motor vehicle use. Transportation accounts for up to 75% of total emissions of VOCs, 98% of total emissions CO, 83% of

[*] An "Emissions Standards Reference Guide for Heavy-Duty and Nonroad Engines" is available here: http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf

total emissions of NO_X, 68% of total emissions of SO_X, and 25% of PM, and contributes significantly to air toxics and diesel (Small and Kazimi 2005[417]; EPA 2011k[170]; EPA 2007[148]).

The majority of existing conditions documentation below comes from either the draft I-710 technical studies (e.g., I-710 HRA) being conducted as part of the EIR/EIS.

In addition to the EIR and the HRA, several studies have been conducted along and nearby the I-710. Many of these studies look specifically at air quality and the impacts on human health in the surrounding communities. When relevant, findings from these studies are included below.

There are three air-monitoring stations within the I-710 Corridor Project study area, providing some insight into existing levels of ambient air pollutants in the area. See Table 3-1 in the HRA for detailed results on air pollutants from these air monitoring stations.

7.2.1 Community Perspective and Concern Regarding Air Quality

In an extensive community outreach effort to ascertain community priorities, the Tier 2 Community Advisory Committee was developed, consisting of persons appointed by the I-710 corridor communities and the I-710 Oversight Policy Committee. This committee had three overarching guiding principles that helped shape their priority-setting work:

- "This [the I-710] is a corridor—considerations go beyond the freeway and infrastructure."
- "Health is the overriding consideration."
- "Every action should be viewed as an opportunity for repair and improvement of the current situation."

These principles illustrate the communities' concern for the health of the people who live along the I-710 corridor. The Tier 2 Committee saw the I-710 Corridor Project as an opportunity to improve current conditions that do not promote health and prepared a report to help inform the I-710 decision-making process (Tier 2 Community Advisory Committee 2004[437]). This report states that "Today, particulates and other pollutants from diesel truck traffic in the I-710 Corridor and the ports of Long Beach and Los Angeles are our communities' primary air-quality-related health concern." Specific conditions identified in the report include "Implement[ing] a corridor level action plan to improve community air quality," and "major infrastructure improvements must be condition on achieving air quality goals to protect public health; corridor air quality must comply with county, state, and federal standards prior to the start of mainline construction and the entire project taken as a whole must result in a net reduction in criteria pollutants" (Tier 2 Community Advisory Committee 2004[437]).

7.2.2 Traffic-Related Air Pollutants

The majority of data presented in this section comes from the draft I-710 HRA (see the HRA for full methodology). Criteria air pollutants attributable to traffic-related emissions and having an impact on human health are presented and 2008 baseline emissions are summarized in Table 7-1. Generally the emissions data in this section is based on the traffic models used in the HRA as well as post-processed data (further processing of the traffic models using actual traffic counts and other refinements).

Concentration and exposure of air pollutants are more meaningful for a health analysis and are estimated where data is available.

Table 7-1. Summary of 2008 Total Emissions along I-710 Corridor Based on Post-Processed Traffic Data

Pollutant	2008 Emissions (pounds/day)
NO_X	24,175
CO	26,557
PM_{10} (exhaust)	1,101
$PM_{2.5}$ (exhaust)	900
ROG	2,483
SO_2	42

Note: Numbers are rounded to nearest whole number.

Source: Environ 2010a[133].

Note: Particulate matter data represented in the AQ/HRA and this analysis only include those from exhaust emissions. This data excludes entrained particulate matter (such as road dust, break, and tire wear). Final numbers are expected to be presented in the final AQ/HRA report.

$PM_{2.5}$

From 2006–2008, levels of $PM_{2.5}$ exceed state standards (12 µg/m^3) at all three air monitoring stations within the I-710 project area (with annual average levels ranging from 14–16 µg/m^3), and both the LA-North Main Street and Lynwood air monitoring stations also exceeded federal standards (of 15 µg/ m^3). See Table 3-1 in the HRA.

Based on post-processed traffic data and emissions, existing 2008 levels of $PM_{2.5}$ from vehicle exhaust (exhaust only) attributable to the I-710, is 900 pounds/day for the entire I-710 mainline as reported in the HRA (see Table 7-1). $PM_{2.5}$ levels reported in the HRA are limited because they only represent PM from vehicle exhaust along the I-710 mainline and do not include other sources of PM such as on-road dust and tire wear. Available data also is limited for existing levels of $PM_{2.5}$ in nearby corridor community areas, posing a great limitation to the usefulness of the data.

In addition to the existing conditions reported in the HRA, Ntziachristos et al. (2007[348]) used a portable air monitoring system along the I-710 to analyze PM concentrations and found that PM (ultrafine, 2.5, and 10) along the I-710 was about 150% higher than a typical urban location (1 mile downwind of the freeway) in Southern California. See Figure 7-4 (Ntziachristos et al. 2007[348]).

Figure 7-4. PM Data near the I-710

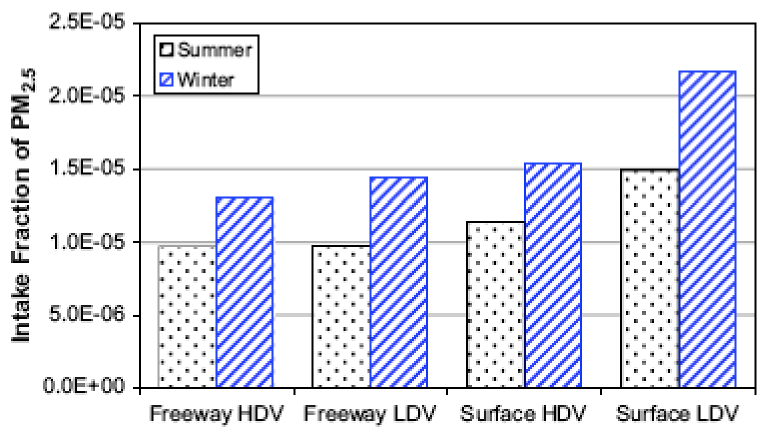
Size fractionated mass concentration in different particle size fractions and distances from the freeway

Fraction	Size range (nm)	Freeway (±SD) ($\mu g\,m^{-3}$)	Urban (±SD) ($\mu g\,m^{-3}$)
Coarse	2500–10000	10.1 (2.69)	6.3 (0.88)
Accumulation	180–2500	8.3 (0.40)	5.8 (0.95)
Ultrafine	18–180	2.6 (0.45)	1.7 (0.67)
UF4	100–180	1.6 (0.73)	–
UF3	56–100	0.72 (0.30)	–
UF2	32–56	0.21 (0.088)	–
UF1	18–32	0.07 (0.026)	–

Source: Ntziachristos et al. 2007[348].

Wu et al. (2009[495]) examined exposure to $PM_{2.5}$ from both diesel and gasoline vehicles in corridor communities near the Ports of Los Angeles and Long Beach (Wu et al. 2009[495]). This study's primary aim was to examine heavy-duty truck and vehicle pollutants on surface streets in relationship to nearby residents and then estimate the intake fraction (population exposure) of $PM_{2.5}$ from using the CALINE4 dispersion modeling method while comparing summer and winter months. The geographic study region was defined as a 4-kilometer (2.5-mile) buffer around the I-710, 1-110, and I-405. Results from this study showed that the average intake fraction (the fraction of a pollutant emitted from a source that is inhaled by a defined population) of $PM_{2.5}$ was 14 ppm (similar to other studies) and that intake fractions were 1.4 times higher on local roadways and during winter months (based on a geographic parcel analysis) (see Figure 7-5). Wu et al. found the average $PM_{2.5}$ exposure due to local traffic was 3.8 μg/m^3 in the study region, which was approximately 22–24% of the total $PM_{2.5}$ concentration in the area.

Figure 7-5. Intake Fraction of $PM_{2.5}$ by Types of Vehicles and Roadway by Season



Note: HDV = heavy-duty vehicle; LDV = light-duty vehicle

Source: Wu et al. 2009[495]

Minguillon et al. (2008[328]) also examined concentrations of PM in the Los Angeles–Long Beach harbor area including seasonal variations. This study found average concentrations to be nearly 15 μg/m^3 in winter months and 14 μg/m^3 in summer months, with both winter and summer concentrations exceeding the CAAQS for $PM_{2.5}$ at 12 μg m^3. Results from these studies suggest that average levels of ambient $PM_{2.5}$ are higher, even if only slightly, in the winter months.

PM_{10}

From 2006–2008, levels of PM_{10} exceeded state standards (annual mean of 20 μg/m^3) at both the LA-North Main Street (annual average of 31-33 μg/m^3) and North Long Beach air monitoring stations (annual average of 29-31 μg/m^3) within the I-710 project area. Lynwood air monitoring station information was not available. See Table 3-1 in the HRA.

Existing levels of PM_{10} from vehicle exhaust attributable to the I-710, as reported in the draft I-710 HRA, are 1,101 pounds/day for the entire I-710 mainline based on post-processed traffic data and emissions factors. PM_{10} levels reported in the draft I-710 HRA are limited because they only represent PM from vehicle exhaust and do not include other sources of PM such as on-road dust and tire wear. See Table 7-1.

Ultrafines

Ultrafines have not been analyzed as part of the draft I-710 HRA, nor are they available through data available from the air monitoring stations. $PM_{2.5}$ was used a surrogate measure in a brief qualitative analysis of ultrafine exposure in the HRA. Existing levels of $PM_{2.5}$ from vehicle exhaust attributable to the I-710, as reported in the HRA, are 900 pounds/day for the entire I-710 mainline based on post-processed traffic data and emissions factors (see Table 7-1). $PM_{2.5}$ levels reported in the HRA are limited because they only represent PM from vehicle exhaust and do not include other sources of PM such as on-road dust and tire wear.

Based on data collected by Zhu et al. (2002[503]) from August 30 to October 27, 2001, and January 14–25, 2002, at 17 meters downwind of the I-710 in South Gate, the measured average concentration of ultrafine particles ranged from 180,000 to 250,000 particles per cubic centimeter. At 90 meters the average concentration ranged from 42,000 to 110,000 particles per cubic centimeter.

Zhu et al. (2004[504]) also examined ultrafine particle distribution along major Los Angeles highways in relation to seasonal trends and found that wintertime months had higher concentrations of particles. Subsequently, Minguillion et al. (2008[328]) examined seasonal variation of particulates at the Long Beach Harbor and came to similar conclusions, with higher concentrations of pollutants in the winter months. This study also concluded that heavy- and light-duty vehicles together with road dust account for 24–54% of total fine PM and for 24–100% of total “quasi-ultrafine” PM (Minguilon et al. 2008[328]). Using a mobile platform to measure air pollutants in the urban Los Angeles area, Westerdahl (2005[483]) found that average levels of ultrafines along the I-710 were over seven times higher than average levels measured along residential areas in Long Beach (190 and 26, respectively, expressed as 1,000s of particles per centimeter cubed [cm^3]). A mobile platform such as this could be used to measure PM and other pollutants for a full analysis of ultrafine particulates along the I-710 mainline and corridor communities (Westerdahl et al. 2005[483]).

SCAQMD is planning on starting a study of ultrafines in the LA region in 2012.

CO

From 2006–2008, CO is not reported as being in excess of state (1 hour = 9 ppm and 8 hour =20 ppm) or federal standards (1 hour = 9 ppm and 8 hour =35 ppm) at any of the air monitoring stations within the I-710 project area. CO maximums ranged from 3–8 ppm for 1 hour and 2.1–6.4 ppm for 8 hour. See Table 3-1 in the HRA.

Existing levels of CO from vehicle exhaust attributable to the I-710, as reported in the draft I-710 HRA, is 26,557 pounds/day for the entire I-710 mainline based on post-processed traffic data and emissions factors. See Table 7-1.

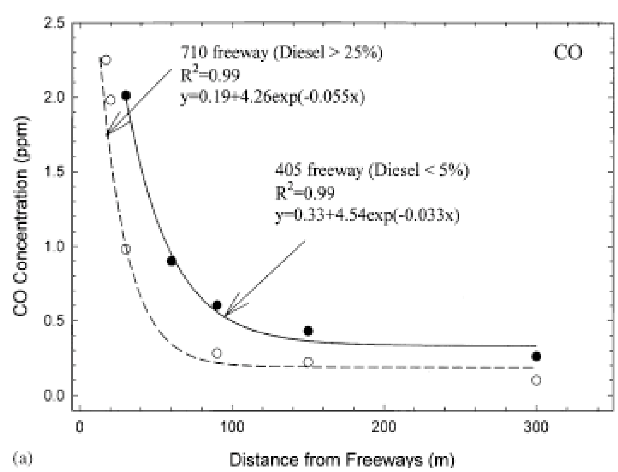
CO estimates (in µg/m^3) were also calculated as a special analysis in the HRA. The AEROMOD air dispersion modeling system was used, and the I-710 traffic model used in the EIR/EIS was used as input. This model does not take into account ambient air quality or other sources of pollutants, such as nearby freeways. See Table 7-2.

Table 7-2. Baseline 2008 CO Ranges Modeled from the I-710 Mainline

Pollutant	Averaging Time	Range of CO Levels at Multiple Points Along the I-710	SCAQMD CEQA Threshold (CAAQS)	NAAQS
CO (µg/m^3)	1-hour	177.79–5,151.59	23,000	40,000
	8-hour	24.55–1,635.79	10,000	10,000
Source: ENVIRON 2010a[133].				

In a 2002 Zhu et al. study, CO was also monitored and analyzed and found to be in higher concentrations in proximity to the I-710 and decreased dramatically with downwind distance. See Figures 7-6 and 7-7 (Zhu et al. 2002[503]).

Figure 7-6. CO Concentration near the I-710 and I-405



Source: Zhu et al. 2002[503].

Figure 7-7. Average Concentrations of CO and Black Carbon near the I-710

Measured averaged concentrations at increasing distances from the freeway[a]

Measurement	Upwind (m)	Downwind distance (m)					
	200	17	20	30	90	150	300
CO (ppm)	0.1 (0.0–0.2)	2.3 (1.9–2.6)	2.0 (1.5–2.4)	1.7 (1.1–1.9)	0.5 (0.2–0.7)	0.4 (0.1–0.5)	0.2 (0.1–0.3)
Black carbon ($\mu g/m^3$)	4.6 (3.1–5.9)	21.7 (20.3–24.8)	19.4 (16.5–21.6)	17.1 (12.6–19.3)	7.8 (4.5–9.3)	6.5 (3.9–9.2)	5.5 (3.5–7.7)
Number concentration ($\times 10^{-5}/cm^3$)	0.48 (0.36–0.57)	2.0 (1.8–2.5)	1.8 (1.5–2.5)	1.6 (1.2–1.9)	0.72 (0.42–1.1)	0.61 (0.35–0.98)	0.49 (0.30–0.59)

[a] Range given in parenthesis.

NO_X (NO_2)

For 2006–2008, annual average ambient levels of NO_2 are reported as being in excess of state standards (1 hour = 0.18 ppm and annual mean 0.03 ppm) at the Lynwood station in 2006 (0.0306 ppm) and 2008 (0.031 ppm). None of the ambient levels of NO_2 are reported as being in violation of national standards (1 hour = 0.1 ppm and annual mean 0.053 ppm). Ambient levels of NO_2 at the other stations come close, but do not exceed most recent state standards. See Table 3-1 in the HRA.

Existing levels of NO_X from vehicle exhaust attributable to the I-710, as reported in the draft I-710 HRA, are 24,175 pounds/day for the entire I-710 mainline based on post-processed traffic data and emissions factors. See Table 7-1.

NO_2 estimates were also calculated as a special analysis in the HRA. The AEROMOD air dispersion modeling system was used and the I-710 traffic model used in the EIR/EIS was used as input. This model does not take into account ambient air quality or other sources of pollutants, such as nearby freeways. See Table 7-3. Many modeled values of 1-hour and annual levels of NO_2 are well above state and national standards. The 2008 modeled 1-hour and annual NO_2 levels are in excess of state and probably national standards.

Table 7-3. Baseline 2008 Average NO_2 Ranges Modeled from the I-710 Mainline to Identified Receptors

Pollutant	Averaging Time	Range of NO_2 Levels at Multiple Points Along the I-710	CAAQS	NAAQS (2010)
NO_2 (all NO_X as NO_2) ($\mu g/m^3$)	1-hour	107.77–3,024.42	339	188
	Annual	0.82–360.52	57	100

Source: Environ 2010a[133].

Note: NO_X and NO_2 are used interchangeably in this section, as per the HRA report assuming that all NO_X is converted to NO_2, so NO_2 is equivalent to NO_X; a conservative assumption.

Mobile Source Air Toxics (MSATs)

Existing levels of MSATs attributable to the I-710 were reported in the draft I-710 HRA and are reflected in Table 7-4. Results represented here were used in the modeling for cancer and chronic non-cancer impacts. Modeled ambient concentrations of the various MSATs are more meaningful when assessing health impacts than absolute emissions. However, modeled ambient concentrations were not available during the HIA review, and thus baseline excess cancer risk (estimated from MSATs) cannot be assessed at this time.

Table 7-4. Baseline 2008 MSAT Emissions Using I-710 Traffic Model Data

MSAT Name	2008 Emissions (pounds/day)
Diesel Particulate Matter	N.D.
Benzene	21.3
Acetaldehyde	4.2
Formaldehyde	16.1
1,3-butadiene	5
Acrolein	1.2

N.D. = no data/data not available.
Source: Data provided by ENVIRON, August 2011

7.2.3 Non-Highway–Related Air Pollutants

Non-highway–related air pollutants contribute to area level concentrations of air pollutants. Locations near major arterials and truck destinations (such as warehouses) are likely to have increased levels of truck emissions as the volume of trucks on or at these facilities increases. Site visits revealed that the list of warehouses identified in a study by the Southern California Association of Governments (SCAG) includes only a portion of the facilities in the area to which large numbers of trucks travel. These other goods movement, manufacturing, or industrial facilities, while each receives a smaller number of trucks, combine to be destinations for a large amount of freight. In addition, site visits also found that not all the warehouses on the list from SCAG are currently in operation.

Households and Sensitive Receptors Located Near Transloading Facilities

Land use patterns in the study area lead to air pollution in many residential neighborhoods. Major arterials with high traffic, and specifically truck, volumes and with high numbers of truck destinations divide the region. Residential neighborhoods are located between these arterials. A thorough and complete list of all current and active transloading facilities, distribution centers, and warehouses is not available. If this list was available, these sites could be mapped in relation to exiting residential sites and other sensitive receptors to identify potential hotspots for increased air pollution from goods movement–related facilities. It is recommended that a current and complete list of all such facilities be developed to assess both the existing conditions as well as impacts such facilities have on air quality and human health.

7.2.4 Greenhouse Gas (GHG) Emissions

CO_2e from I-710 Traffic Emissions

The HRA calculated GHG emissions as CO_2e, as CO_2e is commonly used as a universal unit of measurement to indicate the global warming potential (GWP) of each of the six GHGs, expressed in terms of the GWP of one unit of CO_2. CO_2e was calculated for the region, given the global (i.e., non-local) effect of GHG emissions and the limitations from existing traffic modeling methodologies. See the draft I-710 HRA for full methodology.

Existing levels of CO_2e in the South Coast Air Basin (SCAB) attributable to the I-710, as reported in the HRA are 196,770 tons per day and 71,821,050 tons per year.

CO_2e from I-710 Related Sources (non-traffic)

The draft I-710 HRA does not assess GHG or CO_2e from non-traffic–related sources of air pollution, other than the construction phase (which is not analyzed in this HIA).

7.2.5 Public Transportation and Air Quality

Metro's Clean Fuel Program has 2,221 buses powered by CNG (Metro 2011b[321]). See Chapter 6, "Mobility," for more details regarding existing conditions on public transit routes and ridership in the I-710 corridor communities.

7.2.6 Existing Health Outcomes Affected by Air Pollutants

Existing health conditions were obtained as a percentage of the population where possible for the census tracts within the I-710 Corridor Project study area and compared to the county. Where census tract level health data was not available county and state rates were obtained. See Table 7-5.

No data was available on autism or other neurological diseases in the study area.

Many factors (including air quality) contribute to the health issues described here and these health issues may not be diagnosed consistently due to differences in access to medical care. Because of these issues, in many cases the amount air quality contributes to these health outcomes in the study area cannot be known with certainty. However, in specific cases below, the contribution of air quality to health outcomes is estimated.

Table 7-5. Existing Health Conditions

Condition	Los Angeles County	All Census Tracts within the 1-Mile I-710 Corridor Project study area (N=508,283)[I]	1 Mile Upwind (West) (N=266,776)[I]	1 Mile Downwind (East) (N=241,507)[I]	150 Meters Upwind (West) (N=16,551)[I]	150 Meters Downwind (East) (N=29,451)[I]
Asthma prevalence for Los Angeles County Adult (18+ years)[2] (% of population)	6.5%	6.0%+	5.9%	6.2%	5.9%	N.D.
Asthma prevalence for Los Angeles County children (0–17 years)[2] (% of population)	7.9%	2.7%	4.3%+	N.D.	N.D.	N.D.
Heart Disease (ever diagnosed) Adult (18+ years)[2] (% of population)	7.7%	6.2%	8.2%	3.9%	9.1%	N.D.
Low Birth Weight (crude rate per 1,000 births)[3]	56.09	55.26	51.87	54.28	52.53	57.13
	U.S.	**California**			**Los Angeles County**	
Preterm births (as a percent of all births, 2008)	12.3% [IV]	10.5%[4]			11.4%[5]	
Cancer[6] (2005–2009) rate per 100,000 population	N.D.	Crude rate: 407.28 Age-adjusted rate: 431.33			Crude rate: 370.88 Age-adjusted rate: 411.73	
Mortality[7] (all causes) (2010) rate per 100,000 population	N.D.	Crude rate: 620.6 Age-adjusted rate: 666.4			Crude rate: 567.9 Age-adjusted rate: 624.4	

N.D. = no data/no data available

Sources:

[1] U.S. Census Bureau 2010[454]. Note: Population weighted by census tract total population by percent of population within given geographic boundaries.

[2] Los Angeles County Department of Public Health 2005[292].

[3] Agency for Healthcare Research and Quality 2010[5].

[4] The Henry J. Kaiser Foundation 2011[222].

[5] Los Angeles County Department of Public Health 2011[295].

[6] California Cancer Registry 2011[63].

[7] California Department of Public Health 2010[66]. (based on a 2006–2008 average and 2007 population data)

[+]The estimate is statistically unstable (relative standard error > 23%) and therefore may not be appropriate to use for planning or policy purposes.

Asthma

According to data from the 2005 Los Angeles County Health Survey, 6.0% of persons living in census tracts along the I-710 corridor have ever been diagnosed with asthma (18 years of age +), lower than the county at 6.5%. See Table 7-5.

Data from the 2007 Los Angeles County Health Survey also highlights that 2.7% of children (0–17 years old) living in census tracts along the I-710 corridor have ever been diagnosed with asthma (18 years of age +), lower than the county at 7.9% (Los Angeles County Department of Public Health 2007a[293]). (Note that the I-710 corridor specific number has a wide confidence interval and that the county figure is likely more accurate. See Table 7-5. Children in the I-710 corridor with asthma missed on average 2.1 days of school, compared to 3.1 in the county.)

McConnell et al.'s (2006[311]) study on proximity to freeways and childhood asthma in the Los Angeles region provides the opportunity to calculate the attributable risk of asthma prevalence in the study area for children ages 5–9. The attributable fraction (AFq) was calculated using the following equation:

$$\text{Attributable Fraction} = (Rq - 1)/Rq,$$

Where

$$Rq = \text{the total relative risk for the population exposed.}$$

McConnell's study looks specifically at children ages 5–7, but this age category was not available for this HIA, and thus children ages 5–9 were used. McConnell's study differentiates relative risk of asthma for different distances from the freeway (<75 meters [<246 feet], 75–150 meters [approximately 250–500 feet], 150–300 meters [approximately 500–1,000 feet], and > 300 meters [>1,000 feet]). To calculate the attributable risk, the number of children ages 5–9 was calculated for the 1-mile study area (N=43,847) and broken down per McConnell's distances from the I-710 to obtain the number of population exposed. The population exposed was then multiplied by the relative risk for each geographic boundary, resulting in a total relative risk for the population exposed (Rq). The AFq was then calculated and resulted in 3.93%. This means that 3.93% (or 136 cases using the reported county prevalence) of the asthma prevalence cases in the 1-mile study area are attributable to I-710 pollutants.

Note: The 2005 Los Angeles County Health Survey definition of asthma prevalence consists of those ever diagnosed with asthma by a healthcare provider and reported still having asthma and/or having had an asthma attack in the past 12 months. These numbers do not account for possible unreported or untreated cases of asthma.

Mortality

Jerrett et al.'s (2005[239]) spatial analysis of air pollution and mortality in Los Angeles study provide the dose response relationship between pre-mortality and $PM_{2.5}$ exposure. This study estimated the relative risk for all-cause mortality to be 1.17 (95% CI: 1.05–1.3) for every 10 µg/m^3 change in $PM_{2.5.}$ The result was similar when adjusted for living within 500 meters (1,640 feet) of a freeway.

Wu et al.'s (2009[495]) modeled freeway and traffic $PM_{2.5}$ near the southern portion of the I-710. Block group level data on modeled PM was obtained from the author.

Mortality rates within I-710 corridor community census tracts were not available for this HIA. The 2010 age-adjusted all-cause mortality rates in the county (624.4 per 100,000) were lower than rates for California (666.4 per 100,000). The crude rate of all-cause mortality in the county is 568 per 100,000 persons. All-cause mortality rates for the study area were not available for this HIA, so county rates are being used as a proxy. See Table 7-5.

Excess mortality rate for each block group was estimated using the following equation:

$$\text{Excess Mortality Rate} = (RR - 1) * I_O$$

Where:

$RR = e^{(-\beta * \delta\, PM2.5)}$ = relative risk of the incidence of mortality in a population exposed to a particular change in $PM_{2.5}$

β = coefficient of $PM_{2.5}$ parameter in log-linear regression model

$\delta\, PM_{2.5}$ = change in traffic attributable exposure to $PM_{2.5}$

I_O = crude mortality rate

Relative risk of mortality was calculated for each block group based on traffic-attributable $PM_{2.5}$. Using census population data, the population over age of 30 years was estimated for each block group. Traffic attributable excess mortality for each block group level was calculated and then summed across block groups.

The resulting excess mortality rate was calculated to be 11 (95% CI: 3 – 19) excess annual deaths attributable to traffic $PM_{2.5}$ exposure for the 16,379 persons over age 30 years old living within 500 meters [1,640 feet] of this southern part of the I-710. The excess mortality rate is expected to be similar near other sections of the I-710, assuming the same amount of freeway and arterial traffic. Excess mortality from traffic $PM_{2.5}$ would be expected to be 48 (95% CI: 14 – 84) excess annual deaths for the 73,720 people over 30 years old living within 500 meters of the entire I-710.

Reviews of the health effects of $PM_{2.5}$ by the EPA have established that short-term and long-term exposure has definite causal effects on cardiovascular outcomes such as ischemic heart disease and premature mortality (EPA 2009d[154]). Toxicological evidence from animal and human studies supports this epidemiologic evidence, demonstrating the physiological effects of $PM_{2.5}$ on the cardiovascular system.

There is some uncertainty in the estimate of the exposure response function. The model from Jerrett et al. (2005[239]) is specific to the regional context and includes for 44 individual-level covariates, suggesting little residual opportunity for individual-level confounding. The HIA authors chose not to use an estimate from another model from the same study that additionally controlled for socio-demographic variables at a contextual level for several reasons. Primarily, the contextual variables may be on the causal pathway linking pollution exposure to premature mortality, making them potentially inappropriate covariates. Second, the HIA authors judged that Jerrett et al. modeled the average risk associated with $PM_{2.5}$ exposure for the LA metropolitan area. It is possible, although unlikely, that significant unmeasured factors mediating exposure effects (e.g., baseline mortality and disease rates) are unique to the small segment of the population living within 500 meters of the I-710.

The Wu air dispersion modeling study data used includes uncertainties typically associated with modeling studies: modeling algorithms, representativeness of meteorological data from a single location (Long Beach Airport) to the entire study area, vehicle emission factors, etc. Several other sources of uncertainties in the exposure response function and $PM_{2.5}$ data are discussed the studies by Jerrett and Wu.

Cancer

Cancer rates within I-710 corridor community census tracts were not available for this HIA. However, average age-adjusted cancer rates (2005–2010) in the county (411.73 per 100,000) were lower than rates for California (431.33 per 100,000). See Table 7-5.

According to Matsuoka et al. (2011[308]), an analysis of cancer by census tracts in Los Angeles County by Mack (2004[301]) found elevated rates of throat, mouth, and tongue cancers, as well as certain types of lung cancer, in close proximity to the I-710.

Provided MSAT concentration levels were available, it would be possible to estimate the excess cancer risk due to the I-710. However, without this information this estimate cannot be made.

Cardiovascular Disease (CVD)

According to data from the 2005 Los Angeles County Health Survey, 6.2% of persons living in census tracts along the I-710 corridor have ever been diagnosed with heart disease (18 years of age +), lower than the county at 7.7%. See Table 7-5.

Low Birth Weight

Crude rates of low birth weight are found to be similar in census tracts within the I-710 corridor (55.26 per 1,000 births) to the county (56.09 per 1,000 births). See Table 7-5.

Pre-Term Births

Incidence of pre-term births is higher in the county (11.4% of all births) than for California (10.5%), but lower than in the U.S. as a whole (12.3%). Baseline pre-term birth data was not available at the census tract level for this HIA, limiting the ability to examine conditions along the I-710 corridor community areas. See Table 7-5.

7.3 I-710 Corridor Project Impacts on Air Pollution and Associated Health Outcomes

7.3.1 Impacts of Project Alternatives on Air Pollutants

The draft I-710 HRA analyzes impacts of certain air pollutants for each alternative being considered in the EIR/EIS. See the full I-710 HRA and appendices for an explanation of methodologies, limitations, and complete analysis. The data described below is from a draft version of the I-710 HRA, which used preliminary traffic modeling results. Traffic models have been updated, and revised air quality data is being modeled. The numbers and findings reported here should be updated when the new data is available.

Air pollution from vehicle emissions is directly related to both volume and speed of traffic. Estimating vehicle-related emissions requires a knowledge of vehicle volume (or vehicle miles traveled in a given area), fleet characteristics, and the speed at which the vehicles are traveling (EPA 1996[137]). The relationship between vehicle emissions and speed is that of a “U” shaped curve. Vehicles traveling at slower speeds with more fluctuations (such as stop and go traffic) have higher emissions (including CO, VO, NO_X, and greenhouse gases) than vehicles traveling at speeds of 40–55 mph (Kennesaw State University n.d. [254]; Transportation Research Board National Research Council 1998[443]; EPA 1996[137]; Barth and Boriboonsomsin 2009[29])”, and emissions begin to increase at speeds of approximately 55 mph and above (Claggett and Sun 2007[109]). Baseline (2008) and alternative (2035) traffic volumes and speed have been analyzed and are presented in Tables 7-6 and 7-7 below.

Table 7-6. Traffic Volume on I-710, Percent Change from 2008

Build Alternative Year 2035	Auto Volume	Truck Volume in General Purpose Lanes (Total Truck Volume: General Purpose + Freight Corridor)
AM Travel		
1	0.1%	101.2%
5A	5.0%	134.1%
6A/B	13.5%	46.4% (252.1%)
6C	N.D.	N.D.
Mid Day Travel		
1	12.0%	42.4%
5A	24.0%	54.1%
6A/B	32.9%	13.6% (107.9%)
6C	N.D.	N.D.
PM Travel		
1	3.3%	32.6%
5A	33.0%	51.7%
6A/B	40.2%	2.9% (124.5%)
6C	N.D.	N.D.
Source: ENVIRON 2010b[134]. Volume analyzed at 4 screenlines on the I-710 and then averaged.		

Table 7-7. Estimated Average Vehicle Speeds (2035)

	2008 Baseline (mph)	Alternative 1 No Build 2035 (mph and % Change over Baseline)	Alternative 5A 2035 (mph and % Change over Baseline)	Alternative 6A/6B 2035 (mph and % Change over Baseline)	Alternative 6C/D 2035
AM (6 a.m.–9 a.m.)	41	37 (-9.7%)	42 (2.36%)	48 (16.6%)	Unavailable but likely higher than 6A/6B
MD (9 a.m.–3 p.m.)	50	48 (-5.4%)	52 (1.22%)	56 (12.1%)	Unavailable but likely higher than 6A/6B
PM (3 p.m.–7 p.m.)	31	28 (-8.1%)	33 (6.10%)	37 (20.8%)	Unavailable but likely higher than 6A/6B
Source: Analysis of ENVIRON 2010b[134].					

$PM_{2.5}$ (from Exhaust only)

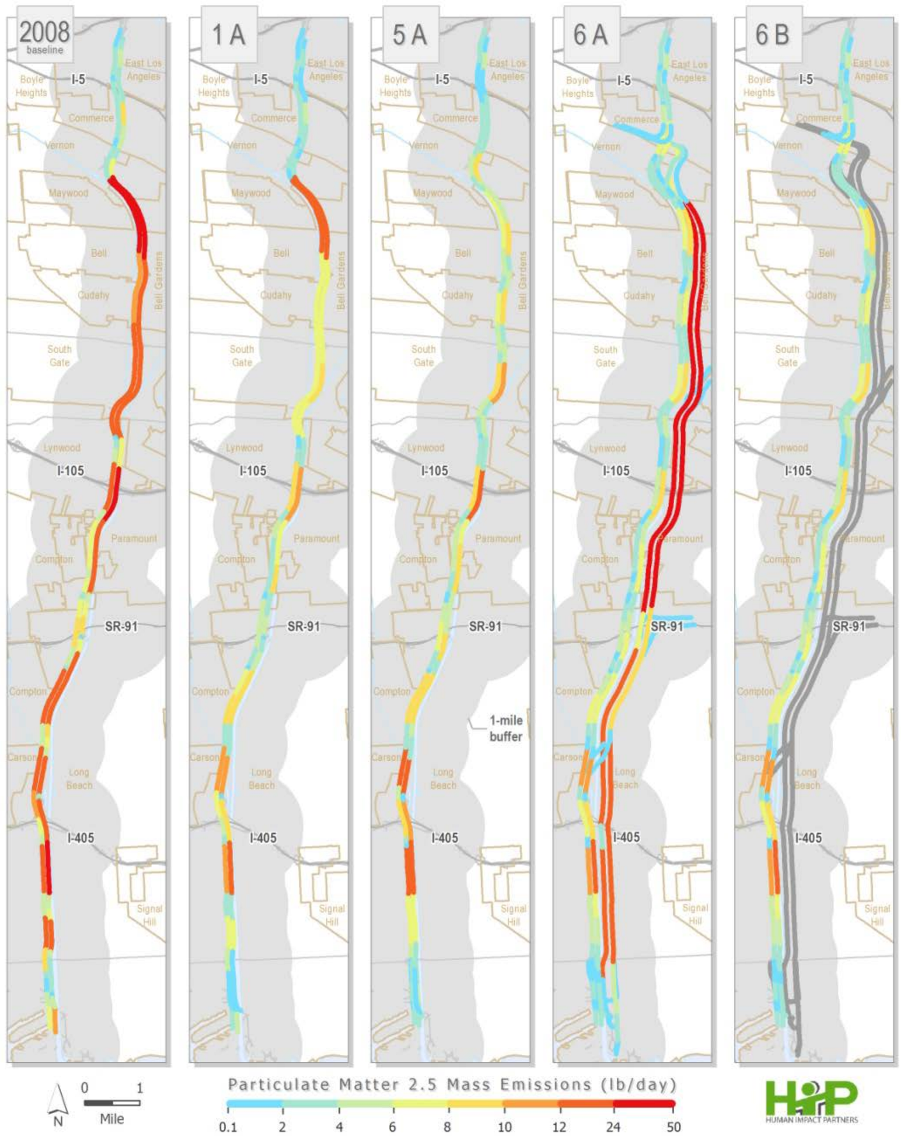
Using post-processed traffic data as compared to the 2008 baseline along the I-710, the draft I-710 HRA identifies Alternative 6B as having the greatest decrease in $PM_{2.5}$ emissions (exhaust only). Alternative 1 has the second greatest decrease in $PM_{2.5}$, followed by Alternative 5A and then Alternative 6A. See Table 7-8. The decrease in $PM_{2.5}$ emissions seen in Alternative 6B is largely due to zero emissions trucks on the highway, and Alternative 1 is likely seeing decreases because of smaller increases in traffic volumes and cleaner fuels and more efficient technologies. This, however, does not take into account non-exhaust sources of $PM_{2.5}$; therefore, this result should be interpreted cautiously when informing health impacts.

Table 7-8. $PM_{2.5}$ Post-Processed Traffic Emissions Attributable from I-710

Pollutant	2008 Baseline	Alternative 1 2035	Alternative 5A 2035	Alternative 6A 2035	Alternative 6B 2035	Alternative 6C 2035
$PM_{2.5}$ (exhaust) (pounds/day)	900	436	510	652	395	N.D.
N.D. = no data/data not available Source: Environ 2010a[133]. Note: PM data represented in the draft I-710 AQ/HRA and this analysis only include those from exhaust emissions. Final numbers are expected to be presented in the final AQ/HRA report.						

The substantial decrease in exhaust $PM_{2.5}$ shown in Table 7-8 may bring $PM_{2.5}$ ambient concentrations into compliance with state standards, though this conclusion is not certain and should be analyzed after final $PM_{2.5}$ modeling in the I-710 HRA is complete.

Figure 7-8. Geographic Representation of Daily $PM_{2.5}$ Emissions



Looking beyond the I-710 mainline to the larger I-170 HRA area of interest (AOI) and the SCAB (using traffic modeled data), Alternative 6B has the greatest decrease (from 2008 baseline levels) of $PM_{2.5}$ followed by Alternative 1, then Alternative 5A and then Alternative 6A. In the AOI and SCAB, the difference between Alternatives 1, 5A, and 6A are minimal. See Table 7-9.

Additional analysis on average concentrations of $PM_{2.5}$ will be calculated for the I-710 HRA in accordance with SCAQMD-adopted California Environmental Quality Act (CEQA) significance thresholds for concentration impacts for $PM_{2.5}$ (24-hour average). This analysis will be completed in the final I-710 AQ/HRA analysis.

Table 7-9. Incremental Daily $PM_{2.5}$ Emissions

		Difference between 2035 Alternative and 2008 Baseline				
Pollutant (pounds/day)	2008 Baseline	Alternative 1	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C
Incremental Mass Emissions within the SCAB						
$PM_{2.5}$	N.D.	(11,070)	(11,052)	(11,048)	(11,273)	N.D.
Incremental Mass Emissions within the Area of Interest (AOI)						
$PM_{2.5}$	N.D.	(3,936)	(3,925)	(3,677)	(4,102)	N.D.
Incremental Mass Emissions for the I-710 Only						
$PM_{2.5}$	N.D.	(542)	(468)	(348)	(574)	N.D.
N.D. = no data/data not available. Source: Environ 2010a[133].						

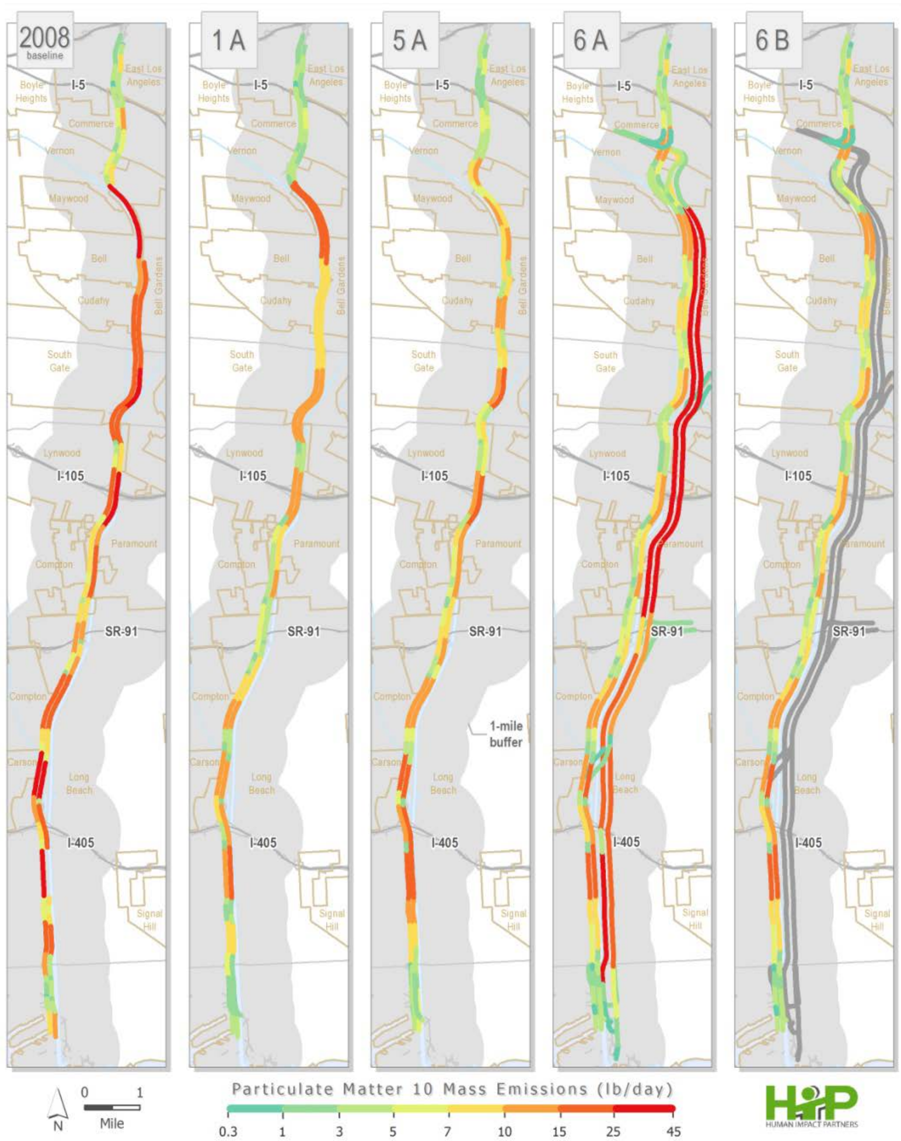
PM_{10} (from Exhaust only)

The draft I-710 HRA identifies Alternative 1 as having the greatest decrease in PM_{10} emissions (exhaust only). Alternative 6B has the second greatest decrease, followed by Alternative 5A and then Alternative 6A. See Table 7-10. It is likely that the decrease in PM_{10} emissions seen in Alternative 1 is largely due to smaller increases in traffic volumes on the freeway combined with cleaner fuels and more efficient technologies. Alternative 6B is likely seeing decreases because, while traffic volume is expected to increase significantly, the trucks will have zero emissions, significantly reducing PM_{10} levels. This, however, does not take into account non-exhaust sources of PM_{10}; therefore, this result should be interpreted cautiously when informing health impacts.

Table 7-10. PM_{10} Post-Processed Traffic Emissions for the I-710 Only

Pollutant	2008 Baseline	Alternative 1 2035	Alternative 5A 2035	Alternative 6A 2035	Alternative 6B 2035	Alternative 6C 2035
PM_{10} (exhaust) (pounds/day)	1,101	553	737	920	583	N.D.
N.D. = no data/data not available. Source: Environ 2010a[133]. Note: PM data represented in the draft I-710 AQ/HRA and this analysis only include those from exhaust emissions. This data excludes entrained particulate matter (such as road dust, break, and tire wear).						

Figure 7-9. Geographic Representation of Daily PM_{10} Emissions



Looking beyond the I-710 mainline to the larger I-710 HRA AOI and the SCAB (using traffic modeled data), Alternative 6B has the greatest decrease (from 2008 baseline levels) of PM_{10} followed by Alternative 1, then Alternative 5A and then Alternative 6A, although, in the AOI and SCAB, the difference between Alternatives 1, 5A, and 6A are minimal. See Table 7-11.

Table 7-11. Incremental PM_{10} Emissions (pounds/day)

		Difference between 2035 Alternative and 2008 Baseline				
Pollutant	2008 Baseline	Alternative 1	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C
Incremental Mass Emissions within the SCAB						
PM_{10}	N.D.	(10,070)	(10,038)	(10,024)	(10,319)	N.D.
Incremental Mass Emissions within the Area of Interest (AOI)						
PM_{10}	N.D.	(4,147)	(4,126)	(4,056)	(4,351)	N.D.
Incremental Mass Emissions attributable to I-710						
PM_{10}	N.D.	(577)	(468)	(312)	(607)	N.D.
N.D. = no data/data not available. Source: Environ 2010a[133].						

Additional analysis on average concentrations of PM_{10} will be calculated for the I-710 HRA in accordance with SCAQMD-adopted CEQA significance thresholds for concentration impacts for PM_{10} (24-hour and annual average). This analysis will be completed in the I-710 AQ/HRA.

Ultrafines

Ultrafines have not yet been qualitatively analyzed in relation to the I-710 alternative build scenarios. A research project of ultrafine particles is currently being conducted for the Gateway City AQAP.

The HRA does provide a brief qualitative analysis using $PM_{2.5}$ as a proxy for ultrafines. Although this information is limited, some tentative conclusions can be drawn regarding the impact of ultrafine particles in relation to the proposed alternatives. Ultrafine particles are expected to decrease in 2035 under all the alternatives being considered as compared to the 2008 baseline. In addition, Alternative 6B $PM_{2.5}$ levels are lower than for Alternative 1, suggesting that ultrafine particles would also be lower.

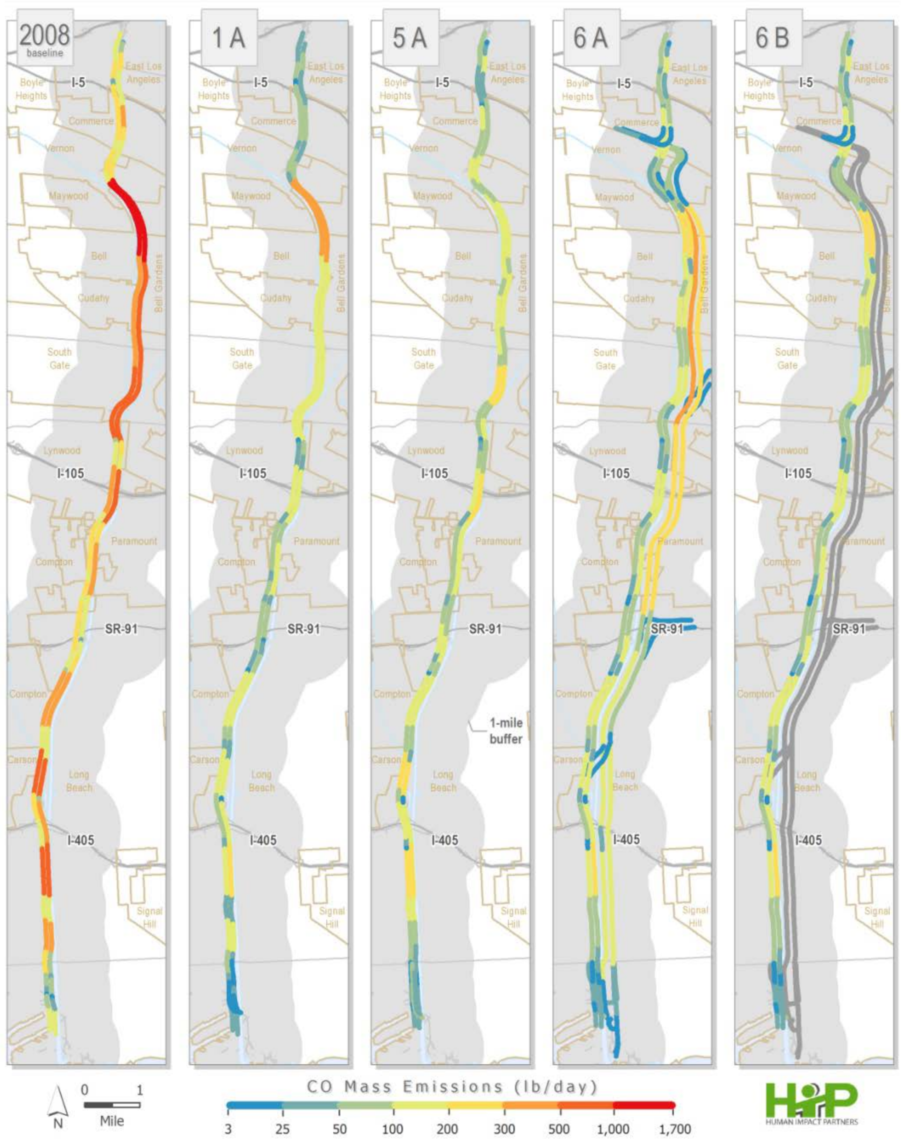
Carbon Monoxide (CO)

CO is analyzed in the draft I-710 HRA and compared to the 2008 baseline along the I-710. The draft I-710 HRA identifies Alternative 1 as having the largest decrease in CO emissions, followed by Alternatives 6B, 5A, and then 6A. See Table 7-12. CO is a result of combustion, and thus it is likely that the greatest decrease would be in Alternative 1 because smaller increases in traffic volumes on the freeway combined with cleaner fuels and technologies will reduce emissions. Alternative 6B is expected to have a decrease because it is likely that even while vehicle volumes are expected to be higher, CO from combustion will decrease as a result of cleaner fuels and technologies.

Table 7-12. CO Post-Processed Emissions for the I-710

Pollutant	2008 Baseline	Alternative 1 2035	Alternative 5A 2035	Alternative 6A 2035	Alternative 6B 2035	Alternative 6C 2035
CO (pounds/day)	26,557	7,763	9,169	10,651	8,066	N.D.
N.D. = no data/data not available. Source: Environ 2010a[133].						

Figure 7-10. Geographic Representation of Daily CO Emissions



Looking beyond the I-710 mainline to the larger HRA AOI, Alternative 6B has the largest decrease (from 2008 baseline levels) of CO followed by Alternative 6A, then 5A and lastly Alternative 1. Incremental mass emissions within the SCAB were found to have the greatest decrease in Alternative 5A, followed by Alternatives 6B, 6A, and 1 (in order of magnitude). See Table 7-13.

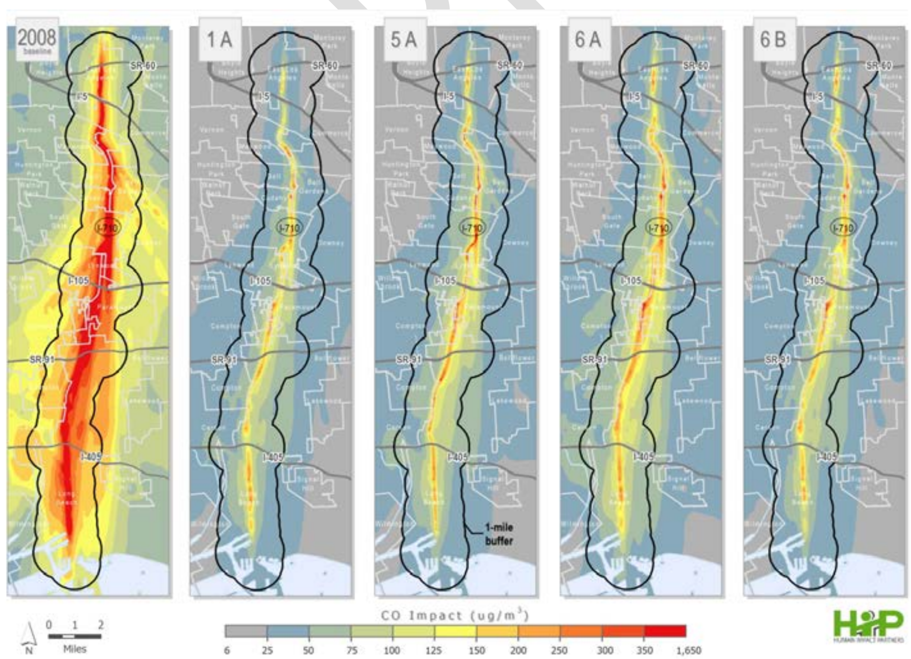
Table 7-13. Incremental CO Emissions Using I-710 Traffic Model Data as Compared to 2008 Baseline

Pollutant (pounds/day)	2008 Baseline	Difference between 2035 Alternative and 2008 Baseline				
		Alternative 1	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C
Incremental Mass Emissions within the SCAB						
CO	N.D.	(1,880,652)	(1,886,404)	(1,882,922)	(1,885,089)	N.D.
Incremental Mass Emissions within the Area of Interest (AOI)						
CO	N.D.	(472,281)	(472,867)	(474,003)	(476,170)	N.D.
Incremental Mass Emissions for the I-710 Only						
CO	N.D.	(25,719)	(24,338)	(23,103)	(25,270)	N.D.

N.D. = no data/data not available.
Source: Environ 2010a[133].

In addition to the general CO analysis, average concentrations of CO were calculated due to the SCAQMD establishing CEQA significance thresholds for concentration impacts for CO (1- and 8-hour). CO impacts (1- and 8-hour) from the I-710 mainline are shown to decrease for Alternatives 1, 6B, 5A, and 6A (in order of magnitude), compared to the 2008 baseline. Alternative 1 shows the greatest decrease in CO impacts. When combined with background concentrations of CO, none of the alternatives listed exceed either SCAQMD CEQA threshold levels or NAAQS.

Figure 7-11. Geographic Representation of CO (8-hour) Concentrations



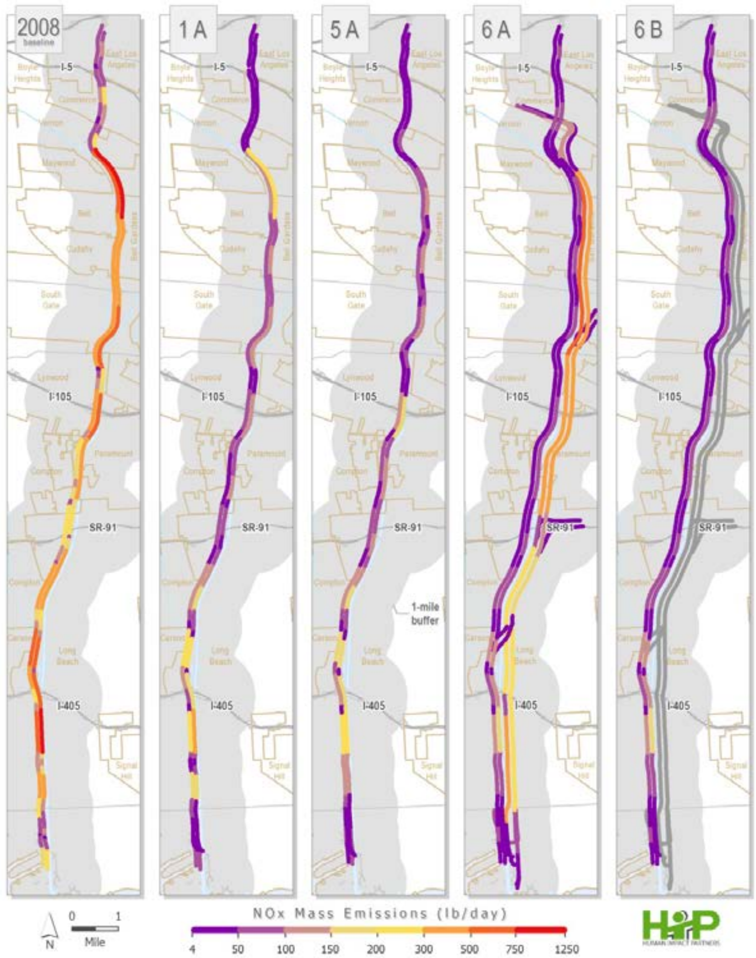
NO_X and NO_2

NO_X is analyzed in the draft I-710 HRA and compared to the 2008 baseline along the I-710. The draft I-710 HRA identifies Alternative 6B as having the largest decrease in NO_X emissions, followed by Alternative 1, Alternative 5A, and then Alternative 6A. See Table 7-14. It is likely that the decrease in NO_X emissions seen in Alternative 6B is due to zero emission trucks on the highway, resulting in lower levels of I-710 emissions gases contributing to the formation of NO_X.

Table7-14. NO_X Post-Processed Emissions for the I-710 Only

Pollutant	2008 Baseline	Alternative 1 2035	Alternative 5A 2035	Alternative 6A 2035	Alternative 6B 2035	Alternative 6C 2035
NO_X (pounds/ day)	24,175	6,614	6,685	8,572	3,990	N.D.
N.D. = no data/data not available. Source: Environ 2010a[133].						

Figure 7-12. Geographic Representation of Daily NO_X Emissions



Looking beyond the I-710 mainline to the larger I-710 HRA AOI, Alternative 6B has the largest decrease (from 2008 baseline levels) of NO_X followed by Alternative 5A, then Alternative 1, and lastly Alternative 6A. Incremental mass emissions within the SCAB were found to have the greatest decrease in Alternative 5A, followed by Alternatives 6A, 5A, and 1 (in the order listed). See Table 7-15.

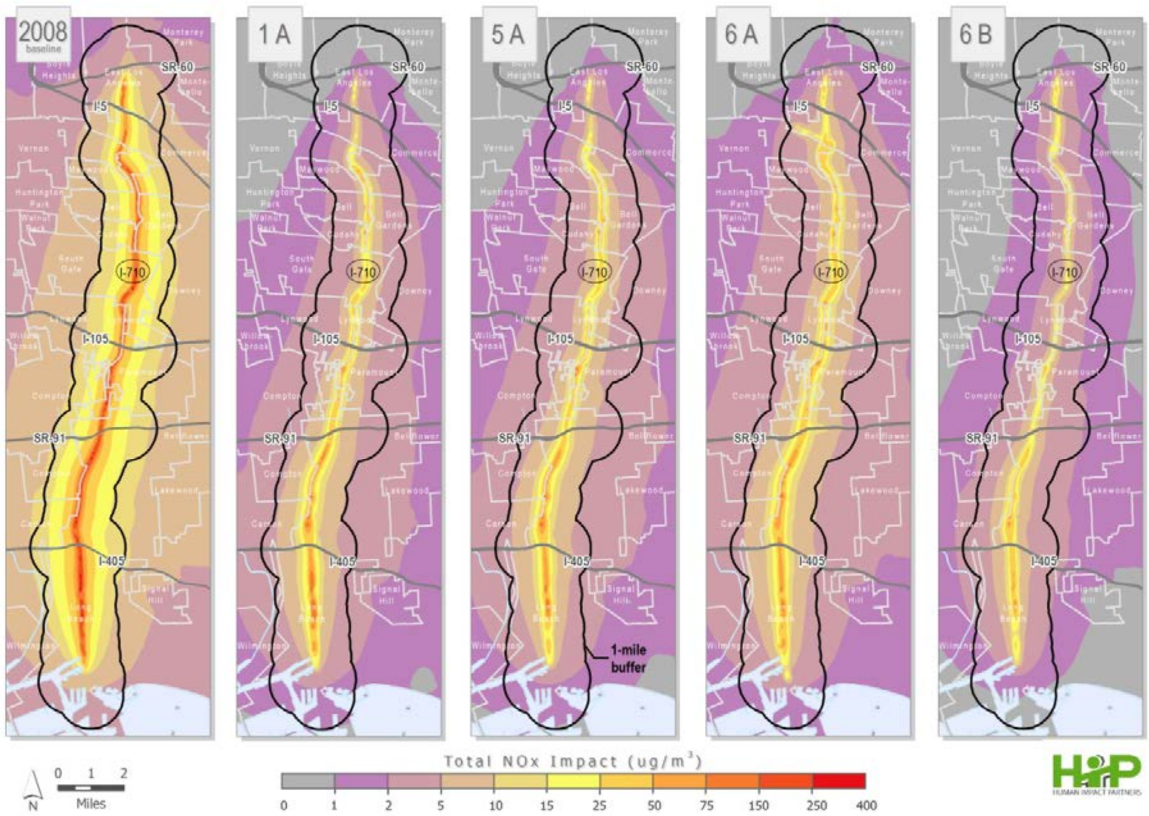
Table 7-15. Incremental NO_X Emissions Compared to 2008 Baseline

		Difference between 2035 Alternative and 2008 Baseline				
Pollutant (pounds/day)	2008 Baseline	Alternative 1	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C
Incremental Mass Emissions within the SCAB						
NO_X	N.D.	(1,393,420)	(1,393,660)	(1,393,840)	(1,397,692)	N.D.
Incremental Mass Emissions within the Area of Interest (AOI)						
NO_X	N.D.	(325, 271)	(325,342)	(325,311)	(329,062)	N.D.
Incremental Mass Emissions attributable from I-710						
NO_X	N.D.	(39,336)	(39,035)	(37,521)	(41,372)	N.D.
N.D. = no data/data not available. Source: Environ 2010a[133].						

In addition to the general NO_X analysis, average concentrations of NO_2 (where all NO_X is reported as NO_2) were calculated due to SCAQMD establishing CEQA significance thresholds for concentration (see Figures 7-2 and 7-3 above) impacts for NO_2 (1-hour and annual averages). Average levels of NO_2 concentration impacts (1-hour and annual average) from the I-710 mainline are shown to decrease for Alternatives 6B, 1, and 5A (in order of magnitude), compared to the 2008 baseline. Estimated averages are calculated from the receptor identification used in the HRA. See Figure 7-13 for estimated concentration impacts.

When combined with background concentrations of NO_2, Alternative 6A exceeds the SCAQMD CEQA threshold and NAAQS (see Tables 4-5 through 4-8 in the HRA).

Figure 7-13. Geographic Representation of Annual NO_X Concentrations



MSATs

The draft I-710 HRA analyzed the levels of the six priority MSATs for each alternative being considered in the EIR/EIS and compared them to the 2008 baseline. See the I-710 HRA for full methodology and assumptions. Table 7-16 shows the decrease for all the alternatives compared to the 2008 baseline levels using post-processed traffic data. All six of the MSATs are seen to decrease for Alternatives 1, 5A, 6A, and 6B as compared to 2008 levels along the freeway mainline.

A reduction is seen in all six MSATs for Alternatives 1, 5A, 6A, and 6B as compared to 2008 baseline levels for AOI and SCAB. See Table 4-10 in the HRA for full data table.

Table 7-16. MSAT Emissions Compared to 2008 Baseline

		Difference between 2035 Alternative and 2008 Baseline				
MSAT (pounds/day)	**2008 Baseline**	**Alternative 1**	**Alternative 5A**	**Alternative 6A**	**Alternative 6B**	**Alternative 6C**
Diesel Particulate Matter (DPM)	N.D.	(570)	(530)	(399)	(639)	N.D.
Benzene	21.3	(19)	(18.5)	(18.5)	(18.5)	N.D.
Acetaldehyde	4.2	(3.9)	(3.9)	(3.9)	(3.9)	N.D.
Formaldehyde	16.1	(14.7)	(14.4)	(14.4)	(14.4)	N.D.

		Difference between 2035 Alternative and 2008 Baseline				
MSAT (pounds/day)	2008 Baseline	Alternative 1	Alternative 5A	Alternative 6A	Alternative 6B	Alternative 6C
1,3-butadiene	5	(4.5)	(4.3)	(4.3)	(4.3)	N.D.
Acrolein	1.2	(1)	(1)	(1)	(1)	N.D.

N.D. = no data/data not available.
Source: Data provided by ENVIRON, August 2011.

Pollutant Summary

The majority of air pollutants are shown to decrease under all the alternatives. Modeling results indicate that Alternatives 6B and 1 result in the greatest reduction in air pollutants, while Alternative 6A results in the smallest reductions.

However, given high levels of existing concentrations of air pollutants, these decreases should be considered cautiously. Conclusions from these estimates and models are based on the assumptions that improved car and truck technology will lead to cleaner engines and less air pollution from vehicular traffic. Gains in air quality will not be realized unless vehicle fleets do in fact turn over and the cleaner engines are used by 2035. Assuming that improvements in air quality are realized along the I-710, effects will be seen at sites near the I-710 such as residences, parks, schools, churches, and senior facilities. Improvements to air quality will positively impact the health of the communities along the I-710, especially for vulnerable populations and populations disproportionately residing in proximity to the I-710.

While a reduction can be seen in many of the pollutants given the alternatives, these reductions may not reach levels such that they provide significantly cleaner and healthier air for communities in the I-710 corridor. Standards are not set purely on health findings (e.g., costs are almost always considered), and health impacts often occur even below the standard. Furthermore, standards continue to evolve as new research is conducted; the EPA is currently considering a significant reduction in the $PM_{2.5}$ standard, for example. Communities in the impacted area will likely still be impacted by I-710 emissions and ambient concentrations of harmful pollutants.

Table 7-17a. Pollutant Emissions Summary as Compared to 2008 Baseline

Alternative	Pollutant Emissions			
	Criteria Air Pollutants			
	NO_X	CO	$PM_{2.5}$	PM_{10}
1	⇓	⇓	⇓	⇓
5A	⇓	⇓	⇓	⇓
6A	⇓	⇓	⇓	⇓
6B	⇓	⇓	⇓	⇓
6C	N.D.	N.D.	N.D.	N.D.

Explanations:
⇑ = increase in pollutant as compared to 2008 baseline
⇓ = decrease in pollutant as compared to 2008 baseline
⇔ = no change in pollutant as compared to 2008 baseline
N.D = no data/data not available.

Table 7-17b. Pollutant Emissions Summary as Compared to 2008 Baseline

Alternative	MSATs					
	DPM	Benzene	Acetaldehyde	Formaldehyde	1,3-butadiene	Acrolein
1	⇓	⇓	⇓	⇓	⇓	⇓
5A	⇓	⇓	⇓	⇓	⇓	⇓
6A	⇓	⇓	⇓	⇓	⇓	⇓
6B	⇓	⇓	⇓	⇓	⇓	⇓
6C	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Explanations:
⇑ = increase in pollutant as compared to 2008 baseline
⇓ = decrease in pollutant as compared to 2008 baseline
⇔ = no change in pollutant as compared to 2008 baseline
N.D = no data/data not available.

7.3.2 Impacts on Non-Highway Traffic Air Pollutant Emissions

The project is likely to impact air quality as a result of traffic on arterials and local roads as well. Traffic volumes on arterials analyzed in the I-710 traffic studies are predicted to be highest for Alternative 1 (as a result of vehicles using the arterials rather than the congested freeway), followed by Alternatives 6A/B, and then by Alternative 5A. Data for Alternative 6C was not available.

Table 7-18. Arterial Street Volumes by Alternative, Percent Change Compared to 2008 Baseline

	Alternative 1	Alternative 5A	Alternative 6A/B	Alternative 6C
Auto	8.45%	7.47%	8.35%	Unavailable
All Truck	43.76%	37.89%	38.02%	Unavailable
Source: URS 2010[464]; SCAG RTP travel demand model				

Predicted speeds on arterials were not available in time for use in the HIA; however, it is likely that speeds for Alternative 1 will be lowest because traffic volumes are the highest and no intersection improvements are proposed. Intersection improvements are proposed for Alternatives 5 and 6 A/B/C, so traffic will be able to move faster on the arterials. Given slightly lower traffic volumes, it is likely that Alternative 5A will have the fastest speeds, but they are likely to be similar to Alternatives 6A/B.

Therefore, emission levels from traffic on arterials are predicted to be highest for Alternative 1 followed by Alternative 5A and Alternative 6A. Alternative 6B is likely to result in lower emissions levels than 6A as a result of the use of zero emission technology.

The destinations of the increased truck traffic on the arterials are warehouses, intermodal facilities, transloading facilities, truck repair shops, and similar goods movement–related destinations. Along the I-710 these destinations are often near residential neighborhoods. Under any alternative, due to increased port throughput, the warehouses and other facilities that are not operating at full capacity currently are likely to increase operations, leading to more truck and freight movement with possible increases in truck emissions. Alternative 6B would result in the lowest emissions as a result of the use of zero emission technology. Alternatives 1, 5A, and 6A would likely result in similar levels of truck emissions at these sites.

It is also possible that, especially for Alternatives 6A and 6B, parts of the goods movement infrastructure may relocate farther from the ports to locations with cheaper land and less congestion. This could lead to decreased use of the facilities in the Gateway Cities and reduced emissions contributing to poor air quality. Because these changes are difficult to predict and have not been modeled elsewhere in the I-710 Corridor Project EIR/EIS analysis, they are not considered further here.

7.3.3 Impacts on Greenhouse Gas Levels

CO_2e

Levels of regional GHGs, represented in the draft I-710 HRA as CO_2e, are estimated to increase in all of the alternatives as compared to the 2008 baseline in the SCAB region. See Table 7-19. Alternatives 5A and 6A/B/C result in lower GHG emissions than Alternative 1, with Alternative 6B leading to the least increase in regional CO_2e. Alternative 6B reduces GHG emissions by over a half million tons/year in 2035 compared to Alternative 1.

Table 7-19. GHG Emissions in the SCAB

Greenhouse Gas	2008 Baseline	Alternative 1 2035	Alternative 5A 2035	Alternative 6A 2035	Alternative 6B 2035
Total (CO_2e) (tons/year)	71,821,050	93,755,113	93,754,738	93,688,557	93,243,945
N.D. = no data/data not available. Source: Data provided by ENVIRON, August 2011					

The draft I-710 HRA does not assess GHG or CO_2e from non-traffic–related sources of information (outside of the construction phase, which is not being analyzed in this HIA). With limited available data and the regional (SCAB) modeling method for CO_2e (as the measure of GHG), it is inconclusive if non-traffic I-710 related sources will significantly impact GHG levels.

At the regional level, greenhouse gases are not expected to noticeably impact health in the I-710 community area.

7.3.4 Impacts on Air Quality from Public Transportation Use

As described in Chapter 6, "Mobility," Alternatives 5A, 6A, and 6B propose improving existing public transit service, and traffic models used in the EIR/EIS assume an increase in public transit ridership. The analysis indicates that the alternatives being considered are likely to lead to different public transit use, with Alternative 1 potentially having the highest rates of public transit use and Alternatives 6A/B/C potentially having the lowest.

Because Metro operates CNG buses, a mode shift from pollutant-emitting private vehicles to public transit will reduce air pollutant emissions and thus improve local-level air quality. Because of the differences in ridership for each alternative, there will be accompanying changes in emissions with Alternative 1 resulting in the most significant reduction and Alternatives 6A/B/C resulting in the least.

7.3.5 Impacts on Associated Health Outcomes

Asthma

General air quality will improve under any of the alternatives being considered in the EIR/EIS, resulting in a high likelihood that asthma prevalence, incidence, and hospitalizations will decrease, significantly improving the health of children, adults, and seniors throughout the corridor.

Existing levels of days of missed school due to asthma (2.1 along I-710 as compared to 3.1 in the county) are expected to decrease with the associated decrease in asthma prevalence. By improving educational outcomes (and thereby employment and income outcomes), future health outcomes for children will improve.

Furthermore, fewer days of work will be missed by adults, resulting in higher incomes and better job-related outcomes. These improvements will also lead to improved health outcomes, as income is correlated with health outcomes.

Mortality

The I-710 HRA explicitly does not quantitatively analyze premature death, mortality, or morbidity associated with PM. However, as described above, our existing conditions analysis indicates that there is currently an estimated excess mortality rate of 48 (95% CI: 14–84) excess annual deaths of persons living within 500 meters (1,640 feet) of the I-710 attributable to traffic $PM_{2.5}$ exposure. Reducing $PM_{2.5}$ exposure provides the opportunity to reduce excess mortality. The I-710 HRA concludes through the modeling and available analysis, that any of the alternatives are likely to reduce human exposure to PM, and therefore reduce health risks associated with PM. Assuming that the traffic and emissions modeling accurately reflects PM emissions, all the alternatives are favorable based on the 2008 baseline exposure levels. A separate quantitative analysis of health outcomes associated with $PM_{2.5}$ exposure is being conducted as part of the AQAP using methodology from the CARB.

It is recommended that the full analysis of premature death associated with $PM_{2.5}$ being conducted as part of the AQAP (in accordance with accepted methodology from the CARB) be completed and used to inform decision makers regarding the I-710 Corridor Project alternatives. A complete dispersion modeling of $PM_{2.5}$ in relation to sensitive receptors, low-income communities, and communities of color will provide a more accurate picture of mortality associated with PM. Based on the $PM_{2.5}$ improvements discussed above, it is highly likely that mortality associated with traffic PM emissions will decrease in the I-710 corridor communities.

Cancer

Using MSAT emissions data (compared to 2008) and using methodology that is consistent with Office of Environmental Health Hazard Assessment (OEHHA) Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA 2003[349]) and SCAQMD Rule 1401/212 (SCAQMD 2005b[404]), the draft I-710 HRA examines the cancer risks associated with a change in MSATs. See the HRA for full methodology and assumptions. The HRA provides a cumulative cancer risk but not cancer risks for individual cancers (such as lung cancer and leukemia), which could be used to determine specific cancer health outcomes as attributable to pollutant concentration exposure.

This analysis finds that Alternative 6B has the lowest maximum incremental cancer risk, with a decreased risk of 6.8 in one million as compared to the 2008 baseline. Alternative 6A shows the highest maximum incremental cancer risk, with an increased risk of 594 in one million as compared to the 2008 baseline. However, receptors for which there is increased risk are not residential; cancer risk is decreased for all sensitive receptors modeled. Cancer risk estimates in this section are conservative in that all receptors were modeled as residential receptors and assume a 24-hour exposure for 70 years. See Table 7-20. As the draft HRA notes, because of the way the modeling was conducted and its conservative nature, the results described here should only be used to compare the relative impacts of alternatives.

Table 7-20. Maximum Incremental Risk Impact from Project Emissions—Cancer Risk (Risk in 1 Million) as Compared to 2008 Baseline

	2008 Baseline	Alternative 1 2008	Alternative 5A 2008	Alternative 6A 2008	Alternative 6B 2008	SCAQMD Hazard Index Threshold[1]
Cancer risk	N.D.	(6.0)	(5.6)	594	(6.8)	10

N.D. = no data/data not available.

Source: Environ 2010a[133].

[1]SCAQMD Cancer Hazard Index Threshold is estimated to be the product of the annual average concentration and the cancer potency (CP) for that carcinogen, the daily breathing rate (DBR), the exposure value factor (EVF), and the multipathway factor (for chemicals having impacts due to multiple pathways). See the Air Quality and Health Risk Assessment for the full definition and equation.

Cardiovascular Disease (CVD)

The literature shows that CVD, a significant health outcome, is associated with high levels of $PM_{2.5}$, PM_{10}, CO, and NO_2, especially for persons living in areas with high levels of air pollutants from vehicular traffic. Based on results in the draft I-710 HRA, indicating that levels of $PM_{2.5}$, PM_{10}, CO, and NO_2 will decrease under all the alternatives being considered, there is a high likelihood that CVD attributable to air quality will decrease under all the alternatives, with Alternative 6B resulting in the greatest decrease in CVD associated with air pollution. However, changes in other environmental stressors and factors under the various alternatives, such as noise, may increase CVD in the study area.

Low Birth Weight

Literature shows that low birth weight and birth defects, both significant health outcomes, have been associated with exposure to air pollution such as $PM_{2.5}$, PM_{10}, CO, and NO_2, especially for pregnant women living closer to freeways or in areas of high air pollution. The draft I-710 HRA finds that levels of $PM_{2.5}$, PM_{10}, CO, and NO_2 will decrease along the mainline and in the area of interest. Therefore, rates of low birth weight and birth defects will likely decrease in all of the alternatives, with the highest decrease under Alternative 6B. Decreasing incidence of low birth weight will improve infant health leading to better infant health outcomes in the I-710 corridor communities and the county.

Pre-Term Births

Literature shows that pre-term births, a significant health outcome, have been associated with exposure to air pollution from high vehicle emissions such as CO, especially for pregnant women living closer to freeways or in areas of high air pollution. The draft I-710 HRA finds that CO levels will decrease along the mainline and in the area of interest. Therefore, rates of pre-term births will likely decrease under all of the alternatives, with the highest decreases in Alternatives 1 and 6B. A decrease in pre-term births will be beneficial to the health of individual babies as well as help minimize the overall rate of pre-term births in the county, especially because incidences are higher in the county than California.

Neurological Health

Autism data was not available for this HIA, limiting the ability to examine conditions along the I-710 corridor community areas. Assuming conclusions from the 2010 study on autism near freeways (Volk et al. 2011[469]) are supported by similar results in future studies, it may be concluded that the existence of pollutants (especially DPM) near freeways is associated with autism. If this were the case, a reduction in air pollution (such as DPM) would result in reduced rates of autism, with Alternative 6B having the most favorable outcome.

Health Impacts Summary

While most of the alternatives see a decrease for the majority of air pollutants in the identified areas of impact, Alternative 6B provides the greatest decrease in I-710 traffic-related emissions, followed by Alternative 1. Table 7-21 provides a summary of the most notable air quality–related health impacts. It is likely that beneficial health impacts will be more pronounced in vulnerable populations and in communities disproportionately residing close to the I-710.

Table 7-21. Summary of Predicted Air Quality–Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Asthma					
1	+	Odds ratio of 1.15 for every 10 μg/m^3 increase of annual average NO_2	High	♦♦♦	Final traffic analyses and air quality modeling were not available at the completion of this HIA; modeling results are not always accurate.
5A					
6A					
6B					
6C					
Mortality					
1	+	Estimates pending $PM_{2.5}$ modeling data	High	♦♦♦	Modeled estimates of mortality attributable to $PM_{2.5}$ were not available for this analysis. Magnitude is not estimated.
5A					
6A					
6B					
6C					
Cancer risk (from MSATs from the I-710 Corridor)					
1	+	Minor	High	♦♦♦	Final traffic analyses and air quality modeling were not available at the completion of this HIA; modeling results are not always accurate.
5A		Minor			
6A		Minor			
6B		Minor			
6C		Not available			
Cardiovascular disease					
1	+	Magnitude not estimated	High	♦♦♦	Final traffic analyses and air quality modeling were not
5A					

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
6A					available at the completion of this HIA; modeling results are not always accurate.
6B					
6C					
Low birth weight and pre-term births					
1	+	Magnitude not estimated	Mod	♦♦	Final traffic analyses and air quality modeling were not available at the completion of this HIA; modeling results are not always accurate.
5A					
6A					
6B					
6C					

Explanations:
Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).
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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between air quality and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

7.4 Recommendations

Strategies to reduce air pollution emissions and mitigate exposures can decrease the risk of air pollution–related health outcomes and illness for neighborhoods situated near freeways with high truck and vehicle volumes. Because air quality is of primary concern to the community, this HIA provides recommendations to further improve air quality in the project corridor.

Air quality has been an ongoing concern in the LA region. Although air quality under all the alternatives being considered will improve, air quality in the region may continue to be a concern. Therefore, it is critically important that implementation of the recommendations to improve air quality be addressed on a regional scale, with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated objective of improving air quality.

7.4.1 Tier 2 Recommendations

The Tier 2 Community Advisory Committee spent considerable time and energy to prepare a set of recommendations and strategies that will contribute to the I-710 Corridor Project and decision-making processes. This HIA concurs that the strategies presented in the *I-710/Major Corridor Study: Major*

Opportunity/Strategy Recommendations and Conditions be considered. Recommended strategies include the following (see Tier 2 2004 report for the full sub-list of each strategy):

- Implement the findings of the AQAP when it is completed to improve community air quality;
- Implement local alternative fuels/electrification and/or hydrogen policies and programs to reduce diesel emissions;
- Pursue opportunities for incremental improvements;
- Implement Port-specific strategies.

7.4.2 Research and Analysis

- Confirm the findings in this HIA with the final data from traffic modeling in the I-710 Corridor Project EIR/EIS and the I-710 HRA, including completing the particulate matter analyses.
- PM Analysis: The draft I-710 HRA does not provide a quantitative impact analysis of health impacts resulting from change in motor vehicle emissions of $PM_{2.5}$, PM_{10}, or Ultrafines, including impacts on mortality or childhood respiratory disease. A complete analysis of PM health effects, based on modeling, is recommended to better evaluate I-710 alternatives and strategies. This analysis is being completed as part of the AQAP.
- Ensure air quality modeling takes into account recent studies related to the distribution of air pollution in the presence of sound walls (Ning et al. 2010[346]) and impacts of low noise road surfaces, if there are any.
- Fund a study to understand the most effective way to accelerate the adoption of zero emission technologies for trucks carrying freight on the I-710. Given that the use of zero emission trucks would improve air quality significantly in all the proposed alternatives, not just Alternative 6B, such technologies should be nurtured and implemented as soon as possible.

7.4.3 Goods Movement, Transportation, and Land Use Planning

- For any alternative, aggressively pursue policies that accelerate the use of zero emission trucks.
- Walking and Biking: Walking and biking are both zero emission forms of transportation. It is recommended that resources for planning and implementation of safe bike and walking infrastructure be invested to improve walking and biking conditions, increase walking and biking mode share, and reduce vehicle trips. One could start with existing residential streets that are walkable/bikeable, then expand the network of walkable/bikeable streets throughout the I-710 corridor to provide safe alternative routes (especially on and across arterials) that can be used for active transportation. (Several studies have shown that physical activity [e.g., biking] in areas with poor air quality [e.g., on a busy arterial] can result in increased inhalation of pollutants. Therefore, it is recommended that these walking/biking facilities are developed as far from busy roadways as possible.)

- Support development and implementation of alternative transport of goods from the ports, such as lowest emission rail technology possible, in the I-710 corridor and beyond.
- Planning departments should ensure that all local land use planning improves the separation of residential and other sensitive uses from the goods movement infrastructure. All attempts should be made to move the goods movement infrastructure as close to the freeway as possible and to move sensitive uses away from the freeway and its associated traffic as well as away from the goods movement infrastructure. For example:
  - Develop truck parking facilities and truck stops with services (e.g., restaurants, repair shops) near the freeway so that drivers do not need to drive farther into the communities and near sensitive uses.
  - Pass city ordinances restricting potential land uses to reduce conflict between sensitive receptors and air pollution–producing facilities. These could include only allowing new residential and recreational developments at distances, such as 300 meters (984 feet), shown to have lower levels of ambient concentrations of harmful pollutants.
  - Pass city ordinances requiring new residential construction or uses (including commercial and recreational) to evaluate air existing pollution levels (including hotspot analysis) and mitigate if necessary before issuing permits.
- Develop a complete inventory of goods movement facilities (e.g., warehouses, transloading facilities, and other port truck destinations) in the I-710 corridor in order to be able to understand the impacts that air pollution related to these facilities (e.g., onsite equipment, truck traffic, truck idling) has on nearby receptors.

7.4.4 Air Pollution Emissions Reductions and Exposure Mitigations

- Aggressively apply a variety of truck emissions reductions strategies. Aggressively pursue strategies outlined by the Federal Highway Administration to reduce truck emissions through technology advancements and operations (FHWA 2005[180]): implementation and use of filters and catalysts, use of alternative “cleaner” fuel, increased fuel efficiency, replacement of vehicle fleets, and reduced truck idling.
- Business and fiscal incentives: Provide increased incentives for cleaner trucks, especially for local and small businesses that may not be able to afford truck upgrades/replacement.
- Vegetation: Increase vegetation known to reduce air pollutants (such as conifer trees) along the I-710 to filter air, mitigating pollution and greenhouse gas impacts. Specific vegetation types and width of vegetation buffer would need to be determined.

7.4.5 Funding, Enforcing, and Strengthening Air Quality–Related Regulations

- Funding: Seek funding for mitigations for air quality impacts (e.g., providing safer and more accessible access to walking, biking, and transit to reduce individual automobile driving by mode shift) and treatment of air quality impacts (e.g., asthma case management programs); or, if Alternative 6C is adopted, use revenue from tolling for this purpose. Consider tolling (per truck or per volume of pollutants emitted) under all alternatives to provide revenue to fund mitigation strategies.

- Clean truck accountability: If cleaner trucks or zero emission trucks are adopted as a strategy, ensure that proper regulatory and enforcement actions maintain emissions reduction goals over time and that such efforts are fully funded.
- Enforcement of truck emissions: Enforce and, if needed, strengthen regulations regarding truck emissions and consider funding truck emissions reduction programs.
- Enforcement of regulations: For any alternative selected, fully fund and, if necessary, strengthen enforcement of truck route usage as well as idling regulations. For example, truck routes should not be located near sensitive receptors such as parks, schools, and senior citizen facilities.

7.4.6 Post Build Out Monitoring and Mitigation

- Before the project begins, develop a complete air quality monitoring plan that will identify and address potential future air quality issues that are attributable to the I-710 project. This plan should include:
  - Monitor and mitigate air quality at sensitive receptor sites: After the project is completed, regularly monitor air quality at sensitive receptors such as schools, community centers, libraries, and senior facilities. If air pollutant levels rise above what is considered harmful to human health and this is attributable to the I-710 project, commit to retrofit these facilities (e.g., providing upgrades to building thermal performance and ventilation systems) to keep indoor air pollutant levels below that which is considered harmful to human health.
  - Monitor and mitigate air quality at parks and playgrounds: After the project is completed, regularly monitor air pollution levels at parks and playgrounds. If air pollutant levels rise above what is considered harmful to human health and this is attributable to the I-710 project, commit to providing communities with new parks away from freeways.

If any alternative that includes zero emission trucks is adopted (e.g., Alternative 6B), policies and mechanisms must be put in place to ensure that the freight corridor be used only by designated clean trucks before construction is begun. If such policies are not securely in place, there is the possibility that the freight corridor could be built and it is then found that implementing the zero emission truck policy is impossible, which would be detrimental to air quality and health. The communities neighboring the I-710 must have concrete assurances that zero emissions truck policies for the freight corridor will be implemented and enforced.

8. Noise

8.1 Introduction

8.1.1 What Is Noise?

Noise is unwanted sound. Noise is characterized by its frequency (or pitch) and loudness (or intensity), and both impact our perception of noise. The decibel (dB) is a measure of sound intensity that is computed based on the ratio of two sound levels (dB = 10 log [$Power_1$ /$Power_0$]). Because noise is measured in this way, an additional 10 dB represents a 10-fold increase in the power of sound.

Noise reporting can take into account the frequency range of the human ear and is then measured in A-weighted decibels (dBA). Rustling leaves produce about 20–30 dBA, normal conversation is at about 50–60 dBA, and a fire engine siren at 100 feet is about 110–120 dBA.

The intensity of noise varies continuously over time. The L_{eq}(hours) is the equivalent average continuous noise level integrated over a period of time. For a 1-hour period, this is denoted, L_{eq}[h]. L_d and L_n represent the A-weighted daytime and nighttime noise, respectively. L_{dn} is the A-weighted day-night equivalent noise level over a 24-hour period with a 10 dB penalty given to noise during sleeping hours. The Community Noise Equivalent Level (CNEL) is similar to the L_{dn} but includes an additional penalty for evening hours.

8.1.2 Traffic and Noise

Road vehicle traffic is a significant source of noise in urban areas. The noise generated by vehicles on a highway depends on the number of vehicles, the speed of vehicles, the type of vehicles (trucks or cars), and the road surface. The more vehicles there are on the road, the higher the speeds, and the greater the proportion of trucks, the louder the traffic will be (FHWA 2006a[181]).

- Traffic volume: All other things being equal, an increase in traffic volume leads to a proportional increase in the generation of sound power.
- Traffic speed: Engine and exhaust noise are usually louder than tire noise at speeds under 30 mph and the reverse is normally true for speeds over 30 mph. Highways are typically dominated by tire noise while local streets are typically dominated by engine and exhaust noise (FHWA 2006a[181]). Noise levels decrease with a reduction in speed. For example, going from 100 kilometers/hour (62 mph) to 90 kilometers/hour (56 mph) will reduce the noise emission by 1.3 dB in a light vehicle. Slowing from 60 to 50 kilometers/hour (37 to 31 mph) will reduce noise by 2.3 dB for a light vehicle (Ellebjerg 2007[128]).
- Vehicle type: At 50 kilometers/hour (31 mph), a light vehicle produces about 80 dB of noise, a medium vehicle about 84 dB, and heavy vehicles produce about 87 dB (Ellebjerg 2007[128]).

Noise intensity decreases with distance from the source. Generally, each doubling of distance from a single-point noise power source results in a 6 dB reduction, and each doubling of distance from a line source of noise, such as a freeway, results in a 3dB reduction. For example, if a sound level is 70 dB at 50 feet it will be 67 dB at 100 feet, and 64 dB at 200 feet.

According to the Federal Highway Administration (FHWA 2006a[181]), there are typically three interventions to reduce traffic noise:

1. *Vehicle controls* such as better mufflers, fans that turn off when not needed, and engine design for decreased noise. Vehicle controls can reduce noise by 5–10 dBA.
2. *Land use planning* to reduce conflicts between sensitive uses such as schools and residences and roadway noise sources.
3. *Highway design and planning,* including noise barriers and pavement treatments. Design to reduce noise may also include speed and flow controls.

8.1.3 Noise and Health

The health impacts of environmental noise depend on the intensity of noise, the duration of exposure, and the context of exposure. According to the WHO Guidelines for Community Noise (Berglund et al. 1999[37]), which reviews a significant amount of the research on noise and health, long-term exposure to moderate levels of environmental noise can adversely affect sleep, school and work performance, blood pressure, and cardiovascular disease. A significant body of the research on noise and health contained in that report and in other public health literature investigates road traffic noise specifically. The focus in this section is on noise levels; though other factors (e.g., the frequency) of noise can be important as well, this is less true for road traffic noise. The following is contained in the literature:

- *Sleep:* Traffic noise has been linked to perceived impairment sleep quality (Griefahn et al. 2006[206], Jakovljevic et al. 2006[236]). Reductions of noise by 6–14 dBA result in subjective and objective improvements in sleep; studies show an increase in the percentage of awakenings at night at noise levels of 55–60 dBA (Berglund et al. 1999[37]). A lack of sleep may have health consequences such as fatigue, impaired endocrine and immune system, and psychological effects. Sleep can also impact quality of life, intellectual capacity, education, and risk of accidents (WHO Regional Office for Europe 2005[485]).
- *Annoyance:* Annoyance is defined as, “a feeling of displeasure associated with any agent or condition known or believed by an individual or a group to be adversely affecting them.” (Lindvall and Radford 1973[283], Koelega 1987[263]) Annoyance is related to several health effects associated with noise, including: elevated blood pressure, circulatory disease, ulcer, and colitis (Passchier 2000[358]). Subjective reports of annoyance are the most widely studied impact of noise (Passchier 2000[358]) and the relationship has been quantified (Miedema and Oudshoorn 2001). Annoyance to noise may stem from anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation, or exhaustion (Job 1993[243], Fields et al. 1997[188], Community Response to Noise Team of ICBEN 2001[115]).
- *Speech and language:* Noise can interfere with speech communication outdoors, in workplaces, and in schoolrooms, interfering with the ability of people to perform their work; (Berglund et al. 1999[37])

- *Learning and educational performance:* Chronic road noise can affect cognitive performance of children, including attention span, concentration and remembering, and reading ability (London Health Commission 2003[287], Stansfeld et al. 2005[422]).
- *Cardiovascular disease:* The biological pathway between noise and cardiovascular disease (both hypertension and myocardial infarction) is based on noise-induced stress, which triggers the release of hormones such as cortisol, noradrenaline, and adrenaline, which in turn affect hypertension, blood lipids, and blood glucose, all of which are risk factors for cardiovascular disease.
  - *Hypertension:* There is a dose-response relationship between environmental noise from traffic and high blood pressure; (Van Kempen et al. 2002[467]) people who live near chronic road noise (more than 20,000 vehicles/day) are twice as likely to have hypertension, and men specifically are almost 4 times more likely (Barregard et al. 2009[27]). A review by Babisch (Babisch 2006[19]) summarizes studies on the relationship between noise and hypertension.
  - *Myocardial Infarction:* Increasing community noise, including traffic noise, increases the risk of myocardial infarction at noise levels above 50–60 dBA (Selander et al. 2009[411], Babisch et al. 2005[21], Babisch 2006[19], Babisch 2008[20]).
- *Stress:* The combination of noise and poor quality housing has been associated with higher stress and stress hormone levels (Evans and Marcynyszyn 2004[173]).

Groups who are at higher risk for noise exposure are those less able to cope with the impacts, including people with decreased abilities (old, ill, or depressed people); people with particular diseases; people dealing with complex cognitive tasks, such as reading acquisition; young children; and the elderly in general.

Table 8-1. Summary of Noise Sources, Health Effects, and Mediating Factors

Determinants of Urban Noise	Health Effects of Noise	Factors Modifying Effect of Noise
Vehicle volume Vehicle type Vehicle speed Roadway Conditions Mechanical Equipment Geography Meteorology	Sleep deprivation Stress Impaired Cognitive Function Hypertension Annoyance Speech Intelligibility Hearing impairment	Noise Intensity Noise Duration Perceived risk associated with noise

8.1.4 Guidelines and Standards for Preventing Health Impacts from Noise

The tables below summarize noise guidelines from the WHO Guidelines (Berglund et al. 1999[37]), the FHWA (2011a[186]) and Caltrans (2011b[76]), the Los Angeles County Code (Section 12.08.390), and the Long Beach General Plan Noise Element (City of Long Beach 2009[108]) (as an example of how local jurisdictions regulate noise).

The WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters as well as setting norms and standards. As can be seen from the tables, many of the local and state standards are not completely health protective according to the WHO guidelines.

Table 8-2.WHO Community Noise Guidelines and Main Health Effects of Concern

Environment	Health Effect	Sound Level (dBA)	Time (hours)
Bedrooms	Sleep disturbance	30	8
Inside dwellings	Speech intelligibility	35	16
School classrooms, indoors	Disturbance of communication	35	School hours
Outdoor living areas	Annoyance	50–55	16
Industrial, commercial, and traffic areas	Hearing impairment	70	24
Music through earphones	Hearing impairment	85	1
Ceremonies and entertainment	Hearing impairment	100	4

The WHO noise exposure thresholds are much lower for levels inside (30 dBA) and outside (50–55 dBA) homes and for classrooms (35 dBA) than for commercial (70 dBA) and other public areas.

Table 8-3. Federal Highway Administration's Highway Traffic Noise Abatement Criteria (NAC) (23 CFR, Part 772) and California Department of Transportation Noise Policy, May 2011: Activity Categories and Noise Abatement Criteria

Activity Category	Activity $L_{eq}(h)$ (dBA)[1]	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	Exterior	Residential
C[2]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[2]	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.

Activity Category	Activity $L_{eq}(h)$ (dBA)[1]	Evaluation Location	Activity Description
F	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	--	Undeveloped lands that are not permitted.

[1]The $L_{eq}(h)$ Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[2]Includes undeveloped lands permitted for this activity category.

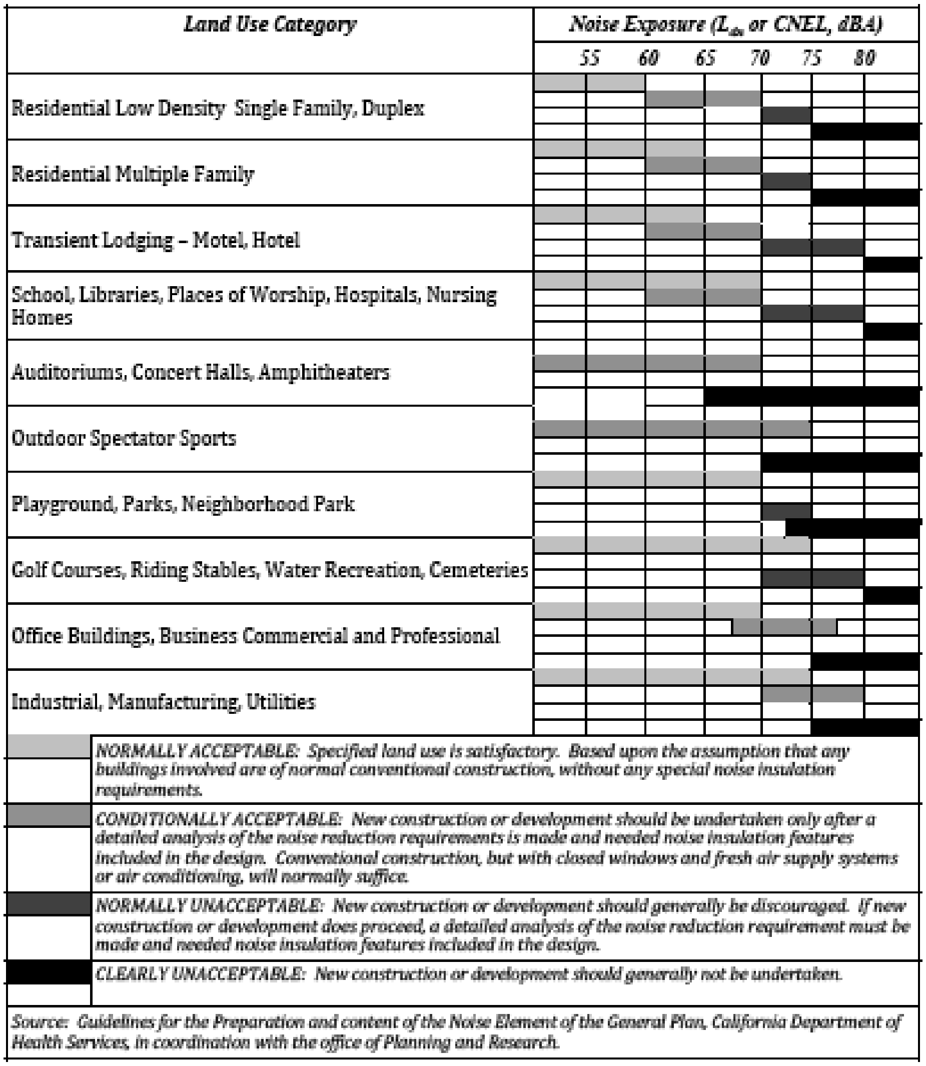
Caltrans and FHWA (23 CFR 772) policy is to predict traffic noise, conduct a traffic noise analysis and an analysis of noise abatement, and inform local officials of their plans. Generally, they abate noise from freeways in residential uses and for other sensitive receptors when noise levels increase substantially and/or at noise levels of 67 dBA and higher.

Table 8-4. Los Angeles County Code, Section 12.08.390

Noise Zone	Designated Noise Zone Land Use (Receptor property)	Time Interval	Exterior Noise Level (dB)
I	Noise-sensitive area	Anytime	45
II	Residential properties	10:00 p.m. to 7:00 a.m. (nighttime) 7:00 a.m. to 10:00 p.m. (daytime)	45 50
III	Commercial properties	10:00 p.m. to 7:00 a.m. (nighttime) 7:00 a.m. to 10:00 p.m. (daytime)	55 60
IV	Industrial properties	Anytime	70

The Los Angeles County Code sets exterior noise limits at levels near residences and other sensitive uses at 45 to 50 dB, in line with the WHO Guidelines (50–55 dBA) and substantially lower than Caltrans and FHWA.

Table 8-5. Long Beach General Plan Noise Element: Land Use Compatibility for Community Noise Sources



Residential noise levels normally acceptable under the Long Beach Noise Element are up to 60–65 dBA measured by L_{dn}, which (as described above) penalizes nighttime noise by 10 dBA. Although a direct comparison with the measurements in the table above is difficult (because one would need to estimate the daytime noise and the nighttime noise separately), these values are higher than the WHO standards and below the Caltrans and FHWA guidelines.

8.2 Existing Conditions for Noise

8.2.1 Current Noise Levels in the I-710 Corridor

The Draft Noise Study Report for the I-710 Corridor Project (URS and Caltrans 2010[463]) prepared for Metro by URS and Caltrans includes short-term (10-minute) measurements at 106 sites and long-term (24-hour) measurements at an additional 19 sites in residential neighborhoods and near sensitive receptors along the I-710 corridor as well as background noise measurements at 8 sites farther from the freeway. Car and truck counts and speeds were recorded simultaneously for the short-term measurements near the freeway and are available in the report. A map of the noise measurements that have been taken to date is shown in Figure 8-2. Of the short-term noise measurements (L_{eq}), 13 are between 40 and 50 dBA; 43 are between 50 and 60 dBA; 46 are between 60 and 70 dBA; and 4 are between 70 and 80 dBA. The 20 long-term measurements range between 56.76 dBA and 74 dBA, with 2 being between 50 and 50 dBA, 15 between 60.1 and 70 dBA, and 2 between 70.1 and 80 dBA. The 8 short-term background measurements range between 49.8 and 56.9 dBA.

Noise levels tend to be lower on the opposite side of the Los Angeles River from the freeway, where measurements were taken farther away from the freeway. Noise levels are also lower where sound walls exist, for example in many areas in Long Beach.

The highest noise levels (over 70 dBA) were found near the freeway in South Gate and, to a lesser extent, in Commerce. There are areas where residential neighborhoods currently are alongside the freeway without any soundwalls, as shown in the photograph in Figure 8-1, taken from the I-710.

Figure 8-1. Residential Neighborhood in Proximity to the I-710, as Seen from the Freeway

Noise levels were not conducted for all residential areas (e.g., Maywood and North of SR-60 in East Los Angeles). Noise measurements were taken on weekdays only, so no data is available regarding noise levels on weekends.

Protocols for measurement and site selection are described in Chapter 5 of the Draft Noise Study Report (URS and Caltrans 2010[463]). As described in the Special Noise Protocol Report section, Caltrans decided to use a streamlined Noise Protocol. Because new noise protocols (Caltrans 2011b[76]) have been adopted since this draft report was written, noise levels at additional sites will be measured by Caltrans.

Using data provided by Caltrans for 24-hour noise measurement for 14 sites along the southern part of the I-710 (from just north of the I-105 to the Port of Long Beach), noise levels were estimated for L_{dn}

(shown in Figure 8-3) and L_n (data not shown) for various distances from the freeway. This analysis is conservative in that it assumes all the noise is coming from a single line source, the I-710, which is not the case. It is accepted that 14 data points are not sufficient to robustly estimate noise over such a great distance. More measurements can be taken or the Traffic Noise Model (TNM) can be used in the future to provide greater accuracy for existing noise levels.

With these noise estimates, 2009 Census data was then used to calculate the number of people near this section of the I-710 exposed to various levels of noise, as shown in Table 8-6.

Table 8-6. Population near the Southern Section of the I-710 Shown in Figure 8-2 Exposed to Various Noise Levels

L_{dn} Contour Level (dBA)	Population Exposed	L_n Contour Level (dBA)	Population Exposed
55–60	167,731	55–60	32,956
60–65	48,997	60–65	16,730
65–70	20,191	65–70	4,659
70–75	10,835	70-75	0

Figure 8-2. Noise Measurement Sites and Noise Levels from Caltrans' Noise Study Report

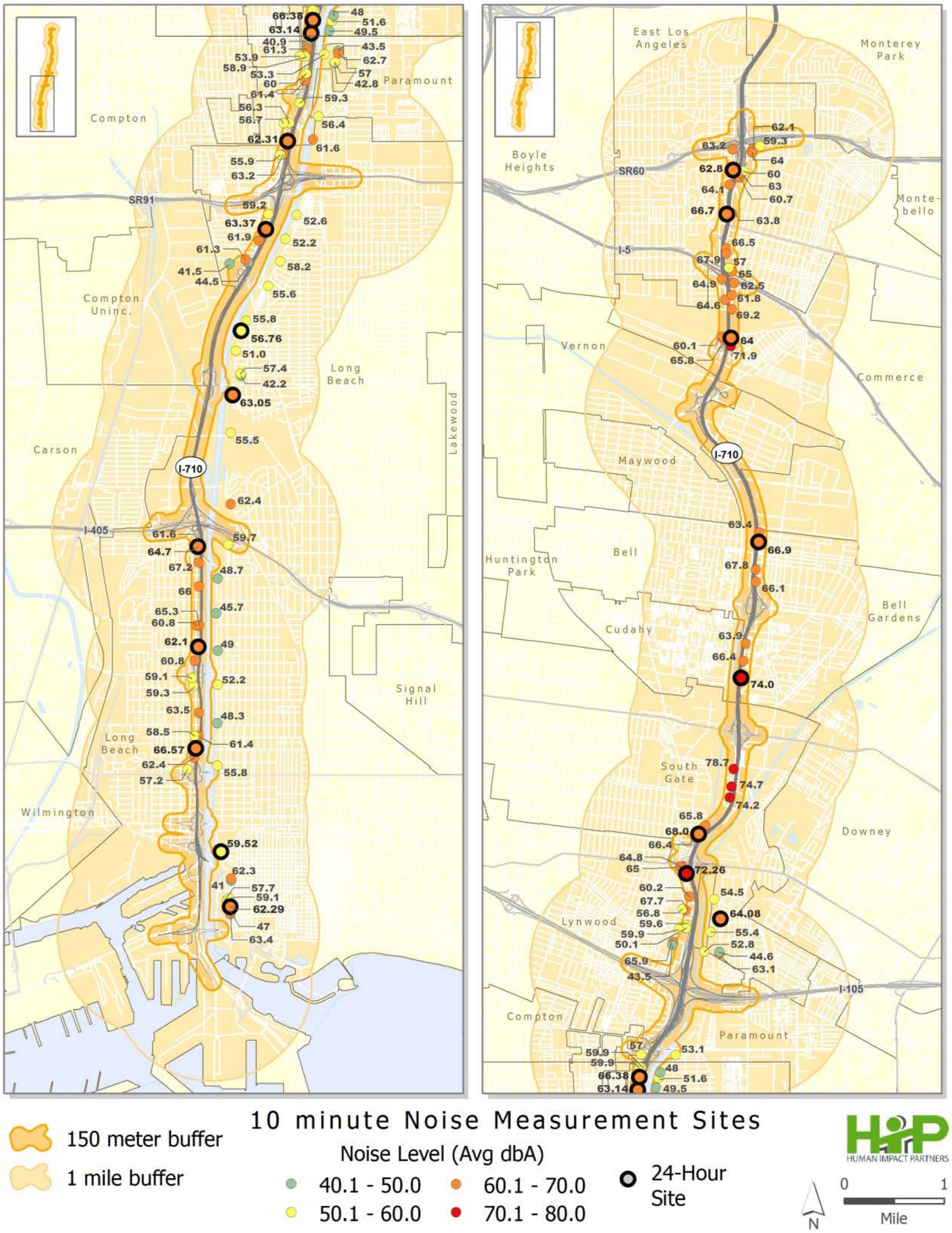
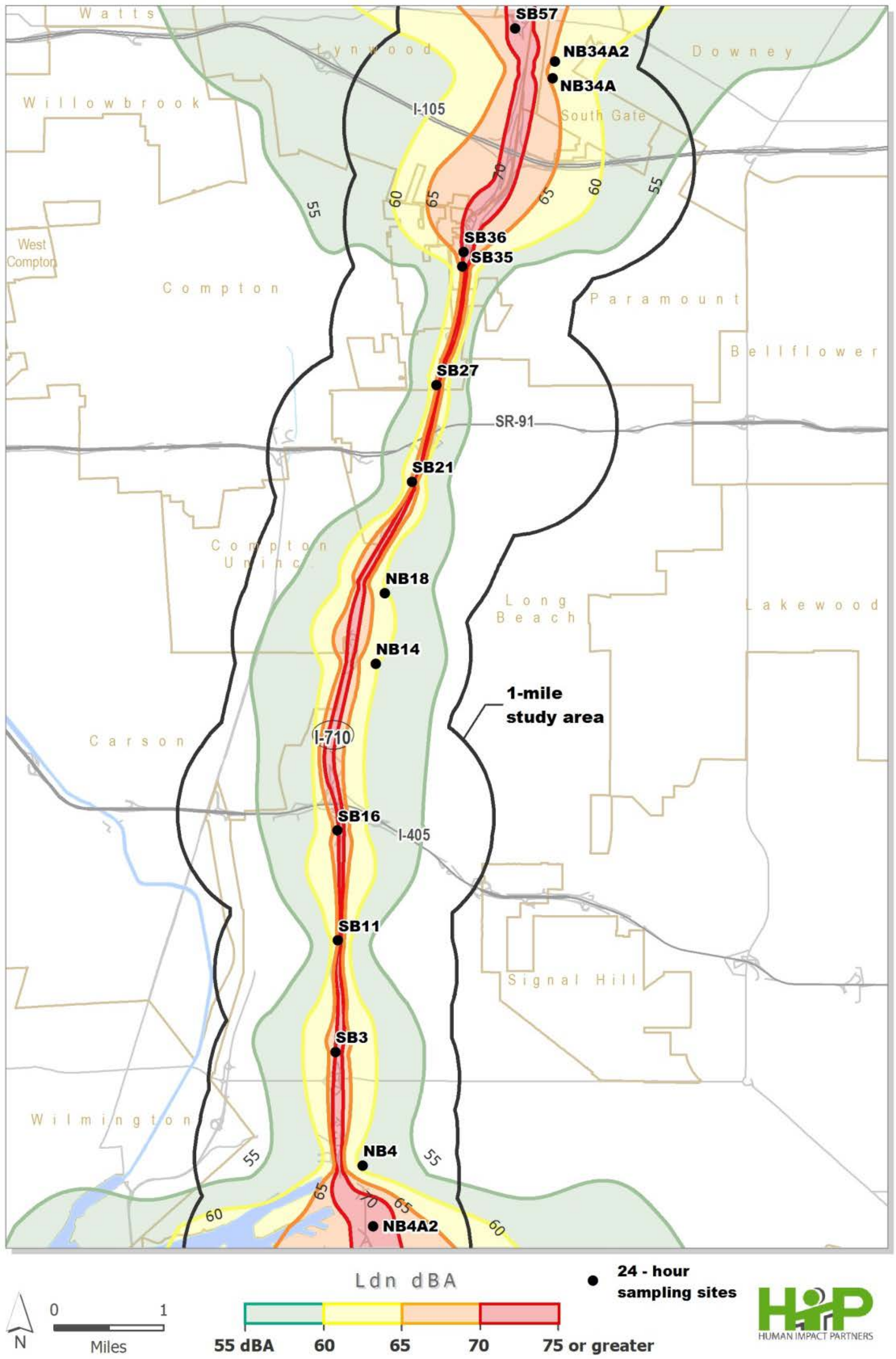


Figure 8-3. Noise (L_{dn}) Contour Levels as Estimated from Caltrans' 24-Hour Noise Measurements



8.2.2 Noise from Other Goods Movement Facilities in the I-710 Corridor

Potential major sources of noise besides freeway traffic noise in the community include:

- Truck traffic on arterial streets used to move between the freeway and other destinations described in this list;
- Intermodal facilities (the ICTF and the Hobart Railyard) where containers are moved between truck and rail;
- Transloading facilities where goods are moved from one container type to another;
- The Port of Long Beach (note that the Port of Los Angeles is outside the study area);
- Warehouses and distribution centers;
- Container storage facilities; and
- Truck repair facilities.

As recognized by Healthy Communities and Healthy Economies: A Toolkit for Goods Movement (MIG and ICF International 2009[326]), prepared for Caltrans and Metro:

> Warehouses and distribution centers can create noise impacts to neighboring communities. Typical noise sources include truck idling, truck entry and exit, and operating heavy-duty equipment. These noise impacts are greatest when heavy truck flow associated with a warehouse passes through residential neighborhoods and other sensitive land uses. In addition, warehouse activities such as freight loading and unloading can create additional noise impacts for nearby residents.

The literature contains little information about noise from these goods movement related uses, though there is a small amount of evidence that these sources of noise (e.g., loading/unloading (Health Council of the Netherlands 2004[218]) can lead to sleep disturbance, for example.

According to a study by the SCAG, there are approximately 240 warehouses within 1 mile of the I-710. Site visits revealed that this list of warehouses includes only a portion of the facilities in the area to which large numbers of trucks travel. These other goods movement, manufacturing, or industrial facilities, while each receiving a smaller number of trucks, combine to be destinations for a large amount of freight. In addition, site visits also found that not all the warehouses on the SCAG list are currently in operation, though a detailed inventory was not conducted for this analysis.

Land use patterns in the study area lead to noise pollution in many residential neighborhoods (e.g., even the eight background noise measurement sites have relatively high noise levels). Major arterials with high traffic, and specifically truck, volumes and with high numbers of truck destinations divide the region. Residential neighborhoods are located between these arterials. Often, one row of commercial use along an arterial is the barrier between the first houses in a residential neighborhood and the noise of the arterial. If the commercial use is noise producing and if trucks stray onto residential streets, there is little or no noise barrier at all; a single truck passing on a street at intermediate speeds typically results in 80 to 90 dBA of noise. As a result, many residents are exposed to noise levels from these sources. The photograph and maps in Figures 8-4, 8-5, and 8-6 show examples of trucks in residential neighborhoods and residential neighborhoods in proximity to busy arterials near the I-710.

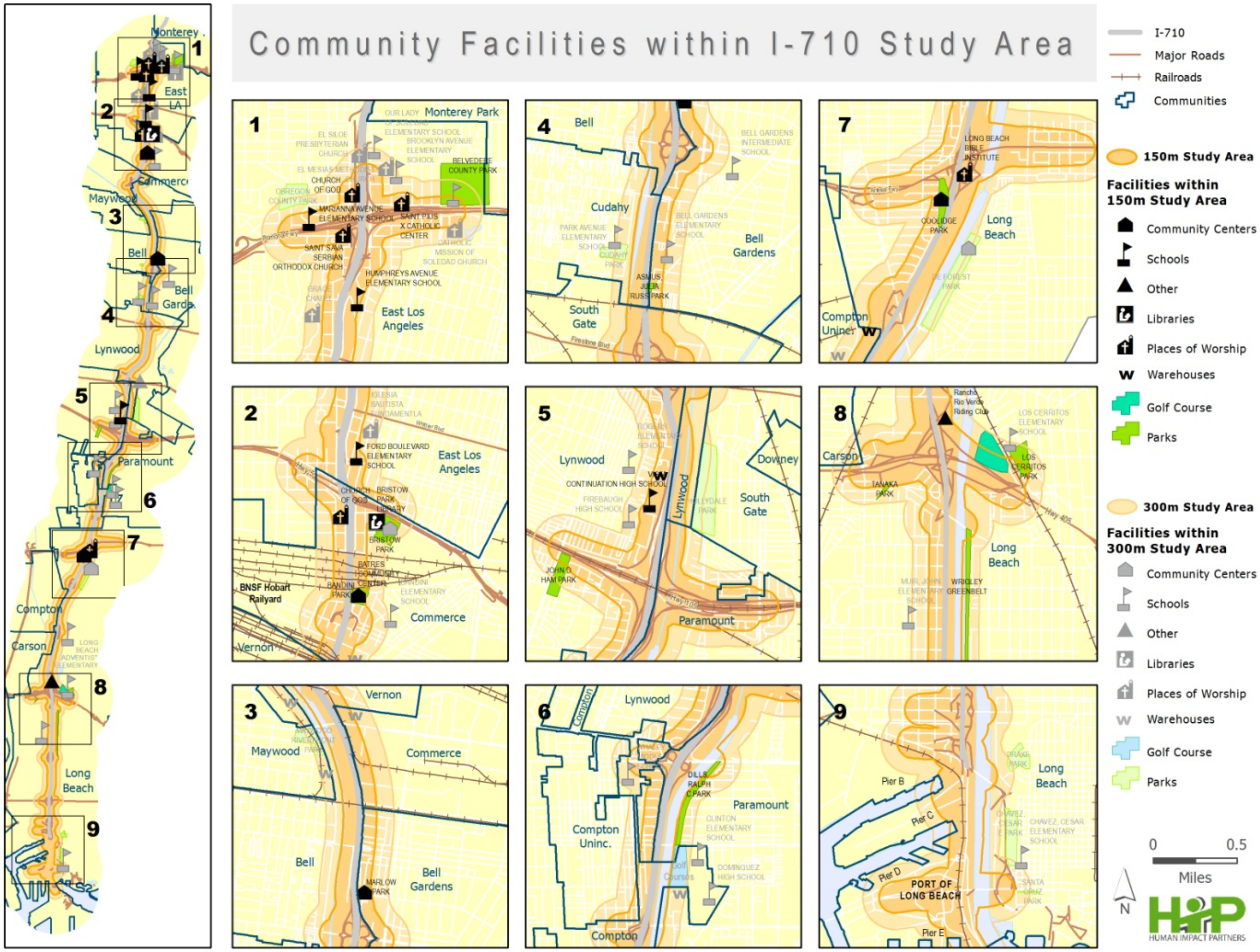
Figure 8-4. Trucks Driving through a Residential Neighborhood near the North End of the Corridor

Figure 8-5. A Google Map View of Atlantic Avenue, Just East of the I-710, Showing Residences Separated from Busy Arterials by One Row of Commercial Buildings

Figure 8-6. A Google Map View of Whittier Boulevard, Just East of the I-710, Showing Residences Separated from Busy Arterials by One Row of Commercial Buildings

The map in Figure 8-7 shows locations of some of the goods movement infrastructure in the study area relative to parks, community centers, libraries, and schools.

Figure 8-7. A Map of Neighborhood Resources and Some of the Goods Movement Infrastructure Close to the I-710



8.2.3 Community Concern Regarding Noise

Noise is of significant concern to the community living in the I-710 corridor. The Final I-710 Tier 2 Committee report (Tier 2 Community Advisory Committee 2004[437]) states:

> Excessive noise is a serious concern in the corridor. Noise has been shown to impact learning ability, skills development and quality of life. While not all noise can be eliminated, noise can be controlled through design and operational strategies, sound walls and retrofit of homes, schools and equipment. Noise must be controlled and we must find the means to do so.

The report goes on to say:

> Noise issues go beyond simply building more soundwalls. A comprehensive analysis of noise along the corridor must lead to a plan that recognizes the health impacts to our communities and seeks to resolve those impacts by providing appropriate relief. Future improvements must consider noise as a primary public health issue and find ways to mitigate those impacts.

One of the conditions for infrastructure improvements listed in the Tier 2 report is "Major infrastructure improvements must be conditioned on achieving a net decrease in noise impacts upon the affected communities."

8.2.4 Health Impacts Attributable to Noise under Baseline Conditions

Annoyance

As described above, annoyance is defined as "a feeling of displeasure associated with any agent or condition known or believed by an individual or a group to be adversely affecting them," and annoyance is related to several health effects associated with noise, including elevated blood pressure, circulatory disease, ulcer, and colitis. The percent of people expected to report being highly annoyed by noise can be modeled based on current noise measurements. Appendix D describes the methodology used here for these calculations. Using the noise exposure levels shown in Table 8-6, which only includes the population from just north of the I-105 to the Port of Long Beach, it is estimated that between 22,000 and 35,000 people would currently report being highly annoyed due to noise exposure from the I-710, as shown in Table 8-7.

Table 8-7. Estimated Number of People That Would Be Expected to Report Being Highly Annoyed Due to Noise near the Southern Portion of the I-710

Noise Level (L_{dn}; dBA)	% Expected to Report Being Highly Annoyed	Number of People Expected to Report Being Highly Annoyed
55–60	6.6–10.6	11,907–17,743
60–65	10.6–16.5	5,183–8,073
65–70	16.5–25.1	3,327–5,060
70–75	25.1–37.1	2,716–4,018
Total		22,322–34,894

Sleep Disturbance

The percent of people expected to report having their sleep highly disturbed by excessive noise can be modeled based on current noise measurements. As described above, lack of sleep may have health consequences such as fatigue, impaired endocrine and immune system, and psychological effects. Sleep can also impact quality of life, intellectual capacity, education, and risk of accidents. Appendix D-1 describes the methodology used here for these calculations. Using the noise exposure levels shown in Table 8-6, which only includes the population from just north of the I-105 to the Port of Long Beach, it is estimated that between 5,000 and 7,000 people would be expected to report high degrees of sleep disturbance as a result of noise exposure from the I-710, as shown in Table 8-8.

Table 8-8. Number of People that Would Be Expected to Report Experiencing Highly Disturbed Sleep Due to Noise near the Southern Portion of the I-710

Noise Level (L_{dn}; dBA)	% Expected to Report Being Highly Sleep Disturbed	Number of People Expected to Report Being Highly Sleep Disturbed
55–60	8.0–11.3	2,637–3,723
60–65	11.3–15.3	1,890–2,565
65–70	15.3–20.1	714–937
Total		5,241–7225

Cardiovascular Disease

As seen in Table 8-9 current rates of hypertension and heart disease in the I-710 corridor are similar to rates in the county, as reported in the 2007 Los Angeles County Health Survey. Rates shown in the table are not statistically different and confidence intervals of measures overlap significantly.

Table 8-9. Cardiovascular Disease Rates near the I-710

	LA County	All Census Tracts in Study Area	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Hypertension rate	24.7%	21.2%	20.1%	22.5%	25.6%	22.2%
Heart disease rate	7.7%	6.2%	8.2%*	3.9%*	9.1%*	N.D.
* indicates the estimate is statistically unstable (relative standard error > 23%) and therefore may not be appropriate to use for planning or policy purposes Source: Los Angeles County Department of Public Health 2007a[293].						

Table 8-10 reports current rates of hospitalizations for CVD. Rates of hospitalization for hypertension are similar in the study area and the county, but these rates are higher than rates in the state. Rates for angina (without procedure) are higher in the study area than in the county, and county rates are higher than state rates.

Table 8-10. Cardiovascular Disease Related Hospitalization Rates (per 100,000)

	State of California	LA County	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Hypertension	35.56	52.63	57.74	65.66	59.03	66.43
Angina without procedure	25.15	29.06	36.09	42.68	36.54	43.26
Source: California Office of Statewide Health Planning and Development 2009[72].						

Many factors (including noise) contribute to cardiovascular disease rates, and CVD may not be diagnosed consistently due to differences in access to medical care. Although rates are not elevated in the I-710 corridor compared to the county, because of these issues, the level that noise is contributing to CVD rates in the study area is unknown. Recent literature suggests that noise levels (L_{dn}) above 70 dBA (which is equivalent to L_{eq}(h) of approximately 64 dBA assuming conservatively that daytime and nighttime noise levels are the same) may contribute causally to hypertension (Passchier 2000[358]). Additional literature suggests that L_d above 60 dBA may contribute causally to myocardial infarction (MI) (Babisch 2008[20]). Research has specifically linked traffic noise and MI incidence, and some researchers have proposed an exposure response relationship for noise and MI. At this point, the exposure-response relationship is not robust enough to quantitatively evaluate the magnitude of the impact of existing or future noise near the I-710 on MI.

Cognitive Impairment and Academic Achievement in Children

As discussed above, strong evidence supports a causal effect of noise, and traffic noise in particular, on children's learning. Though some quantitative relationships between noise and cognitive impairment have been established (e.g., for aircraft noise), a quantitative exposure-response relationship between traffic noise and cognitive impairment does not yet exist. Although it is not possible to quantify the extent to which children in the corridor suffer from attention span, concentration and remembering, and reading ability deficits, the potential impact on future health of these impacts (as established in the literature) is significant enough that it must be considered. Poor performance in school and resulting changes in educational attainment due to cognitive impairment from noise or any other cause can have life-long impacts, including impacts on lifespan, earning potential and the associated impacts on health of income (discussed elsewhere in this HIA), and on the prevalence of chronic and contagious disease and mental health issues (Egerter et al. 2009[125]).

Test scores of schools within 300 meters (984 feet) of the I-710 are shown in Table 8-11. For the highest grade tested at each school, the percent of students found to be proficient and advanced for reading and math on the California Standardized Test for the 2008–2009 school year was compared with county averages. Schools near the I-710 average 13% fewer students proficient or advanced in reading and 11% fewer students proficient in math. Proficiency in these subjects and cognitive impairment in general is multifactorial. Quantitative relationships between noise and these outcomes have not been established, so it is not possible to estimate the magnitude of the impact of noise on cognitive impairment and academic achievement.

Table 8-11. A Comparison of Test Scores for Schools Close to the I-710 to County Averages

School	Highest Grade Tested	% Above (+) or Below (-) County Average for Children Reading at Proficient or Advanced Levels	% Above (+) or Below (-) County Average for Children Doing Math at Proficient or Advanced Levels
Bell Gardens	4	-9	-48
Humphreys Ave	5	4	-10
Ford Boulevard	5	-19	-26
Bandini	5	-16	-7
Clinton	5	-6	6
Los Cerritos	5	-11	-22
Hamasaki	6	-15	-27
Marianna Avenue	6	-3	20
Brooklyn Avenue	6	-24	-26
Park Avenue	6	-13	18
Cesar Chavez	6	10	-3
Rogers	6	-23	-17
John Muir	8	-29	-23
Bell Gardens	8	-7	-4
Whaley	8	-29	-12
Firebaugh	11	-11	-10
Dominguez	11	-18	10
Source: California Department of Education 2010[65].			

There are 5,942 residences, many with children, and 20 schools located within 300 meters (984 feet) of the I-710. Indoor short-term noise (10-minute) measurements taken by Caltrans (URS and Caltrans 2010[463]) at 9 schools indicate that noise levels (L_{eq}) range from 41 to 50.1 dB, which is significantly above the recommended WHO guidelines of 35 dBA discussed above (a standard consistent with the ANSI S12.60-2002 as well) and can lead to disturbance of communication in the classroom. Outdoor measurements at the same schools indicate noise levels (L_{eq}) ranging from 55.3 to 65.9 dB, which are higher than daytime levels allowable for residential properties (50 dB) in the Los Angeles County Code (there is no specific designation for schools in the code; school exterior noise designations are often similar to residential designations) but acceptable under the Long Beach General Plan Noise Element guidelines.

As of yet, noise measurements are not available for all schools in the study area. For example, indoor and outdoor noise levels at Humphreys Avenue Elementary School, pictured below and sited very close to and above the I-710, have not been measured. Once these measurements have been taken, one could look to see if there is any correlation between noise levels and school performance, though many other factors (e.g., poverty rates, English proficiency) would need to be controlled for when doing such an analysis.

Figure 8-8. A Photo of Humphreys Avenue Elementary School, in Proximity to the I-710 and On-/Off-Ramps

The 85 residential short-term noise levels near residences range between 45.7 dB to 78.7 dB. Of these measurements, only 13 are below the exterior noise level at which annoyance begins (55 dBA) according to the WHO. There are 4 above 70 dB, a level at which hearing impairment begins according to the WHO. All but 5 of these measurements are above the county standard for daytime residential noise (50 dB) and 45 are above Long Beach's "normally acceptable" standard for single-family homes (60 dB).

As a result of these high noise levels at many schools and residences with children, many school age children are currently at risk of attention span, concentration and remembering, and reading ability deficits. As described above, these are likely to result in impacts on lifespan, earning potential and the associated impacts on health of income, and on prevalence of chronic and contagious disease as well as mental health issues.

Hearing Impairment

Current noise levels near the I-710 are not likely to result in hearing impairment, based on the WHO guidelines above.

8.3 Assessment of the Impacts of the I-710 Corridor Project on Noise

8.3.1 Predicted Changes in Noise on the I-710 and the On-/Off-Ramps

Noise Emissions

Noise models predicting future noise levels for each of the alternatives being considered in the EIR/EIS are being developed by Caltrans but were not available at the time the HIA was completed. However, based on traffic volumes and speeds, noise emissions for each of the proposed alternatives can be predicted. Tables 8-12 and 8-13 below show projected changes in traffic volume and speed for each alternative.

Truck traffic volumes for Alternatives 6C (freight corridor tolling) are predicted to be 30% higher in the GP lanes (22–61% higher during peak hours) and 23% lower on the freight corridor (13–22% lower during peak hours) compared to Alternative 6A/B. Overall, a 6% decrease in truck traffic on the I-710 is predicted for Alternative 6C compared to 6A/B.

Table 8-12. Traffic Volume on I-710, Percent Change from 2008

Build Alternative	Auto Volume	Truck Volume in GP Lanes (Total Truck Volume: General Purpose + Freight Corridor)
AM Travel		
1	0.1%	101.2%
5A	5.0%	134.1%
6A/B	13.5%	46.4% (252.1%)
6C	N.D.	N.D.
MD Travel		
1	12.0%	42.4%
5A	24.0%	54.1%
6A/B	32.9%	13.6% (107.9%)
6C	N.D.	N.D.
PM Travel		
1	3.3%	32.6%
5A	33.0%	51.7%

Build Alternative	Auto Volume	Truck Volume in GP Lanes (Total Truck Volume: General Purpose + Freight Corridor)
6A/B	40.2%	2.9% (124.5%)
6C	N.D.	N.D.
Source: Data from draft I-710 Corridor Project EIR/EIS traffic studies (URS 2010[464]); Volume analyzed at 4 screenlines on the I-710 and then averaged.		

Table 8-13. Average Vehicle Speeds on the I-710 by Build Alternative

	2008 Baseline (mph)	Alternative 1 (mph and % Change over Baseline)	Alternative 5A (mph and % Change over Baseline)	Alternatives 6A/6B (mph and % Change over Baseline)	Alternative 6C
AM (6 a.m.–9 a.m.)	40.9	36.93 (-9.73%)	41.88 (2.36%)	47.7 (16.6%)	Unavailable but likely higher than 6A/6B
MD (9 a.m.–3 p.m.)	50.4	47.64 (-5.38%)	52.01 (1.22%)	56.4 (12.1%)	Unavailable but likely higher than 6A/6B
PM (3 p.m.–7 p.m.)	30.8	28.31 (-8.11%)	32.69 (6.10%)	37.2 (20.8%)	Unavailable but likely higher than 6A/6B
Source: Based on data from draft I-710 Corridor Project EIR/EIS traffic studies (URS 2010[464]).					

Alternatives 6A and 6B are projected to have the highest traffic volumes, truck volumes, and speeds on the freeway, followed by Alternative 5A, and then Alternative 1 (No Build). Volumes for Alternative 6C are likely to be lower than for 6A and 6B, but speeds are likely to be higher. Volumes in all alternatives are predicted to be higher than 2008 volumes. Speeds for the No Build Alternative are predicted to be slower than in 2008, while speeds for Alternatives 5A and 6A/B are predicted to be higher.

At lower speeds (below approximately 35 mph) zero emission technologies used in Alternative 6B may result in quieter truck engines, but given that road and tire noise is louder than engine and exhaust noise at higher speeds, changes in engine technologies may not significantly reduce aggregate traffic noise.

Because noise emissions are based on both traffic volume and speed, Alternative 6A/B is predicted to result in the highest noise emissions and increases from 2008 levels, followed by Alternative 6C, and then Alternative 5A. Alternative 1 is predicted to result in the smallest increase in noise emissions on the freeway.

Noise Exposure

Noise exposure is a function of noise emissions, distance, and barriers. As described, the freight corridor proposed under Alternatives 6A/B/C would be built between the existing I-710 mainline and the LA River and as far away from residences and other sensitive uses as possible. Additionally, Caltrans has proposed building approximately 5.5 miles of soundwalls before the freeway construction begins, as part of "Early Action Projects." (Metro 2011c[322], URS and Caltrans 2010[463]). These soundwalls are a part of the I-710 Corridor Project, but are being put in place (dependent upon feasibility) before actual the freeway construction. These soundwalls will be "constructed consistent with the existing freeway conditions and the proposed freeway improvements for the ten lanes that are proposed." A map showing the location of new early-action proposed soundwalls (Harris pers. comm. [506]) is shown in Figure 8-9. Additional soundwalls, aside from those in the Early Action Project, are also being considered for the GP lanes and for the freight corridor, including potentially building the entire freight corridor with a soundwall on the side closest to communities and a screenwall on the side closest to the LA River (data not shown).

Because noise intensity falls as distance increases and because the freight corridor is located farther from sensitive uses, the exposure to increased noise emissions from increased truck volumes will be attenuated for Alternatives 6A/B/C. Without more precise models (which are being develop by Caltrans currently), it is difficult to predict whether the increased noise emissions for Alternatives 6A/B/C would be fully mitigated by the increased distance of receptors from the source and by the proposed soundwalls. *This analysis is limited until further noise data is available; however, additional considerations and some conclusions regarding noise exposure are included herein.*

Given the existing noise levels in areas around the I-710, proposed soundwalls are likely to reduce noise exposure in some areas near the I-710 (i.e., where noise levels are currently above 67 dBA). However, it is not clear if the increase in noise emissions due to higher truck volumes and speeds will be completely offset by new soundwalls in areas that do not currently have them. For the many areas with current soundwalls that are not being retrofitted, noise levels will increase as a result of increased traffic volumes.

The goal of building soundwalls is to keep noise exposures below 67 dBA (Caltrans 2010[74]). However, noise levels off the freeway, while reduced, will still be highest for alternatives that produce more noise. If a soundwall reduces noise by 5 dB and the starting noise values are higher for an alternative, they will remain higher for that alternative after subtracting the 5 dB.

It is also important to note that the building of soundwalls, while alleviating noise issues, can lead to other potential health impacts, as follows:

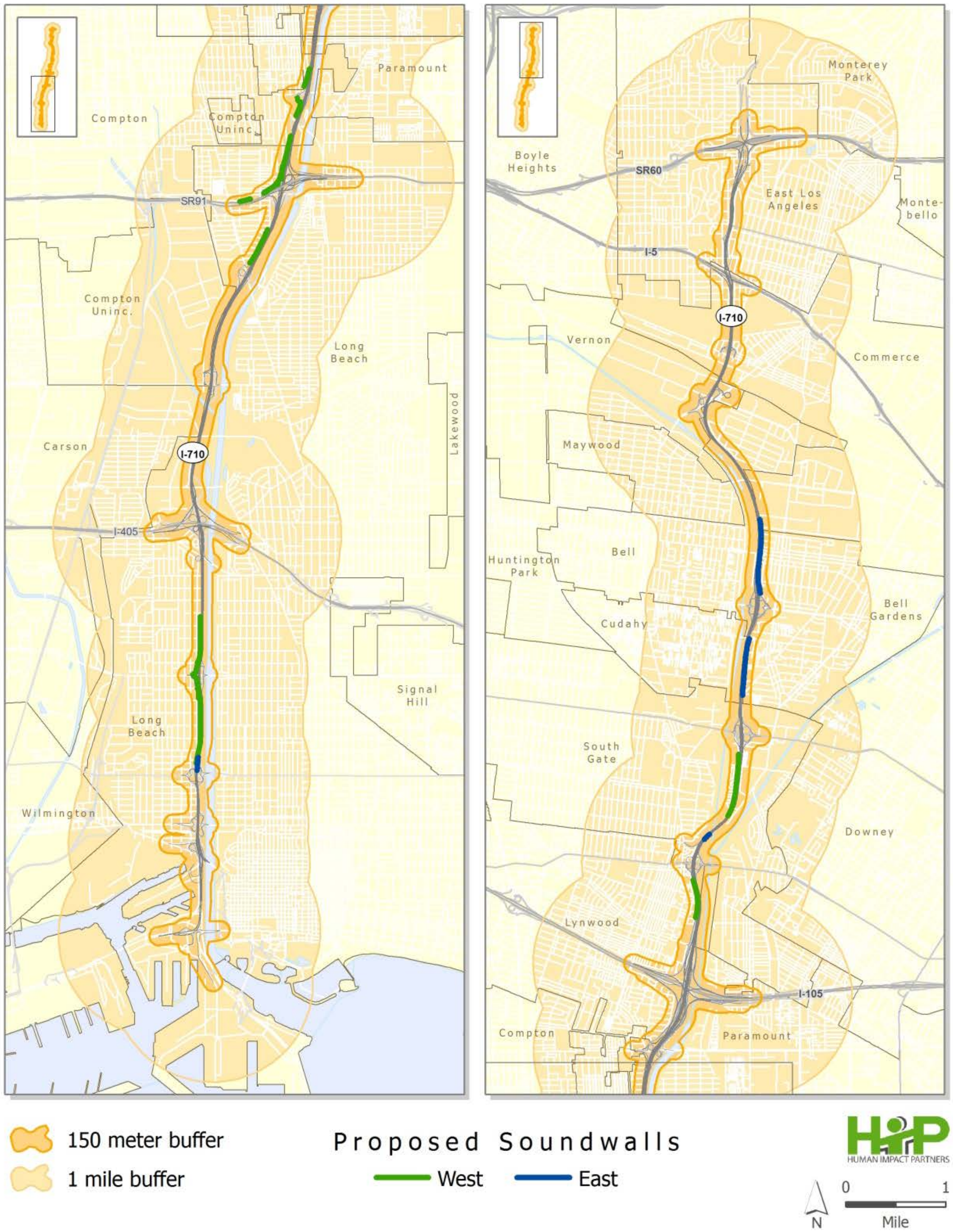
- Air quality: Air pollutant profiles have been shown to be different in the presence/absence of soundwalls on the I-710 (Ning et al. 2010[346]). When soundwalls are present, pollutant concentrations are lower in the immediate vicinity of the freeway but higher farther away (80–100 meters [262–323 feet]).
- Blight and shadow: Soundwalls can be a source of both unappealing views and shadows that may reduce one's pride in one's neighborhood and increase perceptions of the existence of blight. These feelings can translate into reduced social cohesion and, some (though not all) believe (Coles et al. 1996[114]), to increased crime. Figures 8-10 and 8-11 show existing soundwalls on the I-710 that may be considered more and less appealing. Note that the project's Urban Design and Aesthetics Toolbox Report (Gruen Associates 2011[208]) makes recommendations to reduce such impacts.

This analysis did not aim to provide an independent estimate of noise exposure levels. However, the conclusions below regard the relative levels of noise exposure among alternatives.

- Alternatives 6A/B will result in higher noise exposure than Alternative 6C.
- Alternatives 6A/B/C will lead to higher noise exposure for sensitive receptors on the opposite side of the LA River from the freeway because of the location of the freight corridor. These areas currently have lower noise levels than receptors on the same side of the river as the freeway. The width of the river will attenuate the exposure, but it will definitely increase from current levels.
- Alternative 1 is likely to result in the smallest increases in noise exposures because of the lower noise emissions resulting from reduced truck volumes and lower speeds on the freeway due to unrelieved congestion.

Total traffic volumes and speeds are lower for Alternative 5A than Alternatives 6A/B, but much of the truck traffic in Alternatives 6A/B will be farther away from sensitive receptors on the same side of the freeway. Because these will have opposite effects on noise levels, the alternative that will result in higher noise levels cannot be determined. *This finding should be confirmed in the noise modeling being conducted by Caltrans.*

Figure 8-9. A Map of Proposed Early-Action Soundwalls



Note: In its draft Noise Study, Caltrans has also preliminarily identified additional possible locations for soundwalls near all sensitive receptor sites.

Figure 8-10. Existing Landscaped Soundwalls near the South End of the I-710

Figure 8-11. Existing Soundwalls That Are Not Landscaped in the North Section of the I-710

8.3.2 Predicted Changes in Noise on the Arterials and Smaller Roads

The project is likely to impact traffic noise on arterials and local roads. Traffic volumes on arterials are predicted to be highest for Alternative 1 (as a result of vehicles using the arterials rather than the congested freeway), followed by Alternatives 6A/B, and then by Alternative 5A. Data for Alternative 6C was not available.

Table 8-14. Arterial Street Volumes by Alternative, Percent Change Compared to 2008 Baseline

	Alternative 1	Alternative 5A	Alternative 6A/B	Alternative 6C
Auto	8.45%	7.47%	8.35%	Unavailable.
All Truck	43.76%	37.89%	38.02%	Unavailable.
Source: URS 2010[464]; SCAG RTP travel demand model				

Predicted speeds on arterials were not available; however, predicted speeds for Alternative 1 will be lowest because traffic volumes are the highest and no intersection improvements are proposed. Intersection improvements are proposed for the remaining alternatives, so traffic will be able to move faster on the arterials. Given slightly lower traffic volumes, it is likely that Alternative 5A will have the fastest speeds, but they are likely to be similar to Alternatives 6A/B.

Therefore, noise levels from traffic on arterials are predicted to increase by a relatively similar amount for all the alternatives under consideration. Alternative 1 will have higher volumes (leading to increased noise emissions) but lower speeds (leading to decreased noise emissions) than Alternatives 5 and 6A/B. Alternative 6B may result in lower noise levels than 6A if zero emission technologies used result in lower noise emissions at lower speeds.

8.3.3 Predicted Changes in Noise from Other Goods Movement Facilities

The destinations of the increased truck traffic on the arterials are warehouses, intermodal facilities, transloading facilities, truck repair shops, and similar goods movement–related destinations. As described above, these destinations are often near residential neighborhoods. Under any alternative, due to increased port throughput, the warehouses and other facilities that are not operating at full capacity currently are likely to increase operations, leading to more noise.

It is also possible that, especially for Alternatives 6A/B/C, parts of the goods movement infrastructure may relocate farther from the ports to locations with cheaper land and less congestion. This could lead to decreased use of the facilities in the Gateway Cities and reduced noise levels. Because these changes are difficult to predict and have not been modeled elsewhere in the I-710 analysis, they are not considered further here.

8.3.4 Summary of Changes to Noise Levels

Table 8-15. Summary of Predicted Changes in Noise Emissions

Alternative	Changes in Noise Emissions by Source Compared to 2008 Levels and Relative to Each Other		
	Freeway	Arterials	Other Goods Movement Infrastructure
1	⇑⇑	⇑⇑⇑	⇑⇑
5A	⇑⇑⇑	⇑⇑	⇑⇑
6A	⇑⇑⇑	⇑⇑	⇑⇑
6B	⇑⇑⇑	⇑	⇑⇑
6C	⇑⇑⇑	N.D.	⇑⇑
Note: The number of '⇑' signs indicate the relative increase in noise from each source.			

Based on existing noise levels and the changes in noise levels discussed above, many of the people living in the almost 6,000 residences within 300 meters (984 feet) of the freeway will be exposed to noise levels above 60 dBA and potentially as high as 67 dBA, the Caltrans noise abatement level. Further analysis of exposure is pending additional analysis by Caltrans.

8.3.5 Predicted Health Outcomes Related to Noise

Based on the changes in noise levels described above, qualitative predictions can be made regarding changes in annoyance, sleep disturbance, cardiovascular disease, and other health outcomes. While predictions of magnitude are not possible due to a lack of data, the direction, likelihood, and severity of impacts can be estimated. Once noise models from Caltrans are available, quantitative analyses of the magnitude of impacts on annoyance and sleep disturbance should be conducted using the protocols described in Appendices D and D-1 and qualitative predictions of magnitude should be made for other health outcomes.

Annoyance

Estimated future noise levels are well above the 50–55 dBA noise levels at which a causal effect of noise on annoyance has been well established (Berglund et al. 1999[37]). There is therefore a high likelihood that all project alternatives will increase reported noise-related annoyance for residents near the I-710. Of the alternatives being considered, Alternative 1 will lead to the smallest increase in the number of residents who report being highly annoyed due to noise.

Table 8-16. Percent of People Predicted to Likely Report Being Highly Annoyed[1]

Daytime (L_d) and Nighttime (L_n) Noise Level (dBA)	Day-Night Equivalent Noise Level (L_{dn}) (dBA)	% of People Highly Likely to Report Being Highly Annoyed
60	66.4	18.6
61	67.4	20.2
62	68.4	22.0
63	69.4	23.9
64	70.4	25.9
65	71.4	28.1
66	72.4	30.4
67	73.4	32.8

[1]Percent of people likely to report being highly annoyed as a result of noise levels near the I-710, stratified by noise level (conservatively assuming that daytime and nighttime noise levels are the same)

Sleep Disturbance

Sleep disturbance begins in the 55 to 60 dBA range, and predicted noise levels at night are likely to be above this range, especially given programs that encourage nighttime freight movement (continuance of Pier Pass) to manage congestion and other impacts. There is strong evidence that residents near the I-710 are highly likely to report having their sleep disturbed because of noise exposure.

Table 8-17. Percent of People Predicted to Likely Report Having Their Sleep Highly Disturbed

Nighttime (L_n) Noise Level (dBA)	% of People Highly Likely to Report Having Their Sleep Disturbed Significantly
60	11.3
61	12.0
62	12.8
63	13.6
64	14.4
65	15.3
66	16.2
67	17.2

Percent of people likely to report having their sleep highly disturbed at estimated future noise levels near the I-710, stratified by noise level

Cardiovascular Disease

Estimated future noise levels are in the range of noise levels at which noise has been shown to be causative for hypertension (L_{dn} = 70 dBA) and myocardial infarction (L_d = 60 dBA). Prevalence of cardiovascular disease, a significant health outcome, in residents near the I-710 is likely to increase under all alternatives being considered. Alternative 1 will lead to the smallest increase in the number of residents with cardiovascular disease due to noise.

Cognitive Impairment and Academic Achievement in Children

Without mitigation, the number of schools with indoor noise levels well above the WHO recommended 35 dBA is highly likely to increase, and noise levels in schools with already high levels are also highly likely to increase. The large number of children in schools near the I-710 will be exposed to higher noise levels both in school and, for those also living near the I-710, at home. As a result, there is significant evidence that many school age children will be at increased risk of attention span, concentration and remembering, and reading ability deficits. As described above, these are likely to result in significant impacts on lifespan, earning potential and the associated impacts on health of income, and prevalence of chronic and contagious disease as well as mental health issues. Impacts in terms of the number of children experiencing these effects and the significance of the effects will be most significant for Alternatives 6A/B/C/D and 5A, but still significant under Alternative 1.

Hearing Impairment

There is strong evidence that none of the alternatives being considered is likely to result in noise levels that would lead to hearing impairment. However, people with existing hearing impairment, for example seniors experiencing hearing loss, will be impacted. Those populations will have more difficulty communicating with others as a result of higher noise levels.

Other Impacts

In addition to the impacts described above, increased noise at local parks that border the freeway (e.g., Bandini Park, which is bordered by both the I-170 and rail lines, and Maywood Park, which will have a new on-/off-ramp nearby under the build scenarios), may lead to a more negative perception of those parks (Szeremeta and Zannin 2009[431]), which could in turn lead to reduced physical activity for both adults and children. Reduced physical activity would lead to many negative health impacts, including increased diabetes, cardiovascular disease, and depression. These impacts are discussed further in Chapter 11, "Access to Neighborhood Resources."

Summary

Some technologies to reduce vehicle air emissions do have a commensurate benefit for noise. However, as Table 8-18, which summarizes noise-related health impacts, shows, all of the alternatives are likely to lead to negative health impacts as a result of higher noise levels. Noise-related health impacts would diminish the project's objective of improving public health.

Table 8-18. Summary of Predicted Noise-Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Annoyance					
1	-	Estimates pending noise modeling data from Caltrans	Low	♦♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Sleep Disturbance					
1	-	Estimates pending noise modeling data from Caltrans	Mod–High	♦♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Cardiovascular Disease (including hypertension and myocardial infarction)					
1	-	Estimates pending noise modeling data from Caltrans	High	♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Cognitive Impairment and Academic Achievement					
1	-	Estimates pending noise modeling data from Caltrans	Mod–High	♦♦♦	Modeled changes in noise exposure were not available for this analysis; magnitude is not estimated.
5A					
6A					
6B					
6C					
Hearing Impairment					
1	~	None	Mod	♦♦♦	
5A		None			
6A		None			
6B		None			
6C		None			

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between noise and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

8.4 Recommendations

As described above, Caltrans has preliminarily identified sites for potential soundwalls along the I-710 near sensitive receptors. This is a very important mitigation measure, but as the Tier 2 Committee report states, "Noise issues go beyond simply building more soundwalls." The recommendations below would mitigate impacts of noise on health in the I-710 communities. It is critically important that implementation of the recommendations to improve noise be addressed with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated objective of improving public health.

8.4.1 Noise Analysis

- Complete the noise modeling for the I-710 Corridor Project EIR/EIS alternatives and use the results to quantitatively predict changes in annoyance and sleep disturbance and qualitatively assess changes in other health outcomes under the proposed alternatives.
- In the final noise report, describe existing and future noise levels using multiple measures, including separating daytime and nighttime noise, and measure ambient noise at additional sites.

8.4.2 Goods Movement, Transportation, and Land Use Planning

- All strategies for moving freight by other means, such as increasing use of the lowest emission on-dock rail technologies feasible, should be implemented. Fewer trucks on the freeways and arterials will result in decreased noise.
- Planning departments should ensure that all local land use planning improves the separation of residential and other sensitive uses from the goods movement infrastructure. All attempts should be made to move the goods movement infrastructure as close to the freeway as possible and to move sensitive uses away from the freeway and its associated traffic as well as away from the goods movement infrastructure. This is the best long-term solution to noise issues in the community, but it will be the most difficult to implement. For example:
    - Develop truck parking facilities and truck stops with services (e.g., restaurants, repair shops) near the freeway so that drivers do not need to drive farther into the communities and near sensitive uses.
    - Pass city ordinances restricting potential land uses to reduce conflict between sensitive receptors and noise-producing facilities.
    - Pass city ordinances requiring new construction or uses to evaluate noise levels and mitigate if necessary before issuing permits.
- As the Healthy Communities and Healthy Economies: A Toolkit for Goods Movement Report (MIG and ICF International 2009[326]) states, planning departments can:

- "Review and approve applications for new land uses (such as new warehouses) for fit within the General Plan framework and define measures (such as setbacks or noise restrictions) that must be taken to deal with any adverse impacts
- Negotiate voluntary restrictions on hours of operation and noise for existing facilities."

- Use the Conditional Use Permit process to require goods movement related facilities to:
  - Post signage informing drivers of idling regulations and truck routes;
  - Require new facilities to locate loading docks and driveways as far away as possible from sensitive receptors; and
  - Use cargo handling equipment with noise mitigation technology (e.g., electric engines).
- Starting with existing residential streets that are walkable/bikeable, expand the network of safe walkable/bikeable streets in low-noise areas throughout the I-710 corridor to provide quiet and pleasant streets that can be used for active transportation and for physical activity.

8.4.3 Noise Mitigations through Design

- Construct sound walls in all locations in the corridor that are adjacent to a residential area, school, or park. For these soundwalls, use greening and aesthetic principles found in the project's Urban Design and Aesthetics Toolbox Report (Gruen Associates 2011[208]).
- Use low-noise (e.g., rubberized) road surfaces, evaluating alternative materials with regards to their effects on air quality.
- Work with acoustic scientists to design the freeway geometry so as to minimize noise, for example, by minimizing the number of inclines.
- Consider using variable tolling (e.g., congestion pricing) and/or changes to port gate hours to reduce variation of noise and peak noise periods.
- Create and fund a program that provides private property owners funding and technical assistance to augment acoustical insulation in private residences.

8.4.4 Funding, Enforcing, and Strengthening Noise-Related Regulations

- Use revenue from tolling to fund mitigations for noise impacts. Funds could be used, for example, for enforcement of truck routes, parking, idling regulations, and speed limits; installation of truck noise reduction technology; sound insulation at schools; and vegetative buffers between freeways and parks.
- For any alternative selected, fully fund and, if necessary, strengthen enforcement of truck route and parking regulations as well as idling regulations. For example, parking rules could prohibit trucks from parking adjacent to parks and other recreational facilities. Local jurisdictions could implement enforcement of CARB's idling regulations.

- Enforce and, if needed, strengthen regulations regarding truck noise (e.g., engine brake laws) and consider funding truck noise reduction programs.
- Enforce speed limits, considering photo-enforcement as a cost-effective means to limit noise.

8.4.5 Post Build-Out Monitoring and Mitigations

- Before the project begins, develop a complete noise monitoring plan that will identify and address future potential noise issues that are attributable to the I-710 project. This plan should include:
  - After the project is completed, regularly monitor noise levels at schools, community centers, libraries, and senior facilities. If noise levels rise above what is considered harmful to human health and this is attributable to the I-710 project, commit to retrofitting these facilities (e.g., providing upgrades to windows and ventilation systems) to keep indoor noise below levels considered harmful by the WHO guidelines described above.
  - After the project is completed, regularly monitor indoor noise levels in residences near the freeway and near goods movement infrastructure (e.g., train yards and warehouses). If noise levels rise above what is considered harmful to human health and this is attributable to the I-710 project, retrofit to noise insulate either the residences (through windows and ventilation) or, if possible, noise producing equipment in goods movement facilities.

9. Traffic Safety

9.1 Introduction

Motor vehicle traffic collisions are a leading cause of mortality and morbidity in the United States, and the number one cause for mortality for those aged 5–34 years. According to the Centers for Disease Control and Prevention, motor vehicle crashes are the third most common cause of years of life lost, behind only cancer and heart disease (CDC 2011b[98]). According to the USDOT, the total societal economic cost of collisions exceeds $230 billion annually (FHWA 2011b[187]).

Pedestrians and bicyclists are disproportionately injured and killed in traffic collisions. About 14% of motor vehicle collisions involve pedestrians and bipedal vehicles (both bicycles and motorcycles). Improving road safety not only will save lives and money, but will also reduce one of the most significant barriers to active transportation.

This chapter describes the link between environmental conditions and traffic safety, the existing traffic safety conditions on the I-710 and in surrounding areas, the impact of the I-710 Corridor Project on traffic safety, and proposed recommendations to improve health outcomes related to traffic safety.

9.1.1 Background: Roadways, Road Safety, and Health

Motor-vehicle collisions are significant adverse health consequences of the operation of public roadways. Collisions can involve single or multiple motor vehicles, pedestrians and pedal cyclists. However, other health consequences of the operation of roadways considered under the rubric of safety include potential releases of hazardous materials (from tanker trucks, for example). Roadways may also be sources of perceived dangers, contributing to worry and stress.

The following section briefly summarizes the literature on the various types of collisions, defined by the combination of the modes of transit used by the parties involved.

Collision Frequency, Rate, and Risk

The frequency of collisions represents the absolute number of collisions—a raw count. In the traffic safety field, the rate of collisions represents the number of collisions relative to the amount of time, while the risk of collisions represents the number of collisions per aggregate distance traveled (e.g., vehicle miles traveled).

This distinction is important because the raw number of traffic collisions may change over time, but whether or not the rate or risk of collisions changes depends on how the denominator measure changes over the same time period. It is the collision rate, and not the risk, that generally describes the relative burden or severity of the traffic safety situation in a given area.

Freeway Design

Roads and freeways can contribute to increased or decreased risk of collisions directly based on their design characteristics (e.g., number of lanes, lane geometry, and lighting) (Griffith 1994[207]), level of maintenance (e.g., pavement conditions and signage), and indirectly via effects of these environmental characteristics on driver behavior (e.g., a narrower road with more curving naturally encourages drivers to reduce their speeds).

A quantitative modeling study in Florida examined the effect that various roadway designs had on traffic collisions and found that, for urban freeways, larger lane widths, larger outside shoulder widths, and lower annual average daily traffic (AADT) were associated with lower crash rates (Hadi et al. 1995[212]). These characteristics may influence rates of collisions for certain types of collisions more than others; in the above example, those design characteristics may be linked with fewer rear-end type collisions but more high speed collisions, which generally have more severe health consequences.

Poor freeway interchange design may also cause a higher incidence of traffic collisions if it requires vehicles to quickly change lanes, within a limited distance, in order to merge into their intended grade-separated junction lanes ("weaving-type" collisions). A report released by the Transportation Research Board in 1993 advised that cloverleaf ramps, scissor ramps, and left-side ramps should be avoided wherever possible, and that entry and exit terminals of interchanges should be at least 800 feet long. They also found that collision potential was related to the ramp and through-lane traffic volumes, and that collision rates increased as the distance between urban interchanges decreased (Twomey et al. 1993[449]). A 2010 study on weaving-type collisions also found lower collision rates when weaving distances were longer, and higher collision rates when overall volumes were higher (with different crash types resulting from higher entry- and exit-volumes) (Pulugurtha and Bhatt 2010[376]).

In addition to design, lane additions to increase freeway capacity—where extra lanes are created by restriping the traveled way with narrower lanes or converting part of all of a shoulder to a travel lane and not by widening the roadbed—have been shown to increase the frequency of collision rates (Bauer et al. 2004[33]). For example, they found that, in urban freeways in California, converting four lanes to five lanes resulted in a 10 to 11% increase in collision frequency, and converting from five to six resulted in smaller increases. As presently known, there has been no study that has examined the effects of lane additions in conjunction with roadbed widening.

Volume, Congestion, and Speed

While roadway and freeway design has been shown to affect collision rates, a 2006 study that modeled lane-change–related collisions on freeways concluded that, on freeways, geometry was less important than certain traffic conditions that existed immediately before any given collision (notably, average speeds upstream and downstream of crash location, difference in occupancy on adjacent lanes, and standard deviation of volume and speed downstream of the crash location) (Pande and Abdel-Aty 2006[355]).

Additional literature provides significant evidence that injury collision frequency increases with increase in traffic volume (Elvik 2009a[130], Twomey et al. 1993[449]), and that collision frequency increases with speed (Aarts and van Schagen 2006[1], Taylor et al. 2000[434], Elvik 2009b[131]).

The V/C ratio can be used to compare freeway segments as a proxy for relative traffic burden. A report by the Transportation Research Board of the National Academies found a U-shaped relationship between V/C ratios and traffic collisions on I-94 in Detroit, Michigan, where collisions were highest when V/C ratios were on either the lower or higher extremes than in the middle ranges (Zhou and Sisiopiku 1997[500]). At lower V/C ratios, there is a high potential for high-speed–related collisions, where rollovers are more likely and severity of injuries are higher. With higher V/C ratios, there is a greater likelihood of lower-severity rear-end type collisions, as speeds are low but congestion is high.

Congestion is a synonym for high V/C ratios, and is a term that is commonly used in traffic safety literature. Several studies have shown that collision rates are higher under congested conditions compared to lighter traffic conditions (Shefer and Rietvald 1997[414], Sullivan 1990[427]). Correspondingly, collision rates are higher on weekdays compared to weekends, and higher in the afternoon peak period compared to mid-day and morning peak periods and at night (Giuliano 1988a[199]).

Higher speeds generally provide less time to respond to roadway conditions, and lengthen braking distance (Aarts and Schagen 2006[1]). The resources and technologies used to enforce safety rules like speed limits can have large effects on driver risk behaviors (Taylor et al. 2000[434]). A study on highly visible speed camera enforcement was done on a busy urban freeway in Scottsdale, Arizona, and found that they were effective in reducing speeds both near and as far away as 25 miles from the camera locations (Retting et al. 2008[385]).

On- and Off-Ramps

Traffic collisions can also be affected by on- and off-ramp designs. Single point urban interchanges (SPUIs) were found to have no significant differences in the frequencies of rear-end type collisions compared to tight diamond interchanges, but had larger percentages of collisions as sideswipes compared to tight diamond interchanges (Qureshi 2004[380]). They were also found to have no effect on total collision rates; however, they were found to have lower fatality and injury rates compared to tight diamond interchanges (Bared et al. 2005[26]).

While truck collision rates were not addressed in the literature for SPUIs, it is mentioned that SPUIs increase the efficiency for trucks; the shallower angles found in SPUIs allow trucks more room to make their wide radius left-hand turns, in particular (Qureshi 2004[380]).

In addition, SPUIs were found to be non-ideal for roadways that are heavily trafficked by non-motorized travelers, due to the large intersection area and signal phasing compared to tight diamond interchanges (Qureshi 2004[380]). Pedestrians generally have difficulty crossing SPUI intersections in one signal phase. No research was found on how pedestrian and bicycle collision, fatality, and injury rates were affected by the implementation of SPUIs.

Arterials

The previous research on the association between freeway V/C ratios and collision rates may be applicable to arterial and other surface streets, especially at lower speeds, but the additional roadway design features of surface streets (e.g., intersections, one-way vs. two-way streets, traffic calming, etc.) must be taken into consideration if a complete model of risk factors is to be developed.

Intersections carry especially high risks of collisions on surface streets; according to a report by the Transportation Research Board, intersection-related crashes make up 50% of all urban collisions and 30% of all rural collisions. They also found that “just under a quarter” of fatal crashes occur at intersections (Antonucci et al. 2004[14]). Because of the sheer number of variables in intersection design, research on the collision reduction factors for intersections is sparse.

Truck-Related Collisions

A different set of issues surrounding risk factors and outcomes apply to truck-related collisions, and they are still poorly understood in the literature. In the six-county region (Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura), truck collisions account for 6% of all vehicle collisions and 7% of vehicle fatalities. Truck collisions tend to disproportionately damage the other vehicle and cause injury to its occupants due to their vast mass advantage. A total of 84% of fatalities in large truck collisions are passengers in other vehicles (MIG and ICF International 2009[326]).

A study looking at truck data from 1985 to 1987 estimated associations between truck traffic collisions and highway geometric design. The study found that higher AADT per lane, horizontal curvature, and vertical grade were significantly correlated with truck collision rate, but that shoulder width had comparably less correlation (Miaou et al. 1992[324], Miaou 1994[323]).

Freeway ramps provide unique challenges to trucks because of their increased length and weight and their higher weight distribution as compared to automobiles. A report on truck collisions on freeway on- and off-ramps found that specific ramp geometrics (e.g., grade, curvature, and length) were not statistically significantly associated with truck collision rates, but that loop ramps have generally higher collision rates than non-loop ramps, particularly with respect to overturn collisions, when controlling for ramp truck average daily traffic (Janson et al. 1998[237]).

Traffic collisions have been shown to decrease when trucks are separated from automobiles into truck-exclusive lanes, either with a separate carriageway or with “soft” barriers such as reflective traffic lane dividers. Physical separation of heavy-duty trucks from the regular traffic offers the maximum benefits and restricting trucks from the use of the leftmost lane offers the second-highest benefits in terms of efficiency, energy, and environmental impacts (Rakha et al. 2005[381]). Truck lane restrictions were found to be associated with improved traffic measures of effectiveness (speed, capacity, density, and lane changes) and on highways, and may lead to better safety (mostly due to the reduction in lane changes—a major cause of crashes). However, these results were only found at higher flow rates (Jo et al. 2002[242]).

Crash Reduction Factors

USDOT and the FHWA define crash reduction factors as follows: “A CRF is the percentage crash reduction that might be expected after implementing a given countermeasure” (FHWA 2008[184], National Cooperative Highway Research Program 2005[338]). These measures can be applied quantitatively as a generic estimate of the relative effectiveness of a given countermeasure. The crash reduction factor number corresponds to the percent reduction of crashes that would be expected after the implementation of an intervention.

Using the reference tables provided by USDOT and FHWA, it would be possible to conduct an analysis of site-specific crash reduction factors for each proposed improvement under Alternatives 5A and 6A/B/C, as long as the operational and environmental characteristics of the site match with those in the crash reduction factor desktop reference table. Such an analysis is beyond the scope of this HIA.

Factors Affecting Outcome Severity for Collisions

A study by the Centers for Disease Control and Prevention found that 1.1% of collisions result in fatalities (Vyrostek et al. 2004[471]). In California in 2009, excluding collisions that resulted in property damage only, that figure was 1.07% (California Highway Patrol 2009[69]). However, many factors have been researched to explore what characteristics of crashes are more predictive of severe outcomes. Consistent with the laws of physics, collision and injury severity increase exponentially with the impact speed of the vehicle and in proportion to the mass of the vehicle. Collision injury severity increases greatly with speed (Richards 2010[388], Gårder 2004[195]).

Speeding, typically assessed as driving approximately 10 mph over the speed limit, is a proxy for impact speed and also potentially for risky driver behavior. The USDOT and the National Highway Traffic Safety Administration found that speeding is responsible for between 21 and 55% of all fatal crashes (National Highway Transportation Safety Administration 1998[340], 2009a[341]). Also, an issue brief on safer streets reported that crash speeds of 40 mph result in a fatality rate of 4 per 1,000 people, and crash speeds above 50 mph result in 15 per 1,000 people, or 3.75 times the fatality rate seen at 40 mph (STPP 2003[424]).

Consistent with the established relationship between speed and injury severity, lower speed limits and effective enforcement of speed limits reduce injury severity. Lowering speed limits has been shown to effectively reduce average traffic speeds on both rural and urban freeways (Retting and Teoh 2008[383]). Systematic reviews of the literature (Wilson et al. 2010[492], Pilkington and Kinra 2005[364]) found that speed camera enforcement was an effective intervention for reducing traffic injuries and deaths. In a Washington, D.C. study, speed cameras reduced mean speeds by 14%, and the proportion of vehicles exceeding the speed limit by more than 10 mph decreased by 82%. In addition, several studies in the U.S. found increased rates of collisions, fatalities, and injuries associated with an increase in the speed limit (Renski et al. 1999[382], Rock 1995[396]).

Collision rates may change due to changes in vehicle technology (e.g., smaller, lighter, and more fuel-efficient cars). Research has shown that occupants have an increased fatality risk when involved in collisions with cars of higher mass than their own (Evans and Frick 1992[174]). A study, published in 1992, on the relationship between vehicle mass and fatality risk concluded that as improved crashworthiness features get built into larger vehicles, fatality rates will increase alongside increased fuel economy (Evans and Frick 1994[175]). In addition, improved vehicle crashworthiness may facilitate certain risky driver behaviors such as speeding (Richter et al. 2006[390]). Another possibility is that, with the advent and wider adoption of more effective automated collision avoidance systems (CAS) that use advanced collision-free path-planning and path-following technologies (Brandt et al. 2005[50]), there may be a decrease in collision rates over time, though the number of total cars on the road is expected to increase. However, it is unknown how soon this technology will begin to be standard in production cars and what its impact will be.

Vehicle–Pedestrian Collisions

Nationally, in 2009, 71% of pedestrian deaths occurred in urban areas (Insurance Institute for Highway Safety 2009[231]). Factors contributing to vehicle-pedestrian collisions can include driver and pedestrian behaviors, as well as environmental characteristics. A study that drew from over 5,000 pedestrian-related crashes in six states found that over 80% of the pedestrian crashes fell into the following crash-type categories: vehicle turn or merge (9.8%), pedestrian intersection dash (7.2%), driver violation at intersection (5.1%), other intersection (10.1%), pedestrian midblock dart or dash (13.3%), other midblock (13.1%), pedestrian not in roadway and waiting to cross (8.6%), walking along roadway (7.9%), and backing vehicle (6.9%) (Stutts et al. 1996[425]). A majority of these categories suggests that the fault of the collision lies with the driver.

In urban areas, most traffic collisions involving pedestrians occur at intersections, while nationally three-quarters of pedestrian deaths occur on major roadways at locations other than intersections. Roadway, driver, and pedestrian factors contribute to these collisions. High speeds and wide roads are associated with higher frequencies of crashes (Gårder 2004[195]). A study that looked at automobile and pedestrian behavior at intersections in Vancouver, Canada, found that at intersections, 21% of pedestrians committed one of the observed road-crossing violations while 5.9% of drivers committed one of the motorist violations (Cinnamon et al. 2011[105]).

A 2007 report by the Seattle Department of Transportation found that 57% of pedestrian collisions in Seattle involved no pedestrian-contributing circumstances, 9% were influenced by the pedestrian failing to use a crosswalk, 7% involved pedestrians not granting right-of-way to the vehicle, and 5% involved pedestrians who were under the influence of alcohol (Seattle Department of Transportation 2007[410]).

Research consistently demonstrates that pedestrian activity and traffic volume are the main determinants of pedestrian collision frequency at signalized intersections (Harwood et al. 2008[216]). One study (Miranda-Moreno et al. 2011[329]) estimated that a 30% reduction of traffic volumes in each of the studied intersections would reduce the average risk of pedestrian collision by 50% and the total number of injured pedestrians by 35% in the area under analysis. That study found that arterials and urban highways are negatively related with pedestrian activity and positively associated with traffic volume, and that increased pedestrian activity would result in more pedestrian collisions.

The authors of the above study concluded that built environment characteristics of streets influence people's likelihood of walking, and that retrofitting major urban roads into more complete streets would have positive health benefits. Their literature search found that pedestrian activity and vehicle volumes were primary determinants in collision frequency, while vehicle speeds were one of the main contributing factors associated with outcome severity. It is important to note that they do not make any assertions on rates of pedestrian collision, as they do not include person time or exposure in their calculations. Another study found an inverse relationship between traffic volumes and speeds and levels of walking and biking because of the perceived danger and discomfort that non-motorized users feel when faced with traffic (Jacobson et al. 2009[235]).

On top of collision rates, the link between traffic volume and pedestrian fatalities and injuries has also been established in the literature (Lee and Abdel-Aty 2005[274], Loukaitou-Sideris et al. 2007[299]). In North Carolina, a study found that vehicle-pedestrian collisions on freeways were associated with a 330% increase in the average probability of fatal injury for pedestrians compared to non-freeway collisions, which was attributed to the higher average speeds and speed limits on this roadway type. The study also found that the probability of pedestrian fatality decreased by 40% during the peak PM traffic period (3:00 p.m. to 5:59 p.m.), possibly due to lower speeds and greater caution of drivers (Kim et al. 2010[259]).

The vulnerability of pedestrians to vehicle collisions varies with age. Children are especially vulnerable, as their smaller stature makes them more difficult for drivers to spot. A retrospective study on motor vehicle–pedestrian collisions in Long Beach between 2002 and 2005 found that children less than 5 years of age were more likely to be hit at midblock locations while those aged 5–9 and 10–14 were more likely to be hit at an intersection. The majority of mid-block collisions occurred within 0.1 mile of the child's residence, while intersection collisions mostly occurred farther away from the child's residence. In addition, collisions were more likely to occur in census tracts with greater densities of families compared to lower density tracts, which has socioeconomic implications (Lightstone et al. 2001[281]).

The perception of pedestrian and cyclist safety on neighborhood roads influences parent and children's decisions to walk or ride their bicycle to school. In one study, parental concerns about the lack of traffic lights and controlled crossings on their child's school route reduced the likelihood that their child would actively commute to school (Davison and Lawson 2006[119]). Related research has found that parents were more likely to let their child walk in older neighborhoods with a wide, green buffer between the sidewalk and vehicular traffic, while children were more likely to walk in older neighborhoods with mature trees and bike in newer neighborhoods with more sidewalks.

Economic and social factors—such as lack of an accessible vehicle, school bus service, or time to transport their children—may play a significant role in the parents' decision regarding their children's transportation mode to school (Kweon et al. 2006[271], Kweon et al. 2004[270]). This is important to consider when examining the effects of transportation access and mode share for a socioeconomically diverse region, as certain populations may be disproportionately excluded from using some transportation facilities and may have greater exposure to pedestrian-related travel risks.

Many strategies have been researched and implemented by planners to reduce pedestrian–motor vehicle conflicts. A review of engineering modifications designed to reduce motor vehicle–pedestrian collisions categorized the different measures into three groups according to what they try to accomplish: managing vehicle speeds, separating pedestrians and vehicles, and increasing pedestrian visibility (Retting et al. 2003[384]). Some strategies include more visible crosswalks (e.g., laddered or colored brick), traffic calming mitigations (e.g., chicanes, speed bumps, signage, curb extensions), and intersection alterations (e.g., roundabouts and diverters).

A meta-analysis of studies of area-wide traffic calming schemes shows that they, on average, reduce the number of injury collisions by about 15%. The largest reduction in the number of collisions is found for residential streets (about 25%), while a somewhat smaller reduction is found for main roads (about 10%). Similar reductions are found in the number of property damage–only collisions (Elvik 2001[129]).

However, the effectiveness of these mitigations was found to be mixed when used in isolation (Huang and Cynecki 2000[226]). This finding highlights the need for comprehensive pedestrian planning that uses multiple synergistic traffic calming measures to provide the safest possible walking environment (Zein et al. 1997[499]).

Vehicle–Bicycle Collisions

Bicyclists face unique risks on roadways given their speeds, their proximity to vehicle traffic, and the lack of occupant protections. A systematic review of the literature on how transportation infrastructure affects bicycle injuries and crashes found that sidewalks and multi-use trails posed the greatest risk, major roads were more hazardous than minor roads, and the presence of bicycle facilities (e.g., on-road bike routes, on-road marked bike lanes, and off-road bike paths) was associated with the lowest risk to cyclists (Reynolds et al. 2009[386]).

In a 1992 study, older bicyclists (aged 18 an over) were found to be 1.8 times more likely to be involved in a collision with a vehicle than riders who were 17 years old or younger (Wachtel and Lewiston 1994[473]). A potential explanation was that younger children might ride more slowly, cautiously, and in groups, thus increasing their visibility to drivers. Also, the authors found that older cyclists were more likely than younger cyclists to be vulnerable to vehicle driver errors.

As with pedestrian-related collisions, intersections provide a different set of risk factors for bicyclists compared to mid-block sections. However, the 2007 report by the Seattle Department of Transportation mentioned above found that pedestrians were twice as likely to be hit at intersections versus midblock locations, while bicyclists were equally likely to be struck in either location (Seattle Department of Transportation 2007[410]). This may be because bicyclists share the road with vehicles (e.g., where they are also subject to “dooring” by parked vehicles) 100% of the time while pedestrians do not. A 2004 study found different risk factors for bicycle–vehicle collisions at intersections depending on whether the vehicle was traveling straight or making a left or right turn (Wang and Nihan 2004[475]).

In addition to many of the mitigation techniques used to reduce rates of vehicle–pedestrian collisions, some bicycle-specific improvements include dedicated bike lanes, shared-lane markings, and “bicycle boulevards.” (Reynolds et al. 2009[386]) Rider education to encourage the use of helmets, along with legislation to mandate their use, have been very successful at preventing or greatly decreasing the severity of traumatic head and brain injuries (Attewell et al. 2001[16]).

Risk of serious injury for a bicyclist was increased by collision with a motor vehicle (odds ratio (OR) = 4.6), self-reported speed > 15 mph (OR = 1.2), young age (< 6 years), and age > 39 years (OR = 2.1 and 2.2, respectively, compared with adults 20–39 years). Risk for serious injury was not affected by helmet use (OR = 0.9). Risk of neck injury was increased in those struck by motor vehicles (OR = 4.0), hospitalized for any injury (OR = 2.0), and those who died (OR = 15.1), but neck injury was not affected by helmet use (Rivara et al. 1997[394]).

Hazardous Materials Incidents

A potentially important yet often overlooked link between roadways, safety, and health comes in the form of accidental hazardous materials (haz mat) releases, particularly when freight trucks carrying petrochemicals or other noxious and volatile substances are involved in collisions or overturns.

A 1989 report found that, nationwide, 56% of 587 recorded hazardous materials releases in 1986 involved an in-transit vehicle or an activity, such as loading or unloading, related to transportation. Approximately 9% were due to crashes, derailments, and vehicular overturns (Binder 1989[45]), which are the causes that are most likely to be affected by the I-710 Corridor Project. The severity of negative health effects caused by exposure to hazardous materials releases depends on the method of exposure, dose, toxicity of the substance released, and the speediness and effectiveness of treatment to those exposed. Common methods of exposure include direct skin contact, inhalation of fumes (of the substances themselves or via fire/combustion of materials), or through ingestion of contaminated water.

Another important consideration of hazardous materials releases is environmental equity; in other words, are there populations who share a disproportionate risk of being affected by an accidental exposure? In California, low-income households and people of color are living in disproportionate proximity to major roadways (Gunier et al. 2003[211]) and would most likely be exposed to roadway-related hazardous material releases at greater rates compared to higher-income households.

Perceptions of Traffic Safety and Stress

During the scoping phase of the HIA, it was hypothesized that freeway usage and stress were linked to perceptions of the high number of collisions on the freeway. This study was not able to find evidence in the literature relating traffic safety to stress and stress-related transportation behavioral change. Therefore, this link is not investigated further in this chapter.

9.1.2 Established Transportation Standards and Health Objectives

Regulations and guidelines for traffic safety, particularly in the form of standardized goals for reducing, for example, the number of motor vehicle fatalities, are few. Federal- and state-level standards are listed below.

Federal Highway Administration

The FHWA provides guidelines for individual states to develop their own Strategic Highway Safety Plans and corresponding traffic safety performance goals, but does not offer any quantitative national reduction goal in their guidance documents (FHWA 2006b[182]).

American Association of State Highway and Transportation Officials

AASHTO released its comprehensive Strategic Highway Safety Plan in 2005, but then revised its goal for fatality reduction in May 2007 to halve fatalities within 2 decades (from 41,059 fatalities in 2007 to 20,529 fatalities in 2027 (Richardson and Welch 2009[389]).

Healthy People 2020

The U.S. Department of Health and Human Services Healthy People group has set their 2020 health goals, and they include the following objectives relating to motor vehicle collisions: (HealthyPeople.gov 2011[220])

- Reduce deaths caused by motor vehicle collisions to 12.4 deaths per 100,000 population and 1.2 deaths per 100 million vehicle miles traveled.
- Reduce injuries caused by motor vehicle collisions to 694.4 nonfatal injuries per 100,000 population.
- Reduce pedestrian deaths on public roads to 1.3 deaths per 100,000 population.
- Reduce pedestrian injuries on public roads to 20.3 nonfatal injuries per 100,000 population.
- Reduce bicycle deaths on public roads to 0.22 deaths per 100,000 population.

Caltrans Strategic Plan 2007–2012 (2007)

In their 2007–2012 Strategic Plan, Caltrans has set the following objective for the statewide highway system:

- By 2008, reduce the fatality rate on the California state highway system to 1.00/100 fatalities per 100 million vehicle miles traveled on the California state highway system and continuously reduce annually thereafter toward a goal of the lowest rate in the nation.

To our knowledge, there are no established local-level guidelines for reducing traffic collision rates down to a given goal level among the municipalities within the study area.

9.2 Existing Conditions for Traffic Safety

9.2.1 Collisions

In 2008, the census estimated that there were 10.2 million traffic collisions in the country (U.S. Census Bureau 2011b[456]). According to the Fatality Analysis Reporting System (FARS), there were 33,808 motor vehicle–related fatalities across the country in 2009 (National Highway Traffic Safety Administration 2011[343]). Table 9-1 compares the California, national, and “best state” (whichever state had the lowest rate for a given measure for that year) traffic fatality rates.

Table 9-1. Collision Fatality Rates of California and the US

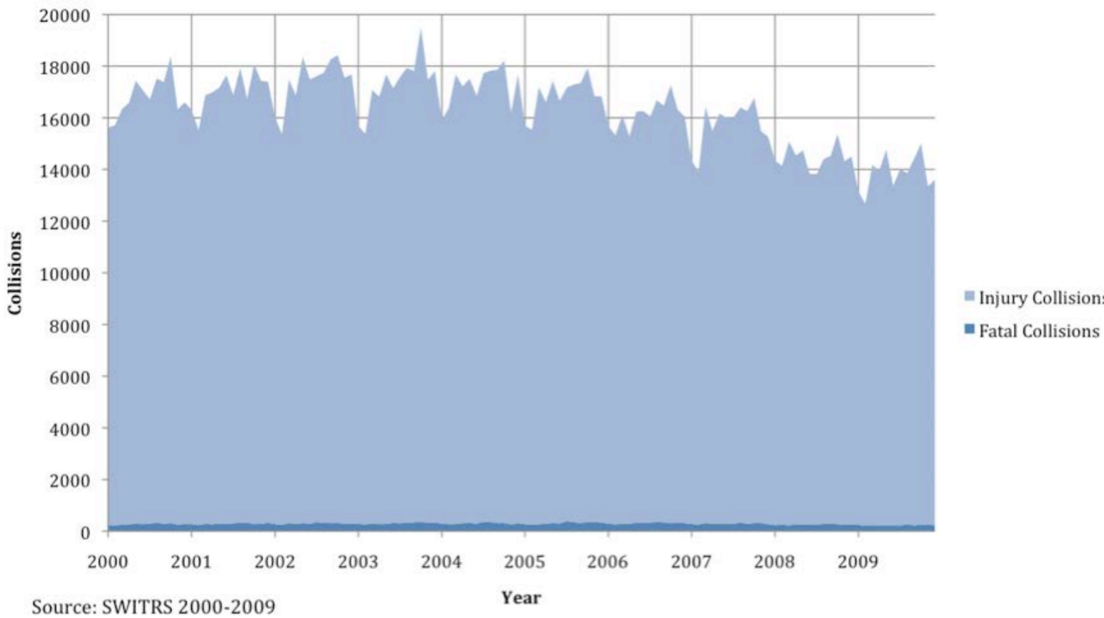
Year		Fatalities	Total Vehicle Miles Traveled (Millions)	Fatalities Per 100 Million Vehicle Miles Traveled	Total Population	Fatalities Per 100,000 Population
2005	California	4,333	329,267	1.32	35,795,255	12.10
	US	43,510	2,989,430	1.46	295,753,151	14.71
	Best State*			0.80		6.83
2006	California	4,240	327,478	1.29	35,979,208	11.78
	US	42,708	3,014,371	1.42	298,593,212	14.30
	Best State*			0.78		6.34
2007	California	3,995	328,312	1.22	36,226,122	11.03
	US	41,259	3,031,124	1.36	301,579,895	13.68
	Best State*			0.79		6.54
2008	California	3,434	327,286	1.05	36,580,371	9.39
	US	37,423	2,976,528	1.26	304,374,846	12.30
	Best State*			0.67		5.56
2009	California	3,081	324,486	0.95	36,961,664	8.34
	US	33,808	2,953,501	1.14	307,006,550	11.01
	Best State*			0.61		4.84

*State (or States) with lowest rates: lowest VMT and population rates could be in different states
Source: National Highway Transportation Safety Administration 2009b[342].

Traffic collisions are a major source of unintentional death and injury. While collision fatality rates by VMT and by population have historically been lower in California compared to the U.S., the resulting deaths and injuries from collisions are still quite costly. In California in 2005, motor vehicle crashes resulted in $4.16 billion in medical and work loss costs (CDC 2011c[99]).

Figure 9-1 shows the total number of traffic collisions, categorized as either fatal or injury collisions, in California from January 2000 to December 2009.

Figure 9-1. Total Traffic Collisions in California, 2000-2009



Source: SWITRS 2000-2009

Clearly, the number of fatal collisions compared to the number of injury collisions has been small. Since 2003, the annual averages of collisions in California have decreased every year from the previous year (California Highway Patrol 2009[69]). Most of this decrease was due to lower rates of collisions that resulted in injury rather than a decrease in collisions that resulted in fatalities, which remained fairly stable in contrast. There was a pronounced seasonality to the collisions, as well, with peaks usually in the spring and fall and local minimums in the winter and summer months. However, under-reporting of traffic collision data is a concern, especially for injury collisions; for example, a 2005 study on collisions involving pedestrians in San Francisco found that police collision reports underestimated the number of injured pedestrians by 21% (Sclortino et al. 2005[409]).

Collisions both on and off the freeway will be affected by the I-710 Corridor Project. Freeway car and truck volumes and speeds will result in impacts to off-freeway volumes and speeds. The degree to which collisions off-freeway are attributable to the freeway is a function of many factors (e.g., distance from freeway, housing density, commercial uses), but it is certain that some portion of these incidents are related to the freeway. This analysis therefore considers both on- and off-freeway collisions.

Table 9-2a shows raw numbers of collisions, those killed, and those injured (both severely and non-severely), based on what modes of transportation were involved, Table 9-2b shows the corresponding percentages out of the grand total number of collisions, and Table 9-2c shows the corresponding percentages out of the column total number of collisions. The data figures were originally from the Statewide Integrated Traffic Records System (SWITRS), but were obtained from the Transportation Injury Mapping System (TIMS) developed by the UC Berkeley Safe Traffic Research and Education Center (TIMS 2011[438]). An important note is that for collisions resulting in both fatalities and injuries, there was no data on the severity of the injuries. Therefore, for the sake of not excluding these injuries, they were classified under the “Severe Injury” category, and thus that category may be slightly overestimated.

Collisions that did not result in any injuries (e.g., property damage only) were excluded from our analysis.

For the I-710 mainline, 30% of the collisions, as well as 46% of the fatalities and 28% of the injuries, on the freeway were classified as “other,” which includes single-vehicle collisions.

Table 9-2a. Number of Collisions, Fatalities, and Injuries in the I-710 Corridor Project Study Area, 2006–2008

Collision Type	I-710 Mainline				Other Freeways (I-405, SR-91, I-105, I-5, SR-60, I-605)				Within 150 Meters of I-710 Mainline				Within 1 Mile of I-710 Mainline (includes collisions within 150 meters of Mainline)			
	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured
Non-truck–related																
Vehicle–vehicle	770	5	53	1,061	768	2	49	1100	315	3	28	470	2,503	17	168	3,616
Pedestrian-related[1]	23	8	11	12	16	5	6	14	40	2	5	35	683	21	91	630
Bicycle-related[1]	3	0	0	3	2	0	0	2	39	0	3	38	376	4	33	348
Truck-related																
Vehicle–vehicle	257	8	29	351	137	8	13	178	26	0	3	29	127	0	6	160
Pedestrian-related[1]	2	1	0	2	1	0	0	1	0	0	0	0	14	2	2	12
Bicycle-related[1]	0	0	0	0	0	0	0	0	4	1	0	3	9	1	2	6
All other accidents	452	19	59	523	375	13	49	420	39	0	6	41	489	19	58	506
TOTAL	1,507	41	152	1,952	1,299	28	117	1715	463	6	45	616	4,201	64	360	5,278

[1]Pedestrian and bicycle fatality and injury counts include both pedestrian/bike and vehicle operator deaths/injuries

Source: TIMS 2011[438].

Table 9-2b. Percentages of Grand Total Collisions, Fatalities, and Injuries in the I-710 Corridor Project Study Area, 2006–2008

Collision Type	I-710 Mainline				Other Freeways (I-405, SR-91, I-105, I-5, SR-60, I-605)				Within 150 Meters of I-710 Mainline				Within 1 Mile of I-710 Mainline (includes collisions within 150 meters of Mainline)			
	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured
Non-truck–related																
Vehicle–vehicle	10.99	3.76	8.43	11.86	10.96	1.50	7.79	12.30	4.50	2.26	4.45	5.25	35.72	12.78	26.71	40.42
Pedestrian-related[1]	0.33	6.02	1.75	0.13	0.23	3.76	0.95	0.16	0.57	1.50	0.79	0.39	9.75	15.79	14.47	7.04
Bicycle-related[1]	0.04	0.00	0.00	0.03	0.03	0.00	0.00	0.02	0.56	0.00	0.48	0.42	5.37	3.01	5.25	3.89
Truck-related																
Vehicle–vehicle	3.67	6.02	4.61	3.92	1.96	6.02	2.07	1.99	0.37	0.00	0.48	0.32	1.81	0.00	0.95	1.79
Pedestrian-related[1]	0.03	0.75	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.20	1.50	0.32	0.13
Bicycle-related[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.75	0.00	0.03	0.13	0.75	0.32	0.07
All other accidents	6.45	14.29	9.38	5.85	5.35	9.77	7.79	4.70	0.56	0.00	0.95	0.46	6.98	14.29	9.22	5.66

[1]Pedestrian and bicycle fatality and injury counts include both pedestrian/bike and vehicle operator deaths/injuries

Source: TIMS 2011[438].

Table 9-2c. Percentages of Column Total Collisions, Fatalities, and Injuries in the I-710 Corridor Project Study Area, 2006–2008

Collision Type	I-710 Mainline				Other Freeways (I-405, SR-91, I-105, I-5, SR-60, I-605)				Within 150 Meters of I-710 Mainline				Within 1 Mile of I-710 Mainline (includes collisions within 150 meters of Mainline)			
	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured	#	Fatally Injured	Severely Injured	Non-Severely Injured
Non-truck–related																
Vehicle–vehicle	51.09	12.20	34.87	54.35	59.12	7.14	41.88	64.14	68.03	50.00	62.22	76.30	59.58	26.56	46.67	68.51
Pedestrian-related[1]	1.53	19.51	7.24	0.61	1.23	17.86	5.13	0.82	8.64	33.33	11.11	5.68	16.26	32.81	25.28	11.94
Bicycle-related[1]	0.20	0.00	0.00	0.15	0.15	0.00	0.00	0.12	8.42	0.00	6.67	6.17	8.95	6.25	9.17	6.59
Truck-related																
Vehicle–vehicle	17.05	19.51	19.08	17.98	10.55	28.57	11.11	10.38	5.62	0.00	6.67	4.71	3.02	0.00	1.67	3.03
Pedestrian-related[1]	0.13	2.44	0.00	0.10	0.08	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.33	3.13	0.56	0.23
Bicycle-related[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	16.67	0.00	0.49	0.21	1.56	0.56	0.11
All other accidents	29.99	46.34	38.82	26.79	28.87	46.43	41.88	24.49	8.42	0.00	13.33	6.66	11.64	29.69	16.11	9.59
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

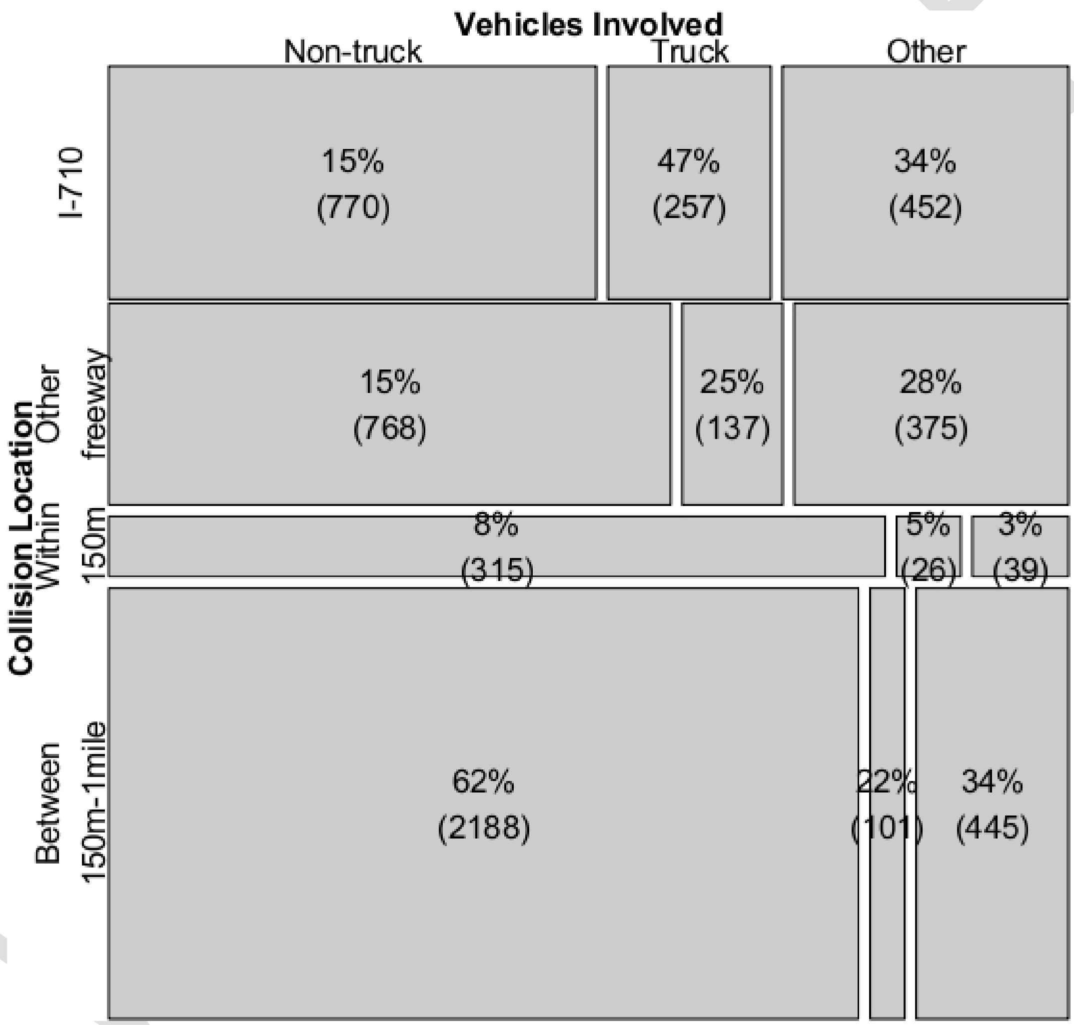
[1]Pedestrian and bicycle fatality and injury counts include both pedestrian/bike and vehicle operator deaths/injuries

Source: TIMS 2011[438].

The following sections refer to Tables 9-2a, 9-2b, and 9-2c as each collision type is discussed in more detail.

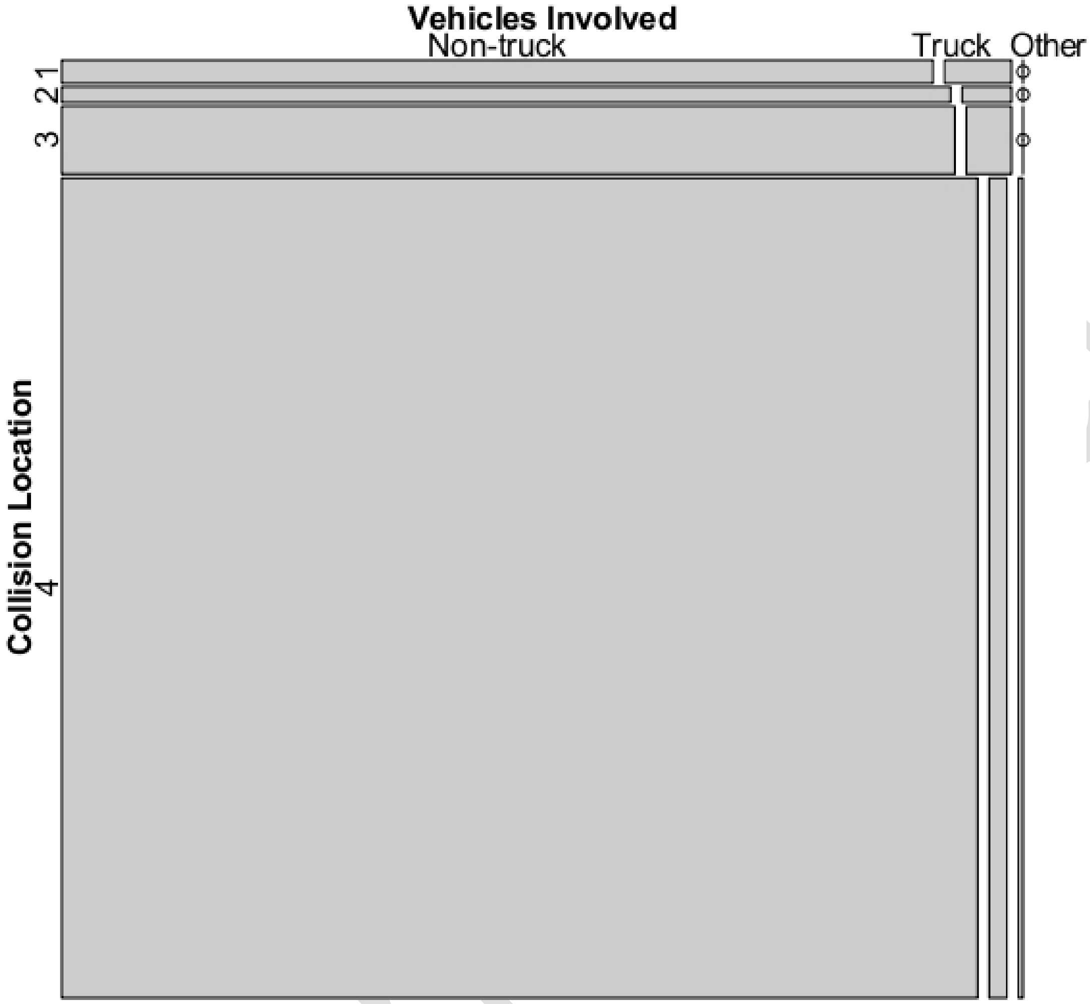
In order to more effectively visualize the relative proportions of collision types, victim type (motorized versus non-motorized) and where collisions occurred, mosaic plots, which use area to show the relative percentages and raw frequencies (in parentheses) of a two-variable contingency table, were created (Figures 9-2a for motorized collisions and 9-2b for non-motorized collisions only).

Figure 9-2a. Column Percentages of Motorized Collision Types Defined by Vehicles Involved, and Where they Occurred, I-710 Corridor Project Study Area 2006–2008



Source: TIMS 2011[438].

Figure 9-2b. Column Percentages of Non-Motorized Collision Types Defined by Vehicles Involved, and Where They Occurred, I-710 Corridor Project Study Area 2006–2008



Legend:

Geographic Region	Non-truck	Truck	Other
1 – I-710	2% (26)	8% (2)	0% (0)
2 – Other Freeways in Study Area	2% (18)	4% (1)	0% (0)
3 – Within 150 meters (~500 feet) of I-710	7% (79)	15% (4)	0% (0)
4 – Between 150 meters (~500 feet) and 1-mile of I-710	89% (980)	73% (19)	100% (5)

Source: TIMS 2011[438].

These plots shows column percentages, so, as one moves down each vehicle type ("Non-truck," "Truck," and "Other"), you can see the percentages of total collisions that occurred for that vehicle type in each location. For example, 15% of non-truck motorized collisions occurred on I-710, while another 15% of total non-truck motorized collisions occurred on other freeways that connect to I-710 within the study area. Percentages across rows should not be summed.

The relative heights of each location type represent the relative proportions of collisions that occurred at each place. For example, in Figure 9-2a, it appears that more than half of all collisions occurred between 150 meters (approximately 500 feet) and 1 mile of the I-710—more than all of the other locations combined. Also, a large majority (89%) of pedestrian/bike collisions occurred between 150 meters and 1 mile away from I-710, while only 7% occurred within 150 meters of the freeway.

Across the rows, the relative widths of each box represent the proportion of collisions in each vehicle type for each location. For example, on I-710, non-truck motorized collisions are about equal to motorized truck and other collisions combined, but one can see that the proportion of truck-related collisions is much higher on the I-710 than on other freeways. Non-truck motorized collisions far outweigh the other categories between 150 meters (approximately 500 feet) and 1 mile of I-710, and truck collisions are much less prevalent. This is not surprising, as a large number of these collisions on the freeways would not be expected at all. Overall, truck-related accidents are highest on I-710, a bit lower on other nearby freeways in the study area, and then lower still off the freeways. Meanwhile, for non-motorized collisions, autos are by far the most commonly involved in accidents with pedestrians or bicycles, rather than trucks.

A high number of collisions occur on or near freeway on- or off-ramps. Table 9-3 shows the row percentages of collisions, for each collision type, that occurred on and in proximity to the on- and off-ramps in the study area, which include ramps to freeways connecting to the I-710.

Table 9-3. Row Percentages of Collisions That Occurred On and Near I-710 On- and Off-Ramps

Collision Type	Ramp-related						Non-ramp Related (n=6,354)	Row Totals
	Ramp Exit, Last 50 Feet (n=188)	Mid-Ramp (n=235)	Ramp Entry, First 50 Feet (n=56)	Not State Highway, Ramp-Related, Within 100 Feet (n=114)	Ramp-Related Intersection (n=49)	Not State Highway, Intersection-Related, Within 250 Feet (n=11)		
Non-truck (n=6,422)	2.43%	3.21%	0.79%	1.65%	0.70%	0.16%	91.06%	100%
Truck (n=585)	5.47%	4.96%	0.85%	1.37%	0.68%	0.17%	86.50%	100%
TOTAL	**2.68%**	**3.35%**	**0.80%**	**1.63%**	**0.70%**	**0.16%**	**90.68%**	**100%**
Source: TIMS 2011[438].								

There were 653 collisions out of 7,007 total collisions (9.3%) that occurred on ramps. The majority of non-truck ramp collisions occurred mid-ramp, while the majority of truck ramp collisions occurred within the last 50 feet of an exit ramp. Trucks were twice as likely as non-trucks to have collisions in the last 50 feet of an exit ramp.

Table 9-2a showed the total number of deaths and injuries for pedestrian and bicycle collisions, regardless of whether they occurred for the driver or the pedestrian or bicyclist. Table 9-4 shows the actual numbers of pedestrian and bicycle fatalities and injuries for each collision type, excluding corresponding deaths to motorized vehicle operators.

Table 9-4. Pedestrian and Bicyclist Fatality and Injury Counts in the I-710 Corridor Project Study Area, 2006–2008

Collision Type	Pedestrian Fatalities	Pedestrian Severe Injuries	Pedestrian Non-Severe Injuries	Bicyclist Fatalities	Bicyclist Severe Injuries	Bicyclist Non-Severe Injuries	Total
Non-truck–Pedestrian	33	106	621		--		760
Truck–Pedestrian	3	2	13				18
Non-truck–Bike		--		4	32	351	387
Truck–Bike				1	3	5	9
Other	0	0	3	0	0	3	6
TOTAL	**36**	**108**	**637**	**5**	**35**	**359**	**1,180**
Source: TIMS 2011[438].							

There were a total of 1,180 pedestrian and bicycle fatalities and injuries. Far fewer fatalities and injuries occurred as a result of trucks versus non-trucks. 18.2% (139/760) of non-truck–pedestrian collisions resulted in fatal or severe injuries, while this percentage was 27.7% for truck–pedestrian, 9.3% for non-truck–bicycle, and 44.4% for truck–bicycle. Clearly, truck-related collisions are more severe, though less frequent.

Non-Truck–Related Vehicle–Vehicle Collisions

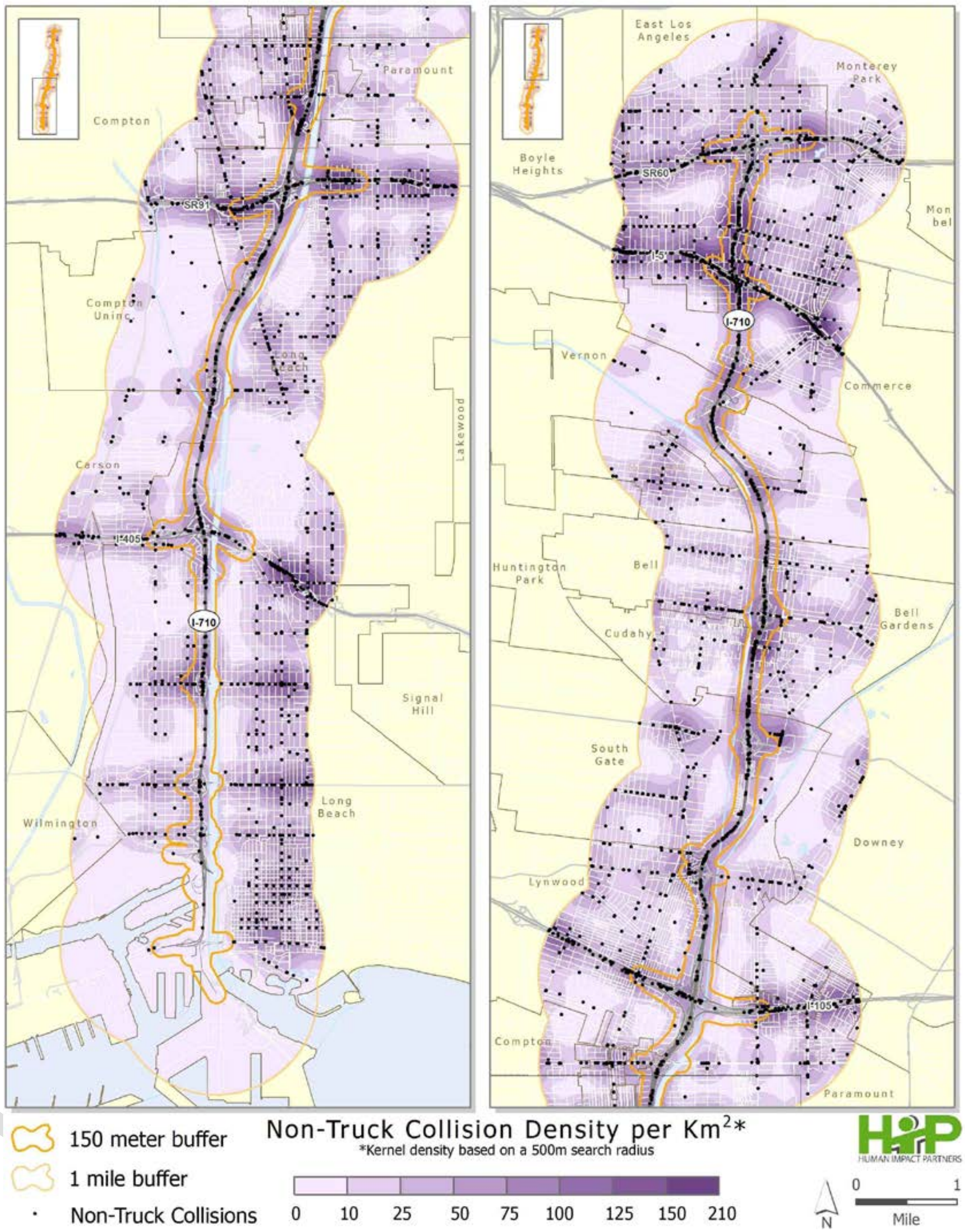
Section 4.4 in the draft I-710 Traffic Operations Analysis Report (ENVIRON 2010b[134]) contains data on north- and southbound traffic collisions on the I-710 mainline and ramps from October 1, 2004, to September 30, 2007, disaggregated by type of collision (e.g., head-on, sideswipe, etc.) and time of day. In this time period, there were 1,327 northbound and 1,308 southbound non-truck–related collisions on the 710 mainline. The north- and southbound directions experienced different rates of types of collision, but for both sections, approximately 60–70% of collisions were sideswipe or rear-end types.

For the northbound direction, 31 out of the 59 ramps (53%) have higher collision rates than the state average, and for the southbound direction, only 2 out of the 54 ramps (4%) have higher collision rates than the state.

Table 4-14 in the draft I-710 Traffic Operations Analysis Report (ENVIRON 2010b[134]) shows traffic collision rates on freeway connectors, parts of the freeway allowing interchange traffic between I-710 and other freeways, which includes those connecting I-710 to I-405, SR-91, and I-105. One-third of the I-405/I-710 connectors had rates higher than the state, as did 5 out of 8 segments of SR-91/I-710, and 7 out of 10 segments of the I-105/I-710 connectors. Table 4-15 shows collision data for sections of these three freeways that include interchanges to I-710, and only segments on the SR-91 interchanges had higher collision rates than the state average.

Referring back to Table 9-2a, from 2006 to 2008, there were 770 non-truck–related motor vehicle–motor vehicle collisions on the I-710 mainline, 768 on other freeway segments within 1 mile of the I-710, 315 collisions within 150 meters (approximately 500 feet) of the freeway, and 2,503 collisions within 1 mile. Unsurprisingly, this type of collision accounts for the majority of collisions for each geographic category (see Table 9-2c). Figure 9-3 is a density map of non-truck collisions both on the 710 mainline and on surface streets within 1 mile of the mainline.

Figure 9-3. Non-Truck Vehicle Collision Heat Map



Source: TIMS 2011[438].

From the map, it appears that roads with higher traffic volumes have higher collision densities. Hotspots of collisions can be seen on the east–west arterials that run perpendicular to the I-710. Collisions seem to be particularly dense at the I-710/I-5 interchange and at the I-5 on- and off-ramps at South Atlantic Boulevard.

To illustrate the relative proportions of collisions that occur at each geographic region, the row percents of non-truck–related vehicle–vehicle collisions are shown in Table 9-5.

Table 9-5. Percentages of Non-Truck Vehicle-Vehicle Collisions, Based on Collision Type and Location

Collision Type	I-710 Mainline				Other Freeways (I-405, SR-91, I-105, I-5, SR-60, I-605)				Within 1 Mile of I-710 Mainline			
	Number of Collisions	Fatally Injured	Severely Injured	Non-Severely Injured	Number of Collisions	Fatally Injured	Severely Injured	Non-Severely Injured	Number of Collisions	Fatally Injured	Severely Injured	Non-Severely Injured
Non-truck vehicle–vehicle	19.05	20.83	19.63	18.37	19.01	8.33	18.15	19.04	61.94	70.83	62.22	62.59
Source: TIMS 2011[438].												

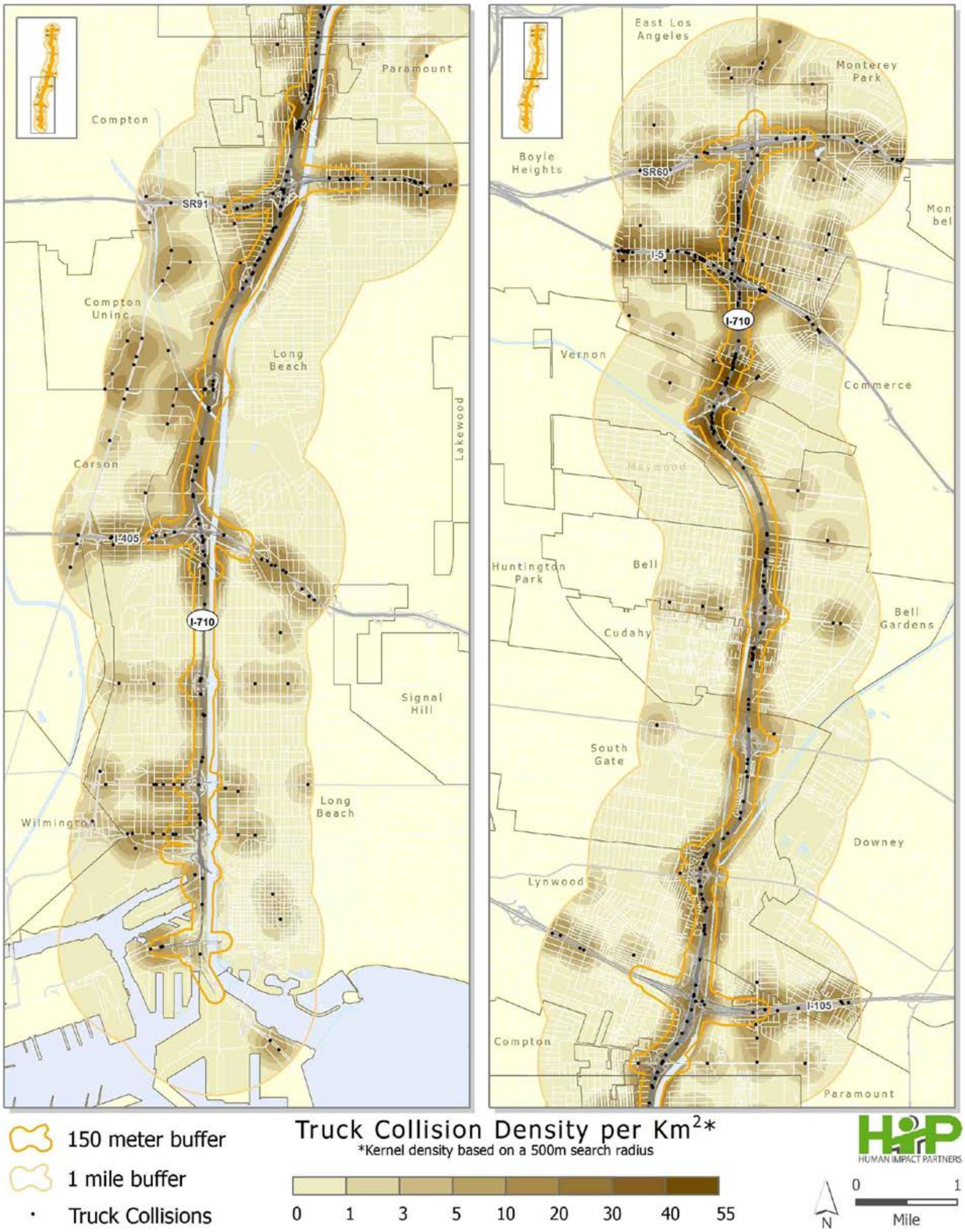
From the table, there seems to be an even proportion of non-truck vehicle collisions occurring on the I-710 versus other freeways that connect to it. There is also a higher preponderance of fatalities compared to the proportion of collisions for the mainline and within 1 mile of the mainline. Injury rates seem to follow fairly closely to the proportion of collisions for each geographic region.

Truck-Related Vehicle–Vehicle Collisions

Section 4.4 in the draft I-710 Traffic Operations Analysis Report (ENVIRON 2010b[134]) shows that, in the 36-month period from 2004 to 2006, there were 593 northbound and 599 southbound truck collisions. These truck-related collisions were 31% of the total collisions that occurred on the I-710 during that time period. From Tables 4-11 and 4-13 in the same report, one can see that truck collision frequencies from October 2004 to December 2007 were fairly uniform across the four northbound sections of the freeway, while they were relatively more concentrated in the middle two sections on the southbound direction of the freeway. Similar numbers of truck collisions occurred for both directions of the freeway.

From 2006 to 2008, there were 257 truck-related motor vehicle–motor vehicle collisions on the I-710, 137 on other freeways in the study area, 26 collisions within 150 meters (approximately 500 feet) of the freeway, and 127 collisions within 1 mile. Figure 9-4 is a density map of truck-related collisions in the study area, between 2006 and 2008. The kernel radius used to calculate the collision densities was 500 meters (1,640 feet).

Figure 9-4. Truck-Related Vehicle Collision Heat Map



Source: TIMS 2011[438].

Table 9-6. Percentages of Truck-Related Vehicle–Vehicle Collisions, Based on Collision Type and Location

Collision Type	I-710 Mainline				Other Freeways (I-405, SR-91, I-105, I-5, SR-60, I-605)				Within 1 Mile of I-710 Mainline			
	Number of Collisions	Killed	Severely Injured	Non-Severely Injured	Number of Collisions	Killed	Severely Injured	Non-Severely Injured	Number of Collisions	Killed	Severely Injured	Non-Severely Injured
Truck-related vehicle–vehicle	49.33	50.00	60.42	50.94	26.30	50.00	27.08	25.83	24.38	0.00	12.50	23.22

Source: TIMS 2011[438].

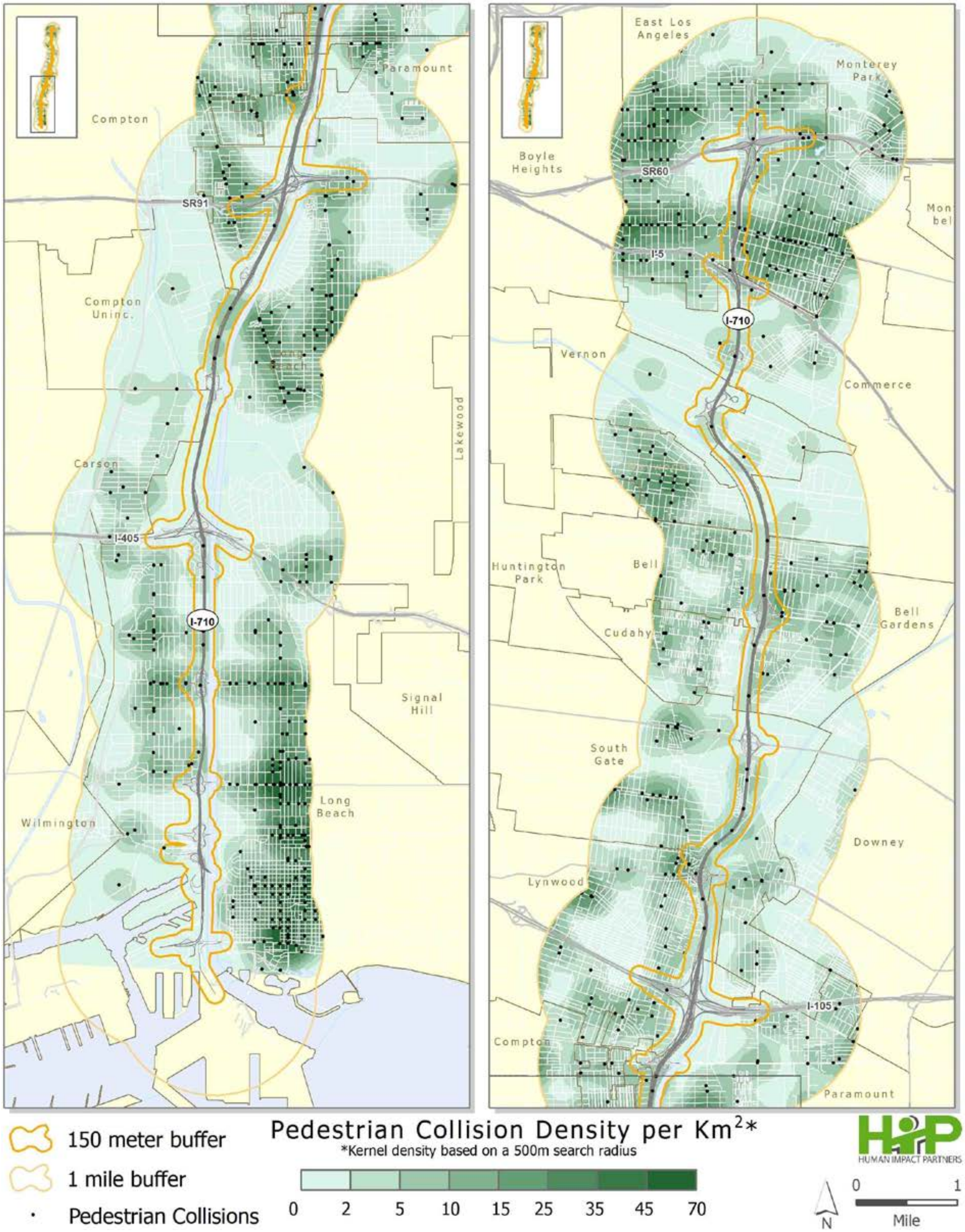
As shown in Figure 9-4, truck-related collisions are heavily centered on the freeways (over 75% of total truck collisions). There are also visible clusters of collisions on arterials near the southern end of the I-710, in unincorporated Compton between the I-405 and SR-91, in Commerce between the I-5 and SR-60, and at the northern terminus of the I-710.

As seen in Table 9-6, almost half of truck-related vehicle collisions in the study area occur on the I-710 mainline, with proportional fatality and injury rates caused by these collisions. On the other hand, the other freeways that connect to the I-710 only share about 26% of the collision burden, yet have the other half of the fatalities. No truck-related collisions off of a freeway resulted in a fatality.

Collisions Involving Pedestrians

From 2006 to 2008, there were 23 non-truck pedestrian collisions on the I-710, 16 on other freeways in the study area, 40 within 150 meters (approximately 500 feet) of the freeway, and 683 within 1 mile. Meanwhile, in the same time period, there were 2 truck/pedestrian collisions on the I-710, 1 on other freeways in the study area, none within 150 meters of the I-710, and 14 within 1 mile of the I-710. Figure 9-5 is a density map of pedestrian-related collisions that occurred in the study area, using a 500-meter (1,640-foot) search radius.

Figure 9-5. Pedestrian Collision Density Map



Source: TIMS 2011[438].

Table 9-7. Percentages of Pedestrian-Related Collisions, Based on Collision Type and Location

Collision Type	I-710 Mainline				Other Freeways (I-405, I-91, I-105, I-5, I-60, I-605)				Within 1 Mile of I-710 Mainline			
	Number of Collisions	Killed	Severely Injured	Non-Severely Injured	Number of Collisions	Killed	Severely Injured	Non-Severely Injured	Number of Collisions	Killed	Severely Injured	Non-Severely Injured
Non-truck–pedestrian-related[1]	3.19	23.53	10.19	1.83	2.22	14.71	5.56	2.13	94.60	61.76	84.26	96.04
Truck–pedestrian-related[1]	11.76	33.33	0.00	13.33	5.88	0.00	0.00	6.67	82.35	66.67	100.00	80.00

[1]Pedestrian fatality and injury counts include both pedestrian and vehicle operator deaths/injuries
Source: TIMS 2011[438].

The map does not necessarily suggest any I-710 related hotspots and is likely to reflect places with more pedestrians. The largest clusters of pedestrian collisions occur in downtown Long Beach and in areas with high levels of commercial zoning.

Another interesting statistic is the relative preponderance of pedestrian fatalities on the I-710 and other freeways. Approximately 3% of all non-truck pedestrian collisions were on the I-710, as were nearly 12% of all truck-related pedestrian collisions. In addition, relatively large percentages of total pedestrian fatalities occurred on the freeway. One study investigated this in Texas, and attributed most of the expressway pedestrian fatalities to those who were “unintended pedestrians” (i.e., those who exited a vehicle on the expressway) (Istre et al. 2007[233]).

An important subset of pedestrian collisions is the proportion that is grade school students that use non-motorized (i.e., walking/biking/skating) means to get to and from school. Areas that have high levels of students may have higher levels of pedestrian and bicycle collisions due to the increased exposure to motor vehicles per capita. Table 9-8 below shows data from the California Health Interview Survey on the percentage of students who take non-motorized means to school. It is important to note that these responses are self-reported by parents of grade-school children, and may not be truly representative of actual rates of commuting.

Table 9-8. Percentage of Grade School Students Who Reported That They Walked, Biked, or Skated to School in the Past Week

Geographic Area[1]	Total Surveyed, Rounded	Percentage
LA SPA 6 (South)	240,000	64.4
LA SPA 7 (East)	264,000	49.5
LA SPA 8 (South Bay)	341,000	48.9
LA County	1,953,000	49.5
California	6,906,000	43.0

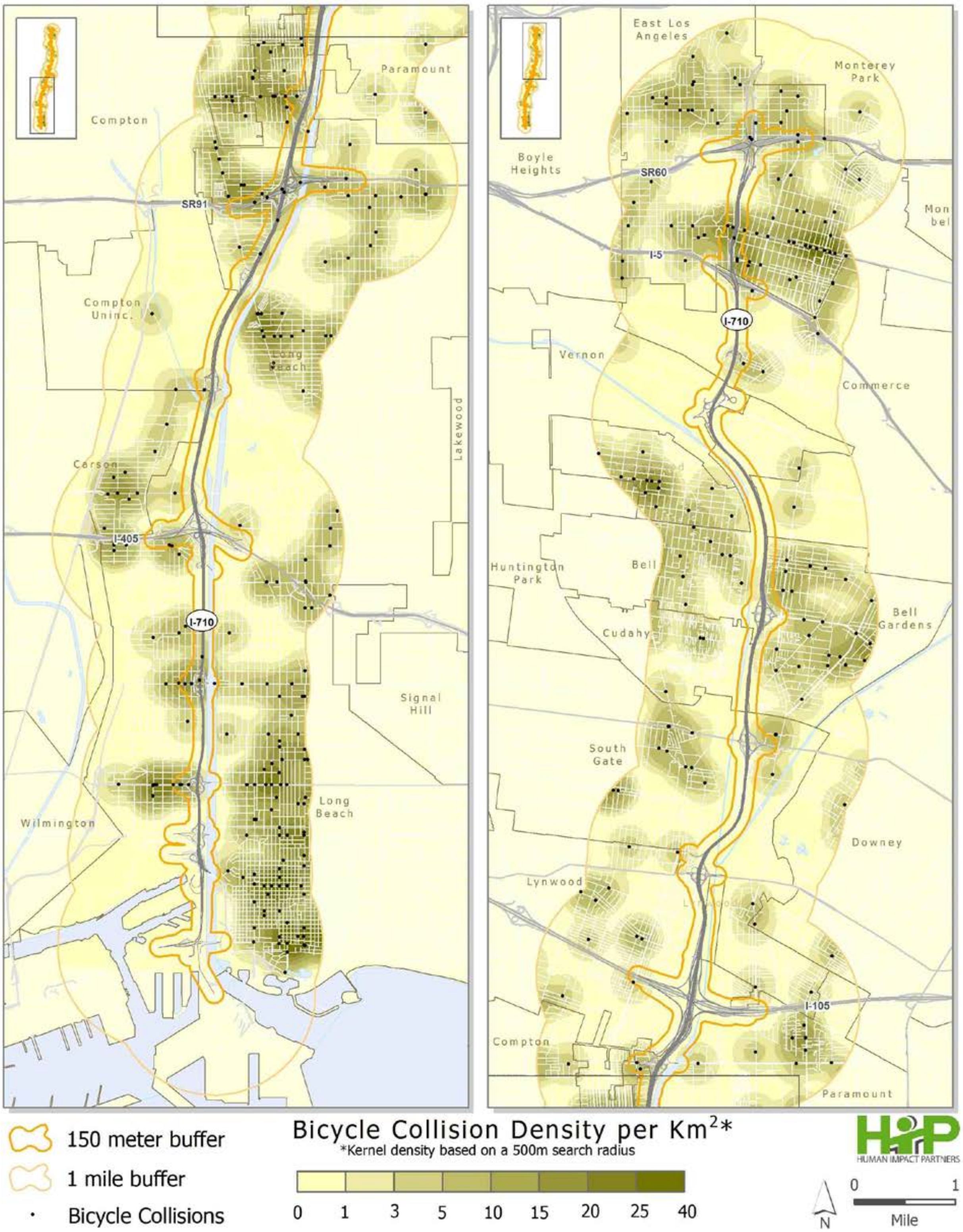
[1]SPA = Service Planning Area
Source: California Health Interview Survey 2009[70].

Los Angeles Service Planning Area (SPA) 6, which is located in the South LA region, has a much higher percentage of students who walk, bike, and skate to school, compared to the other SPAs in the study area. All three SPAs in the Gateway Cities, as well as the county as a whole, have higher percentages of students who use non-motorized transport to get to school than the state. Because each SPA generally includes areas that are outside of the I-710 Corridor Project study area (and in some cases, as in SPA 8, only have a small portion of their area within the study area), these numbers provide only a rough estimation of the relative proportions of non-motorized student commuters.

Collisions Involving Bicyclists

As in pedestrian collisions, bicycle collisions were broken out by whether they were non-truck– or truck-related. From 2006 to 2008, there were 3 non-truck bicycle collisions on the I-710, 2 on other freeways in the study area, 39 within 150 meters (approximately 500 feet) of the freeway, and 376 within 1 mile. For truck-related bicycle collisions, there were no collisions on the freeways in the study area, 4 within 150 meters of the I-710, and 9 total in the study area. To illustrate the geographic areas where bicycle collisions were more likely to occur, Figure 9-6 shows a density map of bicycle-related collisions.

Figure 9-6. Bicycle Collision Density Map



Source: TIMS 2011[438].

Because there are many fewer bicycle collisions than pedestrian or motor vehicle collisions, the density map for this transportation mode looks much more dispersed, with more isolated spots consisting of single collisions. This likely reflects the fact that bicycling is not as common as other modes of transport. However, there are still obvious clusters in Long Beach and in neighborhoods adjacent to the SR-60 and I-5, areas that may have more bicycle usage.

Table 9-9. Percentages of Bicycle-Related Collisions, Based on Collision Type and Location

Collision Type	I-710 Mainline				Other Freeways (I-405, I-91, I-105, I-5, I-60, I-605)				Within 1 Mile of I-710 Mainline			
	Number of Collisions	Killed	Severely Injured	Non-Severely Injured	Number of Collisions	Killed	Severely Injured	Non-Severely Injured	Number of Collisions	Killed	Severely Injured	Non-Severely Injured
Non-truck–bicycle-related[1]	0.79	0.00	0.00	0.85	0.52	0.00	0.00	0.57	98.69	100.00	100.00	98.58
Truck–bicycle-related[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00

[1]Bicycle fatality and injury counts include both bike and vehicle operator deaths/injuries

Source: TIMS 2011[438].

As can be expected, almost all bicycle-related collisions, fatalities, and injuries occurred off the freeway.

9.2.2 Hazardous Materials Incidents

From January 1, 2000, to June 13, 2011, there were only three hazardous materials incidents on the I-710 freeway. (USDOT PHMSA 2011[465])

The earliest incident was on July 15, 2002, at 11:15 p.m., involving a truck, estimated traveling speed of 55 mph, which had a steering-axle tire failure that caused a rollover on the I-710 where it meets the I-405. The driver was fatally injured but no hazardous materials (in this case, liquid nitrogen) were released. It is unspecified whether this incident occurred on the I-710 before the ramp interchange to I-405, or whether it was actually on the ramp. It is possible that the truck was on the connector to southbound I-405, as its destination was San Clemente, California.

The second incident occurred on September 12, 2003, at 2 a.m. and involved a truck that swerved at an estimated 55 mph to avoid an abandoned car in the #4 lane on the Clara Overpass (between the Firestone and Florence exits in Bell Gardens) causing a rollover and subsequent fire. Apparently, there was an unspecified fatality, and no other injuries. The fire consumed 2,800 gallons of the 9,000 gallons of gasoline on-board, and prompted the evacuation of approximately 150 residents from a neighboring apartment complex.

The third and last incident was on August 8, 2007, at 12:05 p.m. and featured a trailer rollover at an estimated speed of 20 mph when the driver failed to properly negotiate the Pico Avenue on-ramp turn in the Port of Long Beach. The collision caused a leak in the aluminum container and a crude oil spill onto the ground and roadway. This incident closed a major arterial for 7 hours.

The total amount of hazardous materials released in these three incidents was 6,160 gallons (2,800 of gasoline burned off and 3,360 of crude oil leaked), or 23.3 kiloliters. All incidents involved trucks traveling northbound on the I-710. Notably, none of these releases involved a collision with another motor vehicle, and only one of the three occurred during the daytime during high traffic hours. The first incident involved a mechanical failure of the truck itself, the second involved an external obstacle that the driver attempted to avoid, and the third involved driver error, potentially from traveling at too great a speed while negotiating a turn.

In summary, hazardous materials release incidents on the I-710 have not posed a major health problem to people living or traveling on the I-710 in the past decade.

9.2.3 Community Concern Regarding Traffic Safety

In August of 2004, the I-710 Tier II Community Advisory Committee recommended the following traffic safety strategies:

4. Continue support and implementation of safety programs.
5. Increase enforcement of traffic and vehicle safety laws and regulations.
6. Increase public and trucker education on safety and neighborhood issues.
7. Implement infrastructure improvements.
8. Separate trucks and cars.

9.2.4 Collision-Related Injuries and Fatalities

Figures 9-7 through 9-9 show the geographic distribution of injuries and fatalities for the various types of collisions. The grey dots display other types of collisions to give a sense of total collision environment. The majority of truck-related injury and fatality collisions occurred on the freeway itself and those that occurred elsewhere were mainly, but not exclusively, arterials.

The largest cluster of pedestrian injury and fatality collisions occurred in Downtown Long Beach. There are two more apparent clusters around the I-710/SR-91 interchange and at the northern end of the study area in East Los Angeles.

Clusters of bicycle injury and fatality collisions occurred along the arterials of downtown Long Beach, Compton, Bell/Bell Gardens, and Commerce/East Los Angeles, potentially where more bicycle-riding is taking place.

Figure 9-7. Truck-Related Vehicle-Vehicle Fatalities and Injuries

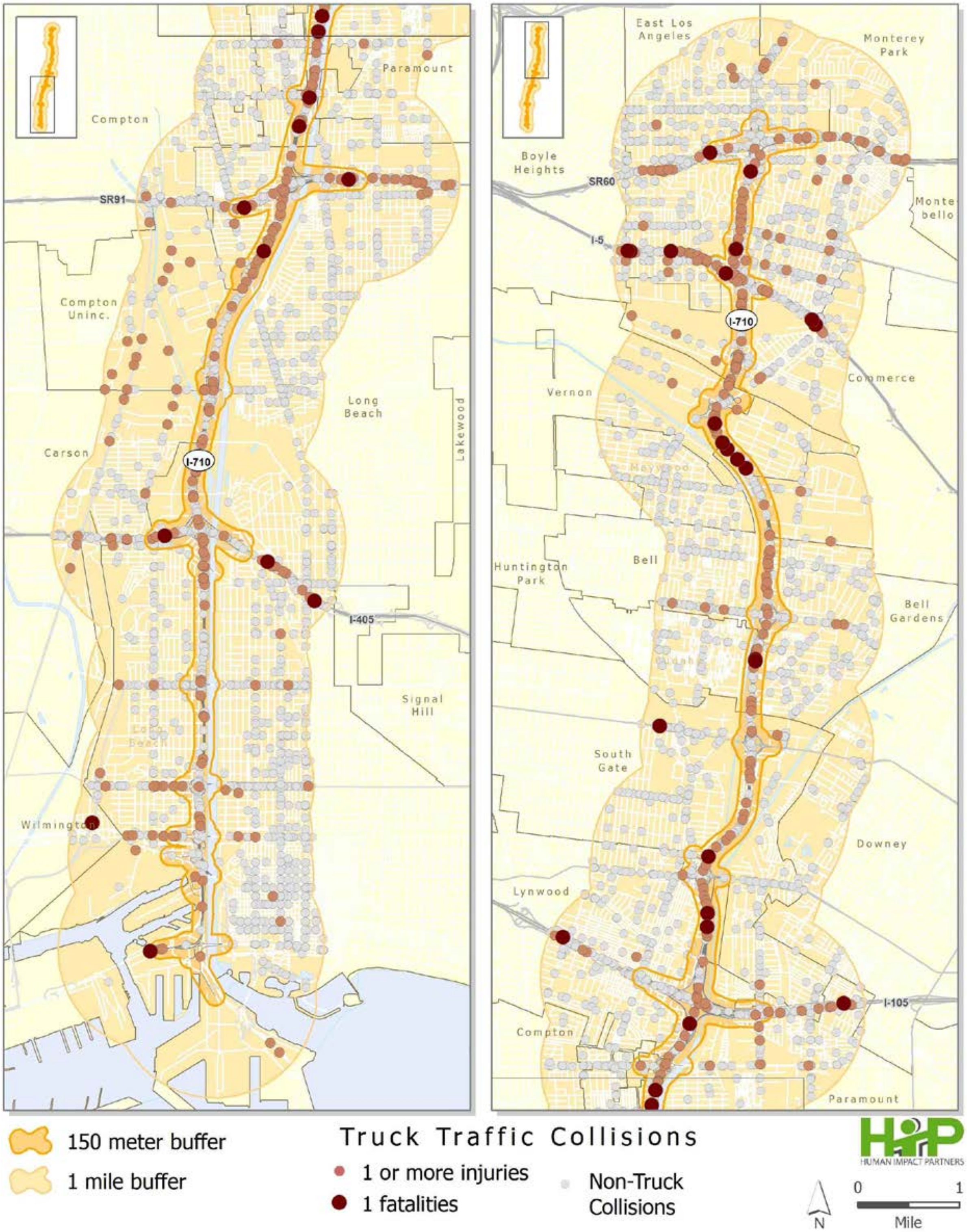


Figure 9-8. Pedestrian Fatality and Injury Map

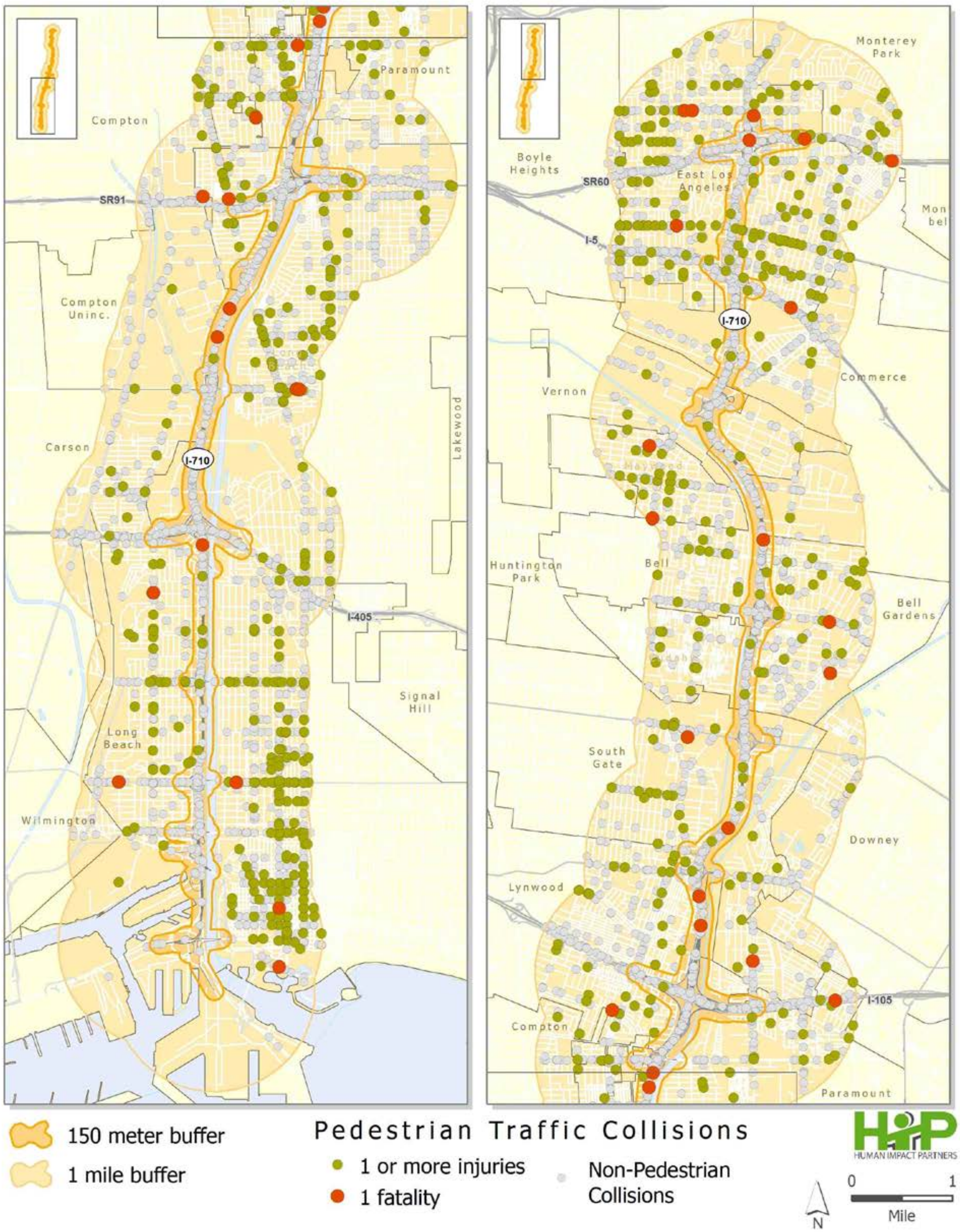
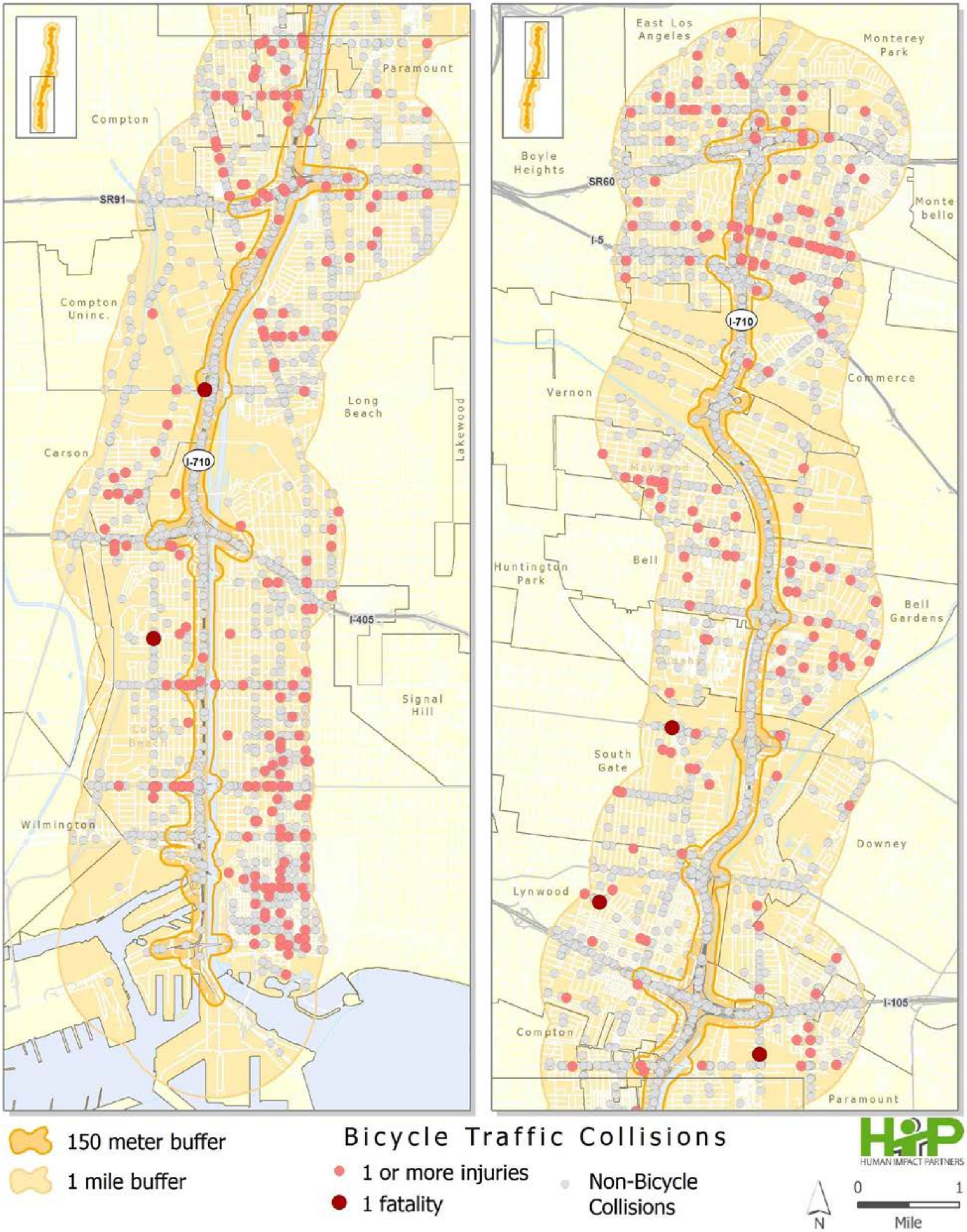


Figure 9-9. Bicycle Fatality and Injury Map



9.2.5 Comparison to Healthy People 2020 Goals

Calculating existing fatality and injury rates in the study area can provide a picture of where the region is compared to traffic safety goals of the Healthy People 2020 Guidelines. Table 9-10 shows the 3-year averages of the related fatalities or injuries, the rate (either by population or by VMT), and whether or not the existing rates are higher than the Healthy People goals.

Table 9-10. Comparison of Existing Collision Rates in the I-710 Study Area to Healthy People 2020 Goals

Healthy People 2020 Goal	Counts[2]	2008 Rate	Achieved Goal?
Reduce deaths caused by motor vehicle collisions to 12.4 deaths per 100,000 population	44.33	8.72	Yes
Reduce deaths caused by motor vehicle collisions to 1.2 deaths per 100 million vehicle miles traveled[1]	44.33	0.34	Yes
Reduce injuries caused by motor vehicle collisions to 694.4 nonfatal injuries per 100,000 population	3,210.33	631.60	Yes
Reduce pedestrian deaths on public roads to 1.3 deaths per 100,000 population	7.67	1.51	No
Reduce pedestrian injuries on public roads to 20.3 nonfatal injuries per 100,000 population	237.67	46.76	No
Reduce bicycle deaths on public roads to 0.22 deaths per 100,000 population	1.67	0.33	No

Study area population was estimated from the American Community Survey 2005–2009 (U.S. Census Bureau 2010[454]), and was 508,283.

[1]Motor vehicle deaths include related pedestrian and bicycle fatalities. VMT used as denominator for 2008 was 35.5 million VMT per day, which was annualized. Source: Southern California Association of Governments 2008[421].

[2]Fatality and injury counts are 3-year averages of fatalities and injuries totaled between 2006 and 2008.

The study area has lower overall rates of fatalities and injuries due to motor vehicles than the Healthy People 2020 goal. However, the pedestrian fatality and injury rates, as well as bicycle fatality rates, are higher than the goal. Existing pedestrian injury rates per capita are particularly high, at more than double the rate of the Healthy People goal. This statistic, for an area not generally known for its high levels of pedestrian activity except in certain high-density commercial areas such as Downtown Long Beach, must be taken into consideration with the general condition of the pedestrian environment. Areas that are not encouraging for pedestrians to walk also make for more dangerous areas to walk, especially for people without access to other means of transportation.

9.3 Assessment of the Impacts of the I-710 Corridor Project on Traffic Safety

The following assessment of traffic collisions was based on the EIR/EIS analysis predictions below, which were covered in Chapter 6, "Mobility."

9.3.1 Summary Impacts on Travel

- Speeds: For morning, mid-day, and afternoon peak traffic periods, vehicle travel speeds on the freeway and on arterials will decrease significantly under Alternative 1 (No Build), compared to the 2008 baseline, while they will increase incrementally in build scenarios 5A, and increase significantly in 6A/B and likely 6C.
- Auto volumes: Auto volumes in the general-purpose lanes are expected to increase incrementally compared to baseline conditions with each advancing alternative. Meanwhile, arterial street auto traffic volume will increase substantially in all scenarios, with Alternative 1 and Alternative 5A options having similar numbers of roadway segments operating at or above capacity and Alternative 6A/6B having slightly fewer such segments.
- Truck volumes: Volumes of trucks will increase significantly in all scenarios, especially port trucks. However, Alternative 6C will feature more trucks in the GP lanes than Alternatives 6A/6B, and likely will have greater truck volumes on surface arterials.
- Vehicle Miles Traveled: VMT will increase for autos and trucks in the I-710 GP lanes for each build alternative.

These findings are summarized in Table 9-11.

Table 9-11. Travel Impact Analysis Summary—Percent Changes from 2008 Baseline Estimates

General Purpose Lanes on the I-710					
		Alternative 1	Alternative 5A	Alternatives 6A/6B	Alternative 6C
Autos	Speeds (AM/MD/PM time periods for the I-710)	-9.73%/-5.38%/ -8.11%	+2.36%/+1.22%/ +6.10%	+16.6%/+12.1%/ +20.8%	Likely lower than 6A/6B
Autos	Volumes (AM/MD/PM time periods for the I-710)	+0.1%/+12.0%/ +3.3%	+5.0%/+24.0%/ +33.0%	+13.5%/+32.9%/ +40.2%	No data
Autos	Vehicle Hours of Delay[1]	Change from 2008 unknown	Lower than Alternative 1	Lower than Alternative 5A	No data
Autos	Vehicle Miles Traveled[1]	+6.2%	+7.8%	+8.8%	No data
Trucks	Speeds	Data not differentiated from automobile speeds, so those numbers apply here			
Trucks	Volumes	+101.2%/+42.4%/ +32.6%	+134.1%/+54.1%/ +51.7%	+46.4%/+13.6%/ +2.9%	GP lanes +30% from 6A/6B
Trucks	Vehicle Hours of Delay[1]	Data not differentiated from automobiles, so those estimates apply here			
Trucks	Vehicle Miles Traveled[1]	+38.88%	+41.67%	+44.44%	No data
Arterials					
Autos	Speeds	No data	No data	No data	No data
Autos	Volumes	+8.45%	+7.74%	+8.35%	No data
Autos	Vehicle Hours of Delay	No data	No data	No data	No data
Autos	Vehicle Miles Traveled	+10.5%	+9.5%	+9.2%	No data

General Purpose Lanes on the I-710					
		Alternative 1	Alternative 5A	Alternatives 6A/6B	Alternative 6C
Trucks	Speeds	Data not differentiated from automobile speeds, so those numbers apply here			
	Volumes	+43.76%	+37.89%	+38.02%	Likely higher than 6A/6B
	Vehicle Hours of Delay	Data not differentiated from automobiles, so those estimates apply here			
	Vehicle Miles Traveled	+37.50%	+31.25%	+25.00%	No data

[1]Figures for VHD and VMT are for all freeways in the study area, not only I-710
Source: ENVIRON 2010a[133].

Future technology may influence the frequency and severity of collisions. If carmakers trend towards lighter, smaller, and more fuel-efficient cars, an increase in fatality risk for the drivers of these cars may be expected. However vehicle technology improvements are also providing vehicles with intelligent systems that allow them to avoid collisions, and such a reduction in collisions could offset changes in fatalities due to automobile size and weight. The analyses below do not consider such changes further.

9.3.2 Proposed Improvements to the I-710 and Surrounding Roadways

Nearly all of the proposed construction improvements to roadway and freeway infrastructure will impact traffic safety in some way. According to the draft EIR/EIS, the following is an abbreviated list of proposed changes for Alternatives 5A and/or 6A/B/C:

- Separated truck corridor.
- Interchange updates, including replacement of loop ramps with direct connectors.
- On- and off-ramp improvements, including replacement of many existing ramps with SPUIs.
- Additional general purpose lanes on I-710.
- Lane improvements.
- Median improvements.
- Barrier/guardrail improvements.
- Vertical/horizontal curve improvements.
- Super elevation improvements.
- Pavement improvements.
- Shoulder improvements.
- Signage improvements/variable message signs.
- Lighting improvements.

- Local roadway improvements.
- Sight distance improvements.
- Bridge improvements.

9.3.3 Predicted Changes to Collisions on the I-710 and On-/Off-Ramps

Impacts on Non-Truck–Related Vehicle–Vehicle Collisions

The number of non-truck–related vehicle–vehicle collisions will vary depending on the alternative chosen. Higher traffic speeds and volumes on freeway mainlines, ramps, and interchanges are expected to correspond to increased traffic collision rates for this conflict type.

Because Alternative 1 is predicted to feature lower speeds but higher traffic volumes, VMT, and V/C ratios (i.e., congestion), compared to existing conditions, the number and rate of low-severity collisions on the I-710 is expected to increase.

In Alternative 5A, slightly increased vehicle volumes, similar speeds, and increased VMT on the freeway are expected compared to the 2008 baseline, which, without freeway-design improvements, would lead to a small increase in the number of collisions and a proportional increase in severe collisions. However, roadway improvements would lead to decreases in the number of collisions. Without further modeling, it is not possible to conclude whether the total number of collisions would increase or decrease. On- and off-ramp improvements would potentially decrease the proportion of severe collisions on ramps, but total ramp collisions are not expected to decrease due to the conversion to SPUI ramps.

In Alternatives 6A and 6B, speeds and volumes would be higher in the I-710 general-purpose lanes. Without freeway-design improvements, this would lead to a greater increase in both the number of collisions and the severity of collisions on the freeway compared to the other alternatives being considered. However, roadway improvements would lead to decreases in the number of collisions. Without further modeling, it is not possible to conclude whether the total number of collisions would increase or decrease. Again, ramp improvements may decrease the proportion of severe collisions in these locations.

For Alternative 6C, data was not available for auto volumes and VMT; however, it can be assumed that they are similar to those for Alternatives 6A/B and that the impacts on collisions would be similar.

Impacts on Truck-Related Vehicle–Vehicle Collisions

Truck collisions are highly dependent on truck volumes on the freeway, which are expected to vary depending on the alternative. For the GP lanes, truck volumes are expected to be the heaviest under Alternative 5A and slightly lower in Alternative 1. Alternatives 6A/6B will have the lowest truck volumes in the GP lanes. Overall, without freeway-design improvements, the I-710 GP lanes would be predicted to have higher rates and higher severity of truck-related vehicle collisions under all the alternatives due to increased truck volumes. For Alternatives 6A/B/C, the separation of a large proportion of trucks from the GP lanes would decrease the truck collision rates from where they might be if these lanes were added as GP lanes, but these alternatives still show an increase in truck volume in the GP lanes compared to 2008. Without further modeling, it is not possible to conclude whether the total number of truck collisions would increase or decrease for Alternatives 5A and 6A/B/C GP lanes.

Another factor that will affect truck collisions in Alternatives 5A and 6A/6B/6C is the addition of improved freeway ramps, namely the replacement of the existing loop ramps with direct connector flyover ramps. As loop ramps were found in the literature to have lower truck collision rates than non-loop ramps, and because a significant proportion of truck collisions currently occur on ramps, these ramp mitigations are likely to decrease the number of truck collisions. However, these collisions tend to be non-severe, so the impact on health may be less significant. In addition, the conversion of on-and off-ramps to SPUIs may affect truck collision rates there, but more research is needed to ascertain their effectiveness at truck collision reduction.

An additional consideration related to increased estimated truck volumes is that freeway pavement conditions are likely to deteriorate much faster than under current conditions, because trucks are extremely damaging to roadway surfaces due to their immense weight per axle compared to automobiles. Decreased road conditions may contribute to increased collision rates for all vehicles, particularly on freeways, especially when the higher speeds on freeways are combined with inclement weather or poor visibility conditions. This can be prevented by timely maintenance of roadway conditions.

Impacts on Vehicle–Pedestrian/Bicycle Collisions

Any changes to the frequency of non-truck–pedestrian/bicycle collision would be expected to vary proportionally with changes in the number of people walking and biking, which may not be related to the expected changes in volume and speed. As pedestrian and bicycle collisions on the freeway are rare and are, for the most part, unrelated to the freeway characteristics, no significant change in the rate of these types of collisions is expected on the freeway.

However, pedestrian and bicycle collisions at intersections which contain on- and off-ramps have much more to do with the design of the ramp facilities. These facilities will remain unchanged in Alternative 1, but they will be converted to SPUIs in Alternatives 5/6A/6B/6C. There is no literature on how SPUIs impact pedestrian and bicycle collisions, but it is noted that these travelers have a more difficult time crossing these types of ramp intersections than more traditional designs. More research is needed to understand how, or if, these increased difficulties impact collision rates.

9.3.4 Predicted Changes to Collisions on Arterial Roads

Changes in vehicle volumes and speeds on the freeway are expected to impact vehicle volumes and speeds on arterials, as is predicted in the traffic models in the I-710 EIR/EIS. Therefore, automobile, truck, pedestrian, and bicycle collisions off the freeway are likely to change as a result of the I-710 Corridor Project and these changes will impact health outcomes.

Non-Truck–Related Vehicle–Vehicle Collisions

For arterials in Alternative 1, auto volumes are expected to increase and speeds are expected to decrease due to the increased congestion (and no new improvements to ameliorate inefficient and unsafe traffic flow street and intersection designs). The frequency of non-severe collisions is expected to increase.

In Alternatives 5A and 6A/B/C, both arterial volumes and intersection levels of service are expected to increase, but it is uncertain how these changes, along with the other intersection improvements, will impact vehicular speeds, and thus collision rates and injury severity. In other words, the proportion of the increased collision rates that is expected from higher arterial volumes that will be offset by increased intersection efficiency and safety is unknown. In Alternative 5A, the predicted arterial auto volumes are expected to be lower than in both Alternative 1 and Alternatives 6A/B/C.

The changes in auto collisions on arterials under Alternative 6C cannot be estimated due to lack of data, but based on the data that is available, severe collisions are likely to change in similar ways as Alternatives 5A and 6A/B.

Truck-Related Vehicle–Vehicle Collisions

Truck collision rates are highly affected by truck volumes. On arterials, truck volumes are expected to increase for each alternative. Volumes will increase the most in Alternative 1 (43.76%) because a full port build-out is assumed but no extra freeway capacity will exist, while Alternatives 5A and 6A/B will hold that increase to 37.89 and 38.02%, respectively. For Alternative 6C, it is expected that truck volumes on arterials will increase compared to Alternatives 6A/B due to the freight corridor tolling, but it is unknown exactly how much Alternative 1 is expected to have the highest truck collision rates on arterials due to having the highest truck volumes and no intersection and roadway improvements. The roadway and intersection improvements will help to dampen the increased truck volumes in Alternatives 5/6A/6B/6C. However, because truck volumes substantially increase across the alternatives compared to the 2008 baseline volumes, there will be an expected increase in truck-related collisions, which tend to be disproportionately severe, on arterials under all the alternatives.

Vehicle-Related Vehicle–Pedestrian/Bicycle Collisions

Changes in the frequency of this collision type are a function of the volumes of vehicles, pedestrians, and bicyclists on surface roadways. Transport modeling in the draft EIR/EIS and described in Chapter 6, ”Mobility,” above assumes that mode share among modes will not change; however, future growth in population and traffic volume will result in an increased frequency of vehicle–pedestrian/bicycle collisions, which are disproportionately severe (especially when the vehicle involved is a truck), under all alternatives unless collision-reducing mitigations are implemented.

As discussed in Chapter 6, “Mobility,” if vehicle volumes increase substantially, some pedestrians and bicyclists may begin to choose different routes or modes:

- For arterials in Alternative 1, walking and public transportation may be more attractive as the highest levels of vehicle congestion, longer vehicle travel times, and lower average traffic speeds make car travel less convenient. If vehicular traffic speeds are slower on surface streets this may reduce the risks of severe and fatal pedestrian collisions. The lack of precise data on changes in speed along arterials precludes an analysis of impacts on vehicle pedestrian injury severity under this alternative.

- Arterials in Alternatives 5A and 6A/B/C will carry greater auto volumes at faster average traffic speeds than the 2008 baseline conditions, with slightly higher volumes in Alternatives 6A/6B compared to 5A. Also, public transportation usage, and pedestrian and bicycle travel are estimated to be similar to baseline rates in Alternative 5A, but decreased in Alternatives 6A/B/C as car travel is made more and more convenient. Reduced pedestrian and bicycle activity, if it occurs, would result in lower auto/pedestrian collision frequencies under Alternatives 6A/B/C than under Alternative 5A. All of these alternatives will feature converted on- and off-ramps to SPUIs, which will make pedestrian and bicycle navigation through these intersections more difficult, but it is unknown whether this will translate to higher collision rates.

9.3.5 Predicted Changes on Hazardous Materials Releases on the I-710

The impact of the freeway expansion on the number of hazardous materials releases on the freeway is difficult to predict, because none of the hazardous material (haz mat) release incidents in the 10.5-year period studied involved anyone but the truck driver, and they were not necessarily traffic speed or density related. There is a lack of strong evidence with which to predict whether the proposed changes to the freeway will increase or decrease haz mat incidents, though some of the incidents occurred on ramps, and ramp design improvements under Alternatives 5A and 6A/B/C may therefore reduce such incidents. The number of such incidents is likely to be proportional to the volume of trucks carrying hazardous materials, which can be assumed to increase proportionately to the increase in truck volume. For all alternatives being considered, therefore, the frequency of hazardous materials incidents on the freeways can be expected to increase proportionally.

The only injury that resulted from the collisions in the recent past involving hazardous materials on the I-710 was a driver being fatally injured in the collision itself. No injuries due to exposure to hazardous substances have been reported. However, haz mat incidents of high severity do occur, though infrequently, and the chances of a severe haz mat incident increase as the frequency of all haz mat–related collisions increases.

9.3.6 Summary of Predicted Changes to Traffic Safety Associated Health Outcomes

In summary, collisions between vehicles are expected to increase due to increases in volumes of both cars and trucks under Alternative 1. For Alternatives 5A and 6A/B/C, impacts on collisions are uncertain because of the opposing impacts of increases in volume and roadway improvements. Increases in vehicle volumes and pedestrian and bicyclist volumes would increase the frequency of pedestrian/bicycle collisions. Changes in speed are likely to impact the severity of collisions, generally leading to the conclusion that the higher speeds under Alternatives 6A/B/C would lead to a higher proportion of severe and fatal injuries. It is unclear if the project will meet its objective of improving traffic safety.

Table 9-12 summarizes traffic safety–related health impacts of each build alternative.

Table 9-12. Summary of Traffic Safety–Related Health Impacts

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Non-Truck vehicle–vehicle fatalities and injuries					
1	–	Minor	High	♦♦♦	Relative impacts of roadway improvements compared to volume and speed changes uncertain
5A	?	Unknown			
6A	?	Unknown			
6B	?	Unknown			
6C	?	Unknown			
Truck–Auto fatalities and injuries					
1	–	Moderate	High	♦♦♦	Relative impacts of roadway improvements compared to volume and speed changes uncertain
5A	?	Unknown			
6A	?	Unknown			
6B	?	Unknown			
6C	?	Unknown			
Vehicle–Pedestrian/Bicycle fatalities and injuries					
1	–	Minor–Mod	High	♦♦	Changes in pedestrian and bicycle activity uncertain
5A		Minor			
6A		Minor			
6B		Minor			
6C		Minor			
Hazardous materials exposure from releases					
1	~/–	Negligible	Typically low, but infre-quently high	♦	High severity hazardous material spills are low probability events
5A		Negligible			
6A		Negligible			
6B		Negligible			
6C		Negligible			

Explanations:

Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~). "?" indicates that the direction is uncertain.

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between traffic safety and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ =

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
causal relationship certain. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.					

9.4 Recommendations

Causes of traffic collisions are complex and intertwined. The goals of vehicle-throughput efficiency and improved traffic safety, especially for non-motorized residents, can be at odds. The following recommendations would help mitigate the decreases in traffic safety that may result from changes in vehicle volumes and speeds on the freeway and arterials as well as increases in pedestrian and bicycle volumes on the arterials. It is critically important that implementation of the recommendations be addressed with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated objective of improving traffic safety.

9.4.1 Traffic Safety Analysis

- Traffic safety experts should conduct an analysis of the impacts of the proposed I-710 improvements and the changes in volumes and speeds on collision rates using crash reduction factor methodology.
- Conduct further traffic modeling to determine vehicle speeds and trips taken on arterials to better understand the relationship between the freeway expansion and traffic collisions in neighborhoods. The results of this analysis may help identify hot spots of poor traffic safety conditions, for both motorized and non-motorized travelers, and should inform future mitigation efforts.

9.4.2 Vehicles

- Separate cars and trucks on the freeway under any alternative. This can be done through the freight corridor, as proposed in Alternative 6A/B/C, or through lane restrictions.
- Strictly enforce truck routes to keep them out of residential neighborhoods in order to reduce truck–pedestrian/bicyclist collisions.

9.4.3 Walking and Bicycling Improvements

- Supplement the intersection improvements outlined in the draft I-710 Corridor Project EIR/EIS with pedestrian-level improvements that increase their visibility and safety. Such improvements include, for example, clearly marked and protected crosswalks (e.g., with laddered crosswalks and pedestrian countdown signals).
- Starting with existing residential streets that are walkable/bikeable, expand the network of walkable/bikeable streets throughout the I-710 corridor to provide safe and pleasant streets that

can be used for active transportation. This could include implementing “bicycle boulevards” (i.e., limited-access, low speed streets that have traffic calming features such as mid-block diverters with bicycle cut-outs) in local streets.

- Provide adequate facilities for pedestrians and bicyclists to cross the new SPUIs safely so that non-motorized transportation use is not discouraged.

10. Jobs and Economic Development

10.1 Introduction

Income is one of the strongest and most consistent predictors of health and disease in public health research literature, and health is inextricably linked to the availability and affordability of material resources. Because of this, the economic health of a region is an important indicator of the potential health of its residents. Although economic development is an extremely broad topic, this section focuses on aspects of jobs and economic development that are directly affected by the alternatives being considered in the I-710 Corridor Project.

This chapter describes the links between economic development and health, the existing economic conditions in communities in the I-710 Corridor, the impact of the I-710 Corridor Project on jobs and development, and recommendations to improve health outcomes related to jobs and economic development.

Although the benefits of I-710 construction-related jobs for health could be significant, these impacts are not analyzed here because the scope of this HIA does not include construction-related impacts.

10.1.1 Background: The Relationship between Jobs and Economic Development and Health

Jobs and economic development impact health in many direct and indirect ways. As the availability of jobs that pay family-supporting wages and provide health-related benefits increases, income and access to health care increase. As the economic means of individuals and communities as a whole increase, they become better able to make decisions that are health-protective, such as buying more healthy food, having time to exercise and to maintain strong social connections at the individual level, and investing in health-promoting resources, such as parks and schools, at the community level. All of these decisions impact lifespan, chronic disease levels, and mental health.

Socioeconomic Status

SES has been extensively researched as a key factor that affects health (Kaplan 2009[246], Kawachi and Dow 2010[249]). Three major indicators of SES often cited in the literature as having links to health are education (Adams 2002[4]), income (Marmot 2002[304]), and occupational prestige or status, or "job control." (Bosma et al. 1997[48]) A recent issue brief on the subject summarizes much of this literature (Braveman et al. 2011[51]). Its findings include the following.

<u>Lifespan</u>

- As income increases, overall life expectancy is higher.
- Mortality risk is associated with greater accumulated wealth among white adult men.

- There is a near-linear gradient correlating step-wise increases of job status to decreasing negative health outcomes such as cardiovascular disease, hypertension, and general mortality risk (Marmot et al. 1978[305]).

Overall Health

- Self-reported health status for adults and their children improves with income.
- Low birth weight, an indicator of health later in life, is highest among low-income mothers.

Chronic Disease

- Wealth is negatively correlated to obesity and other cardiovascular risk factors.

"Locus of control," or the "ability of people to deal with the forces that affect their lives, even if they decide not to deal with them," (Syme 2004[430]) allows one to determine and select behaviors that are conducive to a healthy lifestyle while avoiding health-harming behaviors. Locus of control is dependent on SES, and having this type of control in one's life is associated with decreased stress and better health.

One's education level plays an important role in determining the types of jobs, and therefore the income, one can expect. Level of educational attainment is a variable linked with economic advancement and with accessibility to higher paying jobs (Isaacs and Schroader 2004[232]).

Additionally, different categories of jobs lend themselves to greater or lower health risk factors. Another recent issue brief (An et al. 2011[11]) documents the influences of both physical effects (e.g., toxic exposures, dangerous mechanical operations) and mental/emotional effects (e.g., stress, insomnia) that working conditions can have on workers. These effects are compounded in people who must work more than one job or long hours. Other findings summarized in the brief include the impact of the work environment on happiness and mental health. Jobs that are characterized by high levels of decision-making opportunities, high rewards for hard work, and social support among colleagues tend to have happier and healthier workers. A study looking at the association between job type and risk of mortality found that traits related to "job IQ" (e.g., creativity and cognitive ability) showed "consistent, significant, and positive impacts on health even with a variety of confounding variables, suggesting that job IQ is fundamental to explaining the impact of occupations on health." (Lee 2011[276]) This finding is related to the "locus of control" concept mentioned earlier; mental and creative freedoms in one's job results in health benefits.

Unemployment

Unemployment, especially long-term unemployment, has been shown to be a serious risk factor for both physical and mental health (Kroll and Lampert 2011[266]). A comprehensive systematic review and meta-analysis of 42 studies found that unemployment increased mortality risk for early- and middle-career workers, and less so for late-career workers (Roelfs et al. 2011[398]). Unemployment has also been shown to impact access to health insurance (Fronstin 2010[192]) and other health outcomes including cardiovascular disease, hypertension, depression, and suicide (Jin and Svoboda 1995[241], Voss et al. 2004[470]).

10.1.2 Background: The Relationship between Transportation and Costs of Doing Business

Business costs can strongly influence businesses' decisions to build manufacturing plants and other operations in a given area. Business location is based on land rents, commuter costs, and other costs (Giuliano 1988b[200]). The amount municipalities spend on public goods and services (Gabe and Bell 2004[194]), taxes (Wasylenko 1997[476]), and the presence of unions (Bartik 1985[30], Coughlin et al. 1991[116]), have been found to impact business location decisions, while environmental regulations have been found to have less of an impact (Bartik 1988[31]).

An important measure of economic growth is the number of new businesses. One study found that regional economic diversity, population growth, greater personal wealth, presence of mid-career adults, low unemployment, and greater flexibility in employment relationships were major drivers of start-up rates of businesses. On the other hand, there was a complete absence of any impact of regional variation associated with higher densities of customers, suppliers, workers, research and development resources; costs of production; or, importantly for this HIA, access to national transportation facilities (Reynolds et al. 1995[387]).

Congestion plays a role in both direct and indirect costs of doing business (Centre for International Economics 2006[101]). A 2001 Transportation Research Board report found that industries with higher levels of truck shipping have higher costs of doing business associated with congestion, as do companies that have more specialized material inputs (versus more broad, commodity-based inputs that can more easily be substituted with closer suppliers) (Weisbrod et al. 2001[480]).

The Texas Transportation Institute's 2011 Annual Urban Mobility Report found that for the Los Angeles-Long Beach-Santa Ana (LA-LB-SA) metropolitan region in 2010, the truck congestion costs were $2,254 million, using an estimated cost of $88.12 per hour of truck time travel delay. Among the 15 Very Large Urban Areas (defined as the metropolitan regions having populations over 3 million), the LA-LB-SA metropolitan region ranks 2nd, behind only Chicago-IL-IN in truck congestion cost (Texas Transportation Institute 2011[439]).

10.1.3 Established Jobs and Economic Standards

Although economic growth and employment are the goals of many federal, state, and local policies, aside from minimum wage laws and similar labor laws, there are no current employment or economic standards relevant for this chapter.

10.2 Existing Conditions for Jobs and Economic Development

10.2.1 Jobs

Employment

Los Angeles County is an important center of employment, and it is the nation's largest manufacturing center (Los Angeles County Economic Development Corporation 2011[296]). According to the California

Employment Development Department, as of July 2011, an estimated 4,216,200 people were employed in the county. This is 26.6% of the total number of jobs in California (15,874,800).

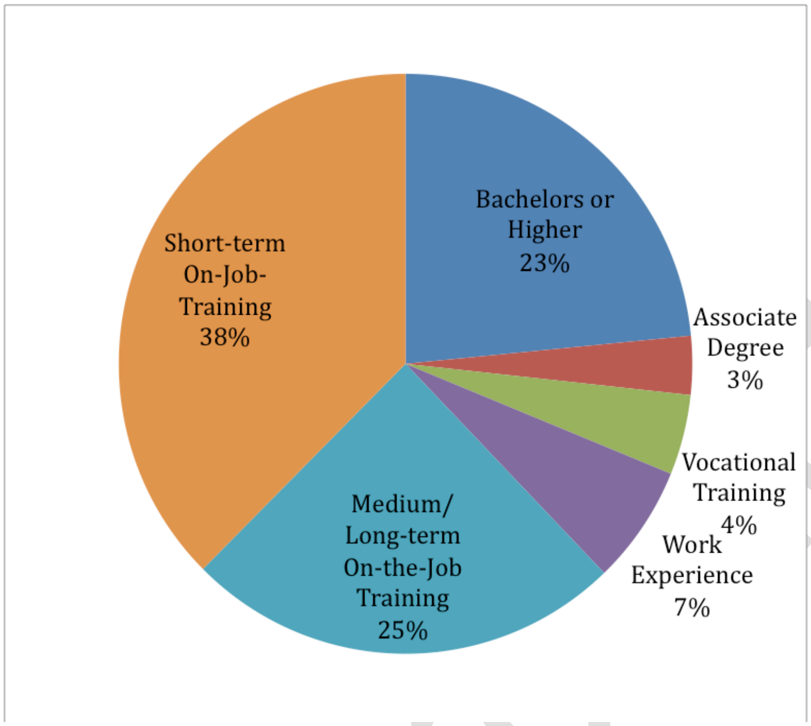
The number of people in the labor force and the number employed for both the county and census-designated cities in the I-710 Corridor Project study area are shown in Table 10-1. This table is from California Employment Development Department's (CA EDD) annual average of monthly labor force estimates for 2008.

Table 10-1. Employment in Los Angeles County and Cities in the I-710 Project Corridor, 2008

Area Name	Labor Force	Employment
Artesia	8,300	7,900
Bell	15,900	14,300
Bell Gardens	17,200	15,100
Bellflower	36,800	34,000
Cerritos	29,400	28,300
Commerce	5,400	4,700
Compton	36,100	31,400
Cudahy	9,800	8,800
Downey	54,400	51,200
Hawaiian Gardens	6,500	5,900
Huntington Park	26,600	23,600
La Habra Heights	3,000	2,900
La Mirada	24,800	23,700
Lakewood	45,500	43,300
Long Beach	237,900	218,300
Lynwood	27,600	24,300
Maywood	12,200	10,800
Montebello	28,900	26,500
Norwalk	49,300	45,400
Paramount	24,600	21,900
Pico Rivera	29,300	27,200
Santa Fe Springs	7,900	7,400
Signal Hill	5,800	5,500
South Gate	41,300	37,400
Vernon	0	0
Whittier	44,200	41,900
Source: CA EDD 2011[61].		

A basic criterion of a job is the minimum education level required. Figure 10-1 shows the types of jobs available in the county by minimum educational attainment required.

Figure 10-1. Percentages of Jobs in Los Angeles County by Minimum Education Required, 2008



Source: CA EDD 2011[61].

Table 10-2. Educational Level and Median Earnings in Los Angeles County, 2008

Education Level	Median Earnings	
	Hourly	Yearly
B.A. or Higher	$35	$75,946
Associate Degree	$28	$57,523
Vocational Training	$21	$43,579
Other Work Experience	$27	$55,881
Medium- to Long-Term On-the-Job Training	$17	$36,154
Short-Term On-the-Job Training	$11	$24,029
Source: CA EDD 2011[61].		

The majority of jobs (74%) in the county do not require any college education, and can be fulfilled with short- or medium-/long-term on-the-job training, or other work experience. Approximately 3% of jobs in 2008 required an Associate's Degree, while 23% of jobs required a Bachelor's Degree or higher. As Table 10-2 shows, the jobs that require an Associate's Degree or higher have much higher median earnings than the jobs that require vocational training, other work experience, or medium-/short-term on-the-job training.

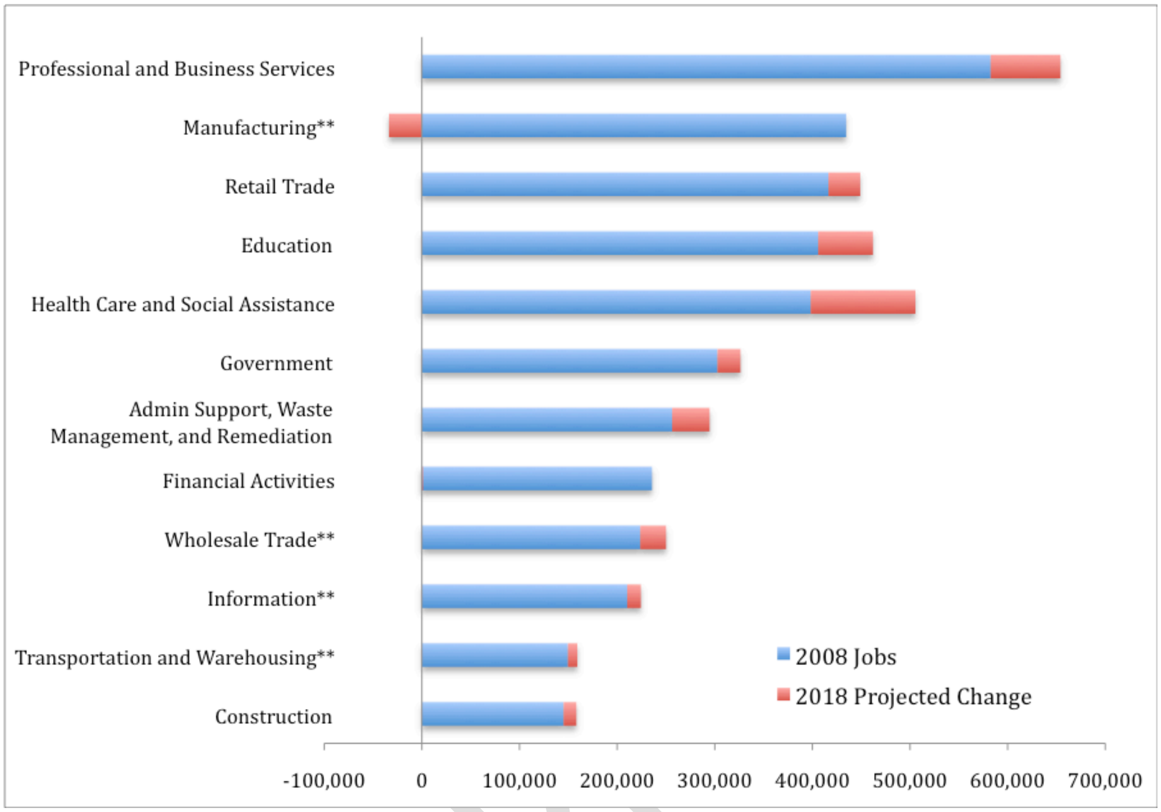
Table 10-3 and Figure 10-2 show estimated 2008 and predicted 2018 employment figures for LA County, by industry. Data for 2018 is included to indicate current trends. The Trade, Government, Professional and Business Services, Education, Health Care, and Social Assistance, Manufacturing, and Leisure and Hospitality sectors accounted for the largest portion of the jobs in 2008. The three sectors that are seeing the largest growth are Education Services, Health Care, and Social Assistance (130,700 jobs), Professional and Business Services (71,500 jobs), and Trade (58,900 jobs). The greatest percent change between 2008 and 2018 projected employment figures is 26% for Education, Health Care, and Social Assistance. Manufacturing shows a significant decrease in employment.

Table 10-3. County Employment Estimates and Projections of Total Non-Farm Jobs, by Industry, 2008–2018

Industry Title	Annual Average Employment		Employment Change	
	2008	2018	Numerical	Percent
Total Non-Farm	4,070,700	4,434,600	363,900	8.9
Transportation and Warehousing	149,600	159,200	9,600	6.4
Construction	145,200	158,200	13,000	9.0
Information	210,300	224,300	14,000	6.7
Wholesale Trade	223,700	250,100	26,400	11.8
Financial Activities	235,700	235,500	-200	-0.1
Administrative and Support and Waste Management and Remediation Services	256,400	294,700	38,300	14.9
Manufacturing	434,500	400,800	-33,700	-7.8
Health Care and Social Assistance	398,300	505,500	107,200	26.9
Retail Trade	416,500	449,000	32,500	7.8
Education	406,000	462,000	56,000	13.8
Government	603,700	659,700	56,000	9.3
Professional and Business Services	582,600	654,100	71,500	12.3

Source: CA EDD 2011[61].
Industry detail may not add up to totals due to independent rounding

Figure 10-2. Employment Projections by Industry, Los Angeles County, 2006–2016



Industries marked with asterisks (**) are "basic" and have a location quotient > 1.10 relative to California as a whole
Source: CA EDD 2006[58].

This HIA used an economic base analysis to evaluate how employment in these sectors in Los Angeles compares to California as a whole (using 2008 baseline figures). A location quotient was calculated for each of these major industries, using the following equation:

$$\text{Location quotient} = \frac{\text{(county employment in industry/Total county employment)}}{\text{(California employment in industry/Total California employment)}}$$

Four industries—Transportation and Warehousing, Information, Wholesale Trade, and Manufacturing—have a location quotient greater than 1.10, indicating that the Los Angeles region has a higher proportion of workers employed in these fields relative to the state.

The freeway expansion will affect transportation and warehousing jobs in particular; therefore, that sector's 2008 job estimates and 2018 projections are shown in Table 10-4. Warehousing and residual jobs are expected to grow by double-digit percentages. Jobs in truck transportation in particular are projected to increase 7.2% from 2008 to 2018.

Table 10-4. Transportation and Warehousing–Related Jobs and Job Projections, 2008–2018

Industry Title	Annual Average Employment		Employment Change	
	2008	2018	Numerical	Percent
Total Transportation and Warehousing	149,600	159,200	9,600	6.4
Air Transportation	19,300	19,500	200	1.0
Truck Transportation	27,600	29,600	2,000	7.2
Transit and Ground Passenger Transportation	13,700	15,000	1,300	9.5
Support Activities for Transportation	45,100	48,000	2,900	6.4
Couriers and Messengers	20,900	21,200	300	1.4
Warehousing and Storage	16,700	18,600	1,900	11.4
Residual	6,300	7,300	1,000	15.9

Source: CA EDD 2011[61].
Industry detail may not add up to totals due to independent rounding

Port-related logistics jobs pay wages that are generally higher than most blue-collar jobs. (King 2007[260]) They are also jobs that are difficult to outsource, as they must be located in proximity to the ports. This is one of the reasons why the Inland Empire, with its abundance of open land to build transloading facilities, saw significant job growth between 1990 and 2005, even though LA County had no net job growth during that time.

There were seven job categories related to goods movement listed in the top 50 jobs, with the most project openings from 2008–2018. These jobs and their median hourly and annual wages are shown in Table 10-5. Note that the wages listed are for all jobs in these categories, not just those in the goods movement sector.

Table 10-5. Jobs Related to Goods Movement from the List of 50 Occupations with the Most Projected Openings in Los Angeles County, 2008–2018

Rank	Occupational Title	Job Openings	Wages	
			Median Hourly	Median Annual
8	Laborers and Freight, Stock, and Material Movers	25,610	$10.94	$22,763
12	Stock Clerks and Order Fillers	19,860	$10.45	$21,739
16	Sales Representatives, Wholesale and Manufacturing	15,080	$25.47	$52,984
32	Truck Drivers, Heavy and Tractor-Trailer	8,880	$19.57	$40,695
36	Truck Drivers, Light or Delivery Services	8,110	$14.23	$29,597
37	Shipping, Receiving, and Traffic Clerks	7,920	$13.02	$27,083
50	Cleaners of Vehicles and Equipment	6,040	$9.31	$19,372

Source: CA EDD 2011[61].

A "living wage" is defined as one that would cover the cost of living for low-wage families; the calculation of a living wage includes data on local costs of food, childcare and education, health care, housing, transportation, other necessities, and taxes. Researchers have gathered data on living wages in many places in the U.S. and data on the county is publicly available (Glasmeier 2008[210]). For the county, the living wage is:

- $11.99 per hour for one adult
- $21.75 for a family with one adult and one child
- $17.14 for two adults
- $26.92 for a family with two adults and one child
- $34.07 for a family with two adults and two children

Only one of the seven job categories with the highest projected job openings in goods movement—sales representatives—have hourly wages greater than the living wage required for any type of family with a child. The goods movement industry employs many temporary workers—in positions such as warehouse workers and truck drivers—that are paid poverty-level wages (Matsuoka et al. 2011[308]). In addition, goods movement jobs typically have longer hours, more hazardous working environments, and provide fewer job-related benefits.

As demand for new, clean, and "green" technology increases, so will the number of jobs for researching, developing, and manufacturing these technologies. There is not currently a standardized method to measure the number of green jobs, so the number of such jobs currently available is not known.

Unemployment

The unemployment rate reflects the number of people who are actively looking for work but cannot find jobs and does not include those who have given up looking for work and those who are working fewer hours than they would like (e.g., someone with a part-time job who would prefer to be working full time). In July 2011, the county's unemployment rate was 13.3% while California's was lower at 12.4%. Table 10-6 is reproduced from Table 3.3-7 in the draft EIR/EIS, and shows the numbers of people in the civilian labor force and the unemployment rates of cities in the study area in August 2009.

Table 10-6. Unemployment Rates in the I-710 Corridor, August 2009

City	Civilian Labor Force	Unemployment Rate (%)
Los Angeles County[1]	4,900,779	7.7
1-mile Study Area[1]	322,292	9.3
Cities in the I-710 Corridor Project Study Area[2]		
Bell	16,300	16.5
Bell Gardens	17,900	19.7
Carson	46,600	12.7
Commerce	5,600	22
Compton	37,700	21
Cudahy	10,100	17.3
Downey	54,100	10.3

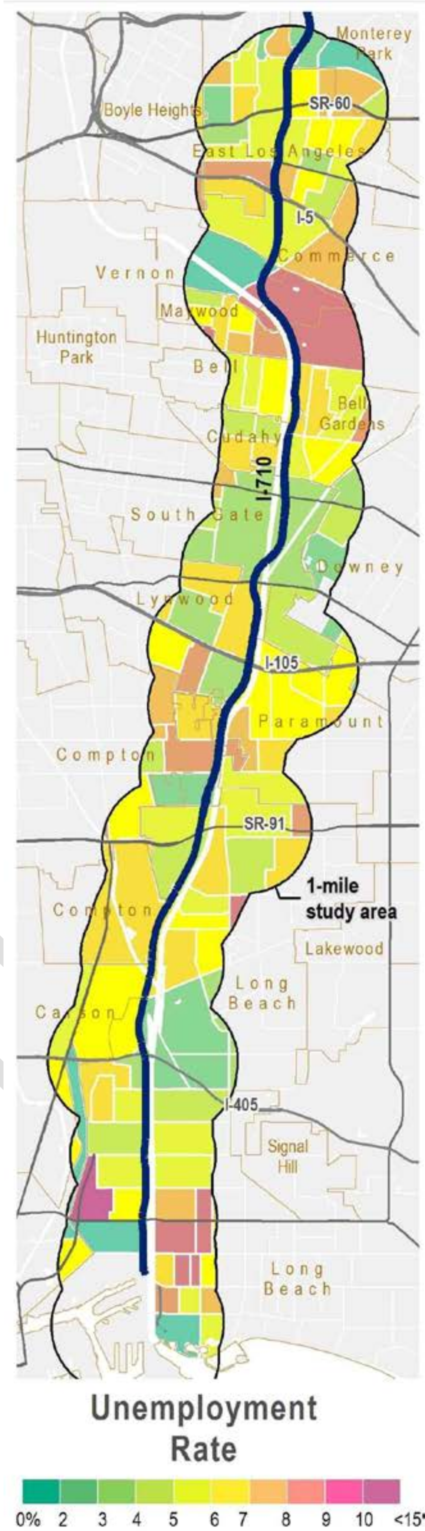
City	Civilian Labor Force	Unemployment Rate (%)
Huntington Park	27,500	18.5
Lakewood	44,800	8.2
Long Beach	240,500	13.8
Los Angeles (includes Boyle Heights, Wilmington, and San Pedro)	1,942,400	13.8
Lynwood	28,700	19.6
Maywood	12,600	18.1
Paramount	25,400	18.1
Signal Hill	5,700	9.5
South Gate	42,200	15.9
Vernon	0	0

Sources:
[1] U.S. Census Bureau 2010[454].
[2] CA EDD 2009[59].
Note: Data not available for unincorporated East Los Angeles.

In August 2009, the unemployment rate was higher in the I-710 1-mile corridor than in the County as a whole. Unemployment rates varied widely among the cities in the study area; not including Vernon, which has a very small population, the range of unemployment is 8.2% in Lakewood to 22% in the City of Commerce.

The distribution of unemployment rates among census tracts is shown in Figure 10-3.

Figure 10-3. Unemployment in the I-710 Corridor Project Study Area, 2008



Source: U.S. Census Bureau 2010[454]

Areas of Long Beach, Compton, South Gate, Bell, and East Los Angeles have relatively higher levels of unemployment; and areas of Carson, Long Beach around the I-710/I-405 interchange, and Downey have relatively lower levels of unemployment.

Full employment is defined in the Full Employment and Balanced Growth Act of 1978 as 3% unemployment for persons 20 and older, and 4% for persons aged 16 and over. Using the 1-mile study area labor force estimate in Table 10-5, the total labor force (322,292) was multiplied by 4% to get 12,892 people unemployed under full employment. This number is then subtracted from the number unemployed as calculated from in Table 10-5 (9.3% of 322,292) to get 17,081 jobs needed in the 1-mile study area to reach full employment.

Job Benefits

In the county in 2009, 28.9% of those employed were uninsured, up from 23% from 2006. This is higher than the rate in California in 2009, which was 24.3% (Yoo 2010[498]). Data specific to the I-710 corridor or to those employed in the goods movement industry were not available.

According to a recent study conducted by the California Healthcare Foundation, roughly 30% of the more than 700,000 employers in California do not offer health insurance to their employees. Most of the businesses that do not offer insurance plans are small- and medium-sized firms with up to 50 employees. In California, 76% of businesses with 10–49 employees offer health coverage. Many of these businesses cannot afford the insurance premiums and so access to health care for employees is limited by their ability to pay for individual plans (Kelly and Spalding 2009[252]).

The U.S. Bureau of Labor Statistics conducts the National Compensation Survey, which collects data on prevalence of employee benefit programs. Overall, government employees are more likely to participate in retirement plans and medical care plans compared to private industry employees. The survey also found that service occupations in private industry had significantly lower rates of access to major benefits than workers in management, professional, and related occupations. The differences between management and professional occupations and government employees were not as large (U.S. Bureau of Labor Statistics 2008[450]).

Estimates for the proportion of employees with access to these job benefits in the study area, the county, or the state are not available. Estimates are also not available for those employed in the goods movement industry.

Proportion of Jobs Held Locally

There is no data for the study area (or for the Gateway Cities in general) on what percentage of jobs are held locally, i.e., how many employees live and work within the study area (or the Gateway Cities). However, in 2009, the Long Beach Redevelopment Agency released a report that showed that 24% of Downtown Long Beach residents work within Long Beach (Long Beach Redevelopment Agency 2009[288]). In addition, the 2005–2010 Long Beach Consolidated Plan found that non-residents held 63% of jobs in the City of Long Beach (City of Long Beach 2005[107]).

10.2.2 Economy

Costs of Doing Business

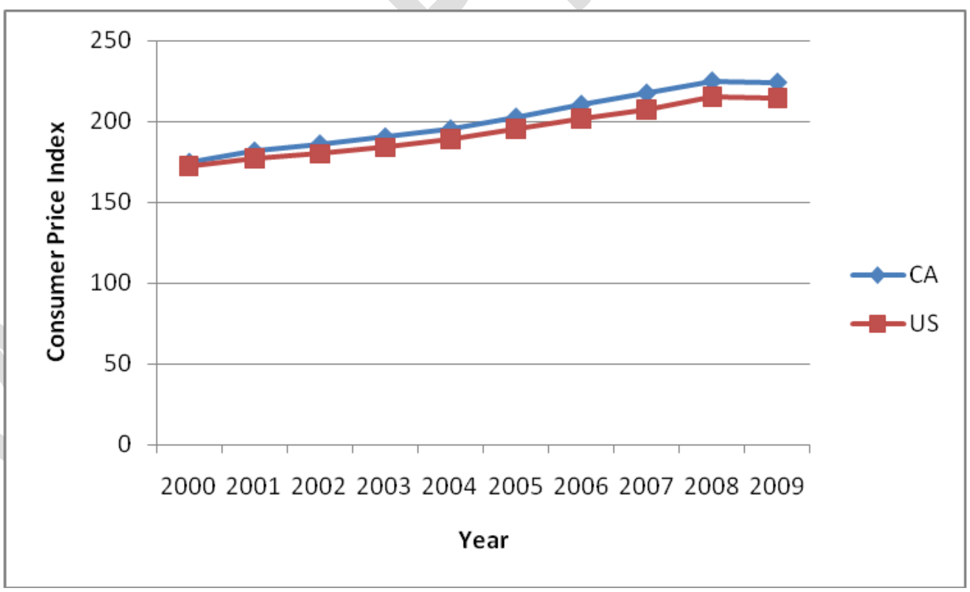
Many impacts on the cost of doing business are directly tied to economic conditions and prevailing business-related policies that are outside of the scope of this document and are, for the most part, unrelated to the I-710 Corridor Project. Calculating the estimate for, and predicting the changes to, aggregate costs of doing business for a region as diverse as the I-710 Corridor Study Area would require a very extensive methodology for modeling all of the potential contributing factors, as well as local data. Combining these difficulties of obtaining data and accurate models with the unpredictability of economic policy creation results in very little evidence to apply to this project outside of congestion-related factors.

Costs of Goods and Services

The U.S. Bureau of Labor Statistics tracks changes in the prices of goods and services using an aggregated measure called the Consumer Price Index (CPI) (U.S. Bureau of Labor Statistics 2011a[451]). The CPI is widely used as a measure of inflation and includes costs of food and beverages, housing, clothing, transportation, medical care, recreation, education, and communication.

Figure 10-4 shows the Consumer Price Indices in California and the U.S. between 2000 and 2009. Data for the county was not available. California's CPI increased faster than the U.S.'s during this time period.

Figure 10-4. Consumer Price Index for California and the United States, 2000-2009



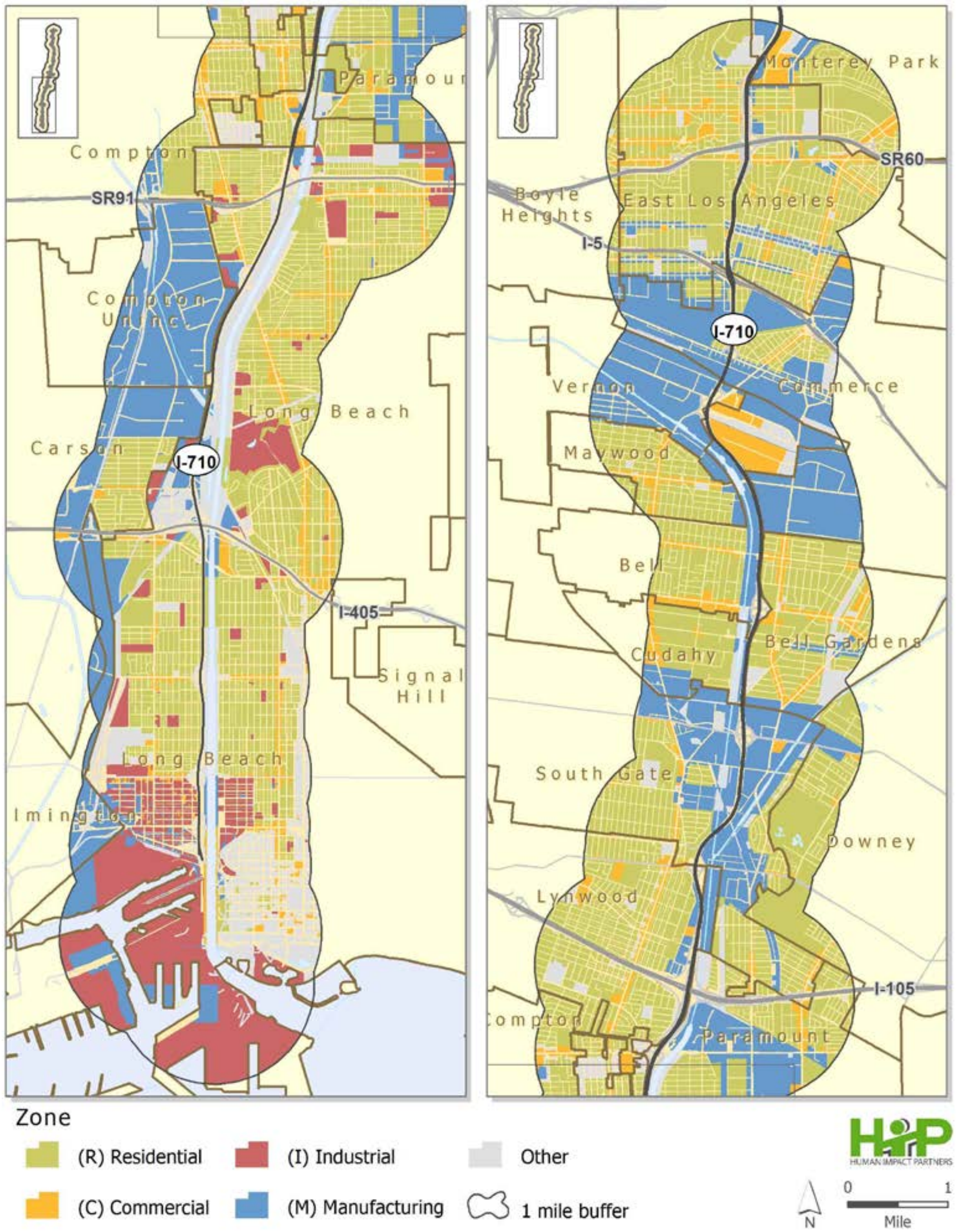
Source: CA EDD 2010[60].

Commercial Property Values

Commercial property values are an important contributing factor in the costs of doing business in an area. Figure 10-5 shows the zoning map of the study area, while Table 10-7 shows the property values for the I-710 Corridor Project study area by zoning classification. The table shows that the 1-mile study area has commercial property values that are less than half of the average commercial property value for the county as a whole.

While a comparative analysis on commercial property values in the Gateway Cities, particularly for those properties around I-710, versus those of sites in the Inland Empire was not done for this HIA, future economic analyses could provide a better picture of differences in the costs of business siting and, therefore, on the attractiveness of these two regions with regards to future job growth.

Figure 10-5. Zoning Map of the I-710 Corridor Project Study Area



Source: Los Angeles County Office of the Assessor 2011.

Table 10-7. Property Values by Zoning Classification

Zone Type	LA County	1-Mile Study Area
Commercial	$1,123,993	$410,689
Industrial	$1,019,397	$844,717
Manufacturing	$1,141,465	$1,019,278
Residential	$364,865	$217,045
Source: Los Angeles County Office of the Assessor 2011.		

Proportions of Goods Purchased Locally and Costs of Local Goods

It is difficult to measure the proportion of goods that are purchased locally versus goods that were shipped in from other regions as this data is not usually tracked. A more in-depth study to estimate this proportion, and a methodology to continuously track this number, would help inform policymakers and economists about the strength of Los Angeles's local economy.

10.2.3 Community Concern Regarding Jobs and Economic Development

In August 2004, as part of its final report, the I-710 Tier 2 Community Advisory Committee recommended the following economic development strategies: (Tier 2 Community Advisory Committee 2004[437])

- Position the I-710 corridor and Gateway communities for a post-oil economy.
- Create a community environment that attracts and retains businesses and residents who can support a new Gateway Cities economy.
- Enable the I-710 corridor and Gateway communities to become more proactive in today's economy.
- Institute corridor-wide programs and partnerships to equip area residents with the skills needed to move into higher-paying jobs in this new economy.
- While promoting the importance of all business, specifically recognize small business as an economic driver and foster their growth within the communities.
- Consistent with current law, advocate policies at the national, state, regional, and local levels to require businesses that benefit from any potential I-710 improvements to pay living wages.

These recommendations clearly reflect concern about, and recognize the importance of, jobs and economic development. Specific concerns regarding the costs of doing business in the corridor and, more specifically, costs related to congestion or goods movement are not reflected in these final recommendations.

10.2.4 Jobs and Economic Development Associated Health Outcomes

As described in the review of the literature at the beginning of this chapter, jobs and economic development impact health in a number of ways. This section reviews the existing conditions for life expectancy, some chronic diseases, and an indicator of mental health, all of which are impacted by jobs and income.

Life Expectancy

Life expectancy in the county has been increasing in the past decade to a 2006 average of 80.3 years. However, the life expectancy gain is not equally distributed among the county's residents; according to the Los Angeles County Public Health Department, poorer neighborhoods with less education, and those with lower access to grocery stores that stock fresh produce, were found to have lower life expectancies (Los Angeles County Department of Public Health 2010). Life expectancies among cities in the I-710 Corridor Project study area vary significantly, from 75.7 years in Compton to 83.2 years in Cerritos, with a median that is the same as that for the county (80.3 years). If broken out by income, differences in life expectancy would be expected to be even more dramatic.

Table 10-8. Life Expectancy Estimates for Los Angeles County and Cities within the I-710 Corridor Project Study Area, 2006

Area	Life Expectancy	Life Expectancy Ranking (out of 103 cities in the county)
Los Angeles County	80.3	--
Artesia	82.0	29
Bell	80.8	47
Bell Gardens	79.0	82
Bellflower	78.0	89
Cerritos	83.2	18
Commerce	NA	NA
Compton	75.7	100
Cudahy	80.7	54
Downey	80.9	43
Hawaiian Gardens	NA	NA
Huntington Park	81.7	34
La Habra Heights	NA	NA
La Mirada	78.9	83
Lakewood	79.3	77
Long Beach	78.6	85
Lynwood	77.7	92
Maywood	83.0	21
Montebello	80.3	64
Norwalk	79.2	79
Paramount	78.1	88

Area	Life Expectancy	Life Expectancy Ranking (out of 103 cities in the county)
Pico Rivera	80.1	67
Santa Fe Springs	80.6	58
Signal Hill	NA	NA
South Gate	81.1	40
Vernon	NA	NA
Whittier	80.8	51
Source: Los Angeles County Department of Public Health 2010[294b]. Excludes cities/communities with populations less than 15,000.		

Chronic Disease and Mental Disorders

Tables 10-9 and 10-10 show cardiovascular disease prevalence and hospitalization rates as well as prevalence of depression in the I-710 Corridor Project study area. As described above, these health outcomes have been associated with income and unemployment. Disease prevalence rates are not elevated in the I-710 corridor compared to the county, but hospitalization rates are. Many factors (including income and unemployment) contribute to cardiovascular disease and depression rates, and these diseases may not be diagnosed consistently due to differences in access to medical care (which is related to job status). Because of these confounding issues, it is not possible to conclude how much job conditions are contributing to disease rates in the study area.

Table 10-9. Rates of Chronic Conditions for Adults, 2007

	LA County	All Census Tracts in Study Area	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Ever Diagnosed with Heart Disease	7.7%	6.2%	8.2%*	3.9%*	9.1%*	N.D.
Ever Diagnosed with Hypertension	24.7%	21.2%	20.1%	22.5%	25.6%	22.2%*
Ever Diagnosed with High Cholesterol	29.1%	27.1%	29.3%	24.6%	36.5%	23.7%*
Ever Diagnosed with Depression	13.6%	9.1%*	7.6%*	10.8%*	7.6%*	9.2%*
* indicates the estimate is statistically unstable (relative standard error > 23%) and therefore may not be appropriate to use for planning or policy purposes Source: Los Angeles County Department of Public Health 2007a[293].						

Table 10-10. Cardiovascular Disease Hospitalization Rates (per 100,000), 2008

	State of California	LA County	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Hypertension	35.56	52.63	57.74	65.66	59.03	66.43
Angina without procedure	25.15	29.06	36.09	42.68	36.54	43.26
Source: California Office of Statewide Health Planning and Development 2009[72].						

10.3 Assessment of I-710 Corridor Project Impacts on Jobs and Economic Development

All of the alternatives assume that the Ports of Los Angeles and Long Beach will expand their operations to process approximately 42 million TEUs annually in 2035 (compared to approximately 13 million TEUs in 2008). In making this assumption, the EIR/EIS also therefore assumes that, under any alternative, the regional goods movement sector will grow the same (substantial) amount. The bulk of goods movement–related job growth is therefore assumed to be the same for all alternatives, and the differences between the alternatives in terms of job growth are limited to changes specific to each alternative. Therefore, the primary factors that inform this impact analysis are the speed of moving freight, which may impact the cost of transported goods, and the location of future growth in the goods movement industry.

10.3.1 Impacts on Jobs and Economic Development

The literature on the potential economic development impacts of a freeway expansion is scarce. Economic development is often cited as a major justification for investments in highways and road systems, but there have been few studies of past projects to analyze their actual economic impacts (Weisbrod 2004[481]). Traditional cost-benefit analysis often covers direct impacts, but not the regional business effects that might occur in a project of this magnitude.

There are at least two competing hypotheses regarding impacts of the I-710 Corridor Project on the local economy in the study area and in the Gateway Cities:

- It is possible that Alternatives 5A and 6A/B/C will lead to economic growth along the corridor. As a result of decreased congestion and travel times, costs of business inputs may be lower and the area may become more attractive to businesses and thus improve commercial land values. On the other hand, under Alternative 1 congestion may increase the costs of doing business (e.g., by requiring the hiring of more truck drivers to move the same amount of goods) and may thereby hurt the local economy. As previously mentioned, businesses that rely on a large shipping operation, and require highly specific material goods versus more commonly available commodities, would be the businesses that would benefit the most from congestion reduction.

- It is also possible that, especially for Alternatives 6A/B/C, parts of the goods movement infrastructure (e.g., warehouses) may relocate farther from the ports to locations with cheaper land and less congestion (e.g., the Inland Empire). This could lead to decreased use of the goods movement facilities in the Gateway Cities and to negative impacts on the local economy. Using this logic, Alternative 1, on the other hand, might make it more difficult for goods movement–related businesses to move farther inland and might keep businesses and jobs in the Gateway Cities. This may result in higher costs of doing business under Alternative 1, but an analysis of this is beyond the scope of this HIA.

Evidence suggests that total goods movement jobs will increase in the I-710 corridor because some industries, such as transloading facilities, are highly unlikely to move farther from the ports (Husing 2004[229]). Overall changes in terms of numbers, types, and locations of jobs are difficult to predict and have not been modeled elsewhere. Therefore, there is not enough information to make more specific predictions regarding the impact of the I-710 alternatives on the future economy, the costs of doing business, business locations, the costs of goods and services, or employment in the study area or in the Gateway Cities.

Green Jobs

According to the U.S. Bureau of Labor Statistics (U.S. Bureau of Labor Statistics 2011b[452]), green jobs are either:

- Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources; or
- Jobs in which workers' duties involve making their establishment's production process more environmentally friendly or use fewer natural resources.

Alternative 6B may potentially create and foster a new sector of jobs in the research, development, and manufacturing of zero emissions technologies. The growth of this "green" industry may help to increase employment rates in the study area, assuming that the education and skills required for these jobs either match the education and skill base of the local population or that a significant investment in local job-training is made.

Number of Employees Relocated Due to Build Alternatives

In the draft I-710 Community Impact Assessment Report, Table 3.3-12 shows the number of employees that will be forced to relocate due to each alternative being considered. In Alternative 5A, between 351 and 2,631 employees in the study area are predicted to be relocated while between 1,040 and 5,760 employees will need to be relocated under Alternatives 6A/B/C. Assuming that these jobs will be relocated within the study area, impacts from these changes are not predicted to be significant. Under Alternative 1 (No Build), there will be no relocation of employees.

10.3.2 Impacts on Tax Revenue

Increased employment and economic development is likely to result in increased tax revenue for local, state, and national government. These revenues could be used for health-beneficial services and projects. However, it is unclear whether income to local governments will offset the increased costs of services required to support businesses (e.g., police and fire protection) as well as the costs of maintaining roads that deteriorate quickly due to high truck volumes related to goods-movement. An analysis of revenue and costs is beyond the scope of this HIA.

10.3.3 Impacts on Jobs and Economic Development Associated Health Outcomes

As mentioned above, the total number of goods movement-related jobs in the I-710 corridor is expected to increase in all alternatives, as some sectors of the industry, such as trans-loading facilities, are unlikely to move away from the ports. Due to the potential local growth of jobs related to zero emissions technology development and manufacture, Alternative 6B could result in additional job growth, though it is not clear that these jobs will need to be located in the I-710 Corridor.

These jobs would result in health benefits (e.g., increased lifespan, reduced chronic and communicable disease, and improved mental health) for corridor residents if employment for these jobs is sourced locally and if ample training opportunities are provided. Table 10-11 summarizes job-related health impacts.

Table 10-11. Summary Table of Jobs and Economy–Related Health Impacts

<table>
<tr><th rowspan="2">Health Impact/ Alternative</th><th colspan="2">Impacts of Alternatives</th><th colspan="2">Health Outcome</th><th rowspan="2">Uncertainties</th></tr>
<tr><th>Impact</th><th>Magnitude</th><th>Severity</th><th>Strength of Causal Evidence</th></tr>
<tr><td colspan="6">Chronic disease (e.g., cardiovascular disease, diabetes) and decreased lifespan (e.g., from changes in income, employment, and access to health benefits)</td></tr>
<tr><td>1</td><td rowspan="5">+</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">High</td><td rowspan="5">♦♦♦</td><td rowspan="5">Distribution of new jobs between I-710 Corridor Communities and greater region uncertain.</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Mental Illness (e.g., depression; from changes in income and employment)</td></tr>
<tr><td>1</td><td rowspan="5">+</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">Mod–High</td><td rowspan="5">♦♦</td><td rowspan="5">Distribution of new jobs between I-710 Corridor Communities and greater region uncertain.</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Explanations:
Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).
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.</td></tr>
</table>

Health Impact/ Alternative	Impacts of Alternatives		Health Outcome		Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	

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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between noise and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

10.4 Recommendations

While job growth in the I-710 corridor is expected under all the alternatives, it is unclear how the alternatives will differentially impact the residents and businesses in the I-710 corridor from the perspective of jobs and economic development. The recommendations below would increase the number and quality of jobs available to local residents who currently face high unemployment rates. This would have a positive impact on health in the I-710 communities. It is critically important that implementation of the recommendations be addressed with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated objective of improving public health.

10.4.1 Jobs and Economic Analysis

- Conduct economic research and modeling to determine how the proposed I-170 Corridor Project alternatives, through changes in traffic volumes and speeds, will impact local and regional costs of doing business and job growth. This analysis should include detailed information regarding geographic job distribution as well as a disaggregated analysis of income from new jobs.
- Conduct a cost-benefit analysis that details the benefits of the I-710 Corridor Project (e.g., business costs related to reduced congestion under some alternatives) and costs (e.g., construction). The analysis should include externalities such as potential changes in healthcare-related costs and potential impacts on business sectors unrelated to goods movement.

10.4.2 Local Job Tracking, Creation, and Training

- Measure and track the proportion of local jobs in each industry that are filled by local residents. This data would allow policymakers to make informed decisions regarding strategies to enhance and stimulate local economies.
- Through incentives, encourage businesses to locate in the I-710 corridor communities. Incentives may be in the form of tax breaks or credits or may be in the form of lower loan interest rates for potential small business owners, among others.

- Increase job-training opportunities for residents in the study area to better prepare the workforce for the employment opportunities in the region and reduce unemployment. Training should target jobs that pay a living wage and provide benefits such as health insurance.
- Encourage educational programs that prepare the local population for living wage jobs.

10.4.3 Green Jobs Tracking and Stimulus

- The green and sustainable technology jobs created locally (e.g., through Alternative 6B or projects at the ports) could be a strong source of employment, training opportunities, and improved health outcomes for residents in the study area. Jobs in this relatively new industry should be encouraged to move into the I-710 study area regardless of the build alternative chosen, and government agencies and employers should be encouraged to train local workers in skills that will ensure that employers have a qualified labor pool and that will allow these new employees to succeed in this field.

11. Access to Neighborhood Resources

A vibrant and complete neighborhood with accessible and adequate private retail and public services can increase social cohesion, increase walking/biking trips, and improve people's ability to meet their basic needs, which in turn can improve health. This analysis of neighborhood resources considered the effects of the I-710 Corridor Project on health through its effects on availability of and access to neighborhood resources. While the primary focus of this chapter is on the presence/absence of neighborhood resources, because of the well-documented relationship of neighborhood resources to social cohesion, perceptions of environmental quality, and neighborhood wealth, the relationship of the I-710 Corridor Project and these factors is discussed as well.

11.1 Background: The Relationship Between Access to Neighborhood Resources and Health

11.1.1 Neighborhood Completeness

The mix of retail goods and public services in a neighborhood is important to the health and quality of life of local residents. Proximity to neighborhood retail and services can increase walking and biking, reduce daily vehicle trips and miles traveled, reduce air and noise pollution, increase possibilities for healthful and meaningful work, and increase interactions among neighbors and others on the street (San Francisco Department of Public Health 2011[402]). Quality of life is an important feature of a competitive city, and amenity-oriented, place-based investments can help regenerate declining urban districts. Importantly, infrastructure investments need to be complemented with sound land-use planning and management.

In places such as Los Angeles, which currently averages some of the highest levels of vehicular travel per capita, the externalities associated with car travel are great. Freeways in Los Angeles and other cities funnel goods and labor throughout the region at the expense of place-making. Freeways can sever long-standing neighborhoods, forming barriers and visual blight, casting shadows, and increasing exposure to air pollution, noise, and vibrations (Cervero 2009[102]). Historically, transportation infrastructure has been designed principally to enhance mobility, and large-scale infrastructure, such as limited-access freeways, often carry with them high environmental costs, land consumption, and urban dislocation. Such infrastructure has also lead to sprawling development, leaving residents aggravated by the speed and volume of traffic where they live and the long distances they must travel to get basic products and services (Cervero 2009[102], Burden 2007[57]). In many places, a growing number of residents are now expressing that they want peacefulness where they live and an end to existing sprawl (Burden 2007[57]).

One of the greatest challenges to any town or city is creating functional yet livable cities, which are essential for community health and prosperity, as well as global competitiveness (Cervero 2009[102]). There is no simple solution to fixing the issues that have arisen due to historically poor land use planning and sprawling development. However, there is a significant and growing body of research that posits numerous approaches to promote livable communities with thriving and diverse populations (Burden 2007[57]). If applied, these findings can aid current and future development patterns, result in improved health for local residents, and show that the goals of economic productivity and community place-making need not always conflict (Cervero 2009[102]).

The following sections discuss the components of complete neighborhoods and their many links to health, specifically focusing on childcare centers, schools, and libraries; parks, community centers, and community gardens; post offices, banks, and pharmacies; public art; food retail; and health care services.

Childcare Centers, Public Schools, and Public Libraries

Today, the majority of U.S. children live in families in which all parents work (National Economic Development and Law Center 2004[339]). Access to childcare is essential for working parents to maintain employment and/or continue education. Accessible high-quality childcare provides children with valuable opportunities for cognitive, behavioral, and educational development, and results in positive physical health outcomes (Karoly 2005[247], Schweinhart 2000[406], Campbell and Pungello 2000[77], Anderson et al. 2002[13]). Parents are more likely to use childcare if it is accessible in terms of proximity and cost. For low-income families, the costs of childcare can consume a major portion of income, leaving less money for food, housing, and other essentials.

Lack of availability of local schools can have negative social impacts and affect both physical and mental wellbeing (Lavin et al. 2006[273]). Living within a half-mile of school greatly increases the likelihood of walking or biking to school across all racial groups (McDonald 2008[312]). Health benefits of active commuting to school include higher cardiovascular fitness among youth, which is linked with reduced risk for coronary heart disease, stroke, cardiovascular disease, and cancer later in life (Blair et al. 2001[47]). Active commuting has also been associated with increased levels of independence in children and with increased social interaction and communication (Merom et al. 2006[315], Leyden 2003[278]).

While proximity is only one measure of access, the physical presence of libraries encourages improved literacy and provides access to health information. Libraries serve as important public educational and cultural facilities that help to disseminate health information to the general public, promote general and health literacy, organize/filter and improve access to reliable internet resources, facilitate educational collaborations between agencies and communities, and promote art and cultural activities both on and off library property (San Francisco Department of Public Health 2011[402]). Recently, libraries have become an important resource for accessing computers. Many libraries in the county allow free internet and computer use, providing access to resources such as job searches, word processing, information gathering, and printing.

Parks, Community Centers, and Community Gardens

Availability of recreational facilities has been shown to increase physical activity. Several studies have examined the association between facility availability and physical activity behavior among youth. Studies involving measures of perceived availability as well as actual availability of facilities for physical activity largely show a positive association between availability and physical activity (Ries et al. 2011[391], Mota et al. 2005[336], Roemmich et al. 2006[399]).

Parks and open space impact health through several mechanisms, including physical activity, social interaction, environmental quality, and illness recovery. In addition to community centers and gyms, parks and open space are important resources for physical activity because they provide fields for play, scheduled and supervised activities, and destinations to which people can walk (Cohen et al. 2007[111]). Parks are particularly important for low-income populations who might not have access to other means of physical activity because they provide low-cost choices for recreation (Transportation Research Board 2005[444]). In a study about Los Angeles, active people who live within 2 miles of a park were more likely to exercise in a park (34%) than at home (21%), at private clubs (6%), or at other locations (4%).

Several studies have quantified the health effects of parks and open space:

- Access to places for physical activity combined with outreach and education can produce a 48% increase in frequency of physical activity (Takano et al. 2002[432]).
- Nationally, about 30% of physically active people report exercising in public parks (Brownson et al. 2001[54]).
- People who live in proximity to parks usually have higher levels of activity compared to those who do not (Powell et al. 2003[371], Humpel et al. 2002[228], Takano et al. 2002[432]).
- A review article in the *American Journal of Preventative Medicine* showed that access to a place to exercise results in a 5.1% median increase in aerobic capacity, along with a reduction in body fat, weight loss, improvements in flexibility, and an increase in perceived energy (Trust for Public Land 2005[447]).
- Parks and open space improve mental health by providing a needed reprieve from everyday stressors, and acting as "escape facilities." Being able to escape fast-paced urban environments improves health by reducing stress and depression and improving the ability pay attention, be productive, and recover from illness (Maller et al. 2005[302]).
- Spending time in parks can reduce irritability and impulsivity as well as promote intellectual and physical development in children and teenagers (Kuo 2001[269]).
- People dissatisfied with their available green spaces have 2.4 times higher risk for mental health issues (Guite et al. 2006[210]). Researchers in Chicago have found that children with Attention Deficit Disorder (ADD) function better than usual after activities in green settings and that the "greener" a child's play area, the less severe their ADD symptoms (Taylor et al. 2001[435]).
- Parks and green space can also contribute to improved environmental quality by filtering dirty air and polluted water, and by dampening noise, thereby contributing to the general health of the area.

Parks and open space have also been linked to reductions in crime and, in particular, to reduced juvenile delinquency (Trust for Public Land 2005[447]). Park-poor neighborhoods, with difficult to access parks or the absence of parks all together, have been found to be more likely to suffer high crime rates and other symptoms of urban blight (Trust for Public Land 2004[446]).

In addition, community gardens, another form of urban green space, offer participants the chance to learn new skills, grow and have access to fresh healthy food, save money, and build community (Twiss et al. 2003[448]).

Post Offices, Banks, and Pharmacies

Services such as post offices, banks, and pharmacies are important resources for local residents. Pharmacies and drug stores are important to health not only for the sale of medications or as resources for medical guidance, but also as places to purchase food. In the past decade, non-traditional food stores of this variety have increased the availability and variety of food options to customers (Sharkey et al. 2010[412]). The variety of services offered in a neighborhood can also increase the number of walking or bicycling trips within the area.

Public Art Works

Research has demonstrated that the influence and effects of the arts on health are associated with a number of physiological and psychological outcomes: (San Francisco Department of Public Health 2011[402])

- Reduced drug consumption
- Shortened length of stay in a hospital
- Improved recovery time
- Increased job satisfaction
- Better doctor-patient relationships
- Improved mental health
- Reduced depression

Food Retail

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 (U.S. Department of Health and Human Services 2001[460], Carlson et al. 1999[92]). The presence of a supermarket in a neighborhood predicts higher fruit and vegetable consumption and a reduced prevalence of overweight and obesity (U.S. Department of Health and Human Services 1999[459], Morland et al. 2002[335]). Having a supermarket close to one's residence also leads to healthier eating and a healthier body weight. One study conducted in Los Angeles County concluded that longer distances traveled to grocery stores were associated with an increased body mass index (BMI) (Ingami et al. 2006[230]). For a person with a height of 5 feet and 5 inches, traveling 1.75 miles or more to get to a grocery store meant a weight difference of about 5 pounds.

For low-income populations in urban areas, in particular, accessible and affordable nutritious food remains a significant unmet need. Poorer households tend to buy less expensive but more accessible food at fast food restaurants or highly processed food at corner stores, which typically charge about

10% more for products than supermarkets (U.S. Department of Agriculture 2002[457]). These types of foods are often higher in calories and lower in nutritional value (Drewnoski et al. 2004[124], Basiotis 1992[32]). Fast food restaurants tend to serve food of low-quality nutrition and are statistically associated with diet-related disease rates, while full-service restaurants are associated with better health outcomes (U.S. Department of Health and Human Services 2001[460], Morland et al. 2002[335]). A national study reported a clear association between each state's obesity rate and the density of fast food retailers in the state (California Center for Public Health Advocacy 2007[64]). Death rates from diabetes—another outcome impacted by the presence of fast food restaurants—were reportedly two times higher in Chicago neighborhoods without supermarkets but with many fast food restaurants, compared to neighborhoods with a more balanced mix of food choices.

Health Care Facilities

The type of health services in a community can impact the health outcomes of local residents. The location of these resources and their proximity to where people live help determine whether people use them, how often, and how they access them (e.g., by walking or driving).

Living in a disadvantaged neighborhood reduces the likelihood of having a usual source of health care and of obtaining recommended preventive services, while it increases the likelihood of having unmet medical needs (Kirby and Kaneda 2005[261]). Individuals living in neighborhoods with greater health care resources may be more likely to use primary care due to shorter travel distances required to see a provider and greater provider choice (Prentice 2006[374]). Health care resources are not distributed equally among neighborhoods, with areas of greater wealth having greater health care resources (Prentice 2006, Fossett et al. 1992[189]). The types of industries in a community also affect the presence of health care resources because certain types of employers are more likely to provide private health insurance coverage, which has higher reimbursement rates than public insurance (Prentice 2006[374]). Additionally, populations with a greater percentage of the very young or elderly may demand more health care because these demographics have greater health care needs, drawing more providers to an area (Prentice 2006[374]).

Primary care is defined as care that gives patients entry into the health care system, coordinates health care services for patients, provides care to the same patient over time, is comprehensive, and takes into account the patient's societal context outside the health care system (Prentice 2006[374]). The use of this type of health care over time improves individual and population health by helping patients prevent and control illnesses (Prentice 2006[374]). Research has found that access to primary care can help to mitigate the negative effects of lower SES and income inequality on health (Prentice 2006[374]). Social capital, health care resources, and where one lives have been shown to be predictors of an individual's ability to access primary care (Kirby and Kaneda 2005[261], Prentice 2006[374]). The difference in ability to access primary care is one of the factors that explains individual-level health disparities between neighborhoods (Prentice 2006[374]).

11.1.2 Perceptions of Environmental Quality

Environmental quality and perceptions of environmental quality—including air quality, noise, congestion, walkability/bikeability, and traffic safety discussed in other chapters of this HIA—influence the decisions that people make about using local goods, services, and resources, as well as how they get to those places. For example, such perceptions influence whether: a parent allows their child to walk or bike to school, or an adolescent chooses active travel to school; someone decides to walk to or even use a neighborhood store; and/or the frequency with which an adult or child decides to use a local park.

Three studies in a recent meta-analysis reported associations between greater parental concerns about environmental conditions and lower active commuting among children (Panter et al. 2008[357]). In one of the studies, children were five times as likely to actively commute to school if their parents had few concerns about the environment—such as presence and quality of walking and biking facilities, or traffic danger—compared to children of parents who had many concerns (Kerr et al. 2006[255]).

Separately, research that spanned 4 years reported that people who perceived an objectively-measured high walkability environment as low walkability, walked 55 minutes less per week for transportation purposes—or one-third the weekly recommended amount—compared to those who perceived the environment as in agreement with objective measures (Gebel et al. 2011[197]). Looking at use of neighborhood stores, specifically, other research reported that adults who perceived their neighborhood as inferior in quality were significantly less likely to shop at their neighborhood food markets than those who did not see it as a low quality environment (71 vs. 97% of respondents) (Kelta et al. 2011[253]).

Other research has reported a higher average number of local park visits each week (4.36 times) for residents who reported higher levels of a number of factors, including perceived neighborhood safety, aesthetics, and traffic safety, compared to residents who did not (3.16 times) (Leslie et al. 2010[277]).

Perceived risk can alter patterns of time spent outdoors by residents, which in turn may affect physical activity, access to resources, and mental health. For example, research has demonstrated that regardless of reports from experts, residents perceive a positive relationship between risk and proximity to transportation facilities (Schweitze et al. 2004[407]). In one study, the relationship between perceived traffic stress on health was stronger for individuals who lived in areas with a greater burden of vehicles and for those who lived with a major street or arterial highways in their neighborhoods (Song et al. 2007[420]).

The availability and mix of stores in a neighborhood can influence the environmental quality of a neighborhood as well. Vacant storefronts present a number of harmful effects on surrounding communities including increases in crime, graffiti, and discouraging investment in a neighborhood. Poorer neighborhoods with more vacant housing units have significantly higher rates of assault-related injuries (Boyle and Hassett-Walker 2008[49]). Conversely, retail and services that are accessible by walking improve environmental quality and promote physical activity.

11.1.3 Social Cohesion

A vibrant neighborhood environment is one type of setting for social interaction, which can lead to an increased sense of community and less crime. Social networks and interaction have been linked to improvements in physical and mental health through multiple mechanisms (Sullivan et al. 2004[428]). Social support, perceived or provided, can buffer stressful situations, prevent feelings of isolation, and contribute to high self-esteem (Cohen et al. 2000[112]). Group membership in a community and some types of social activities have been shown to decrease mortality rates and cognitive impairment (Kreuter and Lezin 2002[265], Hsu 2007[224]). A higher level of civic engagement through ties to community groups has been associated with increased exposure to health-promoting messages (Viswanath et al. 2006[468]). On the other hand, individuals with low levels of social support or who are socially isolated have higher mortality rates, for example from cardiovascular disease, cancer, and HIV (Berkman et al. 1992[39], Frasure-Smith et al. 2000[191], Ell et al. 1992[127], Lee and Rotherman-Borus 2001[275], Kop et al. 2005[264]). There is also a strong association between perceived social isolation and depression (Hawthorne 2008[217]).

Living within walking distance of neighborhood goods and services can increase neighborhood cohesion and safety (MIG 2007[327]). Parks and open space can foster social cohesion. A study that took place in Chicago found that green spaces contained an average of 90% more people than spaces that do not include natural greenery (Berman et al. 2000[40]). Additionally, 83% more people were involved in social activities in green spaces versus barren spaces.

The length of time a resident has lived in a place can also influence social cohesion, and, in turn, health. For example, older residents have stronger local friendship networks the longer they live in a neighborhood, according to one study (Oh 2003[351]). However, researchers have reported that effects vary among populations. A body of research suggests that long-term residents of neighborhoods with high poverty rates, when compared to more affluent neighborhoods, may not experience the same extent of health protective benefits—particularly for mental health—that social networks can offer (Schulz et al. 2006[405]).

Researchers often have suggested a relationship between voter registration and overall community participation (Coulton 2008[117], Brodsky et al. 1999[52]). Among some populations, though, voter registration may not fully capture participation. In the U.S., overall voter registration for naturalized immigrants lags behind that of native-born citizens, with variations depending on the country of origin for the former (Jimenez 2011[240]). However, a study of political participation—including voter registration and other activities—comparing Los Angeles–area immigrants and native-born Mexican Americans reported that immigrants are just as likely to engage in political participation as naturalized citizens (Barreto and Munoz 2003[28]). This suggests that participation may come in forms not captured by voter registration. Research also shows that people who are engaged politically and involved in the electoral process are less likely to report poor/fair health (Kim and Kawachi 2006[258], Cummins et al. 2005[118]).

The presence of religious institutions in a neighborhood has been linked to social and behavioral outcomes, as well as social cohesion (Maselko et al. 2011[307]). In one study, the presence of more churches per capita was significantly associated with lower likelihood of alcohol, drug, and mental health disorders. Researchers suggested the effects were linked to network development among neighbors, to perceptions of social support in the neighborhood, and by churches providing resources to alleviate psychological distress (Stockdale et al. 2007[423]).

Opinions about crime are strongly related to feelings about community. A sense of being part of the community results in less fear (Schweitzer et al. 1999[408]). Land use patterns that encourage neighborhood interaction and a sense of community have been shown not only to reduce crime but also to create a sense of community safety and security (Calhoun 2002[62]). Crime is associated with low social capital (often measured as connection and trust to others in the community and/or civic involvement) (Kawachi et al. 1999[250]). Fear of crime can affect transportation mode choice and thus mobility (Fullilove et al. 1998[193]), usability of resources, and ability to care for basic needs. Adolescent victims of violence have a 38% higher likelihood of "nonsuccess" as an adult (success is defined as employment, abstinence from crime, holding conventional beliefs about right/wrong, and having a support network), and nearly twice the risk for drug use during adulthood (Office of Justice Programs 2002[350], Prevention Institute 2005[375]).

Some types of neighborhood locations in particular have greater potential to decrease neighborhood safety. For example, density of liquor stores in an area is strongly associated with assault rates. In one community, each six additional liquor outlets accounted for one additional violent assault that resulted in at least one overnight stay in a hospital (Gruenewald and Remer 2006[209]). Crime and safety concerns create anxiety among business owners and create reluctance among potential retailers, thereby limiting the ability for commercial revenue for some neighborhood economies.

11.1.4 Neighborhood Wealth

Income, which is one aspect of wealth, is one of the strongest and most consistent predictors of health and disease among individuals in the public health research literature (see Chapter 10, "Jobs and Economic Development," for more income-related health findings) (Yen and Bhatia 2002[496]). Many studies have found that wealth varies by racial or ethnic group, with blacks and Latinos tending to have lower levels of wealth compared with whites (Pollack et al. 2007[366]).

Assessed property value, one factor that contributes to wealth, has been connected to health status. In a recent study, the assessed value of both neighborhood and personal properties were strongly correlated to health: the odds of having fair or poor health status decreased by 0.85 for every $50,000 increase in neighborhood property values, and it decreased by 0.90 for every $50,000 increase in personal property value (Moudon et al. 2011[337]).

Property values can be negatively affected by the noise, emissions, and vibrations presented by close proximity to major roadways (Nikolaou et al. 1997[345], Cervero et al. 2007[103], TranSafety Inc. 1997[441], Wilhelmsson 2000[491]). A study of the impacts of a major roadway expansion in Austin, Texas showed that changes to property values were dependent on a variety of conditions, including the type of improvement, the proximity of properties to the freeway, and the location of property parcels along the freeway. The findings of this study showed that while property values at some locations increased, within a distance of 0.5 mi from the corridor, property values were predicted to have dropped roughly

$50,000/acre of land and $3 per square foot (Siethoff et al. 2002[415]). Similarly, a study in San Francisco found that typical residential units sold for an estimated $18,000 less as a result of being located near an elevated freeway (Cervero et al. 2007[103]). In addition, a 2002 article published in the *Los Angeles Times* highlighted that real estate industry executives had noted lower home prices near freeways, "about $5 less per square foot than a comparable home in the same area far enough away that buyers do not perceive the freeway as a negative" due to noise, air, and light pollution (Kelley 2002[251]).

A separate study that observed home prices near freeways showed that prices of homes were dependent on distance from a freeway: within 0.25 miles of a freeway home prices were on average 3.5% lower; between 0.25 and 0.5 miles of the freeway prices were 2% higher; and 1 to 2 miles from the freeway, home prices were similar to baseline. This demonstrates that where access to roadways is improved or valued, property values may increase, while immediate negative externalities may override gains for those properties located very close to a freeway (Waddell et al. 1993[474]). A study in the Seattle area reported similarly, that proximity to access points, including both rail stations and highway on-ramps, has a positive influence on residential property value, while proximity to the line or route itself has a negative influence on these values (Kilpatrick et al. 2007[257]).

11.1.5 Neighborhood Resources and Physical Activity

Complete neighborhoods with integrated public and retail services as well as quality pedestrian environments can increase physical activity by allowing everyday retail destinations to be accessible by walking (Ewing and Kreutzer 2005[176]). One study looking at non-work–related trips (which make up approximately 75% of all trips) in four neighborhoods, controlled for SES, found that proximity and mix of retail as well as having many quality destinations and modes of transport choices are some of the most influential factors in people's decisions to walk (Handy 1996[215]). Physical activity, such as walking, has been associated with various health benefits including reductions in premature mortality; the prevention of chronic diseases such as diabetes, obesity, and hypertension; and improvements in psychological wellbeing (Powell et al. 2003[371], U.S. Department of Health and Human Services 1999[459]).

Several studies have demonstrated the benefits of neighborhood resources on physical activity:

- A 2009 study examining the associations between walking and land use in six communities, including Los Angeles, found that increases in retail availability was associated with increased probability of walking (Rodriguez et al. 2009[397]).
- A 2007 study in New York revealed that children with low neighborhood amenities or those lacking neighborhood access to sidewalks or walking paths, parks or playgrounds, or recreation or community centers had 20 to 45% higher odds of obesity and overweight, compared with children who had access to these amenities (Purciel 2007[377]).
- The impact of the built environment has been found to be particularly strong for younger children (ages 10 to 11) and for girls. Girls, ages 10 to 11, living in neighborhoods with the fewest amenities had 121 to 276% higher adjusted odds of obesity and overweight than those living in neighborhoods with the most amenities (Gopal et al. 2010[203]).

11.2 Existing Conditions for Neighborhood Resources

The Final I-710 Tier 2 Committee report (Tier 2 Community Advisory Committee 2004) highlights a number of concerns and perceptions about the way that the I-710 currently impacts neighborhood resources and could impact these resources in the future.[4] Potential impacts on neighborhood resources along the I-710 corridor were primarily addressed in the Tier 2 report's section on "Community Enhancements." This section begins by stating:

> The I-710 corridor is more than just a place for trucks to pass through on their way to their final destination. It is the location of our homes, businesses, schools, parks, and lives. A significant consideration for all projects is how they enhance and upgrade the natural and built environment along the corridor. A revitalized I-710 must be the catalyst that improves the region's quality of life and makes the area an even more desirable place to live, work, and play.

Additional recommendations related to impacts on neighborhood resources in the report include:

- "Ensure that a revitalized I-710 would be the catalyst to enhance local communities along the corridor, creating an even more desirable place to live, work, and play."
- "Preserve existing parks, open space, and natural areas."
- "Mitigate any negative impacts to aesthetics."
- "Develop and implement community enhancement projects."

11.2.1 Neighborhood Completeness

The San Francisco Department of Public Health's Neighborhood Completeness Indicator (NCI) was used in this analysis to measure neighborhood completeness within the I-710 Corridor Project study area. These measures, listed in Table 11-1, are key public and retail services that are necessary for meeting daily needs (San Francisco Department of Public Health 2010[401]). The number of each type of service and retail outlet within 1 mile of the I-710 is also listed in the table.

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[4] The Tier 2 committee was a broad-based group appointed by I-710 corridor communities and the I-710 Oversight Policy Committee representing interests including local communities, academic, environmental, business, community and environmental justice. Based on overwhelming concern about congestion and safety of the I-710, the Tier 2 Committee came to consensus on a set of recommendations about the proposed I-710 project, and the impacts that it could have on surrounding communities.

Table 11-1. Number of Neighborhood Services and Retail Outlets in the I-710 Corridor Project Study Area

Services	Retail
Childcare Centers (140)	Banks (81)
Community Centers (29)	Pharmacies (156)
Community Gardens (9)	Healthy Food Retail Markets (578)
Primary Care Clinics (27)	
Libraries (16)	
Parks (74)	
Post Offices (13)	
Public Art (28)	
Public School (79)	
Recreation Facilities (21)	

The map in Figure 11-1 was demonstrates the diversity of key service and retail outlets within the study area and was generated using the location of each of the available services and retail outlets listed in Table 11-1. Half-mile boundaries were drawn around each specific service or retail outlet identified. The areas with the darkest blue color show where the highest number of *different types* of key service and retail outlets are concentrated. The red areas show where the fewest number of different types of these resources are located.

Figure 11-1 shows that the neighborhoods within the study area with a high diversity of key services and retail outlets include:

- Long Beach
- East Los Angeles and Boyle Heights
- Parts of South Gate, Bell Gardens, Lynwood, and Maywood

The areas in the 1-mile buffer zone that appear to be the least complete (have the least diversity of retail and services) include parts of:

- Wilmington[5]
- Carson
- Compton
- Vernon[6]
- Downey

The portions of Carson within the study area clearly have little diversity of key services and retail, even though there are a high number of residents living in these areas. This indicates that Carson is a

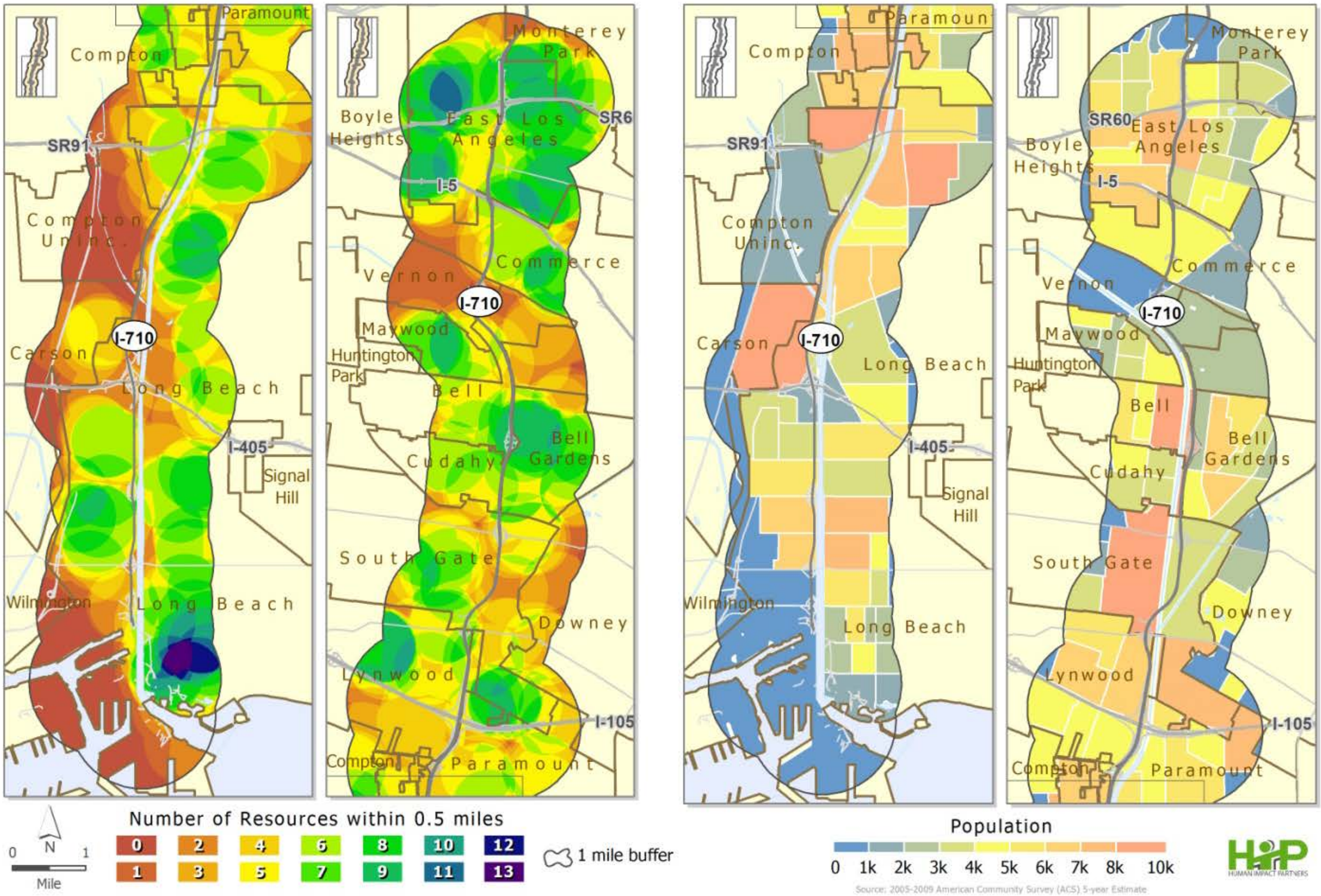
[5] The Wilmington area within the 1-mile buffer of the I-710 also includes parts of the Port of Long Beach, which does not have a high density of residents.
[6] Vernon also has a very small population (approximately 95 residents).

neighborhood that is particularly lacking in resources that contribute to community health and wellbeing, which could contribute to poor health in this area.

There are a high number of residents living in the census tract west of the I-710 in the City of Bell; however, the diversity of key services and retail are primarily located on the other side (east) of the I-710 in Bell Gardens. In East LA, the two census tracts with the highest concentration of residents are located alongside the I-710 (one to the west and one to the east), north of the I-5 and below SR-60. Although there are a range of key services and retail around East LA, they are not located in the same census tracts as the concentrations of people living close to the freeway.

This indicates that residents in the above-mentioned census tracts in Bell and East LA might have challenges accessing key services and retail in their neighborhood, particularly by walking and biking. It also means that the neighborhood service and retail locations may not serve as important social spaces for residents living in proximity to the freeway.

Figure 11-1. Diversity of Neighborhood Resources and Population within 1 Mile of the I-710



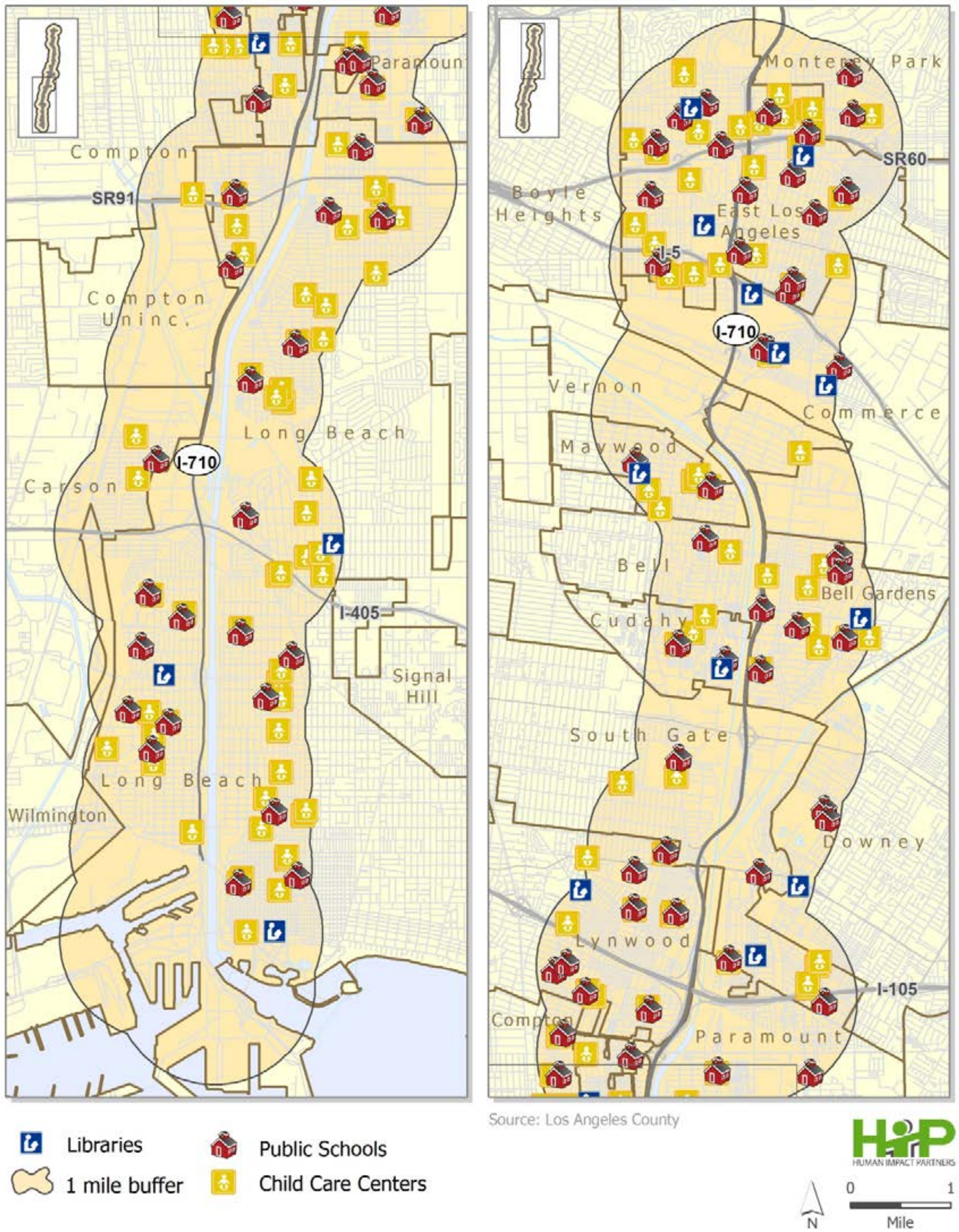
Note: The population map shown in the right panels in this figure is a useful reference for many of the maps shown for specific indicators below.

Childcare Centers, Public Schools, and Libraries

Childcare centers, public schools, and public libraries in the study area are often found in proximity to one another, and are located throughout the study area. Figure 11-2 shows that there are a higher concentration of schools and libraries in areas of the cities located along the northern end of the freeway corridor, and that a number of childcare centers, public schools, and public libraries are located very close to the I-710.

The 2007 Los Angeles County Health Survey found that a statistically higher percentage of people living within 1 mile of the I-710 to the east side had difficulty accessing childcare because it was too costly. The survey also found that for those living in the study area, there was greater difficulty finding a provider with space to accommodate their children (Los Angeles County Department of Public Health 2007a[293]). These findings highlight a need for more affordable childcare facilities accessible to people living within 1 mile of the I-710.

Figure 11-2.Libraries, Public Schools, and Childcare Facilities within 1 Mile of the I-710

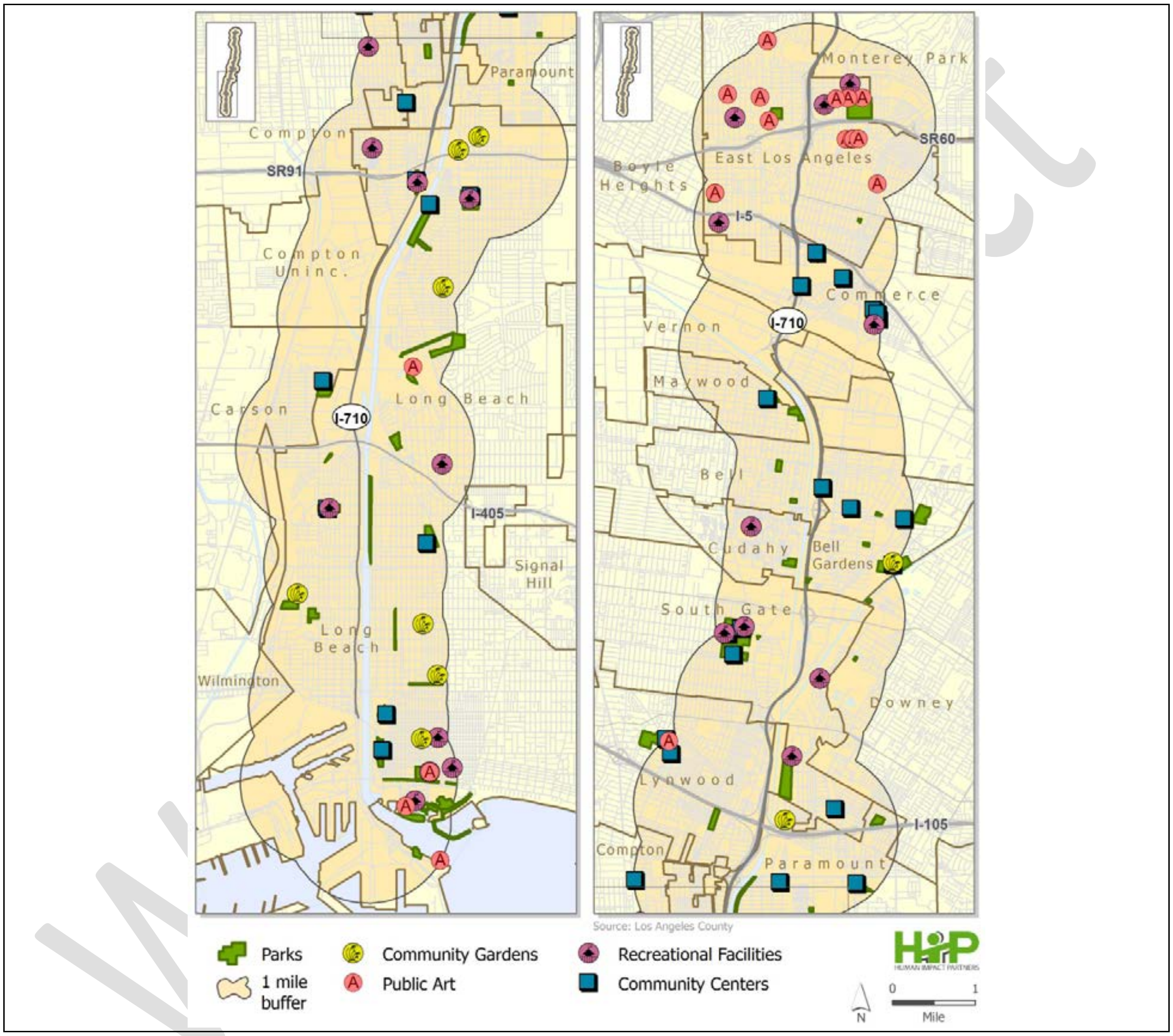


Parks, Community Centers, Public Art, and Community Gardens

Figure 11-3 shows that parks, community centers, public art, and community gardens (Los Angeles Neighborhood Land Trust 2011[298]) are located throughout the I-710 corridor. However, clusters of these facilities are located in Long Beach, Southgate, and East LA, and there is a clear lack of these resources in the portions of Carson, Compton, Vernon, Maywood, Bell, and Downey.

Of the 130 completed permanent artworks on Los Angeles County property, 24 (18%) are in cities that intersect the I-710 study area, with two-thirds (16) of the works located in East LA.[7]

Figure 11-3. Parks, Community Centers, Public Art, and Community Gardens within 1 Mile of the I-710



A number of parks and community centers are located very close to the I-710. The Google Earth images in Figures 11-4 and 11-5 show this proximity to the freeway in more detail for Maywood's Riverfront Park and Bandini Park in the City of Commerce.

[7] Refers to the location of completed art projects implemented by the Los Angeles County Arts Commission Civic Arts Program in their county facilities from 2004 to the present. There are an additional 26 projects in the county that are in development, including 2 in cities in the study area.

Figure 11-4. Maywood Riverfront Park

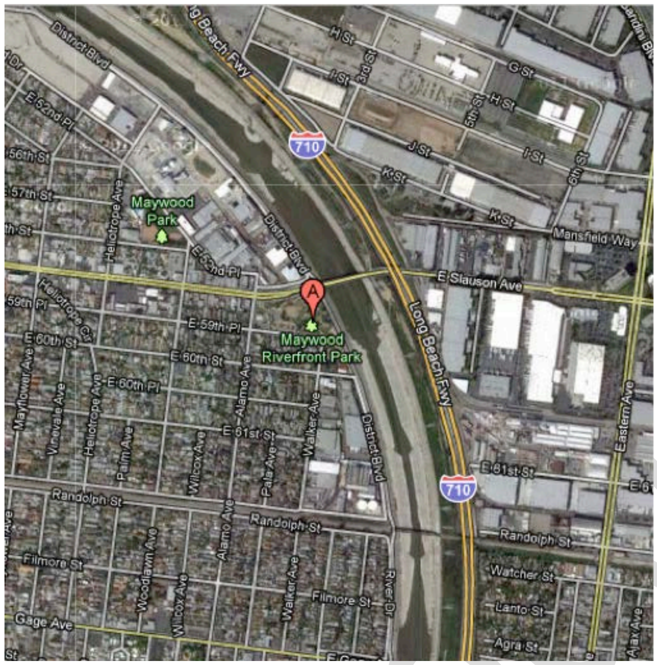
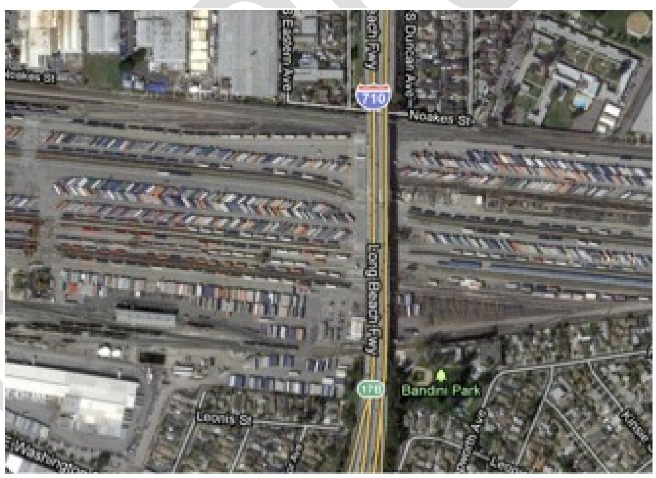


Figure 11-5. Bandini Park in the City of Commerce



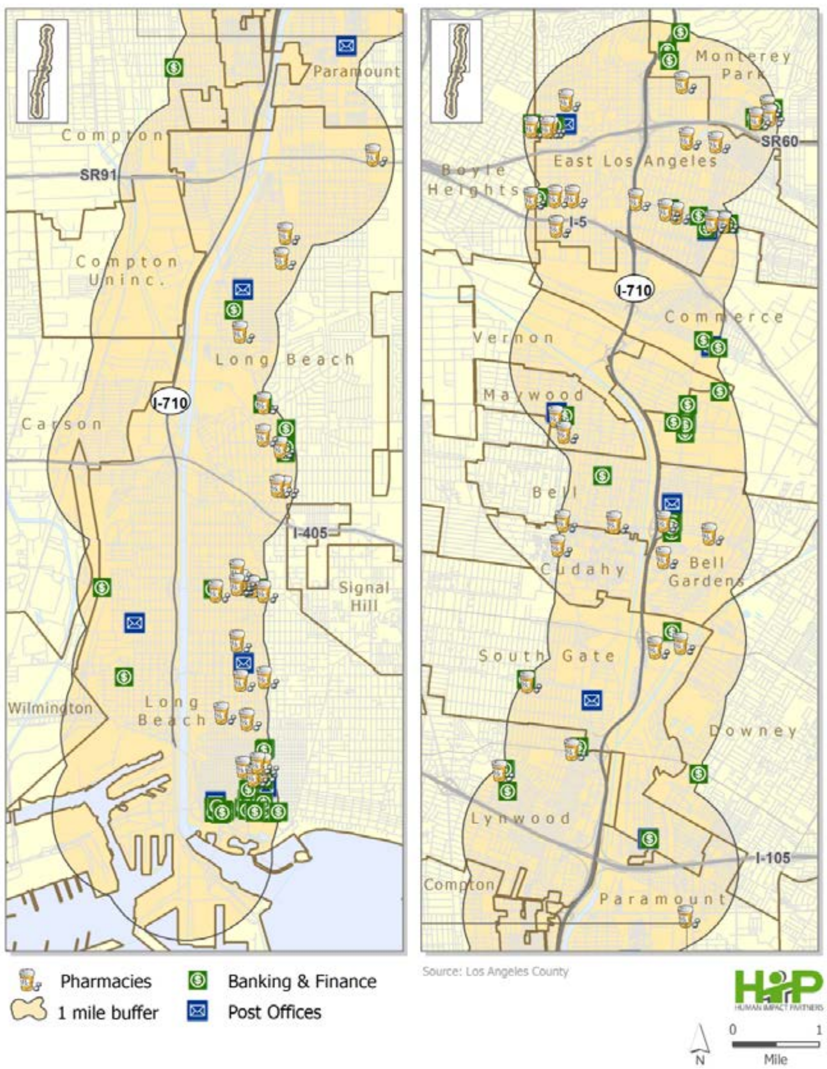
Results from the 2007 Los Angeles County Health Survey show that 80% of residents in the study area find that a park, playground, or other safe place for a child to play is easily accessible (Los Angeles County Department of Public Health 2007a[293]). A higher percentage (90%) of residents living within 150 meters (approximately 500 feet) east of the I-710 report that these facilities are easily accessible. Figure 11-3 shows that there is a higher concentration of parks on the east side of the I-710.

Post Offices, Banks, and Pharmacies

Post offices, banks, and pharmacies are sparsely located along the southwestern portion of the study area where areas of Wilmington, Carson, Compton, and the western areas of Long Beach are located.

Southgate, Lynwood, Downey, and Paramount also have few of these locations. There are a number of banking and finance locations in the City of Commerce, but no pharmacies or post offices.[8] There are higher concentrations of post offices, banks, and pharmacies along the southeastern edge of the study area in Long Beach, as well as in East LA and Boyle Heights, Monterey Park, and Bell Gardens.

Figure 11-6. Post Offices, Banks, and Pharmacies within 1 Mile of the I-710



Food Retail

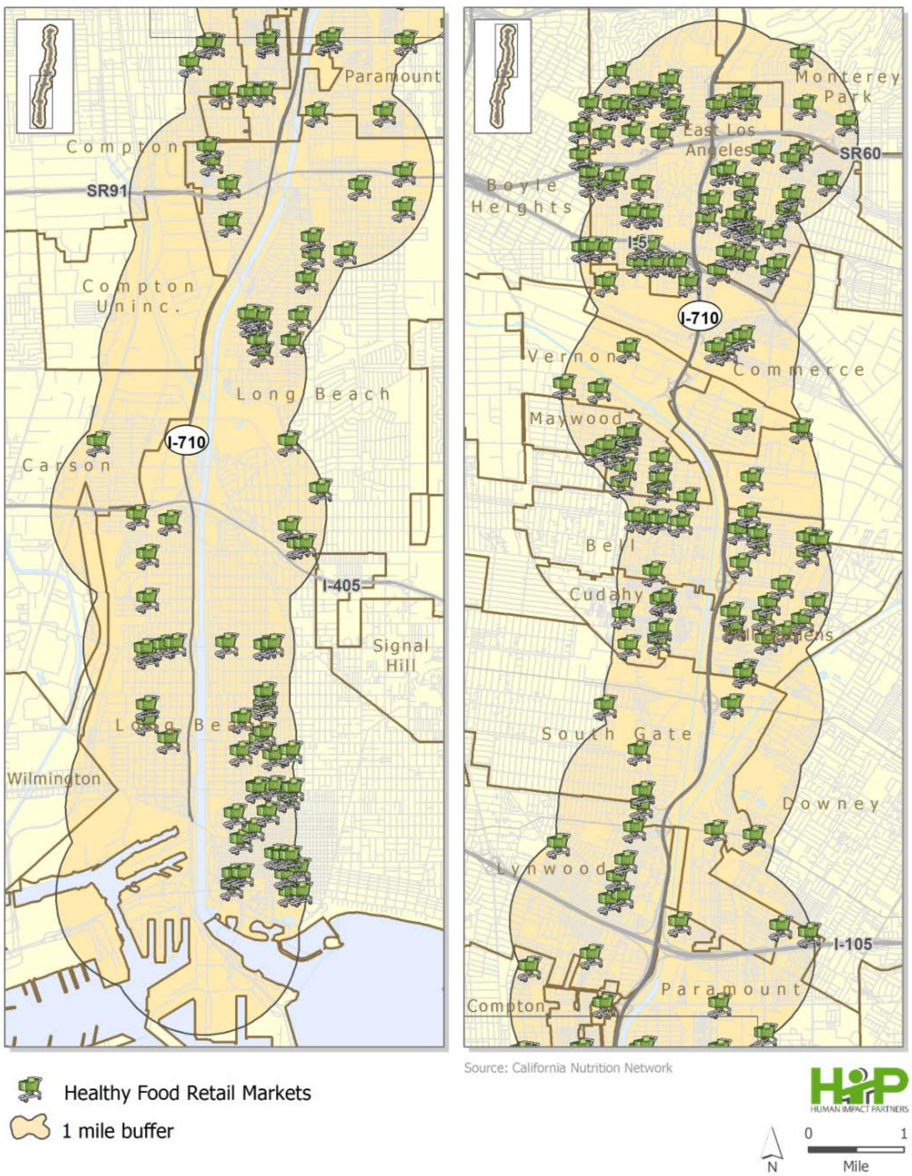
Figure 11-7 shows where healthy food retail outlets (grocery stores, fruit and vegetable markets, and farmers markets) are located within 1 mile of the I-710. Clusters of healthy food retail locations are found in Long Beach, East Los Angeles and Boyle Heights, Maywood, Bell Gardens, Cudahy, and closer to

[8] Banking and finance locations include bank main offices, brokerages, bullion repositories, credit unions, FDIC insured banks, federal reserve branches, financial processing center, and insurance.

the freeway in Lynwood. Although the population in the study area census tracts in Carson and South Gate is high, there are relatively fewer healthy retail food locations in these areas.

In the northern half of the study area, there is more healthy food retail located closer to the freeway than in the southern end of the study area.

Figure 11-7. Healthy Food Retail Locations within 1 Mile of the I-710



Retail Food Environment Index (RFEI)

The Retail Food Environment Index (RFEI) was developed to describe the retail food environment in terms of the availability of healthy versus unhealthy food (California Center for Public Health Advocacy 2007[64]). The RFEI is calculated by dividing the total number of fast-food restaurants and convenience stores by the total number of supermarkets and produce vendors in a given area. The result is the ratio of retail food outlets that offer little in the way of fruits, vegetables, and other healthy foods to those in which fruits, vegetables, and other healthy foods are readily available. A high RFEI means that a region has a large number of fast-food restaurants and convenience stores (i.e., unhealthy food) compared to supermarkets and produce vendors (i.e., healthy food).

Using data from a commercial database, the RFEI was calculated for the I-710 Corridor Project study area by adding the number of fast food outlets and convenience stores, and then dividing this by the number of grocery stores, fruit and vegetable markets, and farmers markets (California Department of Public Health 2011[67]).[9] Although food retail data from a commercial database provides a useful estimate of the types of food retail in an area, research has shown that there can be a significant difference between these estimates and actual counts of food retail locations (Powell et al. 2011[372]).

Within the 1-mile buffer zone along the I-710 corridor, there are 823 unhealthy food retail establishments (fast food outlets and convenience stores), and 578 healthy food retail outlets (general grocery stores, farmers markets, and fruit and vegetable markets) (California Department of Public Health 2011[67]). This results in a RFEI of 1.42, indicating that there are 1.42 times more unhealthy food retail establishments than those that offer healthy food options.

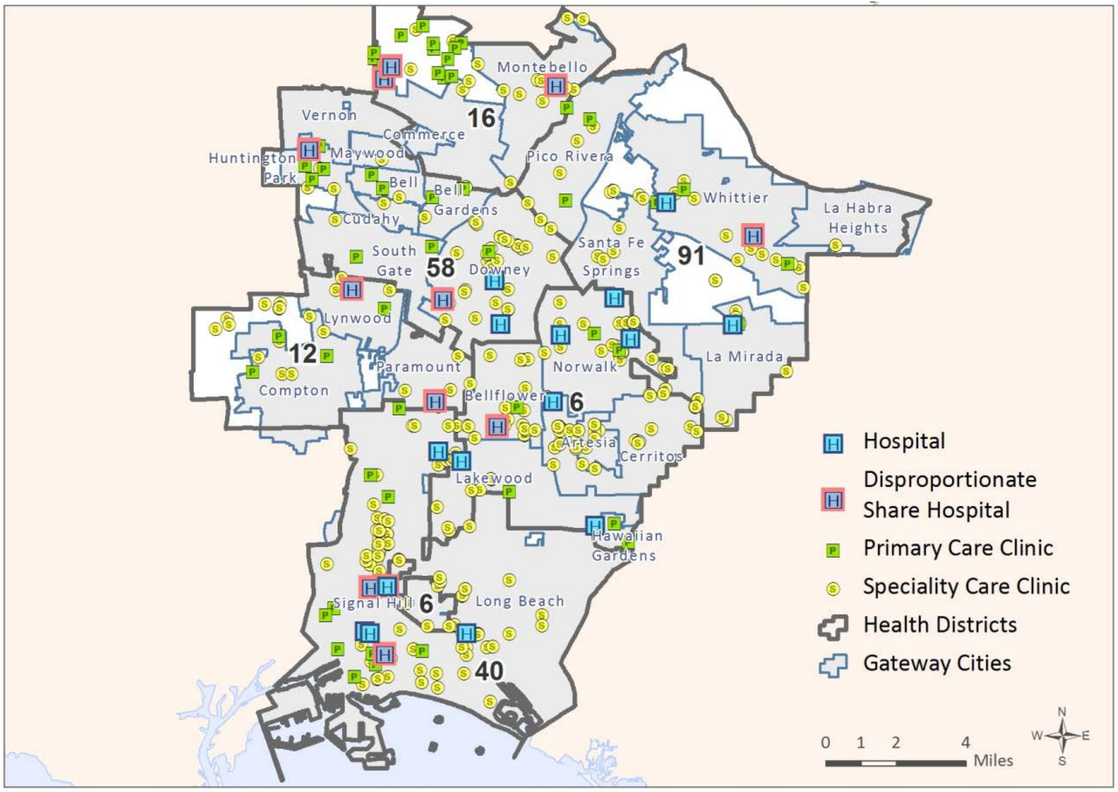
Health Care Facilities

Health care utilization is influenced by a number of interrelated factors, including distance to health care facilities (Billi et al. 2007[44]). The 2007 Los Angeles County Health Survey found that there was not a statistically significant difference in self-reported access to health care for the population living within 1 mile of the I-710 corridor and the county overall (Los Angeles County Department of Public Health 2007a[293]).

The map in Figure 11-8 shows the type of health care facilities that are located in the Gateway Cities area that surrounds the I-710 corridor. Los Angeles County Public Health Department's Health District 12, which includes Compton, Lynwood, and Paramount, has the fewest number of primary care and specialty care clinics, as well as hospitals per capita (per 100,000 people) (Human Impact Partners 2011[227]). Health District 6, which includes Artesia, Bellflower, Cerritos, Hawaiian Gardens, Lakewood, Norwalk, and Signal Hill, has the highest number of specialty care clinics and hospitals, and Health District 16, which includes Commerce and Montebello, has the highest number of primary care clinics per 100,000 people.

[9] Fast food outlets accounted for in the RFEI for the I-710 study area include fast food, pizza and sandwich chains. Convenience stores include convenience stores, chains and liquor stores/retail. Grocery stores include large and small chains, warehouse club stores and cooperatives. For more detail visit the California Nutrition Network at http://www.cnngis.org/viewer.aspx.

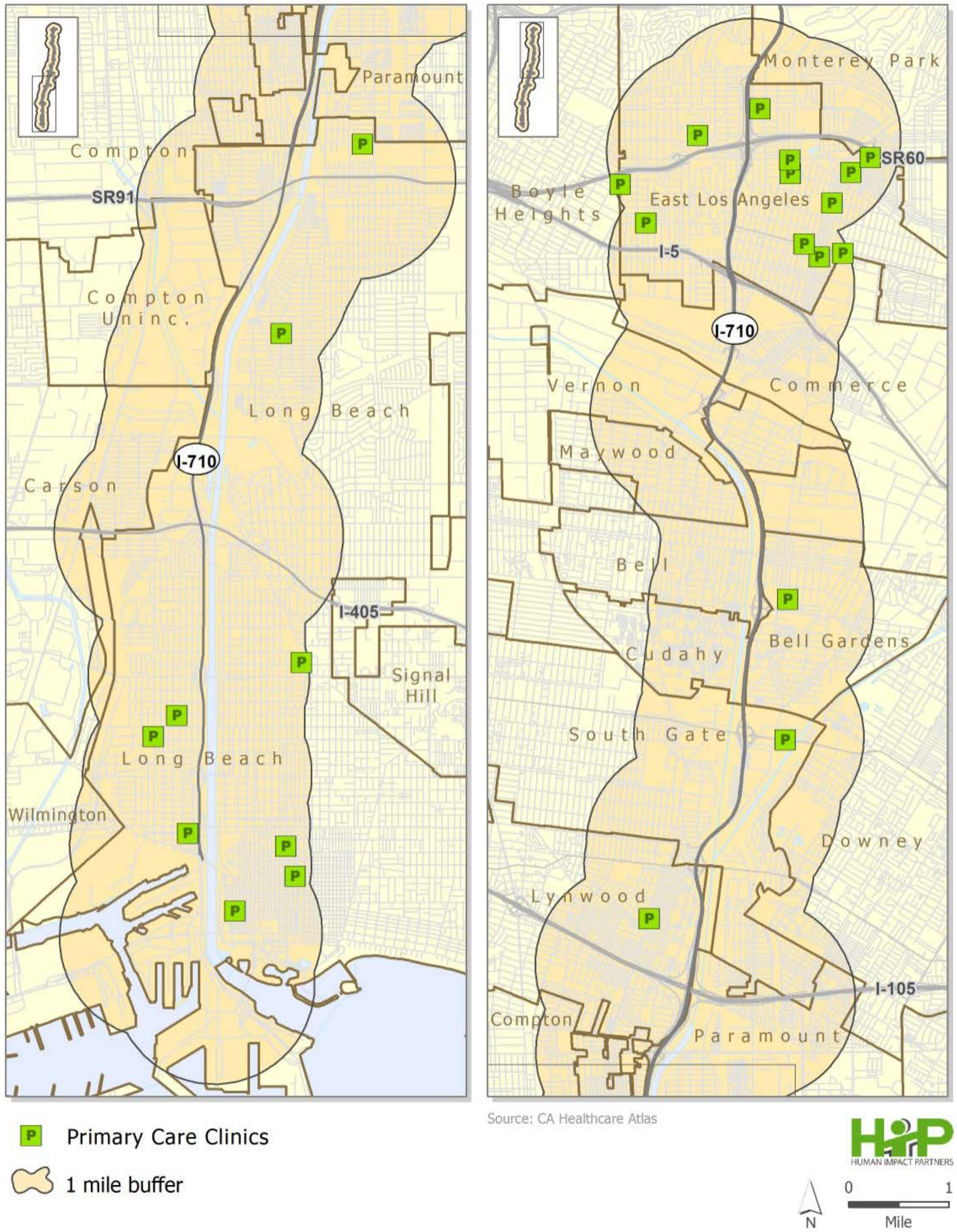
Figure 11-8. Health Care Facilities in the Gateway Cities Region



Primary Care Clinics

Figure 11-9 shows the location of primary care clinics within 1 mile of the I-710 corridor. Primary care clinics are scattered within Long Beach as well as East LA and Boyle Heights. Although the population in the study area census tracts in Carson, parts of Compton, Bell, and Southgate is high, there are few if any primary care clinics in these areas. However, this map does not show the locations of primary care clinics just outside of the study area boundary.

Figure 11-9. Primary Care Clinics within 1 Mile of the I-710



11.2.2 Perception of Environmental Quality

The following section highlights the way in which residents perceive environmental hazards in their neighborhoods associated with the freeway, the types of hazards that are perceived as being problematic, and how these hazards and concerns have been prioritized. As stated in the background section of this chapter, health outcomes can be impacted by the way in which residents perceive their environment and how environmental conditions may affect their lives.

The data presented below shows that communities along the I-710 corridor are greatly concerned in multiple ways about the impact of the freeway on the environment in which they live, work, go to school, and play.

Tier 2 Report

The conditions and recommendations highlighted in the final Tier 2 report (Tier 2 Community Advisory Committee 2004) (described above) provide a strong sense of the way that communities in proximity to the I-710 perceive the current freeway conditions as well as the proposed I-710 Corridor Project, and include:

- "Every action [of the I-710 Corridor Project] should be viewed as an opportunity for repair and improvement."
- "Improvements [to the I-710] cannot be constructed in isolation from all of the other recommendations such as public health, community enhancement, and noise abatement."

Air Quality

- "Poor air quality has had significant negative impacts on public, economic, environmental and community health in the corridor. Particulates and other pollutants from diesel truck traffic in the I-710 Corridor and the ports of Los Angeles and Long Beach are our communities' primary air-quality related health concern."

Safety and Congestion

- "Address the current congestion and design of the I-710. The high number of trucks on the freeway uses up capacity and the mix of cars and trucks poses a serious safety concern."

Community Enhancements

- "Preserve existing parks, open space, and natural areas."
- "A revitalized I-710 must be the catalyst to enhance local communities along the corridor, creating an even more desirable place to live, work, and play."
- "The I-710 corridor project must mitigate any negative impact to aesthetics."
- "Develop and implement community enhancement projects."
- "Minimize or limit the taking of homes within communities along I-710."

Noise

- "Major infrastructure improvements must be conditioned on achieving a net decrease in noise impacts upon the affected communities."

Economic Impacts

- "Improvement of air quality and the environment are essential for the area to take advantage of and capitalize on the area's assets. In addition, an investment in education is necessary to continue to diversify the economy and provide economic opportunity for residents."
- "The central location of the Gateway communities and proximity to ports, waterfronts, airports, downtown, Orange County and the Inland Empire has been undercapitalized. The ports provide economic benefit but statistics do not exist that can track these benefits back to specific communities."
- "While promoting the importance of all business, specifically recognize small business as an economic driver and foster its growth within the [I-710 Corridor] communities."

Environmental Justice

- "Ensure that the low-income and minority communities receive equitable distribution of the benefits from transportation activities without suffering disproportionate adverse impacts."
- "Include the corridor communities in the planning process in a meaningful way, including provision of appropriate language translation."

I-710 Community Participation Framework

The types of concerns and issues that have been expressed by the communities located along the I-710 corridor through the I-710 Community Participation Framework and the I-170 Major Corridor Study process are similar to those that were highlighted in the final Tier 2 report. These include: (Metro 2010[319])

- Health impacts on local neighborhoods
- Noise pollution
- Air pollution
- Need for Physical Improvements
  - Widening bridges
  - Improvements to freeway exits/entrances, ramps, and interchanges
  - Roadway maintenance
  - Keeping elevated roadways away from residential neighborhoods
  - Improved lighting along the corridor
- Limiting truck traffic during rush hours
- Incorporating mass transit, adding carpool and bus lanes
- Safety
  - Separating truck and automobile traffic

  - Public education about sharing the road with trucks
  - Pedestrian safety and walkability
- Impacts on arterial streets
- Aesthetics of the corridor
- Displacement of homes and businesses
- Economic impacts (including loss of tax revenue)
- Job creation
- Impacts on local schools
- I-710 Corridor Project funding
- Public outreach and public involvement in the I-710 Corridor Project process and decision-making (including translation services)
- Mitigating impacts from construction

11.2.3 Social Cohesion

Research makes it clear that the more vibrant and diverse the neighborhood environment is, the better opportunity there is for social interaction and building social cohesion (see the background section of this chapter). Based on this understanding, since they are neighborhoods with the most diverse mix of key services and retail locations (see Figure 11-1), the census tracts in the study area that are part of the Cities of Long Beach, East LA and Boyle Heights, and parts of South Gate, Bell Gardens, Lynwood, and Maywood are likely to have stronger social networks (social cohesion) than others parts of the study area.

Studies also conclude that parks and places of worship are neighborhood locations that can contribute to higher levels of social cohesion. There are notably few parks in the study area census tracts that are part of the Cities of Commerce, Compton, Carson, and Downey, which is one factor that could serve to hinder the development of strong social networks in these areas.

The I-710 Corridor Project EIR/EIS Community Impact Assessment characterizes community cohesion among the population living in areas surrounding the I-710 as the following: (Metro 2010[319])

> With consideration to age, ethnic homogeneity, above-average household size, high tenure of residents, percentages of transit-dependent population, and the active communities within the I-710 Corridor Project study area . . . the affected communities in the I-710 Corridor Project study area are considered to be highly cohesive.

Social cohesion in this analysis is measured through the following indicators: crime rate, year that residents moved into their homes, voter registration, and places of worship.

Crime Rate

Crime can result from, as well as be a cause of, a lack of a sense of community and social cohesion.

Violent crime statistics are composed of four offenses: murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault. Violent crime statistics are routinely collected by the Federal Bureau of Investigation's (FBI) Uniform Crime Reporting Program.

In Los Angeles County in 2009 there were an estimated 555 known violent crimes per 100,000 people. The FBI monitors crime data for 40 of the 88 cities (45.5%) in the County.

- 15 of these 40 cities (37.5%) for which data is available have violent crime rates that exceed those of the County overall.
- Eight (53%) of the 15 cities with violent crime rates that exceed those in the County are in the I-710 study area—Commerce, Compton, Cudahy, Hunting Park, Long Beach, Paramount, South Gate, and Vernon.
- The crime rates in both Commerce and Compton are more than twice those in the County.

Crime rates for cities that have census tracts within the I-710 Corridor Project study area are shown in Table 11-2.[10]

Although reported rates of crime in the many of the study area cities are higher than those in the County, results from the 2007 Los Angeles County Health Survey show that there is not a statistical difference in the perceptions of neighborhood safety related to crime in the study area census tracts compared to the County overall (Los Angeles County Department of Public Health 2007a[293]).

Table 11-2. Offenses Known to Law Enforcement, 2009

	Population	Violent Crime (# of reports)	Property Crime (# of reports)	Burglary (# of reports)	Larceny Theft (# of reports)	Motor Vehicle Theft (# of reports)	Crime Rate per 100k[1]
Los Angeles County	9,863,786	54,747	241,960	50,558	144,589	46,813	555
Bell	36,651	186	546	115	280	151	507
Bell Gardens	44,756	204	829	184	320	325	456
Carson	92,635	500	2,331	475	1,389	467	540
Commerce	13,529	190	1,020	138	597	285	1,404
Compton	93,872	1,457	3,051	768	1,355	928	1,552
Cudahy	24,337	150	500	55	276	169	616
Downey	107,598	444	3,575	524	2,105	946	413
Huntington Park	60,840	546	2,309	248	1,246	815	897

[10] East LA, Lynwood, Montebello, Monterey Park, Boyle Heights, and Wilmington all have census tracts that intersect the I-710 HIA study area, but violent crime statistics for these cities were not available.

	Population	Violent Crime (# of reports)	Property Crime (# of reports)	Burglary (# of reports)	Larceny Theft (# of reports)	Motor Vehicle Theft (# of reports)	Crime Rate per 100k[1]
Long Beach	463,969	3,161	12,643	3,116	7,166	2,361	681
Maywood	28,234	151	467	76	208	183	535
Paramount	55,220	389	1,656	310	721	625	704
Signal Hill	11,062	53	425	96	271	58	479
South Gate	96,651	566	2,571	377	1,070	1,124	586
Vernon	90	49	298	33	175	90	54,444

Source: Federal Bureau of Investigation 2009[179].
[1]Crime rate for all known types of offences.

Year That Residents Moved Into Their Homes

The U.S. Census 2005–2009 American Community Survey data shows that residents in the study area have lived in their homes on average for a similar number of years as other residents in the county. Residents living within 1 mile to the east (upwind) of the freeway have on average lived in their homes for a longer amount of time than those living within 1 mile to the west (downwind). (U.S. Census Bureau 2010[454])

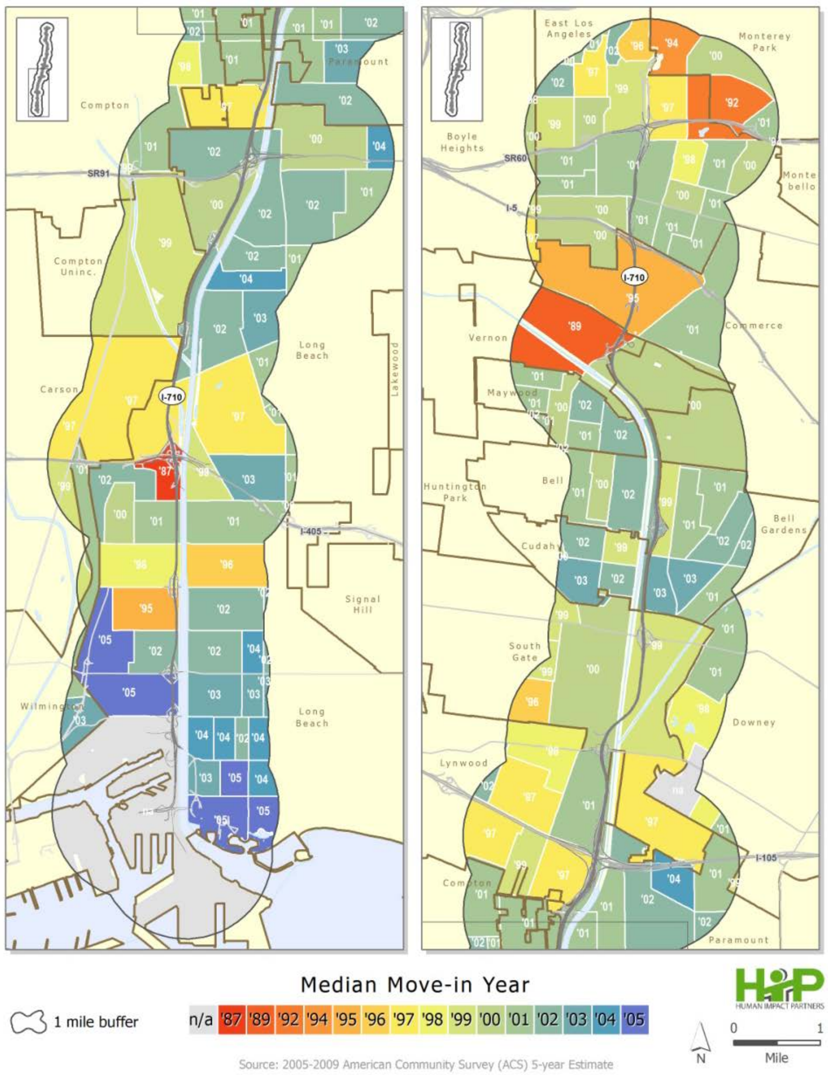
Table 11-3. Median Move-in Year

LA County	Entire Study Area	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
2000	2000	2001	1999	2001	1991

Source: U.S. Census Bureau 2010[454].

Figure 11-10 shows that the majority of residents living in census tracts within 1 mile of the I-710 have not lived in their homes for more than 10 years. The map shows that apart from one census tract very close to the freeway just southeast of Carson, residents living in the study area census tracts in the City of Long Beach moved in more recently than in other areas. Residents in study area census tracts in Vernon, parts of East LA, Monterey Park, and Commerce have lived in their homes longer on average than in other parts of the study area. These areas may have stronger social networks as a result of the length of time that residents have been a part of these communities, whereas in the areas of Long Beach where there are many new residents, social ties may not be as strong.

Figure 11-10. Median Year Tenants Living within 1 Mile of the I-710 Moved into Their Homes



Voter Registration

As described above, voter registration, a measure of political participation, is an additional indicator of social cohesion. Of all of the voting age people (both citizen and non-citizen) living in the county, approximately 61% are registered to vote. Because non-citizens do not have the right to vote, when just the number of citizens who are registered to vote is measured, this percentage increases to 81% (Los Angeles County 2011[291]).

Within the I-710 Corridor Project study area, close to 53% of the total population of voting age (citizen and non-citizen) is registered to vote, which is lower than in the County. However, when non-citizens are excluded from this count, nearly 84% of the citizen-only voting age population in the study area is eligible to vote (Los Angeles County 2011[291]). [11]

Table 11-4. Percent of Voting Age Residents Registered to Vote, 2010/2011

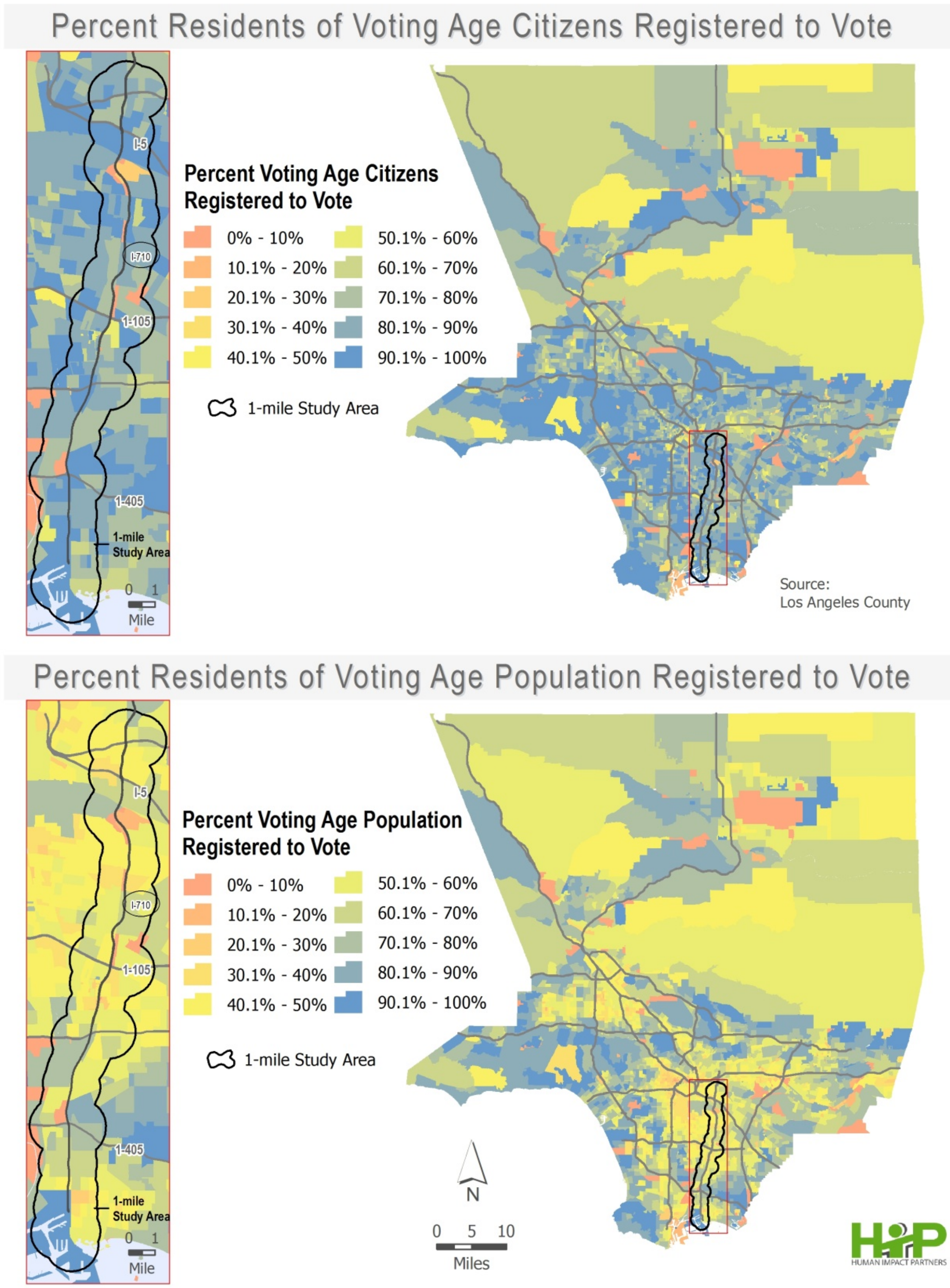
	LA County	I-710 Corridor Project Study Area
Total voting age population registered to vote (citizens + non-citizens)	61%	53%
Voting age citizens registered to vote (citizens only)	81%	84%
Source: Los Angeles County 2011[291]; U.S. Census Bureau 2010[454].		

The data above and maps below (Figure 11-11) show that in the study area there are a higher than county average number of citizens registered to vote, indicating that there is a high interest in civic/political participation, which is an indicator of social cohesion. However, the map(s) and data also highlight that there are a high percentage of non-citizens living in the study area. Because these non-citizen residents cannot vote, there is a lower percentage overall of residents in the study area who are registered to vote.

The high percentage of non-citizens in the area could also indicate that the study area neighborhoods have less of an overall voice in political decision-making as a result of the reduced ability for all of those living in the area to be able to vote, even if there is a high interest among the population to engage in civic affairs and political decision-making.

[11] Voter registration data and population data (to determine population of voting age) come from different sources, which may present inconsistencies. Registration counts are generated from voter registration address data from March 2011, and the population data is from the U.S. Census Bureau (population by Census blocks), that was collected in March/April of 2010. In most areas with significant population these differences are more likely to be insignificant relative to the totals. However, inconsistencies may likely appear in areas with streets containing medians or where there are multiple segments such as railroads and rivers near tract boundaries. There are also some situations where voters are still on the rolls where housing was removed, or unoccupied at the time of the Census, or where new housing has been built since the Census, or was not counted by the Census Bureau. Some voters may have used their business addresses for registration, which could lead to further discrepancy.

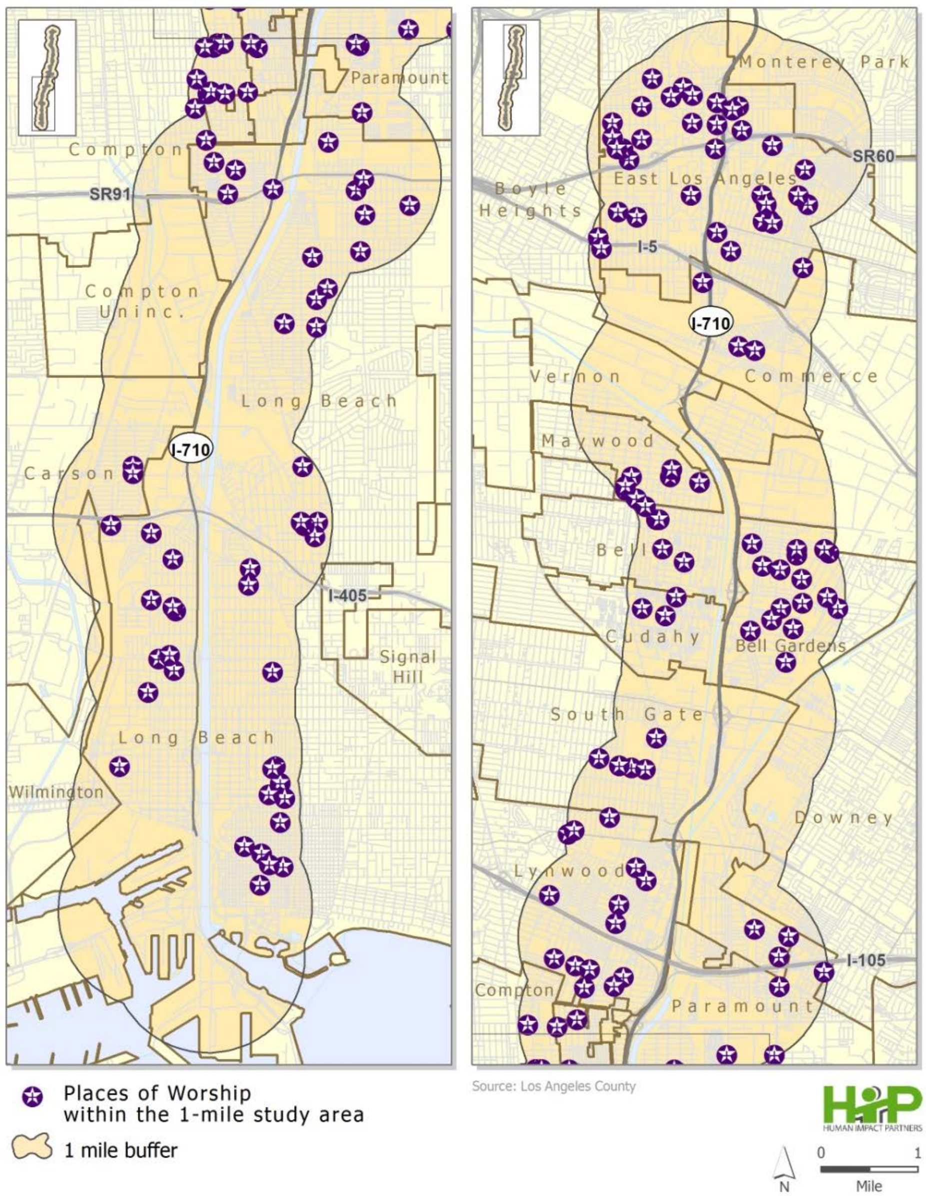
Figure 11-11.Voter Registration among All Voting Age Population and among Citizens



Places of Worship

As mentioned above, places of worship are positively associated with social cohesion. Figure 11-12 shows a map of places of worship within 1 mile of the I-710. A higher concentration of places of worship is located in areas where the population of the census tracts is higher. A number of places of worship in the study area are located very close to the I-710.

Figure 11-12. Places of Worship within 1 Mile of the I-710



11.2.4 Neighborhood Wealth

According to the 2005–2009 American Community Survey of the U.S. Census, measures of neighborhood wealth, including the rate of residents living below the federal poverty level, median household income, unemployment, and household overcrowding, all indicate that residents living in census tracts within 1 mile of the I-710 are on average less wealthy than those in the county overall.

Table 11-5. Indicators of Neighborhood Wealth[12]

Indicator	LA County	I-710 Corridor Project Study Area
Poverty rate (per 1,000 population)	154.43	207.20
Median household income	$60,073	$44,189
Unemployment	5.05%	6.73%
Severe household overcrowding	5.28%	8.60%
Source: U.S. Census Bureau 2010[454].		

As discussed in Chapter 5, "Demographics," median household income in the study area is lowest in the census tracts in downtown Long Beach (excluding those with direct shore access), Westside Long Beach, and East Los Angeles. Household income trends higher in the area east of Carson, parts of Compton, Monterey Park, and Downey.

According to the U.S. Census, unemployment rates within the study area are more variable throughout the study area compared to income. There are relatively low unemployment rates in Long Beach (aside from the downtown area), north of the I-405, South Gate, and Downey. Meanwhile, there are high levels of unemployment in Downtown Long Beach, Commerce, and parts of Compton. The 2007 Los Angeles County Health Survey shows that while employment status in the study area is similar overall to that in County, there is a significantly lower percentage of people who are retired in the census tracts within the buffer zone that is 1-mile upwind of the I-710 (Los Angeles County Department of Public Health 2007a[293]).

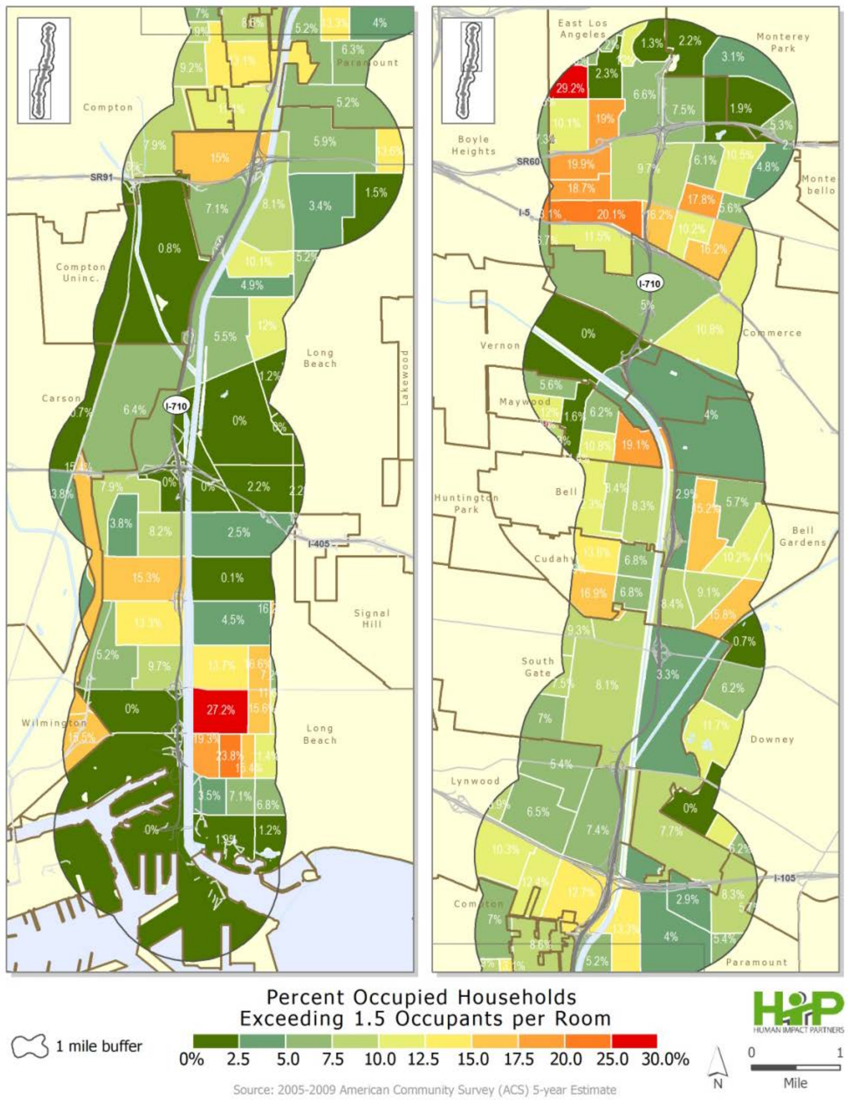
Additional measures of neighborhood wealth assessed in this chapter include household overcrowding and property values.

Household Overcrowding

Overcrowding, as defined by the U.S. Department of Housing and Urban Development (HUD), is having greater than 1 person per habitable room in a household, and severe overcrowding occurs when there are more than 1.5 occupants per habitable room. Overcrowding often occurs when housing costs are so high relative to income that families double up to devote income to other basic needs such as food and medical care. The study area census tracts with the highest percentage of severe household overcrowding are located in downtown Long Beach, East Los Angeles, Bell Gardens, and Maywood—these are all census tracts that have low median household incomes.

[12] It should be noted that these estimates are an average from 2005-2009, so do not reflect recent economic and other trends.

Figure 11-13. Severe Household Overcrowding within 1 Mile of the I-710



Property Values

The average assessed value of residential property parcels in the study area census tracts is an estimated $147,820 (about 40%) less than the average value of a residential parcel in the county overall.[13] A map of the distribution of residential, commercial, industrial, and manufacturing land parcels within the study area can be found in Chapter 5, "Demographics."

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[13] Assessed value of property parcels was calculated by adding the parcel land value to the parcel's improvement value. The assessed value of a parcel is used to determine property tax.

Table 11-6. Average Assessed Value of Residential Property Parcels

Zone Type	LA County	Entire Study Area	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Residential	$364,865	$217,045	$232,371	$191,740	$241,537	$186,318
Source: Los Angeles County Office of the Assessor 2011.						

The map in Figure 11-14 shows the location of residential property parcels together with those coded for commercial, manufacturing, and industrial use.[14] The residential parcels are highlighted in green, and make up the majority of parcels in the study area. Figure 11-15 shows all of the property parcels (not separated by zone code) within the study area and their assessed values. The highest valued parcels are in the industrial and manufacturing areas, including the Port of Long Beach and Railyards in Commerce. Larger pockets of lower value residential parcels are located in East Los Angeles, Bell Gardens, and Downey.

[14] Parcel data and zoning codes are based on information provided by the Los Angeles County Office of the Assessor, for more information, visit http://assessor.lacounty.gov/extranet/Datamaps/Pais.aspx

Figure 11-14. Property Parcels by Zone Code within 1 Mile of the I-710

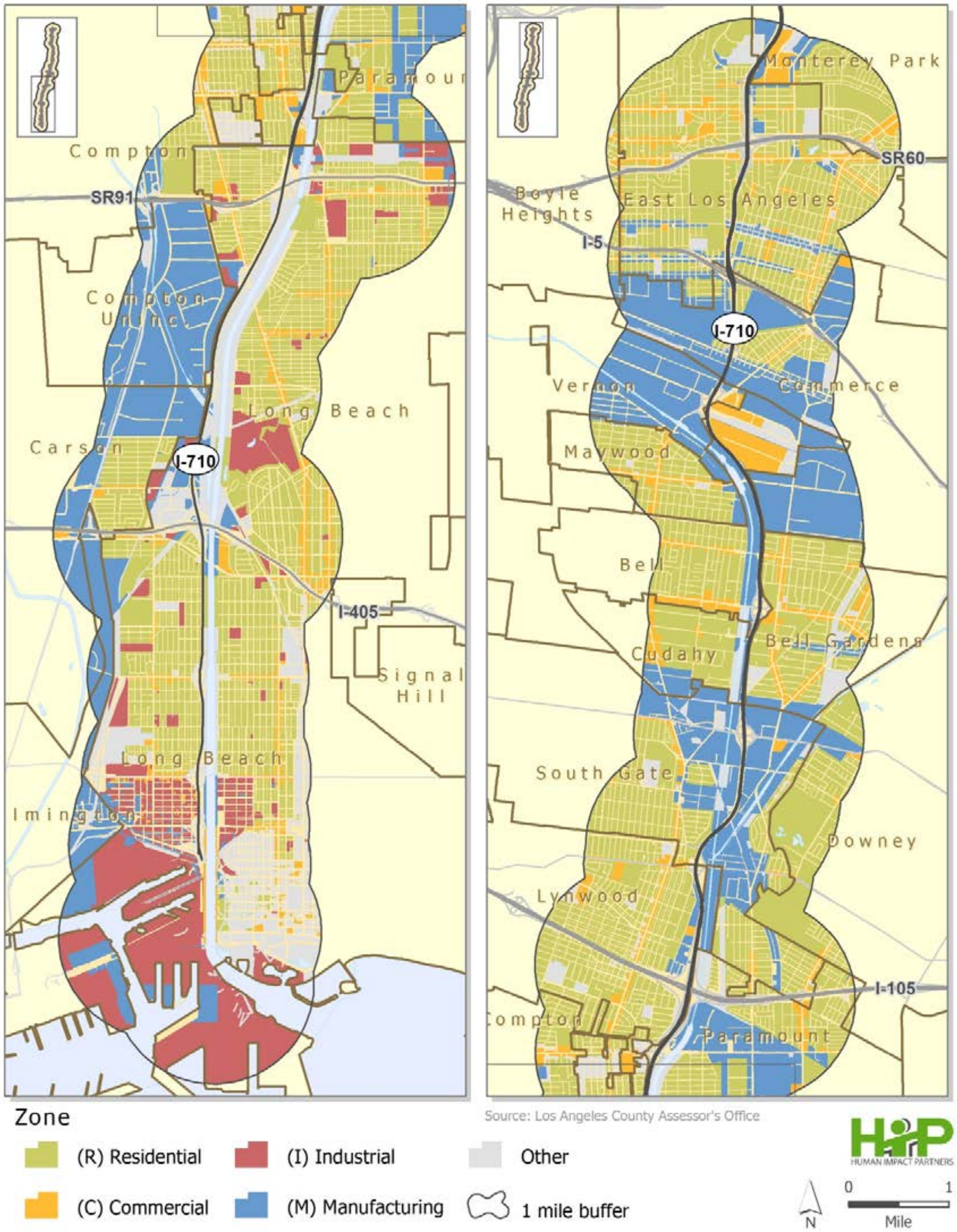
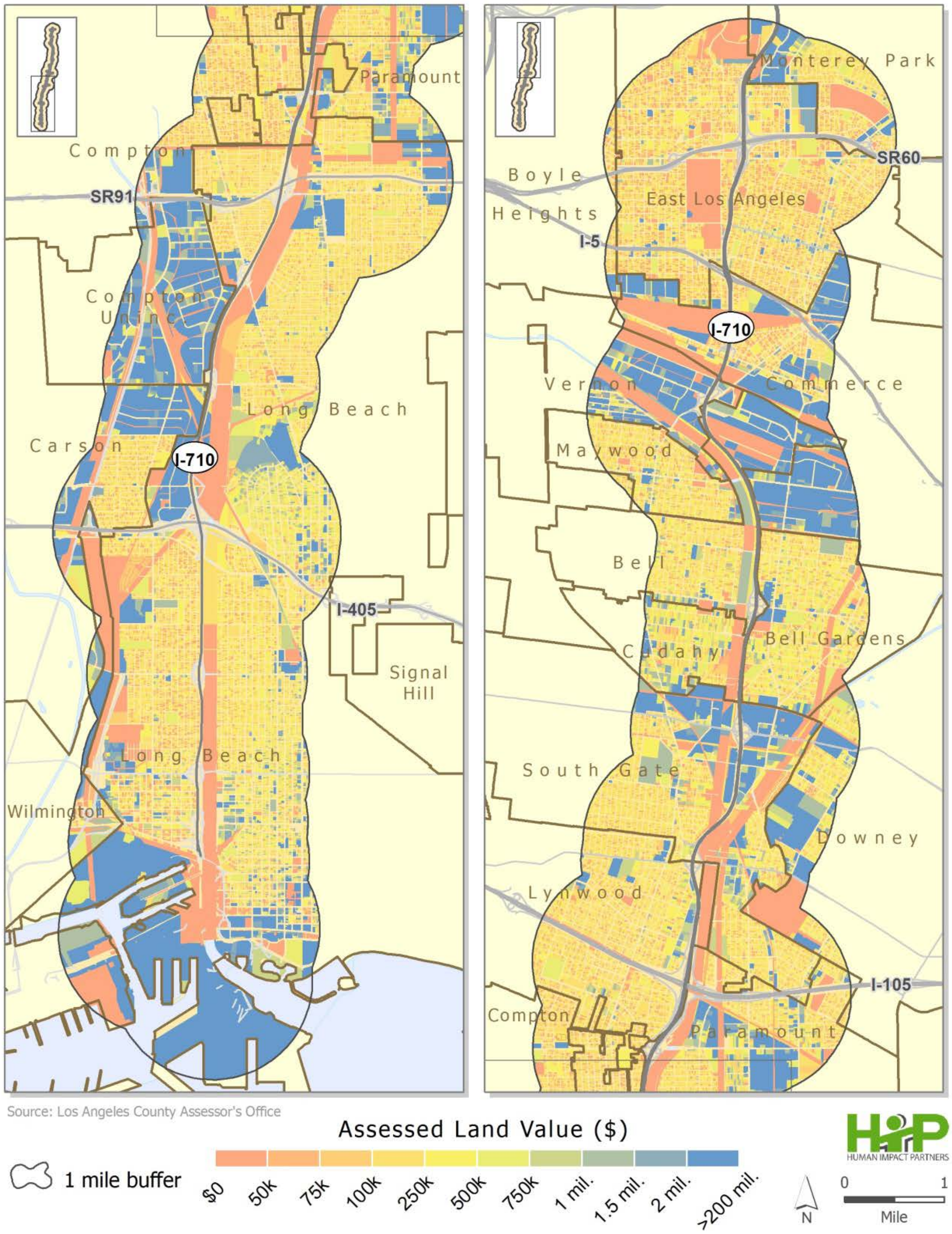


Figure 11-15. Assessed Land Value of All Property Parcels within 1 Mile of the I-710



11.2.5 Health Outcomes Related to Neighborhood Resources, Social Cohesion, Neighborhood Wealth, and Neighborhood Safety

The data below for the I-710 Corridor Project Study Area highlights rates of major diseases related to a population's level of poverty, ability to access neighborhood resources, and strength of social networks.

Avoidable Hospitalizations

The conditions highlighted in the following tables are those for which good outpatient care can potentially prevent the need for hospitalization, or for which early intervention can prevent complications or more severe disease. Data about avoidable hospitalizations gives insight into disease and environmental conditions in an area, as well as the quality of the health care system outside the hospital setting.

For more information about avoidable hospitalizations, see Appendix B.

Table 11-7. Avoidable Hospitalization Admissions for Adults (18 years and older) Per 100,000 Persons

Admission Type	State	County	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Diabetes short-term complication	48.51	45.31	59.71	72.84	61.14	78.48
Diabetes long-term complication	108.23	137.23	212.15	223.45	213.17	232.14
Hypertension	35.56	52.63	57.74	65.66	59.03	66.43
Congestive heart failure	263.47	302.54	282.58	301.63	288.37	313.46
Angina without procedure	25.15	29.06	36.09	42.68	36.54	43.26
Uncontrolled diabetes	11.98	18.79	29.53	32.83	30.69	33.57
Lower-extremity amputation among patients with diabetes	27.88	28.45	46.37	54.79	47.79	55.32
Source: Agency for Health Research and Quality 2010[5].						

Table 11-8. Avoidable Hospitalization Admissions for Children (under 18) Per 100,000 Persons

Admission Type	State	County	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Diabetes short-term complications admission rate	22.57	19.70	12.67	11.59	13.49	12.85

Chronic diseases such as diabetes and heart disease are mediated through a number of factors, including diet, being overweight, physical inactivity, family history of disease, age, and high blood pressure. Poorer adults are twice as likely to have diabetes, and nearly 50% more likely to die of heart disease (California Newsreel 2008[71]). The timely use of primary care has a role in preventing illness and hospitalizations from a number of chronic diseases, including heart disease and diabetes.

Diabetes is the seventh leading cause of death in the United States. Type 2 diabetes is the most common form of diabetes; and is more common in African Americans, Latinos, Native Americans, Asian Americans, Native Hawaiians and other Pacific Islanders, as well as the elderly population (CDC 2011d[100]., American Diabetes Association 2011[6]). Uncontrolled diabetes can damage the eyes, kidneys, nerves, heart, and blood vessels, and reduce the body's ability to fight infections (Los Angeles County Department of Public Health 2007b[294]).

Diabetes is among the top five leading causes of death in five out of six of the health districts in the Gateway Cities, but not for Los Angeles County.[15] Coronary heart disease is the leading cause of death in the county for males and females, all race/ethnic groups, and among the population age 45 years and older. (Los Angeles County Department of Public Health 2007b[294].)

Table 11-6 shows that for adults:

- For all avoidable hospitalization admissions related to diabetes, observed rates for the study area are higher than in the county and the state.
- For hypertension (high blood pressure, a risk factor for heart disease) and angina (chest pain caused by an inadequate blood supply to the heart) without procedure, observed rates for the study area are all higher than those in both the state and the county.
- Observed rates for congestive heart failure are higher in the county than in the state; and observed rates for the downwind study areas are higher than in the county, but those in the upwind study groups are lower than those in the county.

Table 11-7 shows that for children:

- Observed rates for diabetes complications in the study area are lower in the county and in the state.

2007 Los Angeles County Health Survey

In 2007 the Los Angeles County Health Survey (Los Angeles County Department of Public Health 2007a[293]) interviewed a total of 7,200 adults (ages 18 years or older) and 5,728 parents (primarily mothers) of children ages 17 years or under—all of whom reside in Los Angeles County. All the relevant data is available in Appendix A. The following are highlights from the survey that provide information about the health of the populations living within 1 mile of the I-710:

- The percentage of adults in the I-710 study area diagnosed with obesity and diabetes is higher than in the county overall. It is unclear whether these differences are statistically significant.

[15] See section 3.1.5 for a map of Los Angeles County Health Districts

- The percentage of adults in the I-710 study area diagnosed with other chronic health conditions (heart disease, hypertension, high cholesterol, overweight, and depression) is not different than in the county overall.
- The population living within 1 mile of the I-710 did not have significant differences in self-reported health and quality of life measures (fair/poor health status, average unhealthy days [past month] due to poor physical or mental health, and average activity limitation days [past month] due to poor physical/mental health).

11.2.6 Physical Activity

According to the 2007 Los Angeles County Health Survey approximately 47% of adults and 62% of children in the county do not meet recommended guidelines for physical activity, with more than 36% of adults and more than 15% of children engaging in minimal to no physical activity. Rates of physical activity in the study area are similar to those in the county. (Los Angeles County Department of Public Health 2007a[293].)

Table 11-9. Percentage of People Who Do Not Meet Physical Activity Guidelines, 2007

	LA County	All Census Tracts in Study Area	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Adults	46.9%	46.7%	43.0%*	50.9%*	42.0%*	54.0%*
Children	62.4%	61.6%*	62.2%*	60.9%*	66.3%*	58.5%

* indicates the estimate is statistically unstable (relative standard error > 23%) and therefore may not be appropriate to use for planning or policy purposes

Source: Los Angeles County Department of Public Health 2007a[293].

In a study about Los Angeles, active people who live within 2 miles of a park are more likely to exercise in a park (34%) than at home (21%), at private clubs (6%), or at other locations (4%), although many people (35%) reported exercising in more than one location (Cohen et al. 2006[110]). The study also revealed that most park users (81%) live within 1 mile of a park, and that people living within 1 mile of a park are four times as likely to visit the park once per week or more.

11.3 Impacts of the I-710 Corridor Project on Neighborhood Resources

As discussed above, communities in the I-710 corridor have:

- Adequately complete neighborhoods, with access to a reasonable variety of resources, though some areas have more access to this variety than other areas (e.g., Long Beach, East Los Angeles and Boyle Heights, and parts of South Gate, Bell Gardens, Lynwood, and Maywood are more complete than areas of Carson, Compton, and Downey);
- Concerns about the quality of their environment from the perspective of air quality, noise, traffic safety, traffic congestion, jobs, and neighborhood resources;

- Reasonable but not strong social cohesion as judged by crime rates, the percent of people registered to vote, and the length of time people have lived in their homes;
- Higher poverty rates, unemployment and overcrowding, and lower incomes and property values; and
- Disease rates similar to the county for many health outcomes, but higher rates of diabetes and obesity.

Other chapters of this HIA have discussed:

- Past disinvestment in some communities near the I-710 and in the southern LA region;
- The racial distribution of cities near the I-710, with high concentrations of Hispanics living throughout the corridor, but especially in the northern end;
- The increase in traffic volumes on the freeways and arterials likely under all the alternatives being considered in the I-710 Corridor Project EIR/EIS;
- The likelihood that walking and biking environments will not improve and will potentially worsen under all the alternatives being considered but that driving will become easier under some of the alternatives;
- The likelihood that air quality near the I-710 and in the region will improve as a result of improved automobile and truck engine technology under all the alternatives being considered;
- The likelihood that noise exposure will increase as a result of increased noise emissions from traffic on the freeway and arterials as well as other parts of the goods movement infrastructure;
- It is uncertain if traffic safety on the freeway and on the arterials will improve;
- The likelihood that the number of jobs available in the I-710 corridor will increase under all of the alternatives; and
- Proposed aesthetic treatments to freeway and arterial highways are likely to improve community perceptions under Alternatives 5A and 6A/B/C.

Given these existing conditions and environmental impacts, the following section discusses how the project alternatives being considered in the EIR/EIS could impact access to neighborhood resources and related health conditions discussed in this chapter.

11.3.1 Impacts on the Perception of Environmental Quality

As described above, all the alternatives being considered in the I-710 Corridor Project are likely to lead to both improvements in environmental quality (e.g., air quality) and also degradation to other aspects of environmental quality (e.g., noise). Generally, perceptions of environmental quality should correlate with actual changes in environmental quality, but because these perceptions are influenced by many factors outside the control of the project and because some aspects of environmental quality are improving while others are degrading, it is not possible to predict exactly how perceptions will change.

11.3.2 Impacts on Neighborhood Completeness

Neighborhood completeness could be impacted through displacement of key services and/or retail outlets, changes in access to these key community resources, and/or a change in investment in the corridor that would lead to a change in the availability of these resources. Although usability of current neighborhood resources was not assessed in this analysis due to the significant cost of doing so, changes in usability could also lead to changes in access to neighborhood resources. Each of these potential impacts is assessed below.

Displacement

Plans for Alternatives 5A and 6A/B/C displace minimal community resources directly. Tens of housing units and one firehouse may be directly displaced, but few other services or retail outlets discussed in the existing conditions section above may be directly displaced as a result of the freeway expansion itself. Direct displacement will likely not be a source of major change in neighborhood completeness.

Changes in Access

Changes in the accessibility of resources may stem from physical changes to the community resulting from changes to the freeway or from changes in the mode of transportation that people can use to get to neighborhood resources.

Changes to the freeway itself, given for example the proposal to locate the Freight Corridor for Alternatives 6A/B/C in the utility right-of-way, are unlikely to lead to changes in access. However, several interchanges are being removed and one new interchange is being proposed, and these changes could impact access. According to the I-710 Corridor Project EIR/EIS Multimodal Review, these changes will result in increased driving time but will not otherwise impact access. Chapter 9.0 of the Multimodal Review provides a full summary of the proposed changes and their impact.

As described in Chapter 6, "Mobility," the various alternatives are likely to change the ease of using various modes of transport. Under Alternative 1, driving in the I-710 corridor is likely to be more difficult in 2035 due to congestion. This could, but is not certain to, make public transit use more attractive. It is difficult to predict how the use of active transportation (walking and biking) under Alternative 1 will change, but active transport usage is unlikely to increase. These impacts will make it harder for people to access goods and services by car. Access by public transportation and walking/biking will at best remain similar to existing conditions.

Alternative 5A will have the least impact on ease of driving and, similar to Alternative 1, impacts on use of active transport are unclear. Due to proposed public transit infrastructure improvements, public transit access is likely to increase. Therefore, under this alternative, access to goods and services by car in 2035 is likely to not change very much from 2008 levels, while changes in access by walking/biking are difficult to predict but are unlikely to improve and changes in access by public transit will improve.

Alternatives 6A/B/C will make driving easier because they relieve congestion. Proposed public transit infrastructure improvements will increase access by transit but use of active transport is likely to stay the same or decrease. In 2035, access to key goods and services by car and transit will therefore improve, while access by active transport will stay the same or worsen.

One conclusion that can be reached is that those who do not have access to a car (about 8–10% of the population, as described in Chapter 6, “Mobility”) will have a more difficult time accessing needed goods and services through walking and biking. This will have a disproportionately adverse impact on those without access to cars, such as seniors who no longer drive, those who cannot afford a car, and those who are not eligible to get a driver’s license (e.g., non-citizens).

Access to Parks

Access to parks is analyzed in the I-710 Corridor Project EIR/EIS. Alternatives 5A and 6A/B/C would include improvements to Cesar E. Chavez Park in the City of Long Beach, which would result in improved access to the park and provide for a larger contiguous recreation area (See Section 5.12 of the Multimodal Review for additional details). The Multimodal Review states that access to the park within the City of Commerce would be maintained including access for residential areas surrounding the park as well as the neighborhood west of the freeway via the pedestrian undercrossing.

Changes in Investment

Under any of the alternatives being considered, the combination of the lack of a current surplus of goods and services in the corridor, population growth trends, and current government budget shortfalls lead to the conclusion that existing neighborhood resources will be increasingly taxed unless there is significant public and private investment in the I-710 corridor area. Private investment must bring goods and services to the area, as well as jobs. Public investment must maintain existing, and provide new, infrastructure and services to serve the future population.

Chapter 4, “History of the I-710 Communities,” briefly discusses historical trends related to investment in the area. It is unclear how the additional lanes of freeway being proposed in Alternatives 5A and 6A/B/C will impact future investment in the corridor.

Changes in Usability

Goods and services currently located near the I-710 may become more or less usable as a result of environmental changes that result from the alternatives being considered. For example, parks close to the freeway, such as Bandini Park (described above), or near arterials, such as Maywood Riverfront Park (also described above) may experience a decrease in use due to increases in noise and/or potential decreases in walkability/bikeability to these parks. For example, schools, libraries, and places of worship could also become more or less usable. It is difficult to predict such changes because of the above described difficulties in making predictions about how perceptions of environmental quality will change, and because if these are the only resources a community has, people may not have a choice about whether they use them or not, regardless of their quality.

11.3.3 Social Cohesion

As described in Chapter 4, "History of the I-710 Communities," some communities near the I-710 have experienced past disinvestment. These conditions have led many people who could leave for the suburbs or other places to do so (as demonstrated by the higher poverty rates and lower incomes in the I-710 corridor).

An expansion of the I-710 under Alternatives 5A and 6A/B/C is not likely to increase the pride that current residents in the corridor feel for their community, especially to those living closest to the freeway, though this could be offset somewhat by the recommendations proposed in the Urban Design and Aesthetics Toolbox Report (Gruen Associates 2011[208]). The increased traffic and congestion under Alternative 1 may similarly not have positive impacts. These changes could once again encourage those who have the resources to leave and could strain or decrease the strength of existing social networks and weaken social cohesion. While there is little concrete evidence that confirms these potential changes to social cohesion, it is difficult to hypothesize mechanisms by which the predicted changes will lead to increased social cohesion.

11.3.4 Impacts on Neighborhood Wealth

In addition, residential property values are currently lower in the study area than in the rest of the county, and, based on the literature cited above, the changes envisioned under Alternatives 5A and 6A/B/C are likely to decrease property values for those living close to the freeway (due to environmental factors) and increase property values for those living further from the freeway (due to better access). For residents who own and occupy homes close to the freeway, the potential for increased wealth generation is diminished, while for those further away, it is enhanced.

Again, it is difficult to hypothesize scenarios under which the alternatives being considered would encourage those with more wealth to move into the I-710 corridor communities and contribute to increasing neighborhood wealth.

11.3.5 Health Outcome Data

The changes in access to neighborhood resources, social cohesion, and neighborhood wealth described above that may result from the alternatives being considered are likely to be different for different populations (e.g., based on place of residence and access to a vehicle). As a result, health outcomes associated with access to neighborhood resources, social cohesion, and neighborhood wealth would be expected to improve for some (e.g., those living further from the freeway who have access to a car and whose travel times are likely to decrease) and worsen for others (e.g., those that live close to the freeway or rely on active transport). These health outcomes include:

- Chronic disease levels associated with physical activity (e.g., walking to goods and services), diet, access to needed services, and social cohesion;
- Mental health associated with physical activity and from changes in stress as a result of changes in social cohesion;

- Changes in lifespan associated with a physical activity and social cohesion; and
- Changes in injury and fatality rates associated with changes in crime levels that could result from changes in social cohesion.

11.3.6 Summary of Health Impacts

Table 11-9 summarizes health impacts related to access to neighborhood resources, social cohesion, and neighborhood wealth showing that for any alternative under consideration there are likely to be positive health impacts for some populations (e.g., those living further from the freeway who have access to a car and whose travel times are likely to decrease) and negative impacts on other populations (e.g., those that live close to the freeway or rely on active transport).

Table 11-10.Summary of Predicted Health Impacts Related to Neighborhood Resources

<table>
<tr><th rowspan="2">Health Impact/ Alternative</th><th colspan="2">Impacts of Alternatives</th><th colspan="2">Health Outcome</th><th rowspan="2">Uncertainties</th></tr>
<tr><th>Impact</th><th>Magnitude</th><th>Severity</th><th>Strength of Causal Evidence</th></tr>
<tr><td colspan="6">Chronic Disease (e.g., cardiovascular disease, diabetes; from changes in physical activity, social cohesion, and stress)</td></tr>
<tr><td>1</td><td rowspan="5">+/–</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">Mod–High</td><td rowspan="5">♦♦</td><td rowspan="5">Changes in investment in communities difficult to predict</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Mental Illness (e.g., depression; from changes in physical activity, social cohesion, and stress)</td></tr>
<tr><td>1</td><td rowspan="5">+/–</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">Mod–High</td><td rowspan="5">♦</td><td rowspan="5">Changes in investment in communities difficult to predict</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Decreased Lifespan (e.g., from changes in physical activity, social cohesion, and stress)</td></tr>
<tr><td>1</td><td rowspan="5">+/–</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">High</td><td rowspan="5">♦♦</td><td rowspan="5">Changes in investment in communities difficult to predict</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
<tr><td colspan="6">Injury and fatality (e.g., from crime)</td></tr>
<tr><td>1</td><td rowspan="5">+/–</td><td rowspan="5">Potentially significant, non-quantifiable</td><td rowspan="5">Mod–High</td><td rowspan="5">♦</td><td rowspan="5">Changes in investment in communities difficult to predict</td></tr>
<tr><td>5A</td></tr>
<tr><td>6A</td></tr>
<tr><td>6B</td></tr>
<tr><td>6C</td></tr>
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<table>
<tr><th rowspan="2">Health Impact/ Alternative</th><th colspan="2">Impacts of Alternatives</th><th colspan="2">Health Outcome</th><th rowspan="2">Uncertainties</th></tr>
<tr><th>Impact</th><th>Magnitude</th><th>Severity</th><th>Strength of Causal Evidence</th></tr>
<tr><td colspan="6">Explanations:
Impact refers to whether the alternative will improve (+), harm (-), or not impact health (~).
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 Causal Evidence refers to the strength of the research/evidence showing causal relationship between access to neighborhood resources and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.</td></tr>
</table>

11.4 Recommendations

Access to neighborhood resources and the other determinants of health described in this chapter are affected by many factors. The recommendations below would improve access to neighborhood resources and health in the I-710 communities. It is critically important that implementation of the recommendations to improve access to neighborhood resources be addressed with multiple stakeholders, multiple jurisdictions, and multiple agencies collaborating, and with multiple sources of funding. The I-710 Corridor Project can have a role in implementing these recommendations, though it may not be the lead in all cases and will need to coordinate and work with others. The I-710 Corridor Project can provide some of the impetus for change and doing so would help the project meet its stated objective of improving public health.

11.4.1 Access to Neighborhood Resources

- Recommendations contained in Chapter 6, "Mobility," would help ensure that access to goods and services in the I-710 corridor is maximized, especially those describing improvements to walking and biking infrastructure.
- In order to at least partially offset any potential negative impacts on access to neighborhood resources, the I-710 Corridor Project could include additional improvements to existing neighborhood resources. For example, local jurisdictions could each be given funding as part of the project to invest in the neighborhood resources (e.g., libraries, schools, parks, community centers) that are likely to be impacted by the project.
- Adopt or advocate for policies to increase and maintain mixed income housing to ensure that low income communities will not be displaced and social cohesion harmed if economic growth does occur along the corridor.

11.4.2 Environmental Quality

- Recommendations contained in Chapter 7, "Air Quality," Chapter 8, "Noise," and Chapter 9, "Traffic Safety," including those related to future land use, would help ensure improvements to environmental quality. Improved perceptions of environmental quality are likely to follow actual improvements and lead to more investment in the corridor communities, improve social cohesion, increase physical activity, and lead to other neighborhood improvements.
- Fund and implement the recommendations contained in the Urban Design and Aesthetics Toolbox Report (Gruen Associates 2011[208]).

11.4.3 Public Investment

- Increase direct government investment in community infrastructure and services to ensure that people have access to the goods and services they need to live healthy lives and to improve social cohesion in local communities. Such investment could help attract private investment.

12. References

12.1 Printed References

1. Aarts L., and van Schagen, I. 2006. "Driving speed and the risk of road crashes: a review." Accident Analysis and Prevention 38 (2), 215-24.

2. Abram, J. E., and J. D. Hunt. 2001. “Transit system management, equilibrium mode split and the Downs-Thomson Paradox.” Available at: http://www.ucalgary.ca/~jabraham/Papers/dtlogittrb2001julysubmission/DTLogitTRB2001JulySubmission.PDF.

3. Acheson, D. 1998. “Independent Inquiry into Inequalities in Health Report.” The Stationery Office, London.

4. Adams, S.J. 2002. "Educational Attainment and Health: Evidence from a Sample of Older Adults." Education Economics, 10(1): 97-109.

5. Agency for Healthcare Research and Quality. 2010. Pediatric Quality Indicator Admissions for California, Los Angeles County, and the I-710 Corridor Project study area. Updated September 2010.

6. American Diabetes Association. 2011. Diabetes Basics. Availableat: http://www.diabetes.org/diabetes-basics/type-2/.

7. American Heart Association. 1996. “Sudden Cardiac Arrest.”

8. American Heart Association. 2000. “Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, an International Consensus on Science.” *Circulation*. 102(suppl):I1–I384.

9. American Lung Association. 2011. “State of the Air, 2011.” Available at: http://www.stateoftheair.org/2011/city-rankings/most-polluted-cities.html.

10. American Public Transportation Association. 2011. Public Transportation Benefits. Available at: http://www.apta.com/mediacenter/ptbenefits/Pages/FactSheet.aspx.

11. An, J., et al. Robert Wood Johnson Foundation. 2011. "Work and Health."

12. Andersen, L. B., et al. 2000. “All-Cause Mortality Associated with Physical Activity During Leisure Time, Work, Sports and Cycling to Work.” *Archives of Internal Medicine,* 160(11): 1621–1628.

13. Anderson L.M., Shinn C., St. Charles J. 2002. “Community interventions to promote healthy social environments: Early childhood development and family housing. A report on Recommendations of the Task Force on Community Preventive Services.” Morbidity and Mortality Weekly Review 51:1-8.

14. Antonucci, N.D., et al. Transportation Research Board of the National Academies. 2004. "Guidance for Implementation of the Aashto Strategic Highway Safety Plan. Volume 12: A Guide for Reducing Collisions at Signalized Intersections."

15. Arau J.A., B. Barajas, M. Kleinman, X. Wang, B.J. Bennett, K.E. Gong, M. Navab, J. Harkema, C. Sioutas, A.J. Lusis, and A.E. Nel. 2008. “Ambient Particulate Pollutants in the Ultrafine Range Promote Early Atherosclerosis and Systemic Oxidative Stress.” Circulation Research. 102: 589-596.

16. Attewell, R., Glase, K., and McFadden, M. 2001. "Bicycle Helmet Efficacy: A Meta-Analysis." Accident Analysis and Prevention, 33(3): 345-352.

17. Avila E. 2004. "Popular Culture in the Age of White Flight: fear and fantasy in suburban Los Angeles." Berkeley: University of California Press.

18. Avila, E. R. 2008. “The Folklore of the Freeway: Space, Culture and Identity in Postwar Los Angeles.” *Aztlan.* 23(1): 14–31.

19. Babisch, W. 2006. “Transportation noise and cardiovascular risk: Updated Review and synthesis of epidemiological studies indicate that the evidence has increased.” Noise and Health 8: 1-29.

20. Babisch, W. 2008. “Road traffic noise and cardiovascular risk.” Noise Health; 10:27-33. Available at: http://www.noiseandhealth.org/text.asp?2008/10/38/27/39005.

21. Babisch, W., B. Beule, M. Schust, M., N. Kersten, N., and H. Ising. 2005. “Traffic noise and risk of myocardial infarction.” *Epidemiology*, 16(1):33–40.

22. Bailey, L. 2004. “Aging Americans: stranded without options.” Surface Transportation Policy Project. Available at: http://www.transact.org/library/reports_html/seniors/aging.pdf.

23. Bailey, L. 2007. “Public transportation and petroleum savings in the US: reducing dependence on oil.” Available at: www.publictransportation.org/reports/documents/apta_public_transportation_fuel_savings_final_010807.pdf.

24. Bailey, D., T. Plenys, G.M. Solomon, T.R. Campbell, G. Ruderman Feuer, J. Masters, and B. Tonkonogy. 2004. “Harboring Pollution: Strategies to Clean Up U.S. Ports.” A report of the Natural Resources Defense Council, August.

25. Balmes J.R. 2011. “How does diesel exhaust impact asthma?” Thorax;66:4-6.

26. Bared J., A. Powell, E. Kaisar, and R. Jagannathan. 2005. “Crash Comparison of Single Point and Tight Diamond Interchanges.” Journal of Transportation Engineering. 131(5): 379-381.

27. Barregard, L., E. Bonde, and E. Ohrstrom. 2009. “Risk of hypertension from exposure to road traffic noise in a population-based sample.” Occup Environ Med, Published online 2 Feb 2009.

28. Barreto, M.A., and Munoz, J.A. 2003. “Reexamining the ''Politics of In-between'': Political Participation among Mexican Immigrants in the United States.” Hispanic Journal of Behavioral Sciences 25: 427

29. Barth, M., and K. Boriboonsomsin. 2009. “Traffic Congestion and Greenhouse Gasses”. University of California Transportation Center’s ACCESS, 35. Available at: http://www.uctc.net/access/35/access35_Traffic_Congestion_and_Grenhouse_Gases.pdf.

30. Bartik, T.J. 1985. "Business Location Decisions in the United States: Estimates of the Effects of Unionization, Taxes, and Other Characteristics of States." Journal of Business and Economic Statistics, 3(1).

31. Bartik, T.J. 1988. "The Effects of Environmental Regulation on Business Location in the United States." Growth and Change, 19(3): 22-44.

32. Basiotis, P.P. 1992. "Validity of the self-reported food sufficiency status item in the US. In Haldeman, Va, ed. Paper presented at American Council on Consumer Interests." 38th Annual Conference. US Dept. of Agriculture, Columbia, MD.

33. Bauer K.M., D.W. Harwood, W.E. Hughes, and K.R. Richard. 2004. "Safety effects of narrow lanes and shoulder-use lanes to increase capacity of urban freeways." Transportation Research Record: Journal of the Transportation Research Board. 1897: 71-80.

34. BBC. 2000. "Commuting is 'biggest stress'." Available at: http://news.bbc.co.uk/1/hi/health/999961.stm.

35. Bell, M.L., R. Goldberg, C. Hogrefe, P.L. Kinney, K. Knowlton, B. Lynn, J. Rosenthal, C. Rosenweig, and J.A. Patz. 2007. "Climate change, ambient ozone, and health in 50 US cities." Climatic Change, 82: 61-76.

36. Benedict, A., C. Dawkins, P. Haas, C. Makarewicz, and T. Sanchez. 2006. "Housing and transportation cost trade-offs and burdens of working households in 28 metro areas." Center for Neighborhood Technology and Virginia Tech University. Available at: http://www.cnt.org/repository/H-T-Tradeoffs-for-Working-Families-n-28-Metros-FULL.pdf.

37. Berglund, B., T. Lindvall, and D. H. Schwela. 1999. "Guidelines for Community Noise." World Health Organization. Available at: http://www.who.int/docstore/peh/noise/guildelines2.html.

38. Berkman, L. F., and S. L. Syme. 1979. "Social networks, host resistance and mortality: a nine-year follow up study of Alameda County residents." *American Journal of Epidemiology*, 109:186-204.

39. Berkman, L.F., Leo-Summers, and L., Horwitz, R.I. 1992. "Emotional support and survival after myorcardial infaction: A prospective, population-based study of the elderly." Annals of Internal Medicine 117:1003–1009.

40. Berman, L.F., T. Glass, I.C. Brissette, and T.E. Seeman. 2000. "From social integration to health: Durkheim in the new millennium." Social Science and Medicine 51:843-857.

41. Besser, L.M., and A. L. Dannenberg. 2005. "Walking to public transit: Steps to help meeting physical activity recommendations." *American Journal of Preventative Medicine*, 29(4):273–280.

42. Bhatia, .R, P. Lopipero, and A.H. Smith. 1998. "Diesel exhaust exposure and lung cancer." Epidemiology, 9(1): 84–91

43. Bhatia R., S. Kavage, and L. Frank. 2007. King County Health Scape Briefing Paper: Evolving the Evaluation of Health and Climate Impacts.

44. Billi J.E., C.W. Pai, and D.A. Spahlinger. 2007. The effect of distance to primary care physician on health care utilization and disease burden. Health Care Management Review. 32(1), 22-29.

45. Binder, S. 1989. "Deaths, Injuries, and Evacuations from Acute Hazardous Materials Releases." American Journal of Public Health, 79(8): 1042-1044.

46. Blackwell, T. H., and J. S. Kaufman. 2002. “Response time effectiveness: comparison of response time and survival in an urban emergency medical services system.” *Academic Emergency Medicine*, 9(4):288–295.

47. Blair, S.N., Y. Cheng, and J.S. Holder. 2001. “Is physical activity or physical fitness more important in defining health benefits?” Medicine & Science in Sports & Exercise 3:S379-99.

48. Bosma, H., et al. 1997. "Low Job Control and Risk of Coronary Heart Disease in Whitehall Ii (Prospective Cohort) Study." BMJ, 314(7080): 558-565.

49. Boyle, D.J, and Hassett-Walker, C. 2008. “Individual-level and sociostructural characteristics of violence: An emergency department study. Journal of Interpersonal Violence. 23(8), 1011-1026.

50. Brandt, T., T. Sattel, and J. Wallaschek. 2005. "On Automatic Collisions Avoidance Systems." L-LAB: Public Private Partnership of University of Paderborn and Hella KGaA Hueck & Co., Germany.

51. Braveman, P., S. Egerter, and Barclay, C. Robert Wood Johnson Foundation. 2011. "Income, Wealth and Health."

52. Brodsky, A., P. O’Campo, and R. Aronson. 1999. “PSOC in community context: multi-level correlates of a measure of psychological sense of community in low-income, urban neighborhoods.” *Journal of Community Psychology*. 27(6): 659-679.

53. Brodsly, D. 1981. *L.A. Freeway: An Appreciative Essay*. Berkeley: University of California Press.

54. Brownson, R.C., et al. 2001. “Environmental and policy determinants of physical activity in the United States.” American Journal of Public Health 91(12): p. 1995-2003.

55. Brunekreef, B., N.A. Janssen, and J. Hartog. 1997. “Air pollution from truck traffic and lung function in children living near motorways.” *Epidemiology*, 8:298-303.

56. Brunner, E. 1997. “Stress and the biology of inequality.” *BMJ*, 314(7092):1472–76.

57. Burden, Dan. 2007. “Building Communities with Transportation.” Transportation Research Record. Transportation Research Board of the National Academies.

58. CA EDD (California Employment Development Department). 2006. 2006 – 2016 Los Angeles County Projection Highlights. Available: http://pasadenausd.org/modules/groups/homepagefiles/cms/917180/File/LA%20Employment%20Trends.pdf

59. CA EDD (California Employment Development Department). 2009. Monthly Labor Force Data for Cities and Census-Designated Places, August 2009—Preliminary. Labor Market Information Division.

60. CA EDD (California Employment Development Department). 2010. Historical Data for Consumer Price Index (Us Bls & Calif. Dir) in California." Employment Development Department. Available at: http://www.labormarketinfo.edd.ca.gov/cgi/databrowsing/localAreaProfileQSMoreResult.asp?menuChoice=localAreaPro&criteria=Consumer+Price+Index&categoryType=economicindicators&geogArea=0601000000&area=Los+Angeles+County&timeseries=Consumer+Price+IndexTimeSeries.

61. CA EDD (California Employment Development Department). 2011. Labor Market Info. Available at: http://www.labormarketinfo.edd.ca.gov/.

62. Calhoun, J. 2002. "National Crime Prevention Council. New Partners for Smart Growth: Building Safe, Healthy, and Livable Communities." 2nd Annual Conference flyer.

63. California Cancer Registry. 2011. Cancer Data Query System. Data Accessed August 12, 2011.

64. California Center for Public Health Advocacy. 2007. "Searching for Healthy Food: The Food Landscape in Los Angeles."

65. California Department of Education. 2010. DataQuest, 2008–2009. Available: <http://dq.cde.ca.gov/dataquest/>. Last modified: March 23, 2010.

66. California Department of Public Health. 2010 "County Health Status Profiles 2010". Available at: http://www.cdph.ca.gov/pubsforms/Pubs/OHIRProfiles2010.pdf.

67. California Department of Public Health. 2011. "California Nutrition Network Map Viewer." Available at: http://www.cnngis.org/viewer.aspx.

68. California Energy Commission. 2006. Inventory of California Greenhouse Gas Emissions and Sinks: 1994 to 2004. Available at: http://www.energy.ca.gov/2006publications/CEC-600-2006-013/figures/FIGURE-1.PDF.

69. California Highway Patrol. 2009. "2009 Annual Report of Fatal and Injury Motor Vehicle Traffic Collisions." Available at: http://www.chp.ca.gov/switrs/pdf/2009-sec1.pdf.

70. California Health Interview Survey. 2009. AskCHIS. Available: <http://www.chis.ucla.edu/main/default.asp>.

71. California Newsreel. 2008. "Backgrounders from the Unnatural Causes Health Equity Database."

72. California Office of Statewide Health Planning and Development. 2009. 2009 Patient Discharge and Emergency Department datasets.

73. Caltrans (California Department of Transportation). 2008. "Complete Streets Program." Available at: http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets.html.

74. Caltrans (California Department of Transportation). 2010. Soundwall Program. Available at: http://www.dot.ca.gov/dist07/resources/soundwalls/. Last revised: October 13, 2010.

75. Caltrans (California Department of Transportation). 2011a. "Caltrans Missions and Goals." Available at: http://www.dot.ca.gov/hq/paffairs/about/mission.htm.

76. Caltrans (California Department of Transportation). 2011b. Noise Policy. Available at: http://www.dot.ca.gov/hq/env/noise/pub/ca_tnap_may2011.pdf.

77. Campbell F.A., and E. Pungello. 2000. "High quality child care has long-term benefits for poor children." Paper presented at the 5th Head Start National Research Conference, Washington DC.

78. Canadian Public Health Association. 2007. "Health effects of climate change and air pollution." Available at: http://www.ccah.cpha.ca/effects.htm.

79. CARB (California Air Resources Board). 2000. "Diesel Risk Reduction Plan."

80. CARB (California Air Resources Board). 2003. "Ultrafine Particulate Matter: Public Health Issues and Related Research." Available at: http://www.arb.ca.gov/research/health/healthup/jan03.pdf.

81. CARB (California Air Resources Board). 2004. "Recent research findings: Health effects of particulate matter and ozone air pollution, January 2004." Available at: http://www.arb.ca.gov/research/health/fs/PM-03fs.pdf.

82. CARB (California Air Resources Board). 2005a. "Air Quality and Land use Handbook: A Community Health Perspective." Available at: http://www.arb.ca.gov/ch/landuse.htm.

83. CARB (California Air Resources Board). 2005b. "Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling." Available at: http://www.arb.ca.gov/regact/idling/fro1.pdf.

84. CARB (California Air Resources Board). 2005c. "Particulate Matter Overview." Available at: http://www.arb.ca.gov/research/aaqs/caaqs/pm/pm.htm.

85. CARB (California Air Resources Board). 2006a. "Childhood Asthma and Exposure to Traffic." Available at: http://www.arb.ca.gov/research/health/healthup/feb06.pdf.

86. CARB (California Air Resources Board). 2006b. "Health effects of diesel exhaust particulate matter." Available at: http://www.arb.ca.gov/research/diesel/dpm_health_fs.pdf.

87. CARB (California Air Resources Board). 2007. "Recent research findings: health effects of particulate matter and ozone air pollution" Available at: http://www.arb.ca.gov/research/health/fs/pm_ozone-fs.pdf.

88. CARB (California Air Resources Board). 2008. "Truck Idling Fact Sheet." Available at: http://www.arb.ca.gov/msprog/truck-idling/factsheet.pdf.

89. CARB (California Air Resources Board). 2009. "School Bus Idling Airborne Toxic Control Measure." Available at: http://www.arb.ca.gov/toxics/sbidling/sbidling.htm.

90. CARB (California Air Resources Board). 2011a. Standards and Area Designations. Available at: http://www.arb.ca.gov/desig/desig.htm. Last reviewed: September 13, 2011.

91. CARB (California Air Resources Board). 2011b. "Lower-Emissions School Bus Program." Available at: http://www.arb.ca.gov/msprog/schoolbus/schoolbus.htm.

92. Carlson, S.J., M.S. Andres, and G.W. Bickel. 1999. "Measuring food insecurity and hunger in the United States: development of a national benchmark and prevalence estimates." Journal of Nutrition 129:510S-6S.

93. CDC (Centers for Disease Control and Prevention). 1996. "Physical Activity and Health: A Report of the Surgeon General." Washington, DC: Government Printing Office.

94. CDC (Centers for Disease Control and Prevention). 2002a. "Barriers to Children Walking and Biking to School--United States, 1999." MMWR, 51.32 (2002): 701-4. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5438a2.htm.

95. CDC (Centers for Disease Control and Prevention). 2002b. "Infant mortality and low birth weight among black and white infants—United States, 1980–2000." Morbidity and Mortality Weekly Report, 51(27):589-592. Available at: www.cdc.gov/mmwr/preview/mmwrhtml/mm5127a1.htm.

96. CDC (Centers for Disease Control and Prevention). 2010. "Premature Births and the Environment." Available at: http://ephtracking.cdc.gov/showRbPrematureBirthEnv.action.

97. CDC (Centers for Disease Control and Prevention). 2011a. "Physical Activity and Health." Available at: http://www.cdc.gov/physicalactivity/everyone/health/index.html.

98. CDC (Centers for Disease Control and Prevention). 2011b."Motor Vehicle Safety". Centers for Disease Control and Prevention. Available at: http://www.cdc.gov/motorvehiclesafety/.

99. CDC (Centers for Disease Control and Prevention). 2011c. California - Costs of Crash Deaths - Motor Vehicle Safety - Injury Center." Available at: http://www.cdc.gov/Motorvehiclesafety/statecosts/ca.html.

100. CDC (Centers for Disease Control and Prevention). 2011d. Diabetes Public Health Resources. Available at: http://www.cdc.gov/diabetes/consumer/learn.htm. Last revised: July 13, 2011.

101. Centre for International Economics. 2006. "Business Costs of Traffic Congestion." Canberra & Sydney.

102. Cervero, R. 2009. "Transport Infrastructure and Global Competitiveness: Balancing Mobility and Livability." The ANNALS of the American Academy of Political and Social Science November. 626: 210-225.

103. Cervero R., et al. 2007. "Elevated Freeways to Surface Boulevards: Neighborhood, Traffic, and Housing Price Impacts in San Francisco." Department of City and Regional Planning, University of California, Berkeley. Working Paper prepared for University of California Transportation Center. http://www.uctc.net/papers/836.pdf.

104. Chen, L. 2011. "Health Impact Assessment of the Childhood asthma burden of traffic-related pollution: A qualitative meta-analysis." *Working paper.*

105. Cinnamon, J., N. Schuurman, and S. Hameed. 2011. "Pedestrian Injury and Human Behavior: Observing Road-Rule Violations at High-Incident Intersections." PLoS One, 6(6): e21063.

106. City of Long Beach. 2001. Long Beach Bicycle Master Plan. Available at: http://www.longbeach.gov/pw/traffic/projects/bicycle_master_plan.asp.

107. City of Long Beach. 2005. City of Long Beach Consolidated Plan 2005–2010. Available at: http://www.longbeach.gov/cd/neighborhood_services/reports/cp.asp.

108. City of Long Beach. 2009. Long Beach General Plan Noise Element. Available at: http://www.lbds.info/civica/filebank/blobdload.asp?BlobID=3375.

109. Claggett, M., and S.H. Sun. 2007. "Variability of Vehicle Emissions and Congestion Forecasting." Available at: http://tmip.fhwa.dot.gov/resources/clearinghouse/docs/emissions_congestion/emissions_congestion.pdf.

110. Cohen, D., et al. 2006. "Park Use and Physical Activity in a Sample of Public Parks in the City of Los Angeles." RAND Corporation.

111. Cohen, D.A., T.L. McKenzie, , A. Sehgal, S. Williamson, D. Golinelli, and N. Lurie. 2007. "Contribution of public parks to physical activity." *American Journal of Public Health*, 97(3), 509-14.

112. Cohen, S., L.G. Underwood, and B.H. Gottlieb. 2000. "Social Support Measurement and Intervention." Oxford University Press. New York.

113. Cole, B., M. Wilhelm, P. Long, J. Fielding, G. Kominski, and H. Morgenstern. 2004. "Prospects for Health Impact Assessment in the United States: New and Improved Environmental Impact Assessment of Something Different?" *Journal of Health Politics, Policy and Law*, 29(6): 1153-1186.

114. Coles, C.M., and G.L. Kelling. 1996. "Fixing Broken Windows: Restoring Order and Reducing Crime in Our Communities." New York: Free Press.

115. Community Response to Noise Team of ICBEN (The International Commission on the Biological Effects of Noise), J.M. Fields, R. de Jong, T. Gjestland, I.H. Flindell, R.F.S. Job, S. Kurra, P. Lercher, M. Vallet, Yano T. Research Team At Ruhr University, R. Guski, U. Felscher-Suhr, and R. Schumer. 2001. "Standardized General-Purpose Noise Reaction Questions for Community Noise Surveys: Research and a Recommendation." *Journal of Sound and Vibration*, 242(4):641-679.

116. Coughlin, C.C., J.V. Terza, and V. Arromdee. 1991. "State Characteristics and the Location of Foreign Direct Investment within the United States." *The Review of Economics and Statistics*, 73(4): 675.

117. Coulton, C.J. 2008. "Catalog of administrative data sources for neighborhood indicators." The Urban Institute. Available at: www.urbaninstitute.org/UploadedPDF/411605_administrative_data_sources.pdf.

118. Cummins, S., M. Stafford, S. MacIntyre, M. Marmot, and A. Ellaway. 2005. "Neighborhood environment and its associations with self-rated health: evidence from Scotland and England." Journal of Epidemiology and Community Health 59:207-213.

119. Davison, K., and Lawson, C. 2006. "Do Attributes in the Physical Environment Influence Children's Physical Activity? A Review of the Literature." Int J Behav Nutr Phys Act, 3: 19.

120. Delfino, R.J. 2002. "Epidemiologic evidence for asthma and exposure to air toxics: linkages between occupational, indoor, and community air pollution research." Environmental Health Perspective, 110(Sppl 4): 573-589.

121. Dockery, D.W., C.A. Pope, X. Xu, J.D. Spengler, J.H. Ware, M.E. Fay, B.G. Ferris, and F.E. Speizer. 1993. "An association between air pollution and mortality in six US cities." New England Journal of Medicine, 329(24):1753-1759.

122. Downs, A. 1962. "The Law of Peak-Hour Expressway Congestion," *Traffic Quarterly*, 16:393–409.

123. Drayse, M., D. Flaming, D. Rigby, and M. Beltramo. 1998. "The Gateway Cities Economy: Impacts of Aerospace Restructuring." Available at: http://www.economicrt.org/summaries/TGCEIOAR.html.

124. Drewnoski, A., N. Darmon, and A. Briend. 2004. "Replacing fats and sweets with vegetables and fruit – a question of cost." American Journal of Preventative Medicine 94(9):1555-9.

125. Egerter, S., P. Braveman, T. Sadegh-Nobari, R. Grossman-Kahn, and M. Dekker. 2009. "Education Matters for Health." RWJF Commission to Build a Healthier America. Available at: http://www.rwjf.org/vulnerablepopulations/product.jsp?id=48252.

126. Egerter, S., P. Braveman, and C. Barclay. 2011. "How Social Factors Shape Health: The Role of Stress." The Robert Wood Johnson Foundation. Available at: http://www.rwjf.org/vulnerablepopulations/product.jsp?id=72468.

127. Ell, K., R. Nishimoto, L. Medianski, J. Mantell, and M. Hamovitch. 1992. "Social relations, social support and survival among patients with cancer." Journal of Psychosomatic Research 36: 531–541.

128. Ellebjerg, L. 2007. "Controlling noise through traffic management: Results of a literature study." Silence. WP H1. Presentation Brussels, June 11, 2007.

129. Elvik, R. 2001. "Area-Wide Urban Traffic Calming Schemes: A Meta-Analysis of Safety Effects." Accident Analysis and Prevention, 33(3): 327-336.

130. Elvik, R. 2009a. "The non-linearity of risk and the promotion of environmentally sustainable transport." Accident Analysis and Prevention 41 (4), 849-855.

131. Elvik, R. 2009b. "The Power Model of the relationship between speed and road safety. Update and new analyses." Report 1034/2009, Institute of Transport Economics, Oslo, Norway. Available at: http://www.toi.no/getfile.php/Publikasjoner/T%D8I%20rapporter/2009/1034-2009/1034-2009-nett.pdf.

132. English, P., R. Neutra, R. Scalf, M. Sillivan, L. Waller, and L. Zhu. 1999. “Examining associations between childhood asthma and traffic flow using a geographic information system.” Environmental Health Perspective, 107:761-767.

133. ENVIRON. 2010a. Air Quality and Health Risk assessments Technical Study for the I-710 Corridor Environmental Impact Report / Environmental Impact Statement.

134. ENVIRON. 2010b. I-710 Corridor Project Traffic Operations Analysis Report.

135. Environment and Human Health, Inc. 2006. The Harmful Effects of Vehicle Exhaust. Available at: http://www.ehhi.org/reports/exhaust/summary.shtml.

136. Environmental Justice Advisory Committee. 2008. “Recommendations and Comments of the Environmental Justices Advisory Committee on the Implementation of the Global Warming Solutions Act of 2006 (AB 32) on the Proposed Scoping Plan.”

137. EPA (U.S. Environmental Protection Agency). 1996. “Emissions Impact of Elimination of the National 55 mph Speed Limit.” Available at: http://www.arb.ca.gov/cc/scopingplan/submittals/transportation/emissions_impact_of_elimination_of_the_national_55_mph_speed_limit.pdf.

138. EPA (U.S. Environmental Protection Agency). 1997. “Climate change and public health.” Report EPA 236-F-97_005.

139. EPA (U.S. Environmental Protection Agency). 1998. “Emissions Facts: Idling vehicle emissions.” Available at: http://www.epa.gov/otaq/consumer/f98014.pdf.

140. EPA (U.S. Environmental Protection Agency). 2000a. “Benzene.” Available at: http://www.epa.gov/ttn/atw/hlthef/benzene.html.

141. EPA (U.S. Environmental Protection Agency). 2000b. “Formaldehyde.” Available at: http://www.epa.gov/ttn/atw/hlthef/formalde.html.

142. EPA (U.S. Environmental Protection Agency). 2000c. “Acetaldehyde.” Available at: http://www.epa.gov/ttn/atw/hlthef/acetalde.html.

143. EPA (U.S. Environmental Protection Agency). 2001a. “Our built and natural environments: a technical review of the interactions between land use, transportation, and environmental quality.” Available at: www.epa.gov/dced/pdf/built.pdf.

144. EPA (U.S. Environmental Protection Agency). 2001b. “Vehicle travel: Recent trends and environmental impacts. Chapter 4 of Our Built and Natural Environments: A Technical Review of the Interactions between Land Use, Transportation, and Environmental Quality.” Available at: http://www.epa.gov/smartgrowth/pdf/built_chapter3.pdf.

145. EPA (U.S. Environmental Protection Agency). 2002. Health Assessment Document for Diesel Engine Exhaust.” Available at: http://www.epa.gov/ttn/atw/dieselfinal.pdf.

146. EPA (U.S. Environmental Protection Agency). 2003a. “Vehicle travel: recent trends and environmental impacts.” In: “Our Built and Natural Environments: A Technical Review of the

Interactions between Land Use, Transportation, and Environmental Quality." Washington, DC: US Environmental Protection Agency. Available at: http://www.epa.gov/smartgrowth/pdf/built_chapter3.pdf.

147. EPA (U.S. Environmental Protection Agency). 2003b. "What You Should Know About Diesel Exhaust and School Bus Idling." Available at: http://www.epa.gov/cleandiesel/documents/420f03021.pdf.

148. EPA (U.S. Environmental Protection Agency). 2007. "Control of Hazardous Air Pollutants from Mobile Sources: Final Rule to Reduce Mobile Source Air Toxics." Available at: http://www.epa.gov/oms/regs/toxics/420f07017.pdf.

149. EPA (U.S. Environmental Protection Agency). 2008a. "Scoping Comments for Interstate 710 (1-710) Corridor Project from Ocean Boulevard in the City of Long Beach to State Route 60 (SR-60) in Los Angeles County, California." Region IX. September 26, 2008.

150. EPA (U.S. Environmental Protection Agency). 2008b. "Integrated Science Assessment for Particulate Matter (External Review Draft)."

151. EPA (U.S. Environmental Protection Agency). 2009a. "Climate Change: Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Clean Air Act." Available at: http://epa.gov/climatechange/endangerment.html.

152. EPA (U.S. Environmental Protection Agency). 2009b. "1, 3-Butadiene." Available at: http://www.epa.gov/ttn/atw/hlthef/butadien.html.

153. EPA (U.S. Environmental Protection Agency). 2009c. "Acrolein." Available at: http://www.epa.gov/ttn/atw/hlthef/acrolein.html.

154. EPA (U.S. Environmental Protection Agency). 2009d. "Integrated Science Assessment for Particulate Matter." Washington, DC: USEPA.

155. EPA (U.S. Environmental Protection Agency). 2010a. "Six common air pollutants." Available at: http://www.epa.gov/air/urbanair/.

156. EPA (U.S. Environmental Protection Agency). 2010b. "Ozone." Available at: http://www.epa.gov/ozone/.

157. EPA (U.S. Environmental Protection Agency). 2010c. "Sources of Pollutants in the Ambient Air—Stationary Sources." Available at: http://www.epa.gov/apti/course422/ap3b.html.

158. EPA (U.S. Environmental Protection Agency). 2010d. "Health Effects Notebook for Hazardous Air Pollutants." Available at: http://www.epa.gov/ttn/atw/hlthef/hapindex.html.

159. EPA (U.S. Environmental Protection Agency). 2010e. "Region 9 Clean School Bus Program: California." Available at: http://www.epa.gov/region09/childhealth/cleanbus.html#ca.

160. EPA (U.S. Environmental Protection Agency). 2011a. "Heavy-Duty Highway Diesel Program." Available at: http://www.epa.gov/otaq/highway-diesel/index.htm.

161. EPA (U.S. Environmental Protection Agency). 2011b. "Air Pollution Emissions Overview." Available at: http://www.epa.gov/oaqps001/emissns.html.

162. EPA (U.S. Environmental Protection Agency). 2011c. "Particulate Matter: Health and Environment." Available at: http://www.epa.gov/air/particlepollution/health.html.

163. EPA (U.S. Environmental Protection Agency). 2011d. "Carbon Monoxide, Health." Available at: http://www.epa.gov/airquality/carbonmonoxide/health.html.

164. EPA (U.S. Environmental Protection Agency). 2011e. "Nitrogen Dioxide." Available at: http://www.epa.gov/oaqps001/nitrogenoxides/.

165. EPA (U.S. Environmental Protection Agency). 2011f. "Sulfur Dioxide." Available at: http://www.epa.gov/oaqps001/sulfurdioxide/.

166. EPA (U.S. Environmental Protection Agency). 2011g. "Lead." Available at: http://www.epa.gov/lead/.

167. EPA (U.S. Environmental Protection Agency). 2011h. "Lead in paint dust and soil." Available at: http://www.epa.gov/lead/pubs/leadinfo.htm#facts.

168. EPA (U.S. Environmental Protection Agency). 2011i. "Mobile Source Air Toxics." Available at: http://www.epa.gov/otaq/toxics.htm.

169. EPA (U.S. Environmental Protection Agency). 2011j. "An introduction to indoor air quality: Volatile Organic Compounds." Available at: http://www.epa.gov/iaq/voc.html#Sources.

170. EPA (U.S. Environmental Protection Agency). 2011k. "Fact Sheet: Final Revisions to the national ambient air quality standards for particle pollution (particulate matter)." United States Environmental Protection Agency. Available at: http://www.epa.gov/particles/actions.html.

171. EPA (U.S. Environmental Protection Agency). 2011l. "Policy Assessment for the Review of the Particulate Matter National Ambient Air Quality Standards." United States Environmental Protection Agency. Available at http://www.epa.gov/ttn/naaqs/standards/pm/data/20110419pmpafinal.pdf.

172. EPA (U.S. Environmental Protection Agency). n.d. "Health Effects of Diesel Emissions." Prepared by Mark Werner. Available at: http://www.epa.gov/reg5oair/mobile/1MWerner.pdf.

173. Evans, G., and L.A. Marcynyszyn. 2004 "Environmental Justice, Cumulative Environmental Risk, and Health among Low- and Middle-Income Children in Upstate New York." American Journal of Public Health, 94:1942-1944.

174. Evans, L., and M. Frick. 1992. "Car Size or Car Mass: Which Has Greater Influence on Fatality Risk?" American Journal of Public Health, 82(8): 1105-1112.

175. Evans, L., and M. Frick. 1994. "Car Mass and Fatality Risk: Has the Relationship Changed?" American Journal of Public Health, 84(1): 33-36.

176. Ewing, R., and R. Kreutzer. 2005. "Understanding the relationship between public health and the environment." A report prepared for the LEED-ND Core Committee.

177. Ewing, R., and R. Kreutzer. 2006. "Understanding the Relationship between Public Health and the Built Environment." A Report Prepared for the LEED-ND Core Committee. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=3901.

178. Federal Bureau of Investigation. 2009. Uniform Crime Report.

179. FHWA (Federal Highway Administration). 2003. "Transportation Related Air Toxics: Case Study Materials Related to US 95 in Nevada." Available at: http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/us_95_nevada_case_study/us95nv05.cfm.

180. FHWA (Federal Highway Administration). 2005. "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level." Available at: http://www.fhwa.dot.gov/environment/air_quality/publications/effects_of_freight_movement/chapter04.cfm.

181. FHWA (Federal Highway Administration). 2006a. "Highway Traffic Noise." Available at: http://www.fhwa.dot.gov/environment/htnoise.htm.

182. FHWA (Federal Highway Administration). 2006b. "Strategic Highway Safety Plans: A Champion's Guide to Saving Lives." Available at: safety.fhwa.dot.gov/safetealu/guides/guideshsp040506/.

183. FHWA (Federal Highway Administration). 2007. "FAF^2 Freight Traffic Analysis." Available at: http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf2_reports/reports7/c6_capacity.htm.

184. FHWA (Federal Highway Administration). 2008. "Desktop Reference for Crash Reduction Factors." Available at: safety.fhwa.dot.gov/tools/crf/resources/fhwasa08011/fhwasa08011.pdf.

185. FHWA (Federal Highway Administration). 2009. "Freight Analysis Framework, 2008 provisional estimates." Office of Freight Management and Operations.

186. FHWA (Federal Highway Administration). 2011a. Final Rule on 23 CFR 772: Updated Guidance Document. Available at: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf.

187. FHWA (Federal Highway Administration). 2011b. "Safety Facts & Statistics." Available at: http://safety.fhwa.dot.gov/facts_stats/.

188. Fields, J.M., R. de Jong, A.L. Brown, I.H. Flindell, T. Gjestland, R.F.S. Job, S. Kurra, P. Lercher, A. Schuemer-Kohrs, M. Vallet, and T. Yano. 1997. "Guidelines for Reporting Core Information from Community Noise Reaction Surveys." Journal of Sound and Vibration, 206 (5): 685-695.

189. Fossett, J.W., J.D. Perloff, P.R. Kletke, and J.A. Peterson. 1992. "Medicaid and Access to Child Health Care in Chicago." Journal of Health Politics, Policy and Law 17(2), 273–298.

190. Frank, L., M. A. Andresen, and T. L. Schmid. 2004. "Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars." *American Journal of Preventive Medicine* 27.2: 87–96.

191. Frasure-Smith, N., F. Lesperance, G. Gravel, A. Masson, M. Juneau, M. Talajic, and M.G. Bourassa. 2000. “Social support, depression, and mortality during the first year after myocardial infarction.” Circulation 101:1919–1924

192. Fronstin, P. 2010. "The Impact of the Recession on Employment-Based Health Benefits." Employee Benefit Research Institute.

193. Fullilove, M.T., V. Geon, W. Jimenez, C. Parson, L.L. Green, and Fullilove, R.E. 1998. “Injury and anomie: Effects of violence on an inner-city community.” American Journal of Public Health 88:924-927.

194. Gabe, T.M., and Bell, K.P. 2004. "Tradeoffs between Local Taxes and Government Spending as Determinants of Business Location." Journal of Regional Science, 44(1): 21-41.

195. Gårder, P.E. 2004. "The impact of speed and other variables on pedestrian safety in Maine." Accident Analysis and Prevention. 36(4). 533-42.

196. Gauderman, W.J., E. Avol, F. Gilliland, H. Vora, D. Thomas, K. Berhane, R. McConnell, N. Kuenzli, F. Lurmann, E. Rappaport, H. Margolis, D. Bates, and J. Peters. 2004. “The effect of air pollution on lung development from 10-18 years of age.” New England Journal of Medicine, 351:1057-1067.

197. Gebel, K., A.E. Bauman, T. Sugiyama, and N. Owen. 2011. “Mismatch between perceived and objectively assessed neighborhood attributes: Prospective relationships with walking and weight gain.” Health and Place. 17, 519-524.

198. Geller M.D., S.B. Sardar, H. Phuleria, P.M. Fine, and C. Sioutas. 2005. “Measurements of particle number and mass concentrations and size distributions in a tunnel environment.” Environ Sci Technol. 39(22).

199. Giuliano, G. 1988a. “Incident characteristics, frequency, and duration on a high volume urban freeway.” Institute of Transportation Studies. UCI-ITS-WP-88-7.

200. Giuliano, G. 1988b. "New Directions for Understanding Transportation and Land Use." Institute of Transportation Studies.

201. Glasmeier, A. 2008. "Poverty in America: Living Wage Calculator." Available at: http://www.livingwage.geog.psu.edu/places/0601316000.

202. Glinianaia, S.V., J. Rankin, R. Bell, T. Pless-Mulloli, and D. Howel. 2004. “Particulate Air Pollution and Fetal Health: A Systematic Review of the Epidemiologic Evidence.” Epidemiology, 15(1):36-45.

203. Gopal, K., Singh, M., Siahpush, and Kogan, M.D. 2010. “Neighborhood Socioeconomic Conditions, Built Environments, and Childhood Obesity.” Health Affairs 29:503-512.

204. Grant, M., et al. 2008. “Recurring Community Impacts.” American Association of State Highway Officials (AASHTO) Standing Committee on the Environment.

205. Great Communities Collaborative. 2007. "Complete Streets." Available at: http://greatcommunities.org/.

206. Griefahn, B., A. Marks, and S. Robens. 2006. "Noise emitted from road, rail and air traffic and their effects on sleep." Journal of Sound and Vibration. 295:129-140.

207. Griffith, M. 1994. "Comparison of the Safety of Lighting Options on Urban Freeways." Public Roads, 58(2).

208. Gruen Associates. 2011. Urban Design and Aesthetics Report.

209. Gruenewald, P.J., and L. Remer. 2006. "Changes in outlet densities affect violence rates." Alcoholism: Clinical and Experimental Research 30(7):1184-1193.

210. Guite, H.F., C. Clark, G. Ackrill. 2006. "The impact of physical and urban environment on mental well-being." Public Health 120:1117-1126.

211. Gunier, R.B., A. Hertz, J. Von Behren, and P. Reyonolds. 2003. "Traffic density in California: Socioeconomic and ethnic differences among potentially exposed children." Journal of Exposure Analysis and Environmental Epidemiology, 13:240-246.

212. Hadi, M.A., et al. 1995. "Estimating Safety Effects of Cross-Section Design for Various Highway Types Using Negative Binomial Regression." Transportation Research Record: Journal of the Transportation Research Board, (1500): 169-177.

213. Halpern, R. 1995. *Rebuilding the Inner City*. New York: Columbia University Press.

214. Hamer, M., and Y. Chida. 2008. "Walking and primary prevention: a meta-analysis of prospective cohort studies." *British Journal of Sports Medicine*, 42(4):238–43.

215. Handy, S. 1996. "Understanding the link between urban form and non-work traveling behavior." *Journal of Planning Education and Research*, 15:183–98.

216. Harwood, D.W., et al. 2008. "Pedestrian Safety Prediction Methodology." National Cooperative Highway Research Program.

217. Hawthorne G. 2008. "Perceived social isolation in a community sample: its prevalence and correlates with aspects of peoples' lives." Social Psychiatry And Psychiatric Epidemiology. 43(2): 140-150.

218. Health Council of the Netherlands. 2004. "The Influence of Night-time Noise on Sleep and Health." The Hague, Health Council of the Netherlands. Report No.: 2004/14E.

219. Health Effects Institute Panel on the Health Effects of Traffic-Related Air Pollution. 2009. "Special Report 17—Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects." Available at: http://pubs.healtheffects.org/view.php?id=306.

220. HealthyPeople.gov. 2011. Injury Prevention." Available at: http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=24.

221. Hefferman, K. 2006. “Preserving and promoting diverse transit-oriented neighborhoods.” Center for Transit Oriented Development. Available at: www.cnt.org/repository/diverseTOD_FullReport.pdf.

222. The Henry J. Kaiser Foundation. 2011. “California Preterm Births as a Percent of All Births, 2008.” Available at: <http://www.statehealthfacts.org/profileind.jsp?cat=2&sub=11&rgn=6>. Accessed on August 24, 2011.

223. Herner J.D., S. Hu, W.H. Robertson, T. Huai, M.C. Chang, P. Rieger, and A. Ayala. 2011. “Effect of advanced aftertreatment for PM and NOx reduction on heavy-duty diesel engine ultrafine particle emissions.” Environ Sci Technol. 45(6).

224. Hsu, H.C. 2007. “Does social participation by the elderly reduce mortality and cognitive impairment?” Aging and Mental Health 11(6):699-707.

225. Hu, S., S. Fruin, K. Kozawa, S. Mara, S.E. Paulson, and A. Winer. 2009. “A wide area of air pollutant impact downwind of freeway during pre-sunrise hours.” Atmospheric Environment, 43:2541-2549.

226. Huang, H.F. and M.J. Cynecki. 2000. "Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior." Transportation Research Record: Journal of the Transportation Research Board, (1705):26-31.

227. Human Impact Partners. 2011. “Community Medical Needs Assessment of the I-710 Corridor Air Quality Action Plan.”

228. Humpel, N., N. Owen, E. Leslie. 2002. “Environmental factors associated with adults’ participation in physical activity: A review.” American Journal of Preventive Medicine 22(3):188-199.

229. Husing J. 2004. “Logistics and distribution: an answer to regional upward social mobility.” Southern California Association of Governments.

230. Ingami, S., D.A. Cohen, B.K. Finch, and S.M. Asch. 2006. “You are where you shop: Grocery store locations, weight, and neighborhoods.” American Journal of Preventative Medicine 31(1):10-17.

231. Insurance Institute for Highway Safety. 2009. Fatality Facts. Available at: http://www.iihs.org/research/fatality_facts_2009/default.html.

232. Isaacs, S. and Schroader, S.A. 2004. "The Ignored Determinant of the Nation’s Health." The New England Journal of Medicine, 351(11): 1137-1142.

233. Istre, G.R., et al. 2007. "The “Unintended Pedestrian” on Expressways." Traffic Injury Prevention, 8(4): 398-402.

234. Jacobs, J. 1993. *The Death and Life of Great American Cities*. New York, NY: Random House.

235. Jacobsen, P., Racioppi, F., and Rutter, H. 2009. "Who Owns the Roads? How Motorised Traffic Discourages Walking and Bicycling." Injury Prevention, 15(6): 369-373.

236. Jakovljević, B., Belojević, G., Paunović, K., and Stojanov, V. 2006. “Road Traffic Noise and Sleep Disturbances in an Urban Population: Cross-sectional Study.” Croat Med J. 47: 125–133.

237. Janson, B.N., et al. 1998. "Truck Accidents at Freeway Ramps: Data Analysis and High-Risk Site Identification." Journal of Transportation and Statistics, 1(1): 75-92

238. Jerrett, M., K. Shankardass, K. Berhane, W.J. Gauderman, N. Kunzli, E. Avol, F. Gilliland, F. Lurmann, J.N. Molitor, D.C. Thomas, J. Peters, and R. McConnell. 2008. “Traffic-Related Air Pollution and Asthma Onset in Children: A Prospective Cohort Study with Individual Exposure Measurement.” Environmental Health Perspectives, 116:1433-1438.

239. Jerrett, M., R.T. Burnett, R. Ma, C.A. Pope, 3rd, D. Krewski, K.B. Newbold, G. Thurston, Y. Shi, N. Finkelstein, E.E. Calle, and M.J. Thun. 2005. “Spatial Analysis of Air Pollution and Mortality in Los Angeles.” Epidemiology, 16(6):727-36.

240. Jimenez, T.R. 2011. “Immigrants in the United States: How well are they integrating into society?” Washington, DC: Migration Policy Institute.

241. Jin, R., Shah, C., and Svoboda, T. 1995. "The Impact of Unemployment on Health: A Review of the Evidence." The Journal of the Canadian Medical Association, 153(5): 529-540.

242. Jo S., A. Gan, and G. Bonyani. 2002. “Impacts of truck-lane restrictions on freeway traffic operations.” 82nd Annual Meeting of the Transportation Research Board. Washington, DC.

243. Job, R.F.S. 1993. “The role of psychological factors in community reaction to noise. In Noise as a Public Health Problem.” Vol. 3, pp. 47-79. Vallet, M. (ed.) INRETS: Arcueil Cedex, France.

244. Jones & Stokes. 2001. “Port of Los Angeles Virtual History Tour. Board of Harbor Commissioners of the City of Los Angeles.” Available at: http://www.laporthistory.org.

245. Jones, F. M. 2008. “Los Angeles Freeways: Historical context, unintended consequences, and implications for future transportation project.” Unpublished manuscript. Los Angeles: UCLA.

246. Kaplan, G. Robert Wood Johnson Foundation. 2009. "The Poor Pay More--Poverty's High Cost to Health."

247. Karoly, M. 2005. “Early Childhood Interventions: Proven Results, Future Promise.” RAND Corporation.

248. Katznelson, I. 2005. “When Affirmative Action Was White: An Untold History of Racial Inequality in Twentieth-Century America.” W.W. Norton & Company, New York.

249. Kawachi, I., N. Adler, and W. Dow. 2010. "Money, Schooling, and Health: Mechanisms and Causal Evidence." Annals of the New York Academy of Sciences, 1186: 56-68.

250. Kawachi, I., B.P. Kennedy, and R.G. Wilkins. 1999. “Crime, social disorganization and relative deprivation.” Social Science and Medicine 48:719-731.

251. Kelley, W.J. 2002. “Homes along the Southland's busy highways may be more affordable, but new studies show possible health risks linked to increased pollution.” Los Angeles Times. Los Angeles, CA: Dec 15, 2002. p. K.1

252. Kelly, A., and K.S. Spalding. 2009. "The Small Business Perspective on Health-Care-Reform." Community Development Investment Review, 5(3): 97-103.

253. Kelta, A.D., K. Casazza, O. Thomas, and J.R. Fernandez. 2011. “Neighborhood perceptions affect dietary behaviors and diet quality.” Journal of Nutrition Education and Behavior. 43, 244-250.

254. Kennesaw State University, Department of Energy. n.d. “Vehicle Emissions.” Available at: http://esa21.kennesaw.edu/activities/smog-cars/doe-veh-pollutants.pdf

255. Kerr, J., D. Rosenberg, J.F. Sallis, et al. 2006. “Active commuting to school: Associations with environment and parental concerns.” Medicine & Science in Sports & Exercise. 38(4), 787-793.

256. Killingsworth, R., and J. Lamming. 2001. “Development and public health: Could our development patterns be affecting our personal health?” *Urban Land*, 60: 12–17.

257. Kilpatrick, J.A., R.L. Throupe, J.I. Carruthers, and A. Krause. 2007. “The impact of transit corridors on residential property values. Journal of Real Estate Research. 29, 303–320.

258. Kim, D., and Kawachi, I. 2006. “A multilevel analysis of key forms of community- and individual-level social capital as predictors of self-rated health in the United States.” Journal of Urban Health 83(5):813-826.

259. Kim, J., et al. 2010. "A Note on Modeling Pedestrian-Injury Severity in Motor-Vehicle Crashes with the Mixed Logit Model." Accid Anal Prev, 42(6): 1751-8.

260. King, N.R. 2007. “The financial, decision-making and political dimensions of financing and locating goods movement transportation facilities in Southern California.” Health Effects of Surface Goods Movement Symposium Program. UCLA Faculty Center.

261. Kirby, J.B., and T. Kaneda. 2005. “Neighborhood Socioeconomic Disadvantage and Access to Health Care.” Journal of Health and Social Behavior 46 (1): 15-31.

262. Knowlton, K., B. Lynn, R.A. Goldberg, C. Rosenzweig, C. Hogrefe, J.K. Rosenthal, and P.L. Kinney. 2007. “Projecting heat-related mortality impacts under a changing climate in the New York City region.” American Journal of Public Health, 97:2028-2034.

263. Koelega H. 1987. In: H. Koelega, Editor, “Environmental annoyance: characterization, measurement, and control.” Elsevier, Amsterdam.

264. Kop, W.J, D.S Berman, H. Gransar, N.D. Wong, R. Miranda-Peats, M.D. White, M. Shin, M. Bruce, D.S. Krantz, and A. Rozanski. 2005. “Social network and coronary artery calcification in asymptomatic individuals.” Psychosom Med 67(3):343-52.

265. Kreuter, M.W., and N. Lezin. 2002. “Social capital theory: Implications for community-based health promotion.” In Emerging Theories in Health Promotion Practice and Research.

266. Kroll, L.E., and T. Lampert. 2011. "Unemployment, Social Support and Health Problems: Results of the Geda Study in Germany, 2009." Deutsches Arzteblatt International, 108(4): 47-52.

267. Kunzli, N., M. Jerrett, W.J. Mack, B. Beckerman, L. LaBree, F. Gilliland, D. Thomas, J. Peters, and H.N. Hodis. 2005. “Ambient Air Pollution and Atherosclerosis in Los Angeles.” Environmental Health Perspective, 113(2): 201-206.

268. Kunzli, N., R. McConnell, D. Bates, T. Bastain, A. Hricko, F. Lurmann, E. Avol, F. Gilland, and J. Peters. 2003. “Breathless in Los Angeles: The Exhausting Search for Clean Air.*” American Journal of Public Health,* 93:1494–1499.

269. Kuo, F.E. 2001. “Coping with poverty impacts of environment and attention in the inner city.” Environment and Behavior 33(1):5-34.

270. Kweon, B., et al. 2004. "Correlates of Environmental Constructs and Perceived Safety Enhancements in Pedestrian Corridors Adjacent to Urban Streets." Texas Transportation Institute. The Texas A&M University System.

271. Kweon, B., et al. 2006. "Children and Transportation: Identifying Environments That Foster Walking and Biking to School." Texas Transportation Institute.

272. Landis, B.W., V.R. Vatttikuti, R.M. Ottenberg, D.S. McLeod, and M. Guttenplan. 2000. “Modeling the Roadside Walking Environment: A Pedestrian Level of Service.” TRB Paper -1-0511 Tallahassee.

273. Lavin, T., C. Higgins, O. Metcalfe, and A. Jordan. 2006. “Health Effects of the Built Environment: A Review.” The Institute of Public Health in Ireland, Dublin.

274. Lee, C., and M. Abdel-Aty. 2005. "Comprehensive Analysis of Vehicle-Pedestrian Crashes at Intersections in Florida." Accident Analysis & Prevention 37(4): 775-786.

275. Lee, M., and M.J. Rotheram-Borus. 2001. “Challenges associated with increased survival among parents living with HIV.” American Journal of Public Health 91:1303–1309.

276. Lee, K. 2011. "Essays in Health Economics: Empirical Studies on Determinants of Health." Institution.

277. Leslie, E., E. Ceri., and P. Kremer. 2010. “Perceived neighborhood environment and park use as mediators of the effect of area socio-economic status on walking behaviors.” Journal of Physical Activity and Health. 7, 802-810.

278. Leyden, K.M. 2003. “Social capital and the built environment: the importance of walkable neighborhoods.” *American Journal of Public Health*, 93(9):1546–51.

279. Li N., J.R. Harkema, R.P. Lewandowski, M. Wang, L.A. Bramble, G.R. Gookin, Z. Ning, M.T. Kleinman, C. Sioutas, and A.E. Nel. 2010. “Ambient ultrafine particles provide a strong adjuvant effect in the secondary immune response: implication for traffic-related asthma flares.” Am J Physiol Lung Cell Mol Physiol. 299(3):L374-83.

280. Li, F., K.J. Fisher, R.C. Brownson, and M. Bosworth. 2005. “Multilevel modeling of built environment characteristics related to neighborhood walking activity in older adults.” *Journal of Epidemiol Community Health*, 59(7):558–64.

281. Lightstone, A., et al. 2001. "A Geographic Analysis of Motor Vehicle Collisions with Child Pedestrians in Long Beach, California: Comparing Intersection and Miblock Incident Locations." Injury Prevention, 7(2): 155-160.

282. Lin, S., J.P. Munsie, S.A. Hwang, E. Fitzgerald, and M.R. Cayo. 2002. "Childhood asthma hospitalization and residential exposure to state route traffic." Environmental Research, 88(2):73-81.

283. Lindvall, T., and T.P. Radford. 1973. "Measurement of annoyance due to exposure to environmental factors." Environ. Res., 6, 1-36.

284. Linn, W., Y. Szlachcic, H. Gong. Jr., P.L. Kinney, and K.T. Berhane. 2000. "Air Pollution and Daily Hospital Admissions in Metropolitan Los Angeles." Environmental Health Perspectives, 108(5): 427-434.

285. Lipsett, M., and S. Campleman. 1999. "Occupational exposure to diesel exhaust and lung cancer: a meta-analysis." American Journal of Public Health, 89(7):1009–1017.

286. Litman, T. A. 2004. "Economic Value of Walkability." Victoria Transportation Policy Institute. Available at: http://www.vtpi.org/walkability.pdf.

287. London Health Commission. 2003. "Noise and health: making the link." Available at: http://www.london.gov.uk/lhc/docs/publications/hia/evidencesummary/noise_links.pdf.

288. Long Beach Redevelopment Agency. 2009. Downtown Long Beach Market Study." "Downtown Long Beach Market Study."

289. Los Angeles Almanac. 2011. General Population by City, Los Angeles County, CA. 1960 - 2000 U.S. Census. Available: http://www.laalmanac.com/population/po27.htm.

290. Los Angeles Bicycle Coalition. 2009. 2009 L.A. Bike Count. Available at: www.la-bike.org.

291. Los Angeles County. 2011. Redistricting LA County 2011. Available at: http://redistricting.lacounty.gov/index.php/current-supervisorial-districts-and-data/

292. Los Angeles County Department of Public Health. 2005. "2005 Los Angeles County Health Survey." Office of Health Assessment and Epidemiology.

293. Los Angeles County Department of Public Health. 2007a. "2007 Los Angeles County Health Survey." Office of Health Assessment and Epidemiology.

294. Los Angeles County Department of Public Health. 2007b. Mortality in Los Angeles County 2007, Los Angeles County Department of Public Health.

294b. Los Angeles County Department of Public Health. 2010. "Life Expectancy in Los Angeles County: How Long Do We Live and Why? A Cities and Communities Health Report." Office of Health Assessment and Epidemiology.

295. Los Angeles County Department of Public Health. 2011. "2007 Surveillance Report: A Survey of the Health of Mothers and Babies in Los Angeles County". Maternal and Child Health Programs.

April. Available at http://publichealth.lacounty.gov/mch/lamb/LAMBReport/FinalLAMB2007Databook_web.pdf.

296. Los Angeles County Economic Development Corporation. 2011. "Los Angeles County Profile."

297. Los Angeles Fire Department. Weekly bulletin. December 31, 2008. 53.

298. Los Angeles Neighborhood Land Trust. 2011. “A Guide to Los Angeles’ Community Gardens.”

299. Loukaitou-Sideris, A., R. Ligget, R., and H. Sung, H. 2007. "Death on the Crosswalk: A Study of Pedestrian-Automobile Collisions in Los Angeles." Journal of Planning Education and Research, 26(3): 338-351.

300. Lui, M., B. Robles, B. Leondar-Wright, R. Brewer, and R. Adamson. 2006. “The Color of Wealth: The Story Behind the U.S. Racial Wealth Divide.” The New Press. New York.

301. Mack T. 2004. “Cancers in the urban environment.” 1st edition. Oxford, UK: Elsevier Academic Press.

302. Maller, C., M. Townsend, A. Pryor, P. Brown, L. St. Leger. 2005. “Healthy nature healthy people: ‘contact with nature’ as an upstream health promotion intervention for populations.” Health Promotion International 21(1):45-53.

303. Maricq, M.M. 2007. “Chemical characterization of particulate emissions from diesel engines: A review.” J. Aerosol Sci. 38 (11).

304. Marmot, M. 2002. "The Influence of Income on Health: Views of an Epidemiologist." Health Affairs, 21(2): 31-46.

305. Marmot, M., et al. 1978. "Employment Grade and Coronary Heart Disease in British Civil Servants." Journal of Epidemiology & Community Health, 32(4): 244-249.

306. Marshall, J.D. 2008. “Environmental inequality: Air pollution exposures in California’s South Coast Air Basin.” Atmospheric Environment, 42:54999–5503.

307. Maselko, J., C. Hughes, and R. Cheney. 2011. “Religious social capital: Its measurement and utility in the study of the social determinants of health.” Social Science & Medicine. 73(5): 759-767.

308. Matsuoka M., A. Hricko, R. Gottlieb, and J. De Lara. 2011. “Global Trade Impacts: Addressing the Health, Social and Environmental Consequences of Moving International Freight through Our Communities.” Occidental College and University of Southern California.

309. McCann, B. 2000. “Driven to Spend; The Impact of Sprawl on Household Transportation Expenses.” STPP. Available at: www.transact.org.

310. McConnell, R., K. Berhane., F. Gilliland, S.J. London, H. Vora, E. Avol, W.J. Gauderman, H.G. Margolis, F. Lurmann, D.C. Thomas, and J.M. Peters. 1999. Air pollution and bronchitic symptoms in Southern California children with asthma. Environmental Health Perspective, 107:757-760. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566453/

311. McConnell, R., K. Berhane, L. Yao, M. Jerrett, F. Lurmann, F. Filliland, N. Kunzli, J. Gauderman, E. Avol, D. Thomas, and J. Peters. 2006. “Traffic, susceptibility, and childhood asthma.” Environmental Health Perspective, 114:766-772.

312. McDonald, N.C. 2008. “Critical factors for active transportation to school among low-income and minority students.” Evidence from the 2001 National Household Travel Survey. American Journal of Preventative Medicine 34(4):341-40.

313. Medina, J. 2011. “In Los Angeles, Cuts will Make Long Bus Commute Longer.” *New York Times*, July 3, 2011. Available at: http://www.nytimes.com/2011/07/04/us/04bus.html?_r=1&pagewanted=all.

314. Meislin, H.W., J.B. Conn, C. Conroy, and M. Tibbitts. 1999. “Emergency medical service agency definitions of response intervals.” *Ann Emerg Med*, 34(4 Pt 1):453–458.

315. Merom, D., C. Tudor-Locke, A. Bauman, and C. Rissel. 2006. “Active commuting to school among NSW primary school children: implications for public health.” Health Place. 12(4):678-87.

316. Metro (Los Angeles County Metropolitan Transportation Authority). 2006. “Metro Bicycle Transportation Strategic Bike Plan.” Available at: www.metro.net/board/Items/2006/02.../20060215P&PItem6%20Atta.pdf.

317. Metro (Los Angeles County Metropolitan Transportation Authority). 2007. “Clean Fuel Program.” Available at: http://www.metro.net/about_us/govtrela/images/govrel_cng_facts_2.pdf.

318. Metro (Los Angeles County Metropolitan Transportation Authority). 2008. “Multi-County Goods Movement Action Plan Executive Summary, April 2008.” Available at: http://www.metro.net/projects_studies/mcgmap/images/02_Vol1_Executive_Summary_043008.pdf

319. Metro (Los Angeles County Metropolitan Transportation Authority). 2010. I-710 Corridor Project EIR/EIS Community Impact Assessment, February 3, 2010

320. Metro (Los Angeles County Metropolitan Transportation Authority). 2011a. LA Metro Time Tables. Available: < http://www.metro.net/around/timetables/>.

321. Metro (Los Angeles County Metropolitan Transportation Authority). 2011b. Metro Retires Last Diesel Bus, Becomes World’s First Major Transit Agency to Operate Only Clean Fuel buses. Available: http://www.metro.net/news/simple_pr/metro-retires-last-diesel-bus/. Last revised: January 12.

322. Metro (Los Angeles County Metropolitan Transportation Authority). 2011c. “Draft Scope of Work for I-710 Corridor Project Soundwall Projects: Early Action Projects.” Los Angeles County Office of the Assessor. 2011. Property Assessment Information System. Available: <http://assessor.lacounty.gov/extranet/Datamaps/Pais.aspx>.

323. Miaou, S. 1994. "The Relationship between Truck Accidents and Geometric Design of Road Sections: Poisson versus Negative Binomial Regressions." Accident Analysis & Prevention, 26(4): 471-482.

324. Miaou, S., et al. 1992. "Relationship between Truck Accidents and Highway Geometric Design: A Poisson Regression Approach." Institution.

325. Miedema, H.M.E., and C.G.M. Oudshoorn. 2001. “Annoyance from Transportation Noise: Relationships with Exposure Metrics DNL and DENL and Their Confidence Intervals.” Environ Health Perspect, 109(4): 409–416.

326. MIG (Moore Iacofano Goltsman, Inc.) and ICF International. 2009. “Healthy Communities and Healthy Economies: A Toolkit for Goods Movement.” Prepared for the California State Department of Transportation, Los Angeles County Metropolitan Transportation Authority, Riverside County Transportation Commission, and San Bernardino Associated Governments. Available at: http://www.metro.net/projects_studies/mcgmap/images/6-guidebook-chapter6_final.pdf.

327. MIG (Moore Iacofano Goltsman, Inc.). 2007. Richmond general plan update, issues and opportunities, paper #8: community health and wellness (draft). Available at: http://www.cityofrichmondgeneralplan.org/docManager/1000000640/Existing%20Condictions%20Report%20August%202007.pdf.

328. Minguillon, M.C., M. Arhami, J.J. Schauer, and C. Sioutas. 2008. “Seasonal and spatial variations of sources of fine and quasi-ultrafine particulate matter in neighborhoods near the Los Angeles-Long Beach harbor.” Atmospheric Environment, 42:7317-7328.

329. Miranda-Moreno, L.F., P. Morency, and A.M. El-Geneidy. 2011. "The Link between Built Environment, Pedestrian Activity and Pedestrian–Vehicle Collision Occurrence at Signalized Intersections." Accident Analysis & Prevention, 43(5): 1624-1634.

330. Modarres, A. 1998. “Putting Los Angeles in its place.” *Cities*. 15(3): 134–147.

331. Mohl R.A. 2002. “The Interstates and the Cities: highways, housing, and the freeway revolt.” Research Report: Poverty and Race Research Action Council. Available at: http://www.prrac.org/pdf/mohl.pdf.

332. Mohr, R.A. 1998. “The Interstates and the Cities: The U.S. Department of Transportation and the Freeway Revolt, 1966–1973.” *The Journal of Policy History*. 20(2): 193–226.

333. Morello Frosh, R., B. Jesdale, J. Sadd, and M. Pastor. 2010. “Ambient Air Pollution and Full Term Birth Weight.” Environmental Health, 9(44): 6. Available at: http://www.ehjournal.net/content/9/1/44.

334. Morello-Frosch, R., M. Pastor, Jr., C. Porras, and J. Sadd. 2002. “Environmental justice and regional inequality in southern California: implications for future research.” Environmental Health Perspective, 110(Suppl. 2):149–154.

335. Morland, K., Wing, S., Diez Roux, A., Poole, C. 2002. “Neighborhood characteristics associated with the location of food stores and food service places.” American Journal of Preventive Medicine 22(1);23-29.

336. Mota, J., M. Almeida, P. Santos, and J.C. Ribeiro. 2005. “Perceived neighborhood environments and physical activity in adolescents.” Preventive Medicine, 5–6, 834–836.

337. Moudon, A.V., A.J. Cook, J. Ulmer, P.M. Hurvitz, and A. Drewnowski. 2011. “A neighborhood wealth metric for use in health studies.” American Journal of Preventive Medicine 41(1): 88-97.

338. National Cooperative Highway Research Program. 2005. “Research Results Digest 299.”

339. National Economic Development and Law Center. 2004. “The Economic Impact of the Child Care Industry in Humboldt County.”

340. National Highway Traffic Safety Administration. 1998. "Traffic Safety Fact Sheet."

341. National Highway Transportation Safety Administration. 2009a. "An Analysis of Speeding-Related Crashes: Definitions and the Effects of Road Environments." Available: http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/STSI/6_CA/2009/6_CA_2009.htm - TAB1.

342. National Highway Transportation Safety Administration. 2009b. Traffic Safety Facts, California 2005-2009. Available: http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/STSI/6_CA/2009/6_CA_2009.htm - TAB1.

343. National Highway Traffic Safety Administration. 2011. FARS Data Tables: National Statistics. Available at: http://www-fars.nhtsa.dot.gov/Main/index.aspx.

344. Nicolaides, B. M. 1999. “‘Where the Working Man is Welcomed’: Working-Class Suburbs in Los Angeles, 1900-1940.” *Pacific Historical Review*, 68(4): 517–559.

345. Nikolaou, M. et al. 1997. “Traffic Air Pollution Effects of Elevated, Depressed, and At-Grade Level Freeways in Texas.” Texas Transportation Institute, Sponsored by the Texas Department of Transportation in cooperation with U. S. Department of Transportation, Federal Highway Administration. Available at: http://www.chee.uh.edu/faculty/nikolaou/TTIFinalReport.pdf.

346. Ning, Z., N. Hudda, N. Daher, W. Kam, J. Herner, K. Kozawa, S. Mara, and C. Sioutas. 2010. “Impact of roadside noise barriers on particle size distributions and pollutants concentrations near freeways.” Atmospheric Environment, 44(26): 3118-3127.

347. North American HIA Practice Standards Working Group (Bhatia, R., J. Branscomb, L. Farhang, M. Lee, M. Orenstein, and M. Richardson). 2010. “Minimum Elements and Practice Standards for Health Impact Assessment, Version 2.” North American HIA Practice Standards Working Group. Oakland, CA: November 2010.

348. Ntziachristos, L., Z. Ning, M.D. Geller, R.J. Sheesley, J.J. Schauer, and C. Sioutas. 2007. “Fine, ultrafine and nanoparticle trace element compositions near a major freeway with a high heavy-duty diesel fraction.” Atmospheric Environment, 41:5684-5696.

349. Office of Environmental Health Hazard Assessment. 2003. “Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments.” *As cited in the HRA.*

350. Office of Justice Programs. 2002. "Overview of the research literature on consequences of criminal victiminization." National Criminal Justice Referral Service. US. Dept. of Justice. Available at: http://www.ncjrs.gov/html/ojjdp/yv_2002_2_1/page1.html.

351. Oh, J. 2003. "Assessing the social bonds of elderly neighbors: The roles of length of residence, crime victimization, and perceived disorder." Sociological Inquiry 73 (4), pp. 490–510.

352. Ong, P. 1993. "Poverty and Employment Issues in the Inner Urban Core." South-Central Los Angeles: Anatomy of an Urban Crisis. University of California, Los Angeles: The Ralph and Goldy Lewis Center for Regional Policy Studies. A. J. Scott and R. E. Brown (eds.).

353. Ostro, B., R. Broadwin, S. Green, W.Y. Feng, and M. Lipsett. 2006. "Fine particulate air pollution and mortality in nine California counties: results from CALFINE." Environmental Health Perspectives, 114:29-33.

354. Pacific Institute. 2006. "Paying with our Health: The real cost of freight transportation in California." Available at: http://www.pacinst.org/reports/freight_transport/PayingWithOurHealth_Web.pdf.

355. Pande, A. and Abdel-Aty, M. 2006. "Assessment of Freeway Traffic Parameters Leading to Lane-Change Related Collisions." Accid Anal Prev, 38(5): 936-48.

356. Paneth, N.S. 1995. "The problem of low birth weight." Future Child, 5(1): 19-34. Available at: http://futureofchildren.org/futureofchildren/publications/journals/article/index.xml?journalid=60&articleid=370&sectionid=2478.

357. Panter, J.R., A.P. Jones, E.M.F. Van Slujis. 2008. "Environmental determinants of active travel in youth: A review and framework for future research." International Journal of Behavioral Nutrition and Physical Activity. 5(1), 34-48.

358. Passchier-Vermeer, W., and W.F. Passchier. 2000. "Noise exposure and public health." Environ Health Perspect, 108 Suppl 1:123-131.

359. Pastor, M., and J. Tran. 2009. "Roads and Race: An Environmental Justice Analysis for Riverside and Long Beach (Draft Report)." Available from author.

360. Perez, L., N. Kunzil, E. Avol, A. Hricko, F. Lurman, E. Nicholas, F. Gilliland, J. Peters, and R. McConnell. 2009. "Global Goods Movement and the Local Burden of Childhood Asthma in Southern California." American Journal of Public Health, 99(S3): S622-S628.

361. Peters, J.M., et al. 2004. "Epidemiologic Investigation to Identify Chronic Effects of Ambient Air Pollutants in Southern California." Prepared for the California Air Resources Board and the California Environmental Protection Agency.

362. Peters, J.M., E. Avol, J. Guaderman, W.S. Linn, W. Navidi, S.J. London, H. Margolis, E. Rappaport, H. Vora, H. Gong, and D.C. Thomas. 1999. "A study of twelve southern California communities with differing levels and types of air pollution." Am. J. Respir. Crit. Care Med, 159(3):768-775.

363. Pickett K. E. and M. Pearl. 2001. “Multilevel analyses of neighborhood socioeconomic context and health outcomes: A critical review.” *Journal of Epidemiology and Community Health* 55: 111–122.

364. Pilkington P. and S. Kinra. 2005. “Effectiveness of speed cameras in preventing road traffic collisions and related casualties: systematic review.” BMJ. 330(7487): 331-334.

365. PolicyLink. 2002. “Regional development and physical activity: issues and strategies for promoting health equity.” Available at: http://www.policylink.org/Research/PhysicalActivity/.

366. Pollack, C.E., Chideya, S., Cubbin, C., et al. 2007. “Should health studies measure wealth? A systematic review.” American Journal of Preventive Medicine. 33(3): 250-264.

367. Pons, P. T., J. S. Haukoos, W. Bludworth, T. Cribley, K. A. Pons, and V. J. Markovchick. 2005. “Paramedic response time: does it affect patient survival?” *Academ Emerg Med*, 12(7):594–600.

368. Poortinga, W. 2006. “Social relations or social capital? Individual and community health effects of bonding social capital.” *Social Science and Medicine*, 63:255–270.

369. Port of Los Angeles. 2006. “San Pedro Bay Ports Clean Air Action Plan (CCAP).” Available at: http://www.portoflosangeles.org/environment/caap.asp.

370. Port of Los Angeles. 2011. “About the Port of Los Angeles Clean Truck Program.” Available at: http://www.portoflosangeles.org/ctp/idx_ctp.asp.

371. Powell, K.E., L.M. Martin, P.P. Chowdhury. 2003. “Places to Walk: Convenience and Regular Physical Activity.” AJPH 93(9):1519-21.

372. Powell, L.M., et al., 2011. “Field validation of secondary commercial data sources on the retail food outlet environment in the U.S.” Health & Place.

373. Powers, R. 2006. “I-710 Corridor Report to the Los Angeles Harbor Commission.” March 16, 2006. Available at: http://www.gatewaycog.org/publications/I-710CorridorReport-March2006.pdf.

374. Prentice, J. C. 2006. “Neighborhood Effects on Primary Care Access in Los Angeles.” *Social Science & Medicine* 62:1291–1303.

375. Prevention Institute. 2005. “A Lifetime Commitment to Violence Prevention: The Alameda County Blueprint.” Available at: http://www.preventioninstitute.org/alameda.html.

376. Pulugurtha, S., and Bhatt, J. 2010. "Evaluating the Role of Weaving Section Characteristics and Traffic on Crashes in Weaving Areas." Traffic Injury Prevention, 11(1): 104-113.

377. Purciel, M. 2007. “Spatial Equity in New York City Neighborhoods.” A Thesis Presented to the Faculty of The Graduate School of Architecture, Planning, and Preservation and The Mailman School of Public Health, Columbia University.

378. Putnam R.D. 2001. *Bowling Alone: The Collapse and Revival of American Community*. New York, NY: Simon & Schuster.

379. Quigley, R., L. den Broeder, P. Furu, A. Bond, B. Cave, and R. Bos. 2006. "Health Impact Assessment International Best Practice Principles." *Special Publication Series No. 5*. Fargo, USA: International Association for Impact Assessment.

380. Qureshi M., N. Sugathan, R. Lasod, and G. Spring. 2004. "Design of Single Point Urban Interchanges." Missouri DOT Research, Development and Technology.

381. Rakha H.A., A.M. Flintsch, K. Ahn, I. El-Shawarby, and M. Arafeh M. 2005. "Evaluating alternative truck management strategies along Interstate 81." Transportation Research Record: Journal of the Transportation Research Board. 1925: 76-86.

382. Renski, H., A.J. Khattak, and F.M. Council. 1999. "Effect of Speed Limit Increases on Crash Injury Severity: Analysis of Single-Vehicle Crashes on North Carolina Interstate Highways." Transportation Research Record: Journal of the Transportation Research Board, 1665: 100-108.

383. Retting, R. and Teoh, E. 2008. "Traffic Speeds on Interstates and Freeways 10 Years after Repeal of National Maximum Speed Limit." Traffic Injury Prevention, 9(2): 119-124.

384. Retting, R., S. Ferguson, and A. McCartt. 2003. "A Review of Evidence-Based Traffic Engineering Measures Designed to Reduce Pedestrian-Motor Vehicle Crashes." Am J Public Health, 93(9): 1456-63.

385. Retting, R.A., S.Y. Kyrychenko, and A.T. McCartt. 2008. "Evaluation of Automated Speed Enforcement on Loop 101 Freeway in Scottsdale, Arizona." Accident Analysis & Prevention, 40(4): 1506-1512.

386. Reynolds, C., et al. 2009. "The Impact of Transportation Infrastructure on Bicycling Injuries and Crashes: A Review of the Literature." Environmental Health, 8(1): 1-19.

387. Reynolds, P.D., B. Miller, and W.R. Maki. 1995. "Explaining Regional Variation in Business Births and Deaths: U.S. 1976–88." Small Business Economics, 7(5): 389-407.

388. Richards, D.C. 2010. "Relationship between Speed and Risk of Fatal Injury: Pedestrians and Car Occupants." Transportation Research Laboratory. Road Safety Web Publication No. 16. Department for Transport: London, UK. Available at: http://www2.dft.gov.uk/pgr/roadsafety/research/rsrr/theme5/researchreport16/pdf/rswp116.pdf.

389. Richardson N.J. and T. Welch. 2009. "Recommended Safety Performance Measures for AASHTO Consideration." Iowa Department of Transportation.

390. Richter, E., et al. 2006. "Speed, Road Injury, and Public Health." Annual Review of Public Health, 27: 125-152.

391. Ries, A.V., A.F. Yan, and C.C. Voorhees. 2011. "The Neighborhood Recreational Environment and Physical Activity among Urban Youth: An examination of Public and Private Recreational Facilities." Journal of Community Health.

392. Ritz, B., M. Wilhelm, K.J. Hoggatt, and J.K.C. Ghosh. 2007. "Ambient Air Pollution and Preterm birth in the Environment and Pregnancy Outcomes Study at the University of California, Los Angeles." American Journal of Epidemiology, 16(9):1045-1052.

393. Ritz, B., Yu, F., Fruin, S., Chapa, G., Shaw, G.M., and Harris, J.A. 2002. "Ambient Air Pollution and Risk of Birth Defects in Southern California." American Journal of Epidemiology, 155(1):17-25.

394. Rivara, F., D. Thompson, and R. Thompson. 1997. "Epidemiology of Bicycle Injuries and Risk Factors for Serious Injury." Injury Prevention, 3: 110-114.

395. Road Information Program. 2001. "California's Roads and Highways: Conditions and Travel Trends." Washington, DC.

396. Rock, S.M. 1995. "Impact of the 65 Mph Speed Limit on Accidents, Deaths, and Injuries in Illinois." Accident Analysis & Prevention, 27(2): 207-214.

397. Rodriguez, D. et al. 2009. "Land use, residential density, and walking: the multi-ethnic study of atherosclerosis." American Journal of Preventative Medicine 37(5):397–404).

398. Roelfs, D., et al. 2011. "Losing Life and Livelihood: A Systematic Review and Meta-Analysis of Unemployment and All-Cause Mortality." Social Science & Medicine, 72(6): 840-854.

399. Roemmich, J.N., L.H. Epstein, S. Raja, L. Yin, J. Robinson, and D. Winiewicz. 2006. "Association of access to parks and recreational facilities with the physical activity of young children." Preventive Medicine, 6, 437–441.

400. Saelens, B. E., et al. 2003. "Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation." *American Journal of Public Health*, 93: 1552–58.

401. San Francisco Department of Public Health. 2010. "Program on Health, Equity and Sustainability. Neighborhood Completeness Indicator." Available at: <http://www.sfphes.org/HIA_Tools_Neighborhood_Completeness.htm>. Last revised March 25, 2010.

402. San Francisco Department of Public Health. 2011. "The Health Development Measurement Tool Indicator, Public Art Works and Population Density Per Square Mile." Available at http://www.thehdmt.org/indicators/view/97.

403. SCAQMD (South Coast Air Quality Management District). 2005a. "Air Quality Issues in School Site Selection: Guidance Document." Available at: www.aqmd.gov/prdas/aqguide/doc/School_Guidance.pdf.

404. SCAQMD (South Coast Air Quality Management District). 2005b. "Risk Assessment Procedures for Rules 1401 and 212. Version 7.0." *As cited in the HRA.*

405. Schulz , A.J., Israel, B.A., Zenk, S.N., et al. 2006. "Psychosocial stress and social support as mediators of relationships between income, length of residence and depressive symptoms among African American women on Detroit's eastside." Social Science & Medicine 62(2): 510-522.

406. Schweinhart, L.J. 2000. “The High / Scope Perry Preschool Study Through Age 40.” The High Scope Press.

407. Schweitze, L., and Valenzuela, A. 2004. “Environmental injustices and transportation: The claims and the evidence.” Journal of Planning Literature. 18, 383.

408. Schweitzer, J.H., J.W. Kim, J.R. Mackin. 1999. “The impact of the built environment on crime and fear of crime in urban neighborhoods.” Journal of Urban Technology 6(3):59-74.

409. Sclortino, S., et al. 2005. "San Francisco Pedestrian Injury Surveillance: Mapping, under-Reporting, and Injury Severity in Police and Hospital Records." Accident Analysis & Prevention, 37(6):1102-1113.

410. Seattle Department of Transportation. 2007. 2007 Pedestrian and Bicycle Collision.

411. Selander, J., M.T. Nilsson, G. Gluhm, M. Rosenlund, M. Lindqvist, G. Nise, and G. Perhagen. 2009. “Long-term exposure to road traffic noise and myocardial infarction.” Epidemiology 20(2):1-8.

412. Sharkey, .J.R, S. Horel, and W.R. Dean. 2010. “Neighborhood deprivation, vehicle ownership, and potential spatial access to a variety of fruits and vegetables in a large rural area in Texas. International Journal of Health Geographics. 9: 26.

413. Sharp, R. and Walker, B. 2002. “Particle Civics: How Cleaner Air in California Will Save Lives and Money.” Environmental Working Group. Available at: http://www.ewg.org/reports/particlecivics.

414. Shefer D and P. Rietvald P. 1997. “Congestion and safety on highways: towards an analytical model.” Urban Studies. 34(4): 679-692.

415. Siethoff, B., and K. Kockelman. 2002. “Property Values and Highway Expansion: Timing, Size, Location, and Use Effects.” Transportation Research Record. Paper No. 02-4084. Available at: http://trb.metapress.com/content/v67l331374104861/.

416. Singh, M., H.C. Phuleria, K. Bowers, and C. Sioutas. 2006. “Seasonal and spatial trends in particle number concentrations and size distributions at the children’s health study sites in Southern California.” *Journal of Exposure Science and Environmental Epidemiology*, 16:3–18.

417. Small, K., and Kazimi, C. 2005. “On the costs of air pollution from motor vehicles.” J. Trans. Econ. Pol., 29(1):7-32.

418. Soja, E. 1994. “Los Angeles 1965–1992: Six Geographies of Urban Restructuring.” UCLA: Center for Social Theory and Comparative History, Institute for Social Science Research.

419. Soja, E., R. Morales, and G. Wolf. 1983. “Urban Restructuring: An Analysis of Social and Spatial Change in Los Angeles.” *Economic Geography*, 59(2):195–230.

420. Song, Y., G.C. Gee, D.T. Takeuchi. 2007. “Do physical neighborhood characteristics matter in predicting traffic stress and health outcomes?” Transportation Research Part F: Traffic Psychology and Behaviour. 10(2), 164-176.

421. Southern California Association of Governments. 2008. 2008 Regional Transportation Plan.

422. Stansfeld, S.A., B. Berglund, C. Clark, I. Lopez-Barrio, P. Fischer, E. Ohrstrom, M.M Maines, J. Head, S. Hygge, I. van Kamp, and B.F. Berry. 2005. “Aircraft and road traffic noise and children’s cognition and health: a cross-national study.” Lancet, 365:1942-9.

423. Stockdale, S.E., K.B. Wells, L. Tang, et al. 2007. “The importance of social context: Neighborhood stressors, stress-buffering mechanisms, and alcohol, drug, and mental health disorders.” Social Science & Medicine 65: 1867- 1881.

424. STTP (Surface Transportation Policy Partnership). 2003. "Improving Traffic Safety: Reducing Deaths and Injuries through Safer Streets."

425. Stutts, J.C., W.W. Hunter, and W.E. Pein. 1996. "Pedestrian Crash Types: 1990s Update." Transportation Research Record: Journal of the Transportation Research Board, 1538: 68-74.

426. Su, J.G. et al. 2009. “An index for assessing demographic inequalities in cumulative environmental hazards with application to Los Angeles, California.” *Environmental Science and Technology*. 43, 7626–7634.

427. Sullivan E.C. 1990. “Estimating accident benefits of reduced freeway congestion.” Journal of Transportation Engineering. 116: 167-181.

428. Sullivan, W.C., F.E. Kuo, S.F. DePooter. 2004. “The fruit of urban nature: Vital neighborhood spaces.” Environment and Behavior 36(5):678-700.

429. Surface Transportation Policy Project. 2004. “Aging Americans: Stranded Without Options.” Washington DC. Available at: http://www.transact.org/report.asp?id=232.

430. Syme, S.L. National Center for Chronic Disease Prevention and Health Promotion. 2004. "Social Determinants of Health: The Community as an Empowered Partner." National Center for Chronic Disease Prevention and Health Promotion. Available at: http://www.cdc.gov/pcd/issues/2004/jan/03_0001.htm.

431. Szeremeta, B., P.H. Zannin. 2009. “Analysis and evaluation of soundscapes in public parks through interviews and measurements of noise.” Sci Total Environ, 407(24):6143-9.

432. Takano, T., K. Nakamura, M. Watanabe. 2002. “Urban residential environments and senior citizens longevity in megacity areas; the importance of walkable green.”

433. Task Force on Community Preventive Services. 2001. “Increasing physical activity: a report on recommendations of the Task Force on Community Preventive Services.” MMWR, 50(RR-18):1-14.

434. Taylor M.C., D.A. Lynam, and A. Baruya. 2000. "The effects of drivers’ speed on the frequency of road accidents." TRL Report 421. Crowthorne, UK: Transport Research Laboratory. Available at: http://www.trl.co.uk/online_store/reports_publications/trl_reports/cat_traffic_and_transport_planning/report_the_effects_of_drivers_speed_on_the_frequency_of_road_accidents.htm.

435. Taylor, A.F., F.E. Kuo, and W.C. Sullivan. 2001. “Coping with ADD: The surprising connection to green play settings.” Environment and Behavior 33(1)54-77.

436. Taylor, B.D. and C.N.Y. Fink. n.d. The Factors Influencing Transit Ridership: A Review and Analysis of the Ridership Literature." UCLA Department of Urban Planning Working Paper. Available at: www.uctc.net/papers/681.pdf.

437. Tier 2 Community Advisory Committee. 2004. "Major Opportunity/Strategy Recommendations and Conditions."

438. TIMS (Transportation Injury Mapping System). 2011. Safe Transportation Research and Education Center, UC Berkeley.

439. Texas Transportation Institute. 2011. "2011 Annual Urban Mobility Report." College Station, TX.

440. Thomson, J. M. 1977. *Great Cities and their Traffic*. Gollancz, London (Published in Peregrine Books, 1978).

441. TranSafety Inc. 1997. Road Engineering Journal. Transportation Research Record 1559. Available at http://www.usroads.com/journals/p/rej/9710/re971004.htm.

442. Transportation Alternatives. 2006. "Traffic's Human Toll: A Study of the Impacts of Vehicular Traffic on New York City Residents." Available at: transalt.org/campaigns/reclaiming/trafficshumantoll.pdf.

443. Transportation Research Board National Research Council. 1998. "Special Report 254: Managing Speed, Review of Current Practice for Setting and Enforcing Speed Limits". Available at: http://onlinepubs.trb.org/onlinepubs/sr/sr254.pdf.

444. Transportation Research Board, Institute of Medicine of National Academies. 2005. "Does the built environment influence physical activity? Examining the evidence." National Academies of Science.

445. Trowbridge, M.J., M.J. Gurka, and R.E. O'Connor. 2009. "Urban Sprawl and Delayed Ambulance Arrival in the U.S." American *Journal of Preventive Medicine*, 37(5):428–432.

446. Trust for Public Land. 2004. "No Place to Play: a comparative analysis of park access in seven major cities."

447. Trust for Public Land. 2005. "The Benefits of Parks: why America needs more city parks and open space."

448. Twiss, J., et al. 2003. "Community Gardens: Lessons Learned from California Healthy Cities and Communities." American Journal of Public Health. Vol 93, No 9.

449. Twomey, J., et al. 1993. "Accidents and Safety Associated with Interchanges." Transportation Research Record: Journal of the Transportation Research Board, (1385): 100-105

450. U.S. Bureau of Labor Statistics. 2008. "Employee Benefits in the United States, March 2008." Available at: http://www.bls.gov/ncs/ebs/sp/ebnr0014.txt.

451. U.S. Bureau of Labor Statistics. 2011a. Consumer Price Index Frequently Asked Questions." Bureau of Labor Statistics. Available at: http://www.bls.gov/cpi/cpifaq.htm.

452. U.S. Bureau of Labor Statistics. 2011b. "Green Jobs." Available at: http://www.bls.gov/green/.

453. U.S. Census Bureau. 2005. "Extreme Commute Rankings: Cities." Available at: http://www.census.gov/newsroom/releases/archives/american_community_survey_acs/cb05-ac02.html.

454. U.S. Census Bureau. 2010. American Community Survey 2005–2009. Available: http://www.census.gov/acs/www/

455. U.S. Census Bureau. 2011a. FT920—U.S. Merchandise Trade: Selected Highlights (Washington, DC: annual issues). Available at: http://www.census.gov/foreign-trade/Press-Release/ft920_index.html.

456. U.S. Census Bureau. 2011b. Transportation: Motor Vehicle Accidents and Fatalities." United States Census Bureau. Available at: http://www.census.gov/compendia/statab/cats/transportation/motor_vehicle_accidents_and_fatalities.html.

457. U.S. Department of Agriculture. 2002. "US Food Marketing System, Agriculture Marketing Report No. 811." Economic Research Service.

458. U.S. Department of Energy. 2011. Table 2.6 Transportation Energy Use by Mode, 2004-2006 in "Transportation Energy Data Book." Available at: http://cta.ornl.gov/data/chapter2.shtml.

459. U.S. Department of Health and Human Services. 1999. "Physical Activity and Health." A report of the Surgeon General.

460. U.S. Department of Health and Human Services. 2001. Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity. Available at: www.surgeongeneral.gov/topics/obesity/calltoaction/CaltoAction.pdf.

461. Union of Concerned Scientists. 2008. "Diesel trucks: air pollution and public health." Available at: http://www.ucsusa.org/clean_vehicles/vehicle_impacts/diesel/diesel-trucks-air-pollution.html.

462. University of Southern California. 2002. "The Red Cars of Los Angeles." Regional History Collection. Available at: http://www.usc.edu/libraries/archives/la/historic/redcars.

463. URS and Caltrans. 2010. "Draft Noise Study Report: I-710 Corridor Project." Prepared for the Los Angeles County Metropolitan Transportation Authority.

464. URS. 2010. Traffic Impact Analysis Report. Prepared for the Los Angeles Metropolitan Transportation Authority.

465. USDOT (U.S. Department of Transportation) Pipeline and Hazardous Materials Safety Administration (PHMSA). 2011. "Incident Statistics." Available at: http://www.phmsa.dot.gov/hazmat/library/data-stats/incidents.

466. Vallianatos, M., A. Shaffer, and R. Gottlieb. 2002. "Transportation and food: the importance of access." Center for Food and Justice, Urban and Environmental Policy Institute. Available at: http://departments.oxy.edu/uepi/cfj/publications/transportation_and_food.pdf.

467. Van Kempen, E.M., H. Kruize, H.C. Boshuizen, C.B. Amelin, B. Staatsen, and A. de Hollander. 2002. "The association between noise exposure and blood pressure and ischemic heart disease: A meta-analysis." Env Health Pers, 110:307-317.

468. Viswanath, K., Steele, W.R., Finnegan, J.R. 2006. "Social capital and health: Civic engagement, community size, and recall of health messages." American Journal of Public Health 96(8): 1456-1461.

469. Volk, H.E., I. Hertz-Picciotto, L. Delwiche, F. Lurmann, and R. McConnell. 2011. "Residential Proximity to Freeways and Autism in the CHARGE Study." Environ Health Perspective, 119:873-877. doi:10.1289/ehp.1002835. Available at: http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.1002835.

470. Voss, M., et al. 2004. "Unemployment and Early Cause-Specific Mortality: A Study Based on the Swedish Twin." American Journal of Public Health, 94(12): 2155-2161.

471. Vyrostek, S., J. Annest, and G. Ryan. 2004. "Surveillance for Fatal and Nonfatal Injuries --- United States, 2001." MMWR, 53(SS07): 1-57.

472. Wachs, M. 1984. "Autos, Transit, and the Sprawl of Los Angeles: the 1920s." *Journal of the American Planning Association,* (50)3: 297–310.

473. Wachtel, A. and Lewiston, D. 1994. "Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections." ITE Journal: 30-35.

474. Waddell, P., B. Berry, and I. Hoch. 1993. "Residential Property Values in a Multimodal Urban Area: New Evidence on the Implicit Price of Location." Journal of Real Estate Finance and Economics. 7:117-141.

475. Wang, Y. and Nihan, N. 2004. "Estimating the Risk of Collisions between Bicycles and Motor Vehicles at Signalized Intersections." Accident Analysis & Prevention, 36(3): 313-321.

476. Wasylenko, M.J. 1997. "Taxation and Economic Development: The State of the Economic Literature." New England Economic Review, (March): 37-52.

477. Weingroff, R.F. 2011. "Moving the Goods: As the Interstate Era Begins." Federal Highway Administration. Available at: http://www.fhwa.dot.gov/infrastructure/freight.cfm.

478. Weinmayr, G., E. Romeo, M. De Sario, S.K. Weiland, and F. Forastiere. 2010. "Short-term health effects of PM_{10} and NO_2 on respiratory health among children with asthma or asthma-like symptoms: a systematic review and meta-analysis.

479. Weinstein, A., and P. Schimek. 2005. "How much do Americans walk? An analysis of the 2001 NHTS." Transportation Research Board Annual Meeting. Cited in Transit Oriented Development: Using Public Transportation to Create More Accessible and Livable Neighborhoods. Available at: http://www.vtpi.org/tdm/tdm45.htm.

480. Weisbrod G., D. Vary, and G. Treyz. 2001. "Economic Implications of Congestion." National Cooperative Highway Research Program. NCHRP Report 463.

481. Weisbrod, G. 2004. "FHWA Freight BCA Study: Summary of Phase II Results."

482. Wener, R., G. Evans, and J. Lutin. 2006. "Leave the driving to them: comparing stress of car and train commuters." American Public Transportation Association.

483. Westerdahl, D., S. Fruin, T. Sax, P.M. Fine, and C. Sioutas. 2005. "Mobile platform measurements of ultrafine particles and associated pollutant concentrations on freeway and residential streets in Los Angeles." Atmospheric Environment, 39:3597-3610.

484. WHO (World Health Organization). 2003. "Health aspects of air pollution with particulate matter, ozone, and nitrogen dioxide." Report on a WHO Working Group. Bonn, Germany 13-15 January 2003. Copenhagen: World Health Organization.

485. WHO (World Health Organization). 2005. "Quantifying burden of disease from environmental noise: Second technical meeting report." Bern, Switzerland. Regional Office for Europe.

486. WHO (World Health Organization). 2011. "Air Quality and Health." Available at: http://www.who.int/mediacentre/factsheets/fs313/en/index.html.

487. WHO Europe (World Health Organization, Europe). 2005. "Health effects of transport-related air pollution." Available at: http://www.euro.who.int/__data/assets/pdf_file/0006/74715/E86650.pdf.

488. WHO Europe (World Health Organization, Europe). 2011. "Health Economic Assessment Tool (HEAT)." World Health Organization, Regional Office for Europe. Available at: http://www.heatwalkingcycling.org/index.php.

489. Wilhelm, M. and Ritz, B. 2003. "Residential Proximity to Traffic and Adverse Birth Outcomes in Los Angeles County, California, 1994–1996." Environmental Health Perspectives, 111(2): 210.

490. Wilhelm, M. and Ritz, B. 2005. "Local Variations in CO and Particulate Air Pollution and Adverse Birth Outcomes in Los Angeles County, California, USA." Environmental Health Perspective, 113 (9):1212-1221.

491. Wilhelmsson M. 2000. "The Impact of Traffic Noise on the Values of Single-family Houses." Journal of Environmental Planning and Management, 43(6), 799–815.

492. Wilson, C., et al. 2010. "Speed Cameras for the Prevention of Road Traffic Injuries and Deaths (Review)." Cochrane Database of Systematic Reviews, 11.

493. Wilson, S. 2011. "Los Angeles Bus Cuts: MTA Axes 305,000 More Hours of Service, Stranding Low-Income Workers in L.A. Outskirts." *LA Weekly*, June 24, 2011. Available at: http://blogs.laweekly.com/informer/2011/06/los_angeles_bus_cuts_mta.php.

494. Windham, G.C., L. Zhang, R. Gunier, L.A. Croen, and J.K. Grether. 2006. "Autism Spectrum Disorders in Relation to Distribution of Hazardous Air Pollutants in the San Francisco Bay

Area." Environmental Health Perspective, 114(9):1438-1444. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1570060/

495. Wu, J., Houston, D., Lurmann, F., Ong, P., and Winer, A. 2009. "Exposure of $PM_{2.5}$ and EC from diesel and gasoline vehicles in communities near the Ports of Los Angeles and Long Beach, California." Atmospheric Environment, 43:1962-1971.

496. Yen, I. and R. Bhatia. 2002. "How Increasing the Minimum Wage Might Affect the Health Status of San Francisco Residents: A Discussion of the Links Between Income and Health." Working Paper.

497. Yen, I.H., and S.L. Syme. 1999. "The Social Environment and Health: A Discussion of the Epidemiologic Literature." *Annual Review of Public Health* 20:287–308.

498. Yoo, K. 2010. "2006-2009 Overview of the Uninsured." Insure the Uninsured Project.

499. Zein S.R., E. Geddes, S. Hemsing, and M. Johnson. 1997. "Safety Benefits of Traffic Calming." Transportation Research Record: Journal of the Transportation Research Board. 1578: 3-10.

500. Zhou, M., and V.P. Sisiopiku. 1997. "Relationship between Volume-to-Capacity Ratios and Accident Rates." Transportation Research Record: Journal of the Transportation Research Board, 1581: 47-52.

501. Zhu, Y., A. Eiguren-Fernandez, W.C. Hinds, and A.H. Miguel. 2007. "In-cabin Commuter Exposure to Ultrafine Particles on Los Angeles Freeways." Environ. Sci. Technol., 41:2138-2145.

502. Zhu, Y., W.C. Hinds, M. Krudysz, T. Kuhn, J. Froines, and C. Sioutas. 2005. "Penetration of freeway ultrafine particles into indoor environments." Journal of Aerosol Science, 36:303-322.

503. Zhu, Y., W.C. Hinds, S. Kim, S. Shen, and C. Sioutas. 2002. "Study of ultrafine particles near a major highway with heavy-duty diesel traffic." *Atmospheric Environment*, 36:4323–35.

504. Zhu, Y., W.C. Hinds, S. Shen, and C. Sioutas. 2004. "Seasonal Trends of Concentration and Size Distribution of Ultrafine Particles near Major Highways in Los Angeles." Aerosol Science and Technology, 38(S1):5-13.

12.2 Personal Communications

505. Correspondence to Hon. James Kahn and City Council. 31 January 2002.

506. Harris, Jayna. 2011. Personal communication from Jayna Harris at LSA Associates on June 6, 2011.

Appendix A. 2007 Los Angeles County Health Survey

The Los Angeles County Health Survey is a population-based telephone survey administered since 1997 by the Los Angeles County Department of Public Health and focused on the health of county residents. In 2007, the adult survey included 7,200 people ages 18 years or older, and the child survey included 5,728 parents—primarily mothers—of children ages 17 years or under.

Data from the 2007 survey is included throughout the I-710 Corridor Project HIA report. The report compares data for the county overall to four geographies within the I-710 Corridor Project study area described above in Section 5.1.

For all tables below:

- **Red** highlighting signifies estimates that are *lower* than overall county estimates with 95% confidence intervals (CI) that do not overlap.
- **Purple** highlighting signifies estimates that are *higher* than overall county estimates with 95% CIs that do not overlap.
- The 95% CI reflects variability in survey estimates due to sampling. Actual prevalence in the population, 95 out of 100 times sampled, would fall within the range provided.
- An asterisk (*) signifies a statistically unstable estimate (relative standard error > 23%) and one that may not be appropriate to use for planning or policy purposes.
- For confidentiality, results of less than 5 counts are not reported.

For more about the Los Angeles County Health Survey, including methodology and to access the survey tool, please visit www.publichealth.lacounty.gov/ha/hasurveyintro.htm.

Adult Survey

Table A-1. Adult Asthma Prevalence near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Asthma prevalence	6.5%	6.0%	5.9%	6.2%	5.9%	N.D.

Asthma prevalence denotes people ever diagnosed with asthma by a health care provider and who reported still having asthma and/or having an asthma attack in the past 12 months.
Source: Los Angeles County Department of Public Health 2007[1].

Table A-2. Current Employment for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Employed	61.4%	57.6%	58.9%	56.1%	60.6%	51.7%
>35 hours per week	48.2%	50.8%	54.7%	46.5%	55.9%	35.9%
20–34 hours per week	8.3%	*4.3%	*2.7%	*6.1%	N.D.	*10.7%
<20 hours per week	4.2%	*2.2%	N.D.	N.D.	N.D.	N.D.
Unknown hours per week	0.8%	N.D.	N.D.	N.D.	N.D.	N.D.
Unemployed	5.6%	*6.7%	*7.8%	N.D.	N.D.	N.D.
Not in the labor force	33.0%	35.7%	33.3%	38.4%	33.9%	39.2%
Retired	13.6%	10.0%	*8.3%	*11.9%	*9.6%	*14.7%
Disabled and unable to work	4.8%	*6.7%	*8.8%	*4.4%	*6.9%	N.D.
Student or homemaker	14.6%	19.0%	16.2%	22.1%	*17.3%	*20.1%
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-3. Commute Time from Home to Work for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
<30 minutes	56.8%	64.1%	61.8%	66.7%	64.6%	76.0%
At LA County level, excludes 6.4% work at home or commute 0 minutes. Source: Los Angeles County Department of Public Health 2007[1].						

Table A-4. Miles from Home to Work for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
<10 miles	46.9%	54.3%	44.2%	71.4%	*39.0%	69.0%
At LA County level, excludes "work at home" and 7.1% that replied "varies." Source: Los Angeles County Department of Public Health 2007[1].						

Table A-5. Means of Transportation from Home to Work for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Drive alone	76.6%	60.6%	68.3%	51.4%	78.4%	70.5%
Carpool or motorcycle	11.6%	*18.5%	*17.5%	*19.8%	N.D.	N.D.
Bus, metro, or train	7.0%	*11.7%	N.D.	N.D.	N.D.	N.D.
Walk or bicycle	4.3%	*8.3%	N.D.	*12.8%	N.D.	N.D.
Some other way	*0.6%	N.D.	N.D.	N.D.	N.D.	N.D.
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-6. Highest Level of Educational Attainment for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Less than high school	22.1%	40.6%	32.3%	50.1%	31.0%	45.1%
High school	18.6%	22.2%	21.4%	*23.2%	*17.7%	*23.0%
Some college or trade school	24.4%	24.3%	29.6%	*18.2%	31.1%	*17.3%
College or post-graduate degree	34.9%	12.8%	16.6%	*8.5%	*20.2%	*14.6%
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-7. Relationship to Federal Poverty Level (FPL) for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
<100% FPL	24.8%	44.7%	41.7%	48.0%	33.0%	35.9%
100% to <200% FPL	21.6%	28.6%	25.1%	32.5%	25.9%	45.3%
200% to <300% FPL	13.7%	10.2%	*9.1%	*11.5%	*11.0%	*10.8%
300% FPL or more	39.9%	16.5%	24.0%	*7.9%	30.1%	*8.0%
Based on U.S. Census 2006 Federal Poverty Level (FPL) thresholds, which for a family of four (2 adults, 2 dependents) correspond to annual incomes of \$20,444 (100% FPL), \$40,888 (200% FPL), and \$61,332 (300% FPL). These thresholds were the values at the time of survey interviewing. Source: Los Angeles County Department of Public Health 2007[1].						

Table A-8. Prevalence of Chronic Conditions for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Ever diagnosed with diabetes	8.7%	12.4%	*11.6%	*13.3%	*14.4%	*15.8%
Ever diagnosed with heart disease	7.7%	6.2%	*8.2%	*3.9%	*9.1%	N.D.
Ever diagnosed with hypertension	24.7%	21.2%	20.1%	22.5%	25.6%	*22.2%
Ever diagnosed with high cholesterol	29.1%	27.1%	29.3%	24.6%	36.5%	*23.7%
Ever diagnosed with depression	13.6%	*9.1%	*7.6%	*10.8%	*7.6%	*9.2%
Obese	22.2%	31.2%	29.1%	34.0%	26.3%	*32.1%
Overweight	35.9%	38.7%	41.8%	34.6%	46.1%	33.4%

For the categories Obese and Overweight, weight status is based on Body Mass Index (BMI) calculated from self-reported weight and height. National Heart, Lung, and Blood Institute (NHLBI) clinical guidelines are that BMI <18.5 is underweight, BMI ≥18.5 and <25 is normal weight, BMI ≥25 and <30 is overweight, and BMI ≥30 is obese. See: www.nhlbi.nih.gov/guidelines/obesity/ob_exsum.pdf.

Source: Los Angeles County Department of Public Health 2007[1].

Table A-9. Health Related Quality of Life for Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Fair or poor health status	18.5%	23.3%	19.7%	27.4%	24.5%	*25.5%
Average number of unhealthy days in the past month due to poor physical or mental health	5.4	5.5	5.5	5.6	5.2	*6.3
Average number of activity limitation days in the past month due to poor physical or mental health	2.1	1.9	1.7*	2.2*	1.5*	1.6*

Source: Los Angeles County Department of Public Health 2007[1].

Table A-10. Perceptions of Safety among Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Perceive neighborhood is safe from crime	82.1%	74.5%	77.8%	70.7%	73.2%	71.6%
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-11. Physical Activity Levels among Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Active (meet guidelines)	53.2%	53.3%	57.0%	49.1%	58.0%	46.1%
Some activity (do not meet guidelines)	10.7%	12.6%	*15.9%	*8.9%	*14.2%	*8.4%
Sedentary (no activity)	36.2%	34.1%	27.1%	42.0%	27.8%	45.6%

At least one of the following criteria must be fulfilled to meet physical activity guidelines:

1) Vigorous activity: ≥20 minutes on 3+ days a week that causes heavy sweating, and large increases in breathing and heart rate;
2) Moderate activity: ≥30 minutes on 5+ days a week that causes light sweating, and slight increases in breathing and heart rate;
3) A combination of vigorous and moderate activity meeting the time criteria for ≥ 5days/week.

See: U.S. Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. 2nd ed. Washington, DC: U.S. Government Printing Office, November 2000. ; Centers for Disease Control and Prevention/American College of Sports Medicine, www.cdc.gov/nccdphp/dnpa/physical/recommendations/index.htm.
Source: Los Angeles County Department of Public Health 2007[1].

Table A-12. Access to Medical Care among Adults near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Difficulty accessing care	27.3%	34.0%	31.2%	37.3%	*26.8%	*25.6%
Unable to afford to see a doctor when needed in the past year	11.8%	*14.3%	*9.0%	*20.2%	*8.2%	*12.1%
Unable to afford prescription medication when needed in the past year	12.1%	*13.9%	*10.1%	*18.2%	*7.5%	*11.7%
Unable to afford mental health care in the past year	5.9%	*4.4%	N.D.	*5.6%	N.D.	N.D.
Unable to afford dental care, including check-ups, in the past year	22.3%	25.1%	*19.0%	32.0%	*15.7%	*25.6%
Transportation barrier to accessing medical care in the past year	7.4%	*6.6%	*5.7%	*7.6%	N.D.	*9.9%
Has a regular source of care	80.8%	74.7%	79.9%	69.1%	79.7%	81.5%
Source: Los Angeles County Department of Public Health 2007[1].						

Child Survey

Table A-13. Health Status of Children near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Fair or poor health status	8.4%	11.5%	* 9.1%	* 13.9%	* 8.5%	*12.8%
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-14. Asthma-Related Measures among Children near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters downwind (East)
Current prevalence of asthma	7.9%	*2.7%	*4.3%	N.D.	N.D.	N.D.
Limited activity due to asthma	34.9%	N.D.	N.D.	N.D.	N.D.	N.D.
Always	*1.7%	N.D.	N.D.	N.D.	N.D.	N.D.
Most of the time	5.6%	N.D.	N.D.	N.D.	N.D.	N.D.
Some of the time	27.6%	N.D.	N.D.	N.D.	N.D.	N.D.
Average number of days of daycare or school missed in the past year due to asthma	3.1	*2.1	*2.3	N.D.	*3.5	N.D.

Asthma prevalence includes children ever diagnosed with asthma by a health care provider and reported as still having asthma and/or having had an asthma attack in the past 12 months.
Source: Los Angeles County Department of Public Health 2007[1].

Table A-15. Physical Activity Levels among Children Ages 6-17 Years Reported by Parents near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Participates 1 hour a day 5+ days per week	37.6%	38.4%	37.8%	39.1%	*33.7%	41.5%
Participates <1 hour a day and/or <5 days per week	47.2%	48.0%	47.4%	48.7%	48.9%	43.3%
Does not participate	15.2%	*13.6%	*14.8%	*12.2%	*17.4%	*15.2%

Exercise for ≥1 hour on 3+ days a week is considered meeting physical activity recommendations. Activities that were measured included: walk, bike, skateboard to school; participation in team sports; bicycling, rollerblading, skateboarding, etc.; other activities like physically interactive video games – DDR, Eye Toy; gymnastics, dance, karate, or similar type class.
Source: Los Angeles County Department of Public Health 2007[1].

Table A-16. Safety of Built Environment as Reported by Parents near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Safe place for child to be physically active	83.4%	82.4%	87.3%	77.5%	87.2%	76.0%
Park, playground, or other safe place for child to play is easily accessibly	79.8%	80.3%	80.7%	79.9%	90.3%	79.4%
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-17. Access to Medical Care for Children Reported by Parents near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Difficulty accessing medical care	14.7%	17.0%	*10.5%	23.1%	N.D.	*21.3%
Child has a regular source of care	92.6%	88,8%	87.8%	89.8%	91.1%	89.1%
Transportation barrier to accessing medical care for child	5.9%	*10.5%	*7.2%	*13.7%	N.D.	*13.8%
Source: Los Angeles County Department of Public Health 2007[1].						

Table A-18. Type of Childcare Used on a Regular Basis as Reported by Parents near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Head Start program	15.1%	*25.8%	N.D.	*33.2%	N.D.	N.D.
State preschool program	17.6%	N.D.	N.D.	N.D.	N.D.	N.D.
Childcare center, pre-school, or nursery school	43.0%	*27.8%	N.D.	N.D.	N.D.	N.D.
Someone cares for child in their home	47.2%	56.1%	74.6%	46.4%	N.D.	N.D.
Someone cares for child in your own home	33.0%	*27.9%	N.D.	32.0%	N.D.	*58.6%
Categories are not mutually exclusive. Table excludes 12.7% of parents who report that they do not need childcare. Source: Los Angeles County Department of Public Health 2007[1].						

Table A-19: Barriers to Childcare Reported by Parents near the I-710

	LA County	All Census Tracts	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Difficulty getting childcare (among those who need childcare)	36.9%	49.2%	*44.1%	52.3%	*52.1%	57.6%
Reasons reported:						
Costs too much	67.1%	74.5%	91.9%	65.0%	88.6%	*49.6%
Finding a provider with space	49.5%	77.2%	87.2%	71.7%	82.2%	*51.1%
Location and hours	41.4%	56.1%	72.3%	*47.7%	N.D.	*45.7%
Quality not satisfactory	45.4%	60.8%	N.D.	*57.2%	N.D.	*54.6%
Unreliable (provider quit without notice or is late)	28.4%	*42.3%	N.D.	N.D.	N.D.	N.D.
Child is disabled or special needs	4.8%	N.D.	N.D.	N.D.	N.D.	N.D.

Table excludes 12.7% of parents who report that they do not need childcare.
Source: Los Angeles County Department of Public Health 2007[1].

References

1. Los Angeles County Department of Public Health. 2007. “2007 Los Angeles County Health Survey.” Office of Health Assessment and Epidemiology.

Appendix B. Preventable Hospitalizations

Prevention Quality Indicators (PQIs) and Pediatric Quality Indicators (PDIs) are a set of measures developed by the Agency for Healthcare Research and Quality (AHRQ) to identify conditions for which good outpatient care can potentially prevent the need for hospitalization or for which early intervention can prevent complications or more severe disease. The indicators are based on hospital inpatient data, but give insight into disease and environmental conditions in an area, as well as the quality of the health care system outside the hospital setting. PQIs are for adults ages 18 and above. Age definitions vary, for PDIs, but all are for persons 18 years or younger.

The 14 Prevention Quality Indicators measured are:

PQI Number	Description
1	Diabetes short-term complication
2	Perforated appendix
3	Diabetes long-term complication
5	Chronic obstructive pulmonary disease
7	Hypertension
8	Congestive heart failure
10	Dehydration
11	Bacterial pneumonia
12	Urinary tract infection
13	Angina without procedure
14	Uncontrolled diabetes
15	Adult asthma
16	Lower-extremity amputation among patients with diabetes

The 6 Pediatric Quality Indicators measured are:

PDI Number	Description
14	Asthma Admission Rate
15	Diabetes Short-term Complications Admission Rate
16	Gastroenteritis Admission Rate
17	Perforated Appendix Admission Rate
18	Urinary Tract Infection Admission Rate
PQI09[1]	Low Birth Weight

[1]Please note that PQI09 was originally in the Prevention Quality Indicator Module, but starting with version 4.1 of the AHRQ software, PQI09 was moved to the Pediatric Quality Indicator module. However, PQI09 retained the PQI nomenclature and the technical specifications are in the PQI module

The tables below show observed rates of the PQIs and PDIs, by age and sex, for the following:

- California (statewide)
- Los Angeles County (LA County, US FIPS code 06037)
- Four study area groups, as defined by patient zip code of residence

The Office of Statewide Planning and Development (OSHPD) calculated the observed rates as the number of inpatient cases for each admission type (by patient zip code of residence) divided by the population in each specified area. The rates are not adjusted for age, sex, race/ethnicity, or other demographic characteristics. Hospitalization (inpatient discharge) data is from 2008, and the population data for each of the specified areas in the tables is from ESRI, 2009.

Table B-1. Prevention Quality Indicator Admissions per 100,000 Persons in California, Los Angeles County, and the I-710 Corridor Project Study Area

Admission Type	State of California	LA County	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Diabetes short-term complication	48.51	45.31	59.71	72.84	61.14	78.48
Perforated appendix[1]	26.34	26.21	27.39	26.01	27.69	25.76
Diabetes long-term complication	108.23	137.23	212.15	223.45	213.17	232.14
Chronic obstructive pulmonary disease	130.67	133.37	141.07	139.74	141.02	143.73
Hypertension	35.56	52.63	57.74	65.66	59.03	66.43
Congestive heart failure	263.47	302.54	282.58	301.63	288.37	313.46
Dehydration	56.43	68.45	79.61	78.18	80.12	81.79
Bacterial pneumonia	230.98	216.92	228.78	218.12	230.28	223.63
Urinary tract infection	151.62	176.86	200.56	200.88	197.95	211.10
Angina without procedure	25.15	29.06	36.09	42.68	36.54	43.26
Uncontrolled diabetes	11.98	18.79	29.53	32.83	30.69	33.57
Adult asthma	87.76	111.11	144.35	170.72	143.83	168.31
Lower-extremity amputation among patients with diabetes	27.88	28.45	46.37	54.79	47.79	55.32
PQI Composite	N.D.	N.D.	1486.40	1564.18	1496.67	N.D.

[1]Adult perforated appendix rate calculated per 100 appendectomies
Source: Agency for Health Research and Quality 2010[1].

Table B-2. Pediatric Quality Indicator Admissions per 100,000 Persons in California, Los Angeles County, and the I-710 Corridor Project Study Area

Admission Type	State of California	LA County	1 Mile Upwind (West)	1 Mile Downwind (East)	150 Meters Upwind (West)	150 Meters Downwind (East)
Asthma admission rate	105.17	113.47	85.63	90.43	82.55	92.67
Diabetes short-term complications admission rate	22.57	19.70	12.67	11.59	13.49	12.85
Gastroenteritis admission rate	78.08	99.49	105.21	113.28	106.66	109.41
Perforated appendix admission rate[1]	30.12	30.99	35.29	38.29	35.39	36.99
Urinary tract infection admission rate	36.92	45.21	48.00	58.96	48.63	60.74
Low birth weight rate[2]	56.08	55.25	51.8	54.27	52.53	57.13

[1] Pediatric perforated appendix rate calculated per 100 appendectomies
[2] Low birth weight rate calculated per 1,000 births
Source: Agency for Health Research and Quality 2010[1].

References

1. Agency for Healthcare Research and Quality. 2010. Pediatric Quality Indicator Admissions for California, Los Angeles County, and the I-710 Corridor Project study area. Updated September 2010.

Appendix C. Emergency Room Visits

The following tables present 2009 emergency room (ER) visit data from the Office of Statewide Health Planning and Development (OSHPD), and show the number of ER visits from patients living in the State of California, Los Angeles County, and within zip codes that intersect the 1-mile study area along the I-710.

Table C-1. 2009 Emergency Room Visits

Hospital County	Treated and Released		Admitted to Hospital		All	
	Number	Percent	Number	Percent	Number	Percent
Los Angeles	2,455,782	82.1%	535,143	17.9%	2,990,925	100.0%
All Other Counties	7,413,131	85.6%	1,251,880	14.4%	8,665,011	100.0%
Total California	9,868,913	84.7%	1,787,023	15.3%	11,655,936	100.0%
Source: California Office of Statewide Health Planning and Development 2009[1].						

Table C-2. 2009 Emergency Room Visits for Residents Living 1 Mile Upwind of the I-710

Hospital County	Study Area Hospital?	Treated and Released		Admitted to Hospital		All	
		Number	Percent	Number	Percent	Number	Percent
Los Angeles	All	180,411	83.8%	34,939	16.2%	215,350	100.0%
	No	119,929	85.0%	21,102	15.0%	141,031	100.0%
	Yes	60,482	81.4%	13,837	18.6%	74,319	100.0%
All Other Counties		4,991	83.5%	986	16.5%	5,977	100.0%
Total		185,402	83.8%	35,925	16.2%	221,327	100.0%
Source: California Office of Statewide Health Planning and Development 2009[1].							

Table C-3. 2009 Emergency Room Visits for Residents Living 1 Mile Downwind of the I-710

Hospital County	Study Area Hospital?	Treated and Released		Admitted to Hospital		All	
		Number	Percent	Number	Percent	Number	Percent
Los Angeles	All	213,690	84.3%	39,708	15.7%	253,398	100.0%
	No	136,741	84.9%	24,364	15.1%	161,105	100.0%
	Yes	76,949	83.4%	15,344	16.6%	92,293	100.0%
All Other Counties		4,914	84.5%	899	15.5%	5,813	100.0%
Total		218,604	84.3%	40,607	15.7%	259,211	100.0%
Source: California Office of Statewide Health Planning and Development 2009[1].							

Table C-4. 2009 Emergency Room Visits for Residents Living 150 Meters Upwind of the I-710

Hospital County	Study Area Hospital?	Treated and Released		Admitted to Hospital		All	
		Number	Percent	Number	Percent	Number	Percent
Los Angeles	All	169,501	83.7%	32,953	16.3%	202,454	100.0%
	No	110,532	85.1%	19,372	14.9%	129,904	100.0%
	Yes	58,969	81.3%	13,581	18.7%	72,550	100.0%
All Other Counties		4,618	83.5%	915	16.5%	5,533	100.0%
Total		174,119	83.7%	33,868	16.3%	207,987	100.0%
Source: California Office of Statewide Health Planning and Development 2009[1].							

Table C-5. 2009 Emergency Room Visits for Residents Living 150 Meters Downwind of the I-710

Hospital County	Study Area Hospital?	Treated and Released		Admitted to Hospital		All	
		Number	Percent	Number	Percent	Number	Percent
Los Angeles	All	191,607	84.4%	35,508	15.6%	227,115	100.0%
	No	120,689	84.9%	21,482	15.1%	142,171	100.0%
	Yes	70,918	83.5%	14,026	16.5%	84,944	100.0%
All Other Counties		4,494	84.6%	816	15.4%	5,310	100.0%
Total		196,101	84.4%	36,324	15.6%	232,425	100.0%
Source: California Office of Statewide Health Planning and Development 2009[1].							

References

1. California Office of Statewide Health Planning and Development. 2009. 2009 Patient Discharge and Emergency Department datasets.

Appendix D. Estimating the Population at Risk for Being Highly Annoyed from Roadway Noise

Annoyance is a well-established metric for evaluating the significance of community noise. Annoyance due to noise is determined by loudness, temporal patterns (e.g., the time of day the noise is louder), source and predictability (e.g., traffic or gunshots), and the association of the noise with other environmental factors such as vibration or light or air pollution.

Miedema and Oudshoorn (Miedema and Oudshoorn 2001[5]) synthesized results from 18 studies of road traffic noise to estimate noise exposure and annoyance response measures (DNL and percentage of respondents considered to be highly annoyed from noise, respectively) and to derive an exposure-response curve estimating the percentage of highly annoyed persons as a function of L_{dn}. The following formula represents this exposure response curve and can be used to estimate the percentage of the population reporting being highly annoyed (%HA) if exposed to certain L_{dn} due to road traffic noise:

$$\%HA = 9.994 \times 10^{-4} (L_{dn}-42)^3 - 1.523 \times 10^{-2} (L_{dn}-42)^2 + 0.538 (L_{dn}-42)$$

Where

L_{dn} (the “average” A-weighted long-term LA_{eq} noise measure with a nighttime penalty of 10 dB) = 10 $\log[(15/24) \times 10^{LD/10} + (9/24) \times 10^{(LN+10)/10}]$

LD and LN are the A-weighted long-term LA_{eq} defined by the International Standards Organization (International Standards Organization 1987[3]) for the day (7 a.m. to 10 p.m.) and the night (10 pm. to 7 a.m.), respectively.

Given estimates of the population living within a certain distance of roadways and monitored or modeled noise (using the Federal Highway Administration's Traffic Noise Model [TNM] 2.5 (FHWA 2004[1]) based on the number of vehicles of various types and speeds passing specific locations per hour), it is possible to estimate, using this formula, the number of people expected to be highly annoyed based on their exposure to noise from roadway traffic.

This estimation requires the following data:

1. Noise contours—Location-specific LA_{eq} readings during the day (7 a.m. to 10 p.m.) and night (10 pm. to 7 a.m.)
2. Location-specific and precise Census population estimates—Specify the Census data year, geographies (tract, block group, block or aggregation of one of these to an area specified), and source.

This estimation requires the following activities with the data described above:

1. To quantify the population exposed to various noise levels and that is at risk for being highly annoyed, use noise interval buffer areas calculated through modeling or based on measurements. Using a geographic information system (GIS), overlay buffers on Census tracts, measure the proportion of the Census tracts that falls within the buffer area, use that to weight the tracts' population in the buffer, and calculate the population of each buffer area.

2. Apply L_{dn}-associated %HA values to population figures to estimate the population at risk for high annoyance.

Estimating the Population at Risk for Sleep Disturbance from Roadway Noise

Research has indicated associations between self-reported disruptions in sleep due to nighttime noise from aircraft, road traffic, and railways (Griefahn and Robens 2006[2], Jakovljevic et al. 2006[4]). The WHO Community noise guidelines recommend 30 dB LA_{eq} (8 hours) indoor and 45 dB LA_{eq} (8 hours) outdoor as the threshold value for sleep disturbance.

Miedema et al. pooled findings from 14 studies of outdoor noise exposure and sleep disturbance to develop an exposure-response function at the population level for road traffic noise exposure and self-reported sleep disturbance as the response. The meta-analysis included 24 studies and estimated exposure-response curves for aircraft, road traffic, and railway noise. For each noise source, sound levels were plotted against degree of sleep disturbance. The following formula represents the exposure response curve for road traffic noise and can be used to estimate the percentage of the population that would be highly sleep disturbed (%HSD) if exposed to certain noise levels from road traffic (Miedema et al. 2002[6]).

$$\%HSD = 20.8 – 1.05L_n + 0.01486L_n^2$$

Where

L_n is the “average” nighttime A-weighted long-term LA_{eq} defined by the International Standards Organization (International Standards Organization 1987[3]) for the nighttime (10 p.m. to 7 a.m.) measured at the outside façade of the dwelling.

Given estimates of the population living within a certain distance of roadways and monitored or modeled noise (using the Federal Highway Administration's Traffic Noise Model (TNM) 2.5 (FHWA 2004[1]) based on the number of vehicles of various types and speeds passing specific locations per hour), it is possible to estimate, using this formula, the number of people that would be expected to be highly sleep disturbed based on their predicted exposure to nighttime noise from roadway traffic.

This estimation requires the following data:

1. Noise contours—Receptor distance specific LA_{eq} readings during the night (11 p.m. to 7 a.m.).
2. Location-specific and precise Census population estimates—Specify the Census data year, geographies (tract, block group, block or aggregation of one of these to an area we specify), and source.

This estimation requires the following activities with the data described above:

1. To quantify the population exposed to various noise levels and that is at risk for being highly sleep disturbed use noise interval buffer areas provided. Using a geographic information system (GIS), overlay buffers on Census tracts, measure the proportion of the Census tracts that falls within the

buffer area, use that to weight the tracts' population in the buffer, and to calculate the population of each buffer area.

2. Apply Ln-associated %HSD values to population figures to estimate the population at risk for high annoyance.

References

1. FHWA (Federal Highway Administration). 2004. "TNM Look-Up Tables." 2.5th edition. Washington DC.
2. Griefahn, B., A. Marks, and S. Robens. 2006. "Noise emitted from road, rail and air traffic and their effects on sleep." Journal of Sound and Vibration, 295: 129-140.
3. International Standards Organization. 1987. "Acoustics—Description and Measurement of Environmental Noise." ISO 1996-2. Geneva.
4. Jakovljević, B., G. Belojević, K. Paunović, and V. Stojanov. 2006. "Road Traffic Noise and Sleep Disturbances in an Urban Population: Cross-sectional Study." Croat Med J., 47: 125–133.
5. Miedema, H.M.E., and C.G.M. Oudshoorn. 2001. "Annoyance from Transportation Noise: Relationships with Exposure Metrics DNL and DENL and Their Confidence Intervals." Environ Health Perspect, 109(4): 409-416.
6. Miedema, H.M.E., W. Passchier-Vermeer, and H. Vos. 2002. "Elements for a position paper on night-time transportation noise and sleep disturbance." TNO Inro report, 2002-59. Available at: http://www.ocs.polito.it/biblioteca/mobilita/SleepDisturbance.pdf.