Health Risk Assessment

SR 710 North Study

Los Angeles County, California

Prepared for

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Metro

Los Angeles County
Metropolitan Transportation Authority

November 2014

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Executive Summary

Project Description

The California Department of Transportation (Caltrans), in cooperation with the Los Angeles County Metropolitan Transportation Authority (Metro), proposes transportation improvements to improve mobility and relieve congestion in the area between State Route (SR) 2 and Interstates 5, 10, 210, and 605 (I-5, I-10, I-210, and I-605, respectively) in east/northeast Los Angeles and the western San Gabriel Valley. The study area for the SR 710 North Study is approximately 100 square miles and generally bounded by I-210 on the north, I-605 on the east, I-10 on the south, and I-5 and SR 2 on the west. Caltrans is the lead agency under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

The lack of continuous north-south transportation facilities in the study area has the following consequences, which have been identified as the elements of need for the project:

- Degradation of the overall efficiency of the larger regional transportation system
- Congestion on freeways in the study area
- Congestion on the local streets in the study area
- Poor transit operations within the study area

The purpose of the proposed action is to effectively and efficiently accommodate regional and local north-south travel demands in the study area of the western San Gabriel Valley and east/northeast Los Angeles, including the following considerations:

- Improve efficiency of the existing regional freeway and transit networks.
- Reduce congestion on local arterials adversely affected due to accommodating regional traffic volumes.
- Minimize environmental impacts related to mobile sources.

The proposed alternatives for the project include the No Build Alternative, the Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative, the Bus Rapid Transit (BRT) Alternative, the Light Rail Transit (LRT) Alternative, and the Freeway Tunnel Alternative. Components of the TSM/TDM Alternative will also be included with the BRT, LRT, and Freeway Tunnel Alternatives.

The No Build Alternative does not include any planned improvements to the SR 710 Corridor. The No Build Alternative includes projects/planned improvements through 2035 that are contained in the Federal Transportation Improvement Program, as listed in the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan/Sustainable Communities Strategy Measure R (SCAG, 2012), and the funded portion of Metro's 2009 Long-Range Transportation Plan (Metro, 2009).

The TSM/TDM Alternative consists of strategies and improvements to increase efficiency and capacity for all modes in the transportation system with lower capital cost investments and/or lower potential impacts. The TSM/TDM Alternative is designed to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. TSM strategies include Intelligent Transportation Systems (ITS), local street and intersection improvements, and Active Traffic Management (ATM). The TDM strategies include expanded bus service, bus service improvements, and bicycle improvements.

The BRT Alternative would provide high-speed, high-frequency bus service through a combination of new, dedicated, and existing bus lanes, and mixed-flow traffic lanes to key destinations between East Los Angeles and Pasadena.

The LRT Alternative would include passenger rail operated along a dedicated guideway, similar to other Metro light rail lines. The LRT Alternative would begin on Mednik Avenue adjacent to the existing East Los Angeles Civic Center Station on the Metro Gold Line and end at Raymond Avenue adjacent to the existing Fillmore Station on the Metro Gold Line.

The Freeway Tunnel Alternative would start at the existing southern stub of SR 710 in Alhambra, just north of I-10, and connect to the existing northern stub of SR 710, south of the I-210/SR 134 interchange in Pasadena. The Freeway Tunnel Alternative has two design variations: a dual-bore tunnel and a single-bore tunnel. Five operational variations for the Freeway Tunnel Alternative include the Freeway Tunnel Alternative without Tolls, Freeway Tunnel Alternative with Trucks Excluded, Freeway Tunnel Alternative with Tolls, Freeway Tunnel Alternative with Tolls and Trucks Excluded, and Freeway Tunnel Alternative with Toll and Express Bus.

Health Risk Assessment Methodology

A health risk assessment (HRA) was performed for the SR 710 North Study (the project). The purpose of the HRA was to understand the localized and regional health risk impacts and benefits of the project. HRAs are typically performed for projects with stationary sources where emissions occur at a fixed location. Such HRAs follow guidance adopted by the Office of Environmental Health Hazard Assessment (OEHHA) and the California Air Resources Board (CARB), as well as guidance from the South Coast Air Quality Management District (SCAQMD). However, such guidance may not be well suited to transportation projects where emissions occur along a roadway over substantial distances.

Nonetheless, to address community concerns on the health impact from the project, a methodology was developed to assess the potential health risks associated with the project. The methodology is modeled after established protocols for stationary sources, but recognizes the spatial differences inherent in transportation projects. The HRA incorporated the methodologies specified in the following:

- *Air Toxics Hot Spots Program Risk Assessment Guidelines* (OEHHA, 2003)
- *Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk* (CARB, 2003)
- *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics “Hot Spots” Information and Assessment Act (AB2588)* (SCAQMD, 2011b)

In addition, HRA reports for several approved or ongoing transportation projects—such as the I-710 Corridor Project (ENVIRON, 2012), the Schuyler Heim Bridge Replacement and SR 47 Expressway Project (Western Solutions, Inc., 2008), the Berth 136-147 (TraPac) Container Terminal Project (Port of Los Angeles, 2007), and the Berth 97-109 (China Shipping) Container Terminal Project (Port of Los Angeles, 2008)—were reviewed and the HRA approaches in those reports were evaluated and used in this HRA when appropriate. Cancer and non-cancer chronic and acute risks were evaluated in the HRA. The HRA covered the entire study area, and focused on the vehicle emissions from the highways and principal arterials during the project operation.

The HRA was performed based on the emissions of seven priority Mobile Source Air Toxic (MSAT) compounds as established by the United States Environmental Protection Agency (EPA), including acrolein, benzene, 1,3-butidiene, diesel particulate matter (DPM), formaldehyde, naphthalene, and polycyclic organic matter (POM). In addition, although acetaldehyde was removed from EPA’s priority MSAT list in 2007, it was included in this HRA. MSAT emissions were estimated using the Caltrans CT-EMFAC model (Version 5); AERMOD air dispersion modeling was used to determine the ground-level concentrations of each MSAT. CARB’s Hotspots Analysis Reporting Program (HARP) was used to assess the toxic exposure and to estimate the incremental health risks of the project.

The HRA was performed using the following multistep approach to estimate health impact results:

1. Emission estimation to quantify project-generated MSAT emissions
2. Source characterization to define the emission sources
3. Air dispersion modeling to estimate the ground-level concentrations of MSATs at the receptors
4. Exposure assessment to evaluate the potential health effects at each receptor location

Two risk scenarios were evaluated in the HRA:

- Scenario 1 compared the risks of the no build and build alternatives to the existing condition in 2012.
- Scenario 2 compared the risks of the build alternatives to the No Build Alternative.

Health Risk Assessment Results

The project is intended to improve efficiency of the regional freeway and transit networks, and to reduce congestion on local arterials. Improved traffic conditions would increase vehicle travel speed and, in general, reduce vehicle emissions in the area. Therefore, the project would result in overall reduced cancer and non-cancer chronic and acute risks in the region. Some of the build alternatives, especially the Freeway Tunnel Alternative, would relocate some vehicle trips from existing traffic corridors to the new freeway tunnel that connects between I-10 and I-210/SR 134. This redistribution of the traffic volumes in the region could have the potential to cause localized health impacts in some areas. Results of the two HRA scenarios are summarized below.

Scenario 1: No Build and Build Alternatives vs. Existing Condition

Scenario 1 is the 70-year average emissions scenario that evaluates cancer risks starting at the project baseline of 2012, and extending to 2081. For informational purposes, cancer risks of 10 in 1 million were used as a reference level when evaluating the health impacts from the project for Scenario 1.

Cancer Risks

The Scenario 1 HRA indicated that the project would result in substantial regional benefits that reduce health risks from exposure to MSATs in the majority of the study area. Compared to the 2012 existing condition, the project would result in net benefits in the entire study area for all of the no build and the build alternatives.

The no build and all build alternatives would cause a net decrease of cancer risks compared to the 2012 existing condition everywhere in the study area, including locations at the point of maximum impact (PMI), maximally exposed individual resident (MEIR), and maximally exposed individual worker (MEIW) receptors. The cancer risk decreases ranged from 14.7 to 16 at the MEIR locations for the alternatives, and ranged from 3.46 to 3.71 at MEIW locations. The overall decreased cancer risk from the existing condition is consistent with the Federal Highway Administration (FHWA) forecasted nationwide DPM emission decrease trend attributed to the implementation of more stringent emission standards, the improvements of vehicle emission-control technologies, and improved fuel efficiency, regardless of the regional vehicle miles traveled (VMT) increase in future years.

The majority of the cancer risks near the freeways are attributed to DPM emissions from vehicle travel. Due to the installation of the particulate matter control system at the tunnel ventilation system, vehicle emissions from the tunnel ventilation towers contribute minimally to the cancer risks at the MEIR and MEIW locations.

Chronic and Acute Risks

The hazard index (HI), both chronic (HIC) and acute (HIA), for the project no build and all build alternatives is either less than zero (net benefits) or much lower than the HIC and HIA threshold of 1.0 compared to the existing condition. The worst-case HIC of 0.039 occurs with the Freeway Tunnel Dual-Bore without Toll (T2_V4) variation at the western boundary of the SR 710 right-of-way (ROW) near the freeway tunnel north portal area. The worst-case HIA of 0.0047 occurs with the T2_V4 variation near the freeway tunnel south portal.

Scenario 2: Build Alternatives vs. No Build Alternative

Scenario 2 of the HRA compares the potential health risk impacts of the build alternatives to the No Build Alternative. Because the vehicle MSAT emissions would decrease in future years, the health risk analysis under Scenario 2 used the worst-case emissions during project operation—emissions from the project opening year (2020 or 2025). As such, the Scenario 2 HRA results represent conservative estimates of the risks.

Cancer Risks

Compared to the No Build Alternative, cancer risks would increase in some of the areas, and decrease in other areas of the region, depending on how each alternative would shift the traffic locally or regionally. The levels of cancer risk increase caused by the TSM/TDM, BRT, and LRT Alternatives at MEIR, MEIW, and sensitive receptors range from 0.058 to 9.52 in 1 million. MEIR and MEIW locations of the TSM/TDM, BRT, and LRT Alternatives are near the intersections of Fremont Avenue/West Main, Fremont Avenue/Beech Street, and Fremont Avenue/ Valley Boulevard.

Maximum incremental cancer risks from the Freeway Tunnel Alternative and the variations range from 0.13 at a student receptor to 149 in 1 million at the MEIR location. The design variations that restrict truck access to the new freeway tunnel have lower incremental cancer risks at MEIR and MEIW locations than design variations that allow trucks. The maximally impacted locations of the Freeway Tunnel Alternative are near the north portal area and the I-5/I-10 interchange.

Although cancer risks may increase from the no build condition at the maximally impacted locations, each build alternative would also have health benefits that reduce cancer risk in the study area. In general, the TSM/TDM, BRT, and LRT Alternatives would result in lower levels of cancer risk increase or decrease in the study area compared to the Freeway Tunnel Alternative. Areas of impacts or benefits are scattered throughout the study area, depending on how the vehicle traffic pattern would shift under the TSM/TDM, BRT, or LRT Alternatives.

For the Freeway Tunnel Alternative, the majority of the study area would have net cancer risk benefits; the impact areas with higher cancer risk increases are primarily near the two freeway tunnel portals and the nearby interchanges. The extent of the areas and the levels of cancer risk decrease or increase are dependent on the tunnel configuration, operational variation, and whether the tunnel would allow truck access. Near the tunnel portal areas where most of the impacts would occur, the single-bore design would have a lower level of risk increase and smaller impacted areas than the dual-bore design with similar operational features. However, the single-bore design would also have less risk reduction and smaller beneficial areas at other locations than the dual-bore design.

Chronic and Acute Risks

Compared to the No Build Alternative, all of the build alternatives would cause minimal HIC and HIA increases under Scenario 2. The Dual-Bore without Toll (T2_V4) variation has the worst-case HIC increase of 0.11 near the north portal and the worst-case HIA increase of 0.047 at a residential receptor location near the south portal.

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Signature Page

The following individuals have participated in the preparation of the *SR 710 North Study, Health Risk Assessment*, or have completed quality review, or both.

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Acronyms and Abbreviations

°F	degrees Fahrenheit
μg/m^3	micrograms per cubic meter
ATM	Active Traffic Management
BRT	Bus Rapid Transit
Cal State LA	California State University, Los Angeles
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CMS	changeable message signs
DPM	diesel particulate matter
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ELAC	East Los Angeles College
EPA	United States Environmental Protection Agency
FHWA	Federal Highway Administration
fpm	feet per minute
g/s	grams per second
GIS	geographic information system
HARP	Hotspots Analysis Reporting Program
HHD	heavy heavy-duty trucks
HI	hazard index
HIA	hazard index (acute)
HIC	hazard index (chronic)
HRA	health risk assessment
I	Interstate
ITS	Intelligent Transportation Systems
K-12	kindergarten through 12th grade
L/kg body weight-day	liters per kilogram body weight per day
LHD	light heavy-duty trucks
LRT	Light Rail Transit
MEIR	maximally exposed individual resident
MEIW	maximally exposed individual worker

Metro	Los Angeles County Metropolitan Transportation Authority
MHD	medium heavy-duty trucks
mph	miles per hour
MSA	Metropolitan Statistical Area
MSAT	mobile source air toxic
NAD 83	North American Datum 1983
NED	National Elevation Dataset
NEPA	National Environmental Policy Act
O&M	operations and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
POM	polycyclic organic matter
PMI	point of maximum impact
REL	reference exposure level
ROW	right-of-way
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SR	State Route
TDM	Transportation Demand Management
TSM	Transportation System Management
TSSP	Traffic Signal Synchronization Program
US-101	United States Route 101
USGS	United States Geological Survey
UTM	universal transverse Mercator
VMT	vehicle miles traveled
Western	Western Solutions, Inc.

SECTION 1

Project Description

1.1 Introduction

The California Department of Transportation (Caltrans), in cooperation with the Los Angeles County Metropolitan Transportation Authority (Metro), proposes transportation improvements to improve mobility and relieve congestion in the area between State Route (SR) 2 and Interstates 5, 10, 210, and 605 (I-5, I-10, I-210, and I-605, respectively) in east/northeast Los Angeles and the western San Gabriel Valley. The study area for the SR 710 North Study, as shown in Figure 1-1, is approximately 100 square miles and generally bounded by I-210 on the north, I-605 on the east, I-10 on the south, and I-5 and SR 2 on the west. Caltrans is the lead agency under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

1.2 Purpose and Need

1.2.1 Purpose of the Project

Due to the lack of continuous north-south transportation facilities in the study area, there is congestion on freeways, cut-through traffic that affects local streets, and low-frequency transit operations in the study area. Therefore, the following project purpose has been established.

The purpose of the proposed action is to effectively and efficiently accommodate regional and local north-south travel demands in the study area of the western San Gabriel Valley and east/northeast Los Angeles, including the following considerations:

- Improve efficiency of the existing regional freeway and transit networks.
- Reduce congestion on local arterials adversely affected due to accommodating regional traffic volumes.
- Minimize environmental impacts related to mobile sources.

1.2.2 Need for the Project

The study area is centrally located within the extended urbanized area of Southern California. With few exceptions, the area from Santa Clarita in the north to San Clemente in the south (a distance of approximately 90 miles) is continuously urbanized. Physical features such as the San Gabriel Mountains and Angeles National Forest on the north, and the Puente Hills and Cleveland National Forest on the south, have concentrated urban activity between the Pacific Ocean and these physical constraints. This urbanized area functions as a single social and economic region that is identified by the Census Bureau as the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area (MSA).

There are seven major east-west freeway routes:

- SR 118
- United States Route 101 (US-101)/SR 134/I-210
- I-10
- SR 60
- I-105
- SR 91
- SR 22

There are seven major north-south freeway routes:

- I-405
- US-101/SR 170
- I-5
- I-110/SR 110
- I-710
- I-605
- SR 57

All of these major routes are located in the central portion of the Los Angeles-Long Beach-Santa Ana MSA. Of the seven north-south routes, four are located partially within the study area (I-5, I-110/SR 110, I-710, and I-605), two of which (I-110/SR 110 and I-710) terminate within the study area without connecting to another freeway. As a result, a substantial amount of north-south regional travel demand is concentrated on a few freeways, or diverted to local streets within the study area. This effect is exacerbated by the overall southwest-to-northeast orientation of I-605, which makes it an unappealing route for traffic between the southern part of the region and the urbanized areas to the northwest in the San Fernando Valley, the Santa Clarita Valley, and the Arroyo-Verdugo region.

The lack of continuous north-south transportation facilities in the study area has the following consequences, which have been identified as the elements of need for the project:

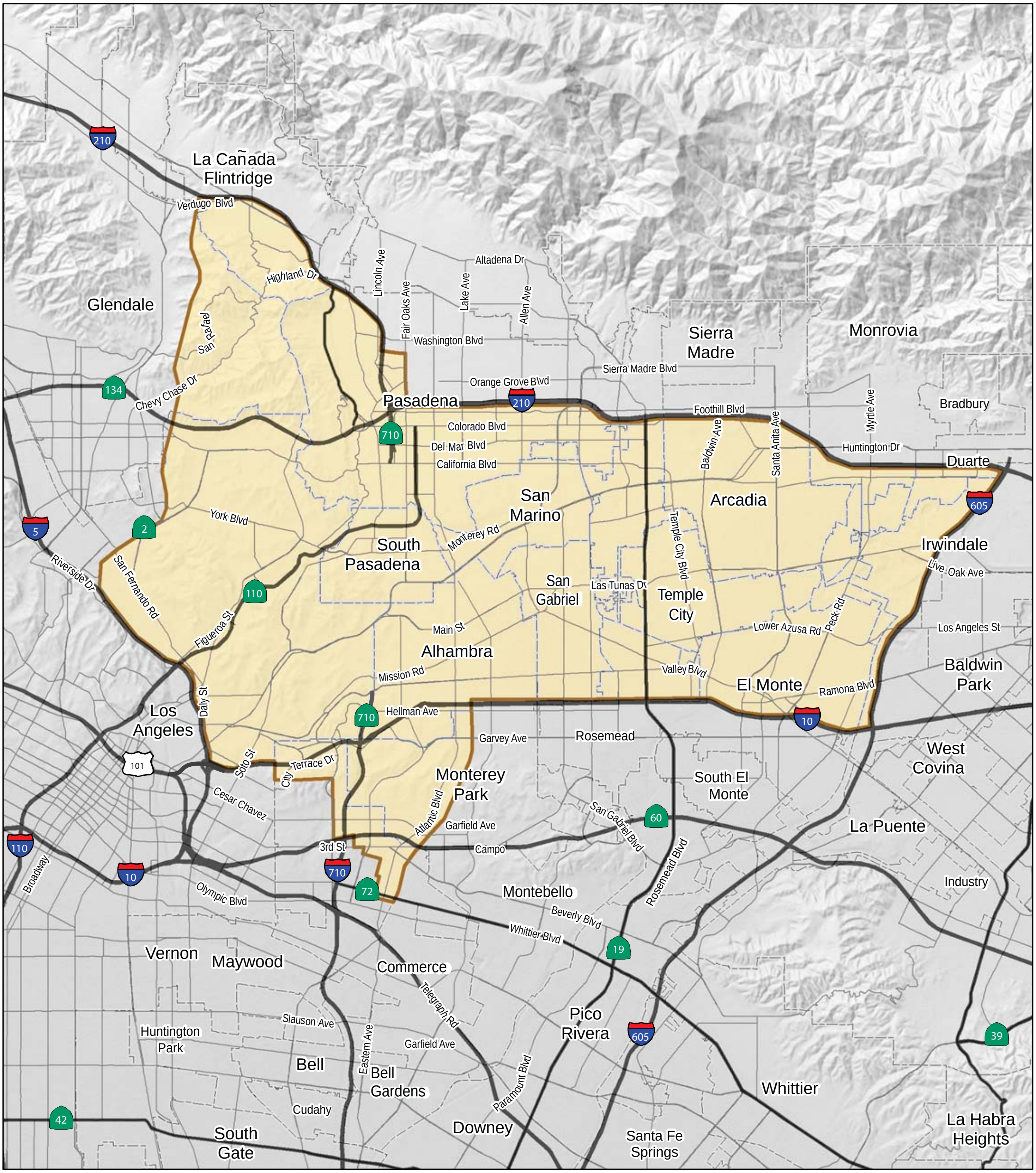
- Degradation of the overall efficiency of the larger regional transportation system
- Congestion on freeways in the study area
- Congestion on the local streets in the study area
- Poor transit operations within the study area

1.3 Alternatives

The proposed alternatives include the No Build Alternative, the Transportation System Management/ Transportation Demand Management (TSM/TDM) Alternative, the Bus Rapid Transit (BRT) Alternative, the Light Rail Transit (LRT) Alternative, and the Freeway Tunnel Alternative. These alternatives are each discussed below.

1.3.1 No Build Alternative

The No Build Alternative includes projects/planned improvements through 2035 that are contained in the Federal Transportation Improvement Program, as listed in the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan/Sustainable Communities Strategy Measure R (SCAG, 2012), and the funded portion of Metro's 2009 Long-Range Transportation Plan (Metro, 2009). The No Build Alternative does not include any planned improvements to the SR 710 Corridor. Figure 1-2 illustrates the projects in the No Build Alternative.



LEGEND

SR 710 North Study Area

N

0 1.25 2.5

MILES

SOURCE: ESRI (2008); LSA (2013)

FIGURE 1-1

Project Location

Health Risk Assessment

SR 710 North Study

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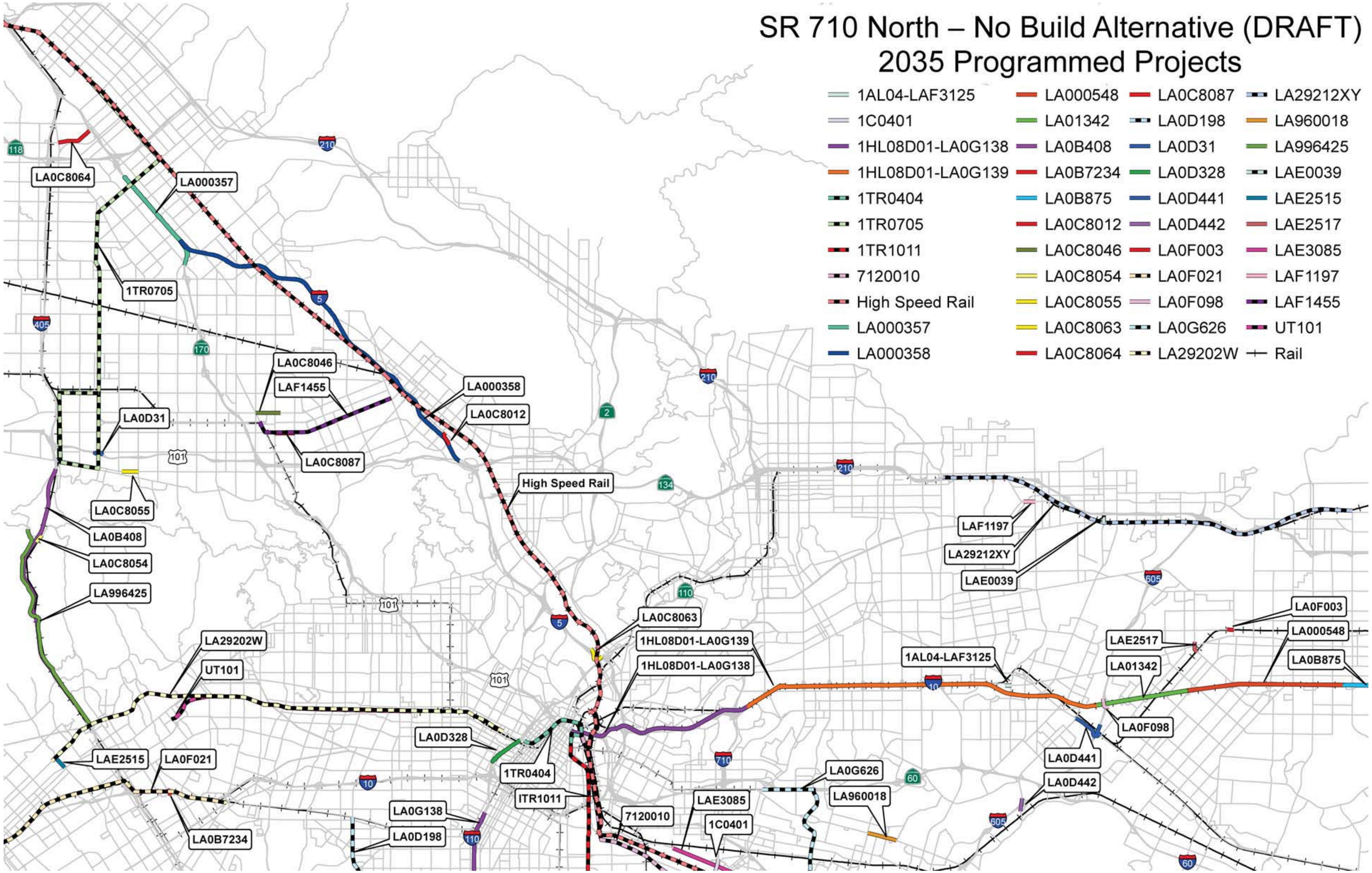

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NOT TO SCALE

SOURCE: CH2M HILL (2013)

FIGURE 1-2
No Build Alternative
Health Risk Assessment
SR 710 North Study

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1.3.2 Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative

The TSM/TDM Alternative consists of strategies and improvements to increase efficiency and capacity for all modes in the transportation system with lower capital cost investments and/or lower potential impacts. The TSM/TDM Alternative is designed to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. Components of the TSM/TDM Alternative are shown in Figure 1-3. TSM strategies increase the efficiency of existing facilities (that is, TSM strategies are actions that increase the number of vehicle trips that a facility can carry without increasing the number of through lanes).

1.3.2.1 Transportation System Management

TSM strategies include Intelligent Transportation Systems (ITS), local street and intersection improvements, and Active Traffic Management (ATM):

- **ITS Improvements:** ITS improvements include traffic signal upgrades, synchronization and transit prioritization, arterial changeable message signs (CMS), and arterial video and speed data collection systems. The TSM/TDM Alternative includes signal optimization on corridors with signal coordination hardware already installed by Metro's Traffic Signal Synchronization Program (TSSP). These corridors include Del Mar Avenue, Rosemead Boulevard, Temple City Boulevard, Santa Anita Avenue, Fair Oaks Avenue, Fremont Avenue, and Peck Road. The only remaining major north-south corridor in the San Gabriel Valley in which TSSP has not been implemented is Garfield Avenue; therefore, TSSP on this corridor is included in the TSM/TDM Alternative. The locations are shown in Table 1-1. The following provides a further explanation of the ITS elements listed above:
  - Traffic signal upgrades include turn arrows, vehicle and/or bicycle detection, pedestrian countdown timers, incorporation into regional management traffic center for real-time monitoring of traffic, and updating of signal timing.
  - Synchronization is accomplished through signal coordination to optimize travel times and reduce delay.
  - Transit signal prioritization includes adjusting signal times for transit vehicles to optimize travel times for public transit riders.
  - Arterial CMS are used to alert travelers about unusual road conditions, special event traffic, accident detours, and other incidents.
  - Video and speed data collection includes cameras and other vehicle detection systems that are connected to a central monitoring location, allowing for faster detection and response to traffic incidents and other unusual traffic conditions.
- **Local Street and Intersection Improvements:** The local street and intersection improvements are within the cities of Los Angeles, Pasadena, South Pasadena, Alhambra, San Gabriel, Rosemead, and San Marino. Table 1-2 outlines the location of the proposed improvements to local streets, intersections, and freeway ramps, as well as two new local roadways.
- **Active Traffic Management:** ATM technology and strategies are also included in the TSM/TDM Alternative. The major elements of ATM are arterial speed data collection and CMS. Data on arterial speeds would be collected and distributed through Los Angeles County's Information Exchange Network. Many technologies are available for speed data collection, or the data could be purchased from a third-party provider. Travel time data collected through this effort could be provided to navigation system providers for distribution to the traveling public. In addition, arterial CMS or "trailblazer" message signs would be installed at key locations to make travel time and other traffic data available to the public.

TABLE 1-1
TSM/TDM Alternative Elements

ID No.	Description	Location
	ITS Improvements	
ITS-1	Transit Signal Priority	Rosemead Boulevard (from Foothill Boulevard to Del Amo Boulevard)
ITS-2	Install Video Detection System on SR 110	SR 110 north of US-101
ITS-3	Install Video Detection System at Intersections	At key locations in study area
ITS-4	Arterial Speed Data Collection	On key north/south arterials
ITS-5	Install Arterial CMS	At key locations in study area
ITS-6	Traffic Signal Synchronization on Garfield Avenue	Huntington Drive to I-10
ITS-7	Signal optimization on Del Mar Avenue	Huntington Drive to I-10
ITS-8	Signal optimization on Rosemead Boulevard	Foothill Boulevard to I-10
ITS-9	Signal optimization on Temple City Boulevard	Duarte Road to I-10
ITS-10	Signal optimization on Santa Anita Avenue	Foothill Boulevard to I-10
ITS-11	Signal optimization on Peck Road	Live Oak Avenue to I-10
ITS-12	Signal optimization on Fremont Avenue	Huntington Drive to I-10

1.3.2.2 Transportation Demand Management

TDM strategies focus on regional means of reducing the number of vehicle trips and vehicle miles traveled (VMT), as well as increasing vehicle occupancy. TDM strategies facilitate higher vehicle occupancy or reduce traffic congestion by expanding the traveler's transportation options in terms of travel method, travel time, travel route, travel costs, and the quality and convenience of the travel experience. The TDM strategies include reducing the demand for travel during peak periods, reducing the use of motor vehicles, shifting the use of motor vehicles to uncongested times of the day, encouraging rideshare and transit use, eliminating trips (that is, telecommuting), and improving transportation options. The TDM strategies include expanded bus service, bus service improvements, and bicycle improvements.

- **Expanded Bus Service and Bus Service Improvements:** Transit service improvements included in the TSM/TDM Alternative are summarized in Tables 1-3 and 1-4 and illustrated in Figure 1-3. The transit service improvements enhance bus headways between 10 and 30 minutes during the peak hour and between 15 and 60 minutes during the off-peak period. Bus headways are the amount of time between consecutive bus trips (traveling in the same direction) on the bus route. Some of the bus service enhancements almost double existing bus service.
- **Bicycle Facility Improvements:** The bicycle facility improvements include on-street Class III bicycle facilities that support access to transit facilities through the study area and expansion of bicycle parking facilities at existing Metro Gold Line Stations. Proposed bicycle facility improvements are outlined in Table 1-4.

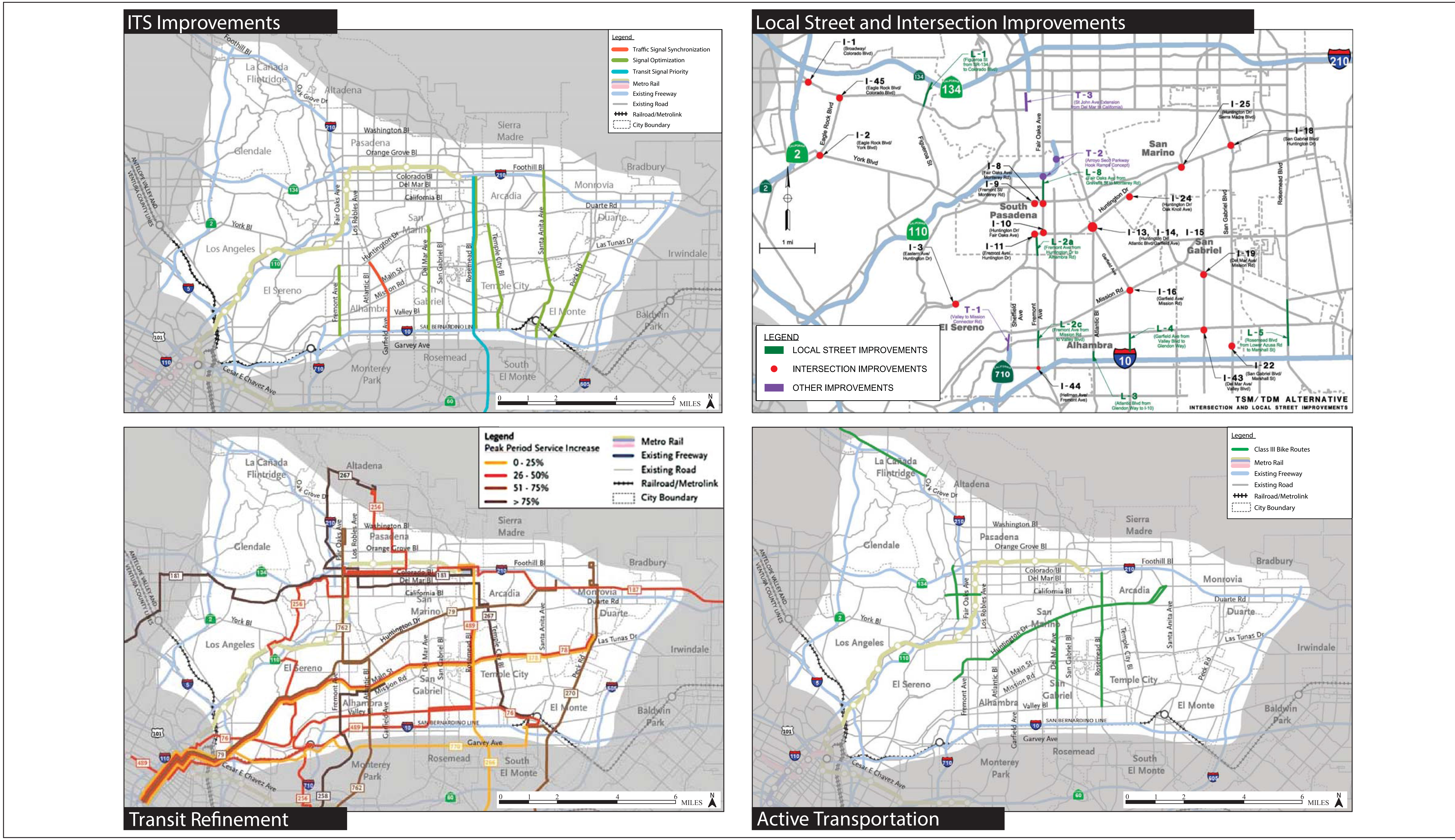

FIGURE 1-3
TSM/TDM Alternative
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SOURCE: CH2M HILL (2013)

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TABLE 1-2
Local Street and Intersection Improvements of the TSM/TDM Alternative

ID No.	Description	Location
	Local Street Improvements	
L-1	Figueroa Street from SR 134 to Colorado Boulevard	City of Los Angeles (Eagle Rock)
L-2a	Fremont Avenue from Huntington Drive to Alhambra Road	City of South Pasadena
L-2c	Fremont Avenue from Mission Road to Valley Boulevard	City of Alhambra
L-3	Atlantic Boulevard from Glendon Way to I-10	City of Alhambra
L-4	Garfield Avenue from Valley Boulevard to Glendon Way	City of Alhambra
L-5	Rosemead Boulevard from Lower Azusa Road to Marshall Street	City of Rosemead
L-8	Fair Oaks Avenue from Grevelia Street to Monterey Road	City of South Pasadena
	Intersection Improvements	
I-1	West Broadway/Colorado Boulevard	City of Los Angeles (Eagle Rock)
I-2	Eagle Rock Boulevard/York Boulevard	City of Los Angeles (Eagle Rock)
I-3	Eastern Avenue/Huntington Drive	City of Los Angeles (El Sereno)
I-8	Fair Oaks Avenue/Monterey Road	City of South Pasadena
I-9	Fremont Street/Monterey Road	City of South Pasadena
I-10	Huntington Drive/Fair Oaks Avenue	City of South Pasadena
I-11	Fremont Avenue/Huntington Drive	City of South Pasadena
I-13	Huntington Drive/Garfield Avenue	Cities of Alhambra/South Pasadena/San Marino
I-14	Huntington Drive/Atlantic Boulevard	Cities of Alhambra/South Pasadena/San Marino
I-15	Atlantic Boulevard/Garfield Avenue	Cities of Alhambra/South Pasadena/San Marino
I-16	Garfield Avenue/Mission Road	City of Alhambra
I-18	San Gabriel Boulevard/Huntington Drive	City of San Marino/Unincorporated Los Angeles County (East Pasadena/East San Gabriel)
I-19	Del Mar Avenue/Mission Road	City of San Gabriel
I-22	San Gabriel Boulevard/Marshall Street	City of San Gabriel
I-24	Huntington Drive/Oak Knoll Avenue	City of San Marino
I-25	Huntington Drive/San Marino Avenue	City of San Marino
I-43	Del Mar Avenue/Valley Boulevard	City of San Gabriel
I-44	Hellman Avenue/Fremont Avenue	City of Alhambra
I-45	Eagle Rock Boulevard/Colorado Boulevard	City of Los Angeles (Eagle Rock)
	Other Road Improvements	
T-1	Valley Boulevard to Mission Road Connector Road	Cities of Alhambra/Los Angeles (El Sereno)
T-2	SR 110/Fair Oaks Avenue Hook Ramps	Cities of South Pasadena/Pasadena
T-3	St. John Avenue Extension between Del Mar Boulevard and California Boulevard	City of Pasadena

TABLE 1-3
Transit Refinements of the TSM/TDM Alternative

Bus Route	Operator	Route Type	Route Description	Existing Headways		Enhanced Headways	
				Peak	Off-Peak	Peak	Off-Peak
70	Metro	Local	From Downtown Los Angeles to El Monte via Garvey Avenue	10-12	15	10	15
770	Metro	Rapid	From Downtown Los Angeles to El Monte via Garvey Avenue/Cesar Chavez Avenue	10-13	15	10	15
76	Metro	Local	From Downtown Los Angeles to El Monte via Valley Boulevard	12-15	16	10	15
78	Metro	Local	From Downtown Los Angeles to Irwindale via Las Tunas Drive	10-20	16-40	10	15
378	Metro	Limited	From Downtown Los Angeles to Irwindale via Las Tunas Drive	18-23	-	20	30
79	Metro	Local	From Downtown Los Angeles to Santa Anita via Huntington Drive	20-30	40-45	15	30
180	Metro	Local	From Hollywood to Altadena via Los Feliz/Colorado Boulevard	30	30-32	15	30
181	Metro	Local	From Hollywood to Pasadena via Los Feliz/Colorado Boulevard	30	30-32	15	30
256	Metro	Local	From Commerce to Altadena via Hill Avenue/Avenue 64/Eastern Avenue	45	45	30	40
258	Metro	Local	From Paramount to Alhambra via Fremont Avenue/Eastern Avenue	48	45-55	20	30
260	Metro	Local	From Compton to Altadena via Fair Oaks Avenue/Atlantic Boulevard	16-20	24-60	15	30
762[1]	Metro	Rapid	From Compton to Altadena via Atlantic Boulevard	25	30-60	15	30
266	Metro	Local	From Lakewood to Pasadena via Rosemead Boulevard/Lakewood Boulevard	30-35	40-45	15	30
267	Metro	Local	From El Monte to Pasadena via Temple City Boulevard/Del Mar Boulevard	30	30	15	30
485	Metro	Express	From Union Station to Altadena via Fremont/Lake Avenue	40	60	30	60
487	Metro	Express	From Westlake to El Monte via Santa Anita Avenue/Sierra Madre Boulevard/San Gabriel Boulevard	18-30	45	15	30
489	Metro	Express	From Westlake to East San Gabriel via Rosemead Boulevard	18-20	-	15	-
270	Metro	Local	From Norwalk to Monrovia via Workman Mill/Peck Road	40-60	60	30	60
780	Metro	Rapid	From West LA to Pasadena via Fairfax Avenue/Hollywood Boulevard/Colorado Boulevard	10-15	22-25	10	20
187	Foothill	Local	From Pasadena to Montclair via Colorado Boulevard/Huntington Drive/Foothill Boulevard	20	20	15	15

[1] This route would not be included as part of the BRT Alternative because the BRT Alternative would replace this service.

Express – Express Bus

Foothill – Foothill Transit

Rapid – Bus Rapid Transit

TABLE 1-4
Active Transportation and Bus Enhancements of the TSM/TDM Alternative

ID No.	Description	Location
	Bus Service Improvements	
Bus-1	Additional bus service	See Table 1-3 and Figure 1-3
Bus-2	Bus stop enhancements	Along TSM routes
	Bicycle Facility Improvements	
Bike-1	Rosemead Boulevard bike route (Class III)	Colorado Boulevard to Valley Boulevard (through Los Angeles County, Temple City, Rosemead)
Bike-2	Del Mar Avenue bike route (Class III)	Huntington Drive to Valley Boulevard (through San Marino, San Gabriel)
Bike-3	Huntington Drive bike route (Class III)	Mission Road to Santa Anita Avenue (through the City of Los Angeles, South Pasadena, San Marino, Alhambra, Los Angeles County, Arcadia)
Bike-4	Foothill Boulevard bike route (Class III)	In La Cañada Flintridge
Bike-5	Orange Grove bike route (Class III)	Walnut Street to Columbia Street (in Pasadena)
Bike-6	California Boulevard bike route (Class III)	Grand Avenue to Marengo Avenue (in Pasadena)
Bike-7	Add bike parking at transit stations	Metro Gold Line Stations
Bike-8	Improve bicycle detection at existing intersections	Along bike routes in study area

1.3.3 Bus Rapid Transit (BRT) Alternative

The BRT Alternative would provide high-speed, high-frequency bus service through a combination of new, dedicated, and existing bus lanes, and mixed-flow traffic lanes to key destinations between East Los Angeles and Pasadena. The proposed route length is approximately 12 miles. Figure 1-4 illustrates the BRT Alternative.

The BRT Alternative includes the BRT trunk line arterial street and station improvements, frequent bus service, new bus feeder services, and enhanced connecting bus services. BRT includes bus enhancements identified in the TSM/TDM Alternative, except for improvements to Metro Route 762.

Buses are expected to operate every 10 minutes during peak hours and every 20 minutes during off-peak hours. The BRT service would generally replace, within the study area, the existing Metro Route 762 service. The 12-mile route would begin at Atlantic Boulevard and Whittier Boulevard to the south; follow Atlantic Boulevard, Huntington Drive, Fair Oaks Avenue, and Del Mar Boulevard; and end with a terminal loop in Pasadena to the north. Buses operating in the corridor would be given transit signal priority from a baseline transit signal priority project that will be implemented separately by Metro.

Where feasible, buses would run in dedicated bus lanes adjacent to the curb, either in one direction or both directions, during peak periods. The new, dedicated bus lanes would generally be created within the existing street rights-of-way (ROW) through a variety of methods that include restriping the roadway, restricted on-street parking during peak periods, narrowing medians, planted parkways, or sidewalks. Buses would share existing lanes with other traffic in cases where there is not enough ROW. The exclusive lanes would be exclusive to buses and right-turning traffic during a.m. and p.m. peak hours only. At other times of day, the exclusive lanes would be available for on-street parking use.

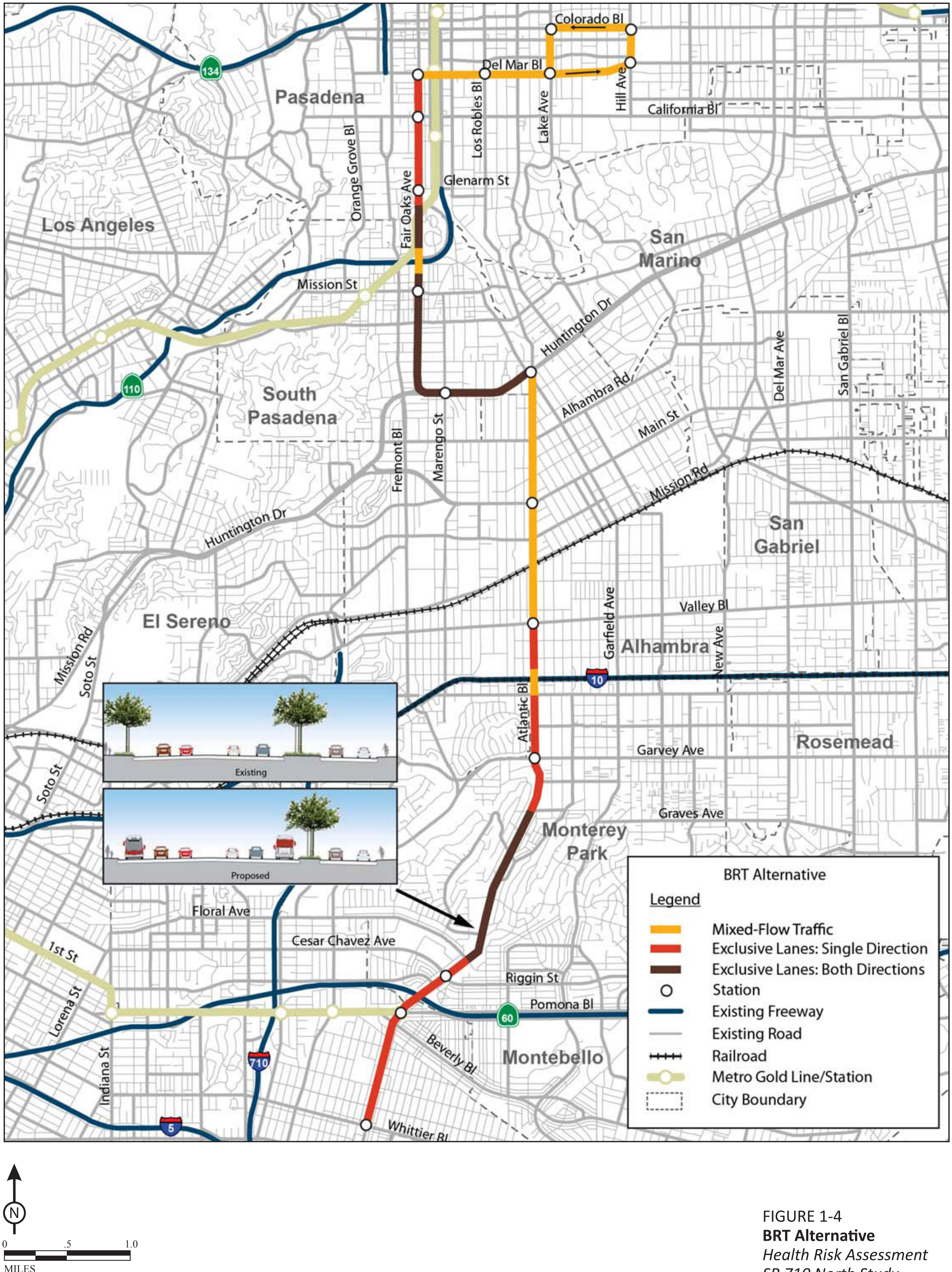
A total of 17 BRT stations with amenities would be placed, on average, at approximately 0.8-mile intervals at major activity centers and cross streets. Typical station amenities would include new shelters, branding elements, seating, wind screens, leaning rails, variable message signs (next bus information), lighting, bus waiting signals, trash receptacles, and stop markers. Some of these stops will be combined with existing stops, while in some cases, new stops for BRT will be provided. The BRT service would include 60-foot articulated buses with three doors, and would have the latest fare collection technology such as on-board smart card (Transit Access Pass [TAP] card) readers to reduce dwell times at stations.

The BRT stops would be provided at the following 17 locations:

- Atlantic Boulevard at Whittier Boulevard
- Atlantic Boulevard between Pomona Boulevard and Beverly Boulevard
- Atlantic Boulevard at Cesar Chavez Avenue/Riggin Street
- Atlantic Boulevard at Garvey Avenue
- Atlantic Boulevard at Valley Boulevard
- Atlantic Boulevard at Main Street
- Huntington Drive at Garfield Avenue
- Huntington Drive at Marengo Avenue
- Fair Oaks Avenue at Mission Street
- Fair Oaks Avenue at Glenarm Street
- Fair Oaks Avenue at California Boulevard
- Fair Oaks Avenue at Del Mar Boulevard
- Del Mar Boulevard at Los Robles Avenue
- Del Mar Boulevard at Lake Avenue
- Del Mar Boulevard at Hill Avenue (single direction only)
- Colorado Boulevard at Hill Avenue (single direction only)
- Colorado Boulevard at Lake Avenue (single direction only)

Additionally, this alternative would include bus feeder routes that would connect additional destinations with the BRT mainline. Two bus feeder routes are proposed: one that would run along Colorado Boulevard, Rosemead Boulevard, and Valley Boulevard to the El Monte transit station; and another bus feeder route that would travel from Atlantic Boulevard near the Gold Line Station to the Metrolink stations in the City of Commerce and Montebello via Beverly Boulevard and Garfield Avenue. In addition, other existing bus services in the study area would be increased in frequency and/or span of service. The El Sol shuttle improvements are an existing bus service that would be increased in frequency. The headways on the El Sol shuttle “City Terrace/East Los Angeles College (ELAC)” route that connect ELAC to the proposed Floral Station would be reduced from 60 minutes to 15 minutes.

The TSM/TDM Alternative improvements would also be constructed as part of the BRT Alternative, except as noted below. These improvements would provide the additional enhancements to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. Local Street Improvements L-8 (Fair Oaks Avenue from Grevelia Street to Monterey Road) and the reversible lane component of L-3 (Atlantic Boulevard from Glendon Way to I-10) would not be constructed with the BRT Alternative.



SOURCE: CH2M HILL (2013)

FIGURE 1-4
BRT Alternative
Health Risk Assessment
SR 710 North Study

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1.3.4 Light Rail Transit (LRT) Alternative

The LRT Alternative would include passenger rail operated along a dedicated guideway, similar to other Metro light rail lines. The LRT alignment is approximately 7.5 miles long, with 3 miles of aerial segments and 4.5 miles of bored tunnel segments. Figure 1-5 illustrates the LRT Alternative.

The LRT Alternative would begin at an aerial station on Mednik Avenue adjacent to the existing East Los Angeles Civic Center Station on the Metro Gold Line. The alignment would remain elevated as it travels north on Mednik Avenue, west on Floral Drive, north across Corporate Center Drive, and then along the west side of I-710, primarily in Caltrans ROW, to a station adjacent to the California State University, Los Angeles (Cal State LA). The alignment would descend into a tunnel south of Valley Boulevard and travel northeast to Fremont Avenue, north under Fremont Avenue, and easterly to Fair Oaks Avenue. The alignment would then cross under SR 110 and end at an underground station beneath Raymond Avenue adjacent to the existing Fillmore Station on the Metro Gold Line.

Two directional tunnels are proposed with tunnel diameters approximately 20 feet each, located approximately 60 feet below the ground surface. Other supporting tunnel systems include emergency evacuation cross passages for pedestrians, a ventilation system consisting of exhaust fans at each portal and an exhaust duct along the entire length of the tunnel, fire detection and suppression systems, communications and surveillance systems, and 24-hour monitoring, similar to the existing LRT system.

Trains would operate at speeds of up to 65 miles per hour (mph) approximately every 5 minutes during peak hours and every 10 minutes during off-peak hours.

Seven stations would be located along the LRT alignment at Mednik Avenue in East Los Angeles, Floral Drive in Monterey Park, Cal State LA, Fremont Avenue in Alhambra, Huntington Drive in South Pasadena, Mission Street in South Pasadena, and Fillmore Street in Pasadena. The Fremont Avenue Station, the Huntington Drive Station, the Mission Street Station, and the Fillmore Street Station would be underground stations. New park-and-ride facilities would be provided at all of the proposed stations except for the Mednik Avenue, Cal State LA, and Fillmore Street Stations.

A maintenance yard to clean, maintain, and store light rail vehicles would be located on both sides of Valley Boulevard at the terminus of SR 710. A track spur from the LRT mainline to the maintenance yard would cross above Valley Boulevard.

Two bus feeder services would be provided. One would travel from the Commerce Station on the Orange County Metrolink line and the Montebello Station on the Riverside Metrolink line to the Floral Station, via ELAC. The other would travel from the El Monte Bus Station to the Fillmore Station via Rosemead and Colorado Boulevards. In addition, other existing bus services in the study area would be increased in frequency and/or span of service. As part of the LRT Alternative, the I-710 northbound off-ramp at Valley Boulevard would be modified.

The TSM/TDM Alternative improvements would also be constructed as part of the LRT Alternative. These improvements would provide the additional enhancements to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. The only component of the TSM/TDM Alternative improvements that would not be constructed with the LRT Alternative is Other Road improvements T-1 (Valley Boulevard to Mission Road Connector Road).

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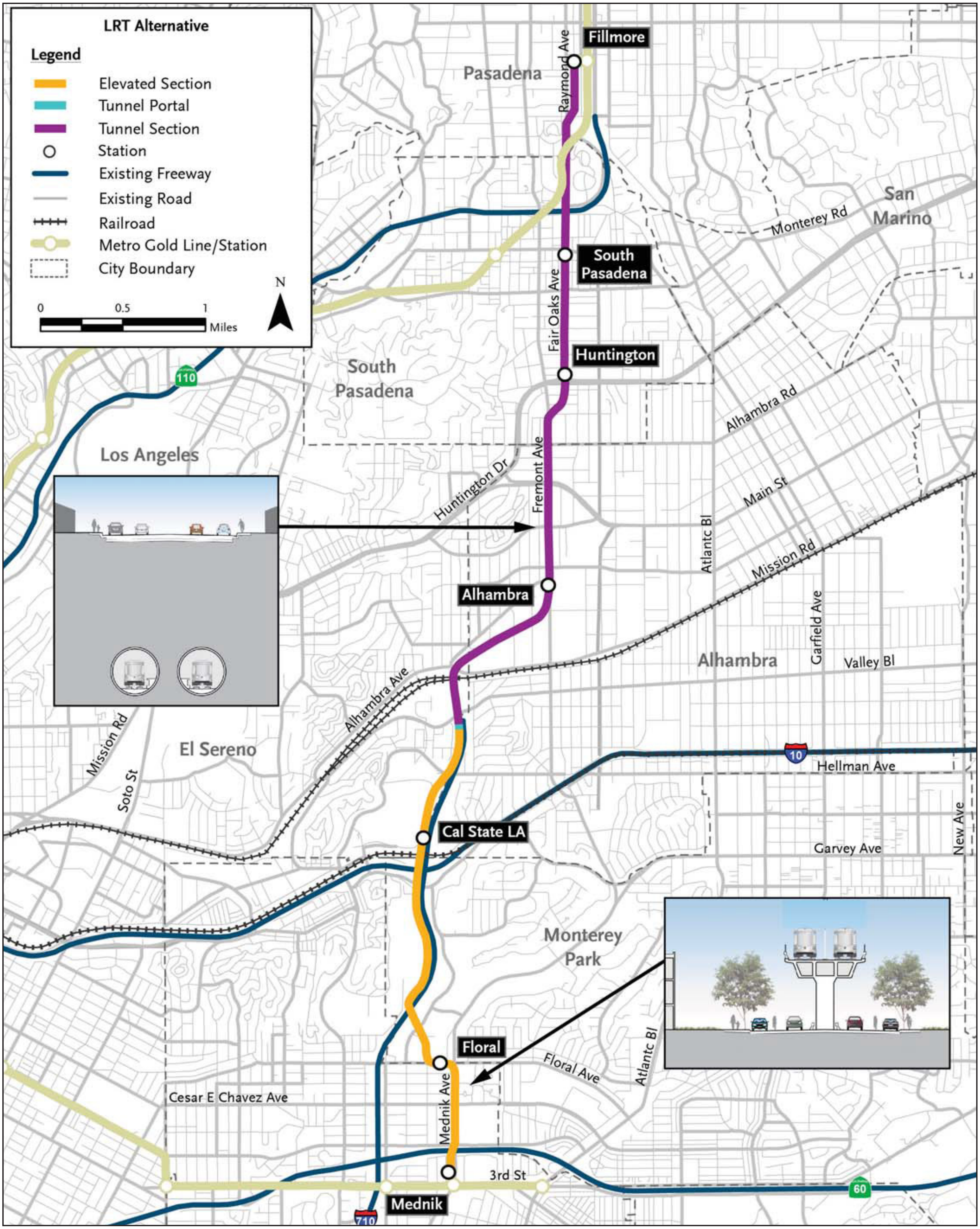

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FIGURE 1-5
LRT Alternative
Health Risk Assessment
SR 710 North Study

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1.3.5 Freeway Tunnel Alternative

The alignment for the Freeway Tunnel Alternative starts at the existing southern stub of SR 710 in Alhambra, just north of I-10, and connects to the existing northern stub of SR 710 south of the I-210/SR 134 interchange in Pasadena. The Freeway Tunnel Alternative would include the following tunnel support systems: emergency evacuation for pedestrians and vehicles, air scrubbers, a ventilation system consisting of exhaust fans at each portal, an exhaust duct along the entire length of the tunnel and jet fans within the traffic area of the tunnel, fire detection and suppression systems, communications and surveillance systems, and 24-hour monitoring. An operations and maintenance (O&M) building would be constructed at the northern and southern ends of the tunnel. There would be no operational restrictions for the tunnel, with the exception of vehicles carrying flammable or hazardous materials. As part of both design variations of the Freeway Tunnel Alternative, the I-710 northbound off-ramp and southbound on-ramp at Valley Boulevard would be modified.

The TSM/TDM Alternative improvements would also be constructed as part of the Freeway Tunnel Alternative, including either the dual-bore or single-bore design variations. These improvements would provide the additional enhancements to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. The only components of the TSM/TDM Alternative improvements that would not be constructed with the Freeway Tunnel Alternative are Other Road Improvements T-1 (Valley Boulevard to Mission Road Connector Road) and T-3 (St. John Avenue Extension between Del Mar Boulevard and California Avenue).

1.3.5.1 Design Variations

The Freeway Tunnel Alternative includes two design variations. These variations relate to the number of tunnels constructed. The dual-bore design variation includes two tunnels that independently convey northbound and southbound vehicles. The single-bore design variation includes one tunnel that carries both northbound and southbound vehicles. Figure 1-6 illustrates the dual-bore and single-bore tunnel design variations for the Freeway Tunnel Alternative. Each of these design variations is described below.

Dual-Bore Tunnel: The dual-bore tunnel design variation is approximately 6.3 miles long, with 4.2 miles of bored tunnel, 0.7 mile of cut-and-cover tunnel, and 1.4 miles of at-grade segments. The dual-bore tunnel design variation would consist of two side-by-side tunnels (the east tunnel would convey northbound traffic, and the west tunnel would convey southbound traffic). Each tunnel would have two levels with traffic traveling in the same direction. Each tunnel would consist of two lanes of traffic on each level, traveling in one direction, for a total of four lanes in each tunnel. The eastern tunnel would be constructed for northbound traffic; the western tunnel would be constructed for southbound traffic. Each bored tunnel would have an outside diameter of approximately 58.5 feet and would be located approximately 120 to 250 feet below the ground surface. Vehicle cross passages would be provided throughout this tunnel variation that would connect one tunnel to the other tunnel for use in an emergency situation. Figure 1-6 illustrates the dual-bore tunnel variation of the Freeway Tunnel Alternative.

Short segments of cut-and-cover tunnels would be located at the south and north termini to provide access via portals to the bored tunnels. The portal at the southern terminus would be located south of Valley Boulevard. The portal at the northern terminus would be located north of Del Mar Boulevard. No intermediate interchanges are planned for the tunnel.

Single-Bore Tunnel: The single-bore tunnel design variation is also approximately 6.3 miles long, with 4.2 miles of bored tunnel, 0.7 mile of cut-and-cover tunnel, and 1.4 miles of at-grade segments. The single-bore tunnel design variation would consist of one tunnel with two levels. Each level would have two lanes of traffic traveling in one direction. The northbound traffic would traverse the upper level; the southbound traffic would traverse the lower level. The single-bore tunnel would provide a total of four lanes. The single-bore tunnel would also have an outside diameter of approximately 58.5 feet and would be located approximately 120 to 250 feet below the ground surface. The single-bore tunnel would be in the same location as the northbound tunnel in the dual-bore tunnel design variation. Figure 1-7 illustrates the single-bore tunnel variation cross section of the Freeway Tunnel Alternative.

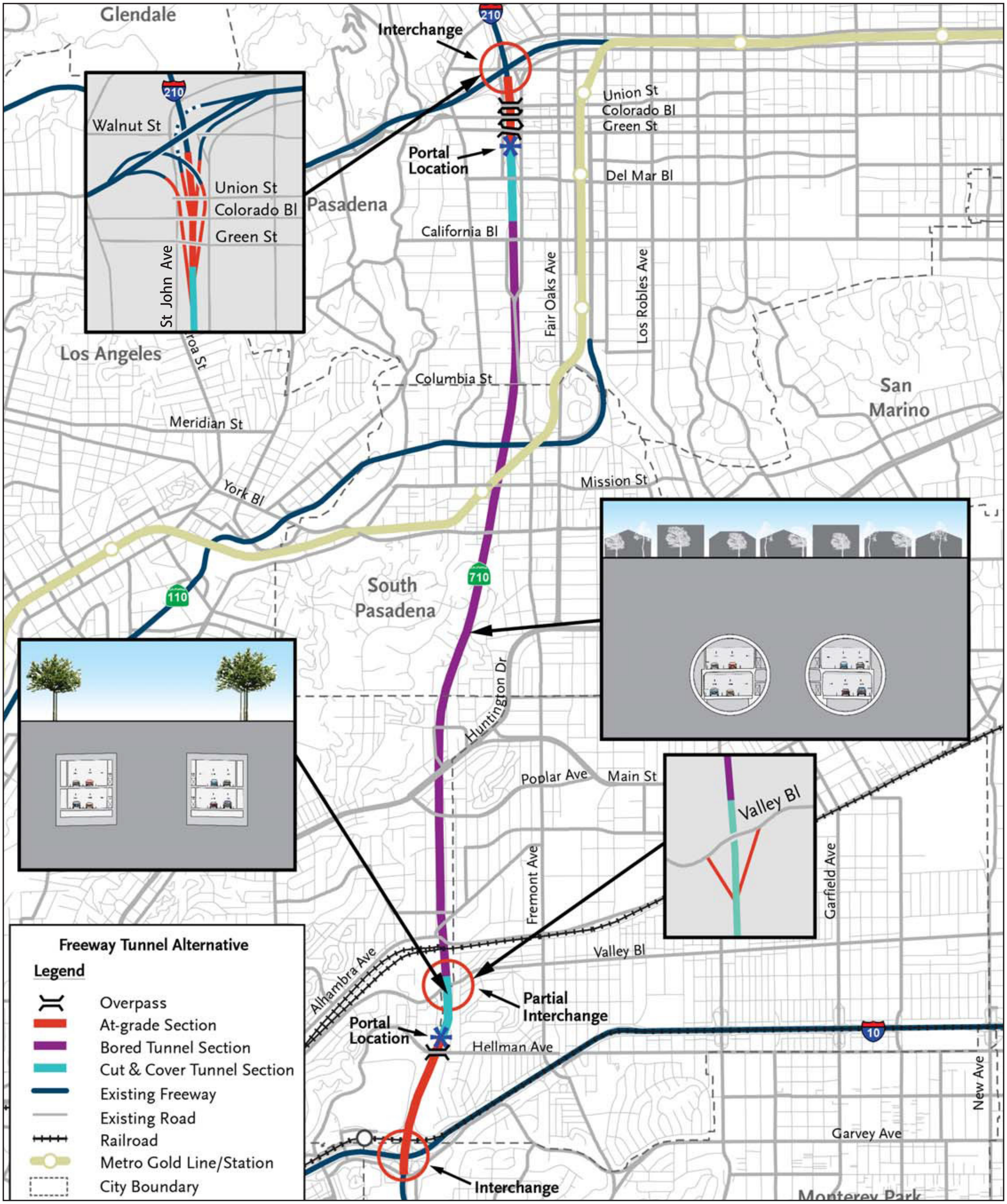
1.3.5.2 Operational Variations

There were three different parameters related to the operational variations of the Freeway Tunnel Alternative:

- **Tolling:** Tolls could be charged for vehicles using the tunnel, or it could be free for all drivers (a conventional freeway).
- **Trucks:** Trucks could be prohibited or allowed.
- **Express Bus:** A dedicated Express Bus could be operated using the tunnel. The Express Bus route would start at the Commerce Station on the Orange County Metrolink line, and then serve the Montebello Station on the Riverside Metrolink line and ELAC before entering I-710 at Floral Drive. The bus would travel north to Pasadena via the proposed freeway tunnel, making a loop serving Pasadena City College, the California Institute of Technology, and downtown Pasadena before re-entering the freeway and making the reverse trip.

The following operational variations have been studied for the Freeway Tunnel Alternative:

- **Freeway Tunnel Alternative without Tolls:** The facility would operate as a conventional freeway with lanes open to all vehicles. Trucks would be allowed and there would be no Express Bus service. This operational variation would be considered for only the dual-bore tunnel design variation.
- **Freeway Tunnel Alternative with Trucks Excluded:** The facility would operate as a conventional freeway; however, trucks would be excluded from using the tunnel. There would be no Express Bus service. Signs would be provided along I-210, SR 134, I-710, and I-10 to provide advance notice of the truck restriction. This operational variation would be considered for the dual-bore tunnel only.
- **Freeway Tunnel Alternative with Tolls:** All vehicles, including trucks, using the tunnel would be tolled. There would be no Express Bus service. This operational variation would be considered for both the dual- and single-bore tunnels described above.
- **Freeway Tunnel Alternative with Trucks Excluded and with Tolls:** The facility would be tolled for all automobiles. There would be no Express Bus service. Trucks would be excluded from using the tunnel. Signs would be provided along I-210, SR 134, I-710, and I-10 to provide advance notice of the truck restriction. This operational variation would be considered for the single-bore tunnel only.
- **Freeway Tunnel Alternative with Toll and Express Bus:** The freeway tunnel would operate as a tolled facility and include an Express Bus component. The Express Bus would be allowed in any of the travel lanes in the tunnel; no bus-restricted lanes would be provided. Trucks would be permitted. This operational variation would be considered for the single-bore tunnel only.



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SOURCE: CH2M HILL (2013)

FIGURE 1-6
Freeway Tunnel Alternative Single and Dual Bore
Health Risk Assessment
SR 710 North Study

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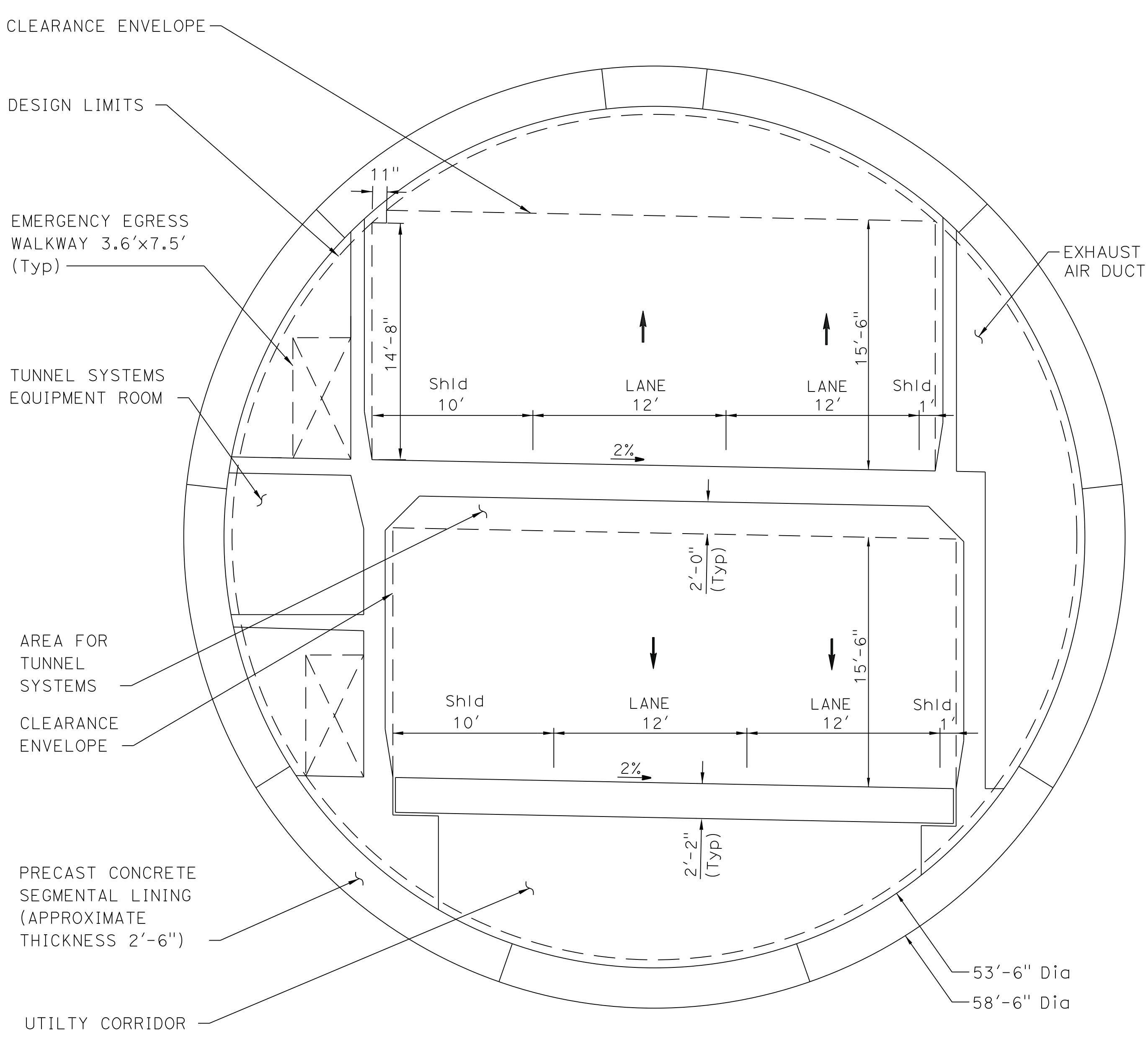

FIGURE 1-7
Freeway Tunnel Alternative
Single Bore Cross Section
Health Risk Assessment
SR 710 North Study

SOURCE: CH2M HILL (2014)

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SECTION 2

Health Risk Assessment Methodologies

2.1 Scope of the Health Risk Assessment

2.1.1 General Methodology

The health risk assessment (HRA) was performed to assess health risk impacts due to vehicle operational mobile source air toxics (MSAT) emissions from each of the SR 710 North Study no build and build alternatives. The HRA evaluated the cancer risks, in terms of the probability or chance of contracting cancer over a human lifetime in a population of 1 million, and the non-cancer risks in terms of the chronic hazard index (HIC) and acute hazard index (HIA). The purpose of the HRA was to understand the localized and regional health impacts and benefits of the project.

The project is intended to improve the efficiency of the regional freeway and transit networks, and reduce congestion on local arterials in the study area. Improved traffic conditions would increase vehicle travel speed and travel efficiency, and in general reduce vehicle emissions in the area. Therefore, the project would likely result in overall reduced health risks in the region. However, some of the alternatives, especially the Freeway Tunnel Alternative, would redistribute some vehicle trips from existing traffic corridors. This redistribution of the traffic volumes in the region could have the potential to cause localized health impacts in some areas due to the locally increased MSAT emissions.

Projected MSAT emissions from the study area due to vehicle travel have been calculated as part of the MSAT analysis in order to comply with NEPA requirements, which will be reported in the Environmental Impact Report/ Environmental Impact Statement (EIR/EIS) for the project. The detailed HRA was performed for the project for informational purposes.

HRAs are typically performed for projects with stationary sources where emissions occur at a fixed location. These HRAs follow guidance adopted by the Office of Environmental Health Hazard Assessment (OEHHA) and the California Air Resources Board (CARB), as well as guidance from the South Coast Air Quality Management District (SCAQMD). However, such guidance may not be well suited to transportation projects where emissions occur from moving vehicles along a roadway over substantial distances. The Federal Highway Administration (FHWA) and Caltrans are not aware of any science-based NEPA or CEQA HRA guidance and significance thresholds for transportation projects. FHWA and Caltrans have not adopted any significance thresholds for health risks under NEPA or CEQA.

Nonetheless, to address community concerns on the health impact from the project, a methodology was developed to assess the potential health risks associated with the project. The methodology is modeled after established protocols for stationary sources, but recognizes the spatial differences inherent in transportation projects. The HRA was performed in a manner consistent with methodologies specified in the following:

- *Air Toxics Hot Spots Program Risk Assessment Guidelines* (OEHHA, 2003)
- *Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk* (CARB, 2003)
- *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act (AB2588)* (SCAQMD, 2011b)

In addition, HRA reports for several approved or ongoing transportation projects—such as the I-710 Corridor Project (ENVIRON, 2012), the Schuyler Heim Bridge Replacement and SR 47 Expressway Project (Western Solutions, Inc. [Western], 2008), the Berth 136-147 (TraPac) Container Terminal Project (Port of Los Angeles, 2007), and the Berth 97-109 (China Shipping) Container Terminal Project (Port of Los Angeles, 2008)—were reviewed, and the HRA approaches in those reports were evaluated and used in this HRA when appropriate. Cancer and non-cancer chronic and acute risks were evaluated in the HRA. In addition, the HRA considered cancer burden, which is the estimated number of cancer cases for a population exposed over a 70-year period to project emissions.

The HRA was performed based on the emissions of seven priority MSAT compounds as established by the United States Environmental Protection Agency (EPA), including acrolein, benzene, 1,3-butidiene, diesel particulate matter (DPM), formaldehyde, naphthalene, and polycyclic organic matter (POM). In addition, although acetaldehyde was removed from EPA's priority MSAT list in 2007, it was included in this HRA.

The HRA for the SR 710 North Study was performed following the steps described below.

1. **Emission Estimation:** Quantify the non-carcinogenic and carcinogenic MSAT emissions from the vehicles on existing and future roadways using emission factors from the Caltrans program CT-EMFAC (Caltrans, 2013) that were developed based on the EPA/CARB-approved EMFAC2011 model (CARB, 2011).
2. **Source Characterization:** Characterize the release of the vehicle emissions by defining multiple volume source releases along the roadway surface using actual geographic coordinates and elevations for the various alternatives. Highways, highway interchanges, and principal arterials were assigned with different source parameters due to the differences in the types of vehicles traveled and the dimensions of the roadways.
3. **Air Dispersion Modeling:** Use an appropriate air quality dispersion model (AERMOD) and meteorological data set to model the dispersion of MSATs to the receptors in the area.
4. **Exposure and Risk Assessment:** Estimate the short- and long-term ground-level concentrations of pollutants at receptors of interest, and convert those concentrations via the CARB Hotspots Analysis Reporting Program (HARP, Version 1.4f) (CARB, 2012) to the appropriate corresponding hazard index (HI) or carcinogenic risk at each receptor.

Because FHWA and Caltrans have not adopted any HRA risk thresholds, for informational purposes, the HRA used the health risk thresholds in the SCAQMD Air Quality Significance Thresholds (SCAQMD, 2011a) as reference levels when evaluating the health impact levels of the project. Health risk is considered potentially substantial if the incremental increase of cancer risk due to a project exceeds 10 in 1 million (10×10^{-6}), or if the increase of chronic HI (HIC) or acute HI (HIA) from the project exceeds 1.0 compared to the existing condition.

Detailed methodologies and assumptions used in each step of the HRA are discussed in the following sections.

2.1.2 Study Area and Emission Sources of the HRA

The HRA evaluated the vehicle emissions from the highways and principal arterials in the study area (Figure 1-1). The area is bounded by I-210 on the north, I-605 on the east, I-10 on the south, and I-5 and SR 2 on the west.

MSAT emission sources included in the HRA are the vehicle operation emissions from the project corridor and the major highways including I-5, I-10, I-210, I-605, SR 2, SR 110, SR 134, and SR 710. A network of principal arterials within the study area was also included to capture the vehicle trip change and the subsequent risk impacts from major surface streets.

Tables 2-1 and 2-2 summarize the major highways and principal arterials that are included in the HRA, respectively.

In addition, the Freeway Tunnel Alternative would vent the vehicle emissions within the tunnels through a ventilation tower at each end of the tunnel. Based on the ventilation system design, the ventilation tower located near the north portal of the tunnel will vent the northbound tunnel emissions; the ventilation tower located near the south portal will vent the southbound tunnel emissions. Therefore, in addition to the vehicle emissions from roadways, emissions from the two ventilation towers were included in the HRA.

TABLE 2-1
Major Highways Included in the SR 710 North Study HRA

Road Name	From	To
I-5	I-5 and Hwy 2 interchange	East Cesar Chavez Avenue ramps
I-10	I-10 and I-5 interchange	I-10 and I-605 interchange
I-210	I-210 and I-605 interchange	La Crescenta Avenue
I-605	I-605 and I-210 interchange	I-605 and I-10 interchange
SR 2	SR 2 and I-210 interchange	SR 2 and I-5 interchange
SR 110	SR 110 and I-5 interchange	Glenarm Street
SR 134	SR 134 and I-210/SR 710	SR 134 and SR 2 interchange
SR 710	SR 710 and I-210 interchange	SR 710 and SR 60 interchange

TABLE 2-2
Principal Arterials Included in the SR 710 North Study HRA

Road Name	From	To
Colorado Boulevard	South Verdugo Road	Huntington Drive
Huntington Drive	North Mission Road	Crestfield Drive
North Broadway	South Avenue 20	North Mission Road
Live Oak Avenue	Santa Anita Avenue	Commerce Drive
Las Tunas Drive	Huntington Drive	Santa Anita Avenue
Valley Boulevard	North Mission Road	I-605
Myrtle Avenue	Colorado Boulevard	Live Oak Avenue
Peck Road	Live Oak Avenue	Garvey Avenue
Santa Anita Avenue	Colorado Boulevard	Garvey Avenue
Rosemead Boulevard	Orange Grove Boulevard	Garvey Avenue
San Gabriel Boulevard	I-210	Garvey Avenue
Fremont Avenue	Columbia Street	Valley Boulevard
Garfield Road/Avenue	Fremont Avenue	Valley Boulevard
Atlantic Boulevard	Huntington Drive	Whittier Boulevard
South Arroyo Parkway	Colorado Boulevard	Glenarm Street
South Los Robles Avenue	Corson Street	Huntington Drive
Eagle Rock Boulevard	Colorado Boulevard	Cypress Avenue
Cypress Avenue	Eagle Rock Boulevard	North Figueroa Street
North Figueroa Street	York Boulevard	I-5
York Boulevard	Eagle Rock Boulevard	North Figueroa Street
Foothill Boulevard	Rosemont Avenue	Oak Grove Drive
Angeles Crest Highway	I-210	Angeles Forest Highway
Descanso Drive	Verdugo Boulevard	Chevy Chase Drive
Chevy Chase Drive	Descanso Drive	Highland Drive
Highland Drive	Chevy Chase Drive	Linda Vista Avenue/I-210 overpass

2.1.3 Alternatives and Project Analysis Years

The HRA was performed for the existing condition, the No Build Alternative, and the build alternatives, as well as the design or operational variations listed below:

- Existing Condition
- No Build
- TSM/TDM
- BRT
- LRT
- Freeway Tunnel (broken into six design/operational variations):
  - Single-Bore with Express Bus (T1_V1)
  - Single-Bore with Toll (T1_V6)
  - Single-Bore with Toll without Trucks (T1_V7)
  - Dual-Bore with Toll (T2_V2)
  - Dual-Bore without Toll (T2_V4)
  - Dual-Bore without Toll without Trucks (T2_V5)

The project analysis years include the existing condition 2012, project opening year, and horizon year 2035. Opening years are not the same for each alternative. While TSM/TDM and BRT Alternatives open in 2020, LRT and Freeway Tunnel Alternatives would open in 2025 due to the longer construction period. The project analysis years for each alternative are summarized in Table 2-3.

TABLE 2-3
Project Analysis Years for Build Alternatives

Alternative/Variations	Existing Condition	Project Opening Year	Horizon Year
TSM/TDM	2012	2020	2035
BRT	2012	2020	2035
LRT	2012	2025	2035
Freeway Tunnel (all variations)	2012	2025	2035

2.1.4 Emission and Risk Scenarios

Two scenarios were evaluated in the HRA: one compared the risks of the No Build Alternative and the build alternatives to the existing condition in 2012; the other compared the risks of build alternatives to the No Build Alternative. Cancer, non-cancer chronic, and non-cancer acute risks were estimated for each of the scenarios as described below. Details of how each type of emission was estimated and used in the risk analysis are discussed in Sections 2.2 and 2.4, respectively.

- **Scenario 1: No Build and Build Alternatives vs. Existing Condition:** Scenario 1 used the 2012 existing condition as the baseline, and compared the health risks of the no build and build alternatives of the project to the health risks of the existing condition.
  - Cancer Risks: Cancer risks under Scenario 1 were evaluated based on 70-year average emissions from 2012 to 2081. Existing condition cancer risks were modeled based on the assumption that the 2012 MSAT emission levels would remain constant throughout the 70-year period. For no build and build alternatives, MSAT emissions between 2012 and 2035 were calculated for each year based on the forecasted VMT and corresponding emission factors for that year. Emissions after 2035 were assumed to be constant.
  - Non-cancer Chronic Risks: Non-cancer chronic risks for existing conditions were modeled using the 2012 annual average MSAT emissions. Chronic risks for no build and build alternatives were based on MSAT emissions during the opening year.

  - Non-cancer Acute Risks: Non-cancer acute risks for existing conditions were modeled using the 2012 peak hour MSAT emissions. Acute risks for no build and build alternatives were based on the peak hour MSAT emissions during the opening year.

  Caltrans and FHWA have not adopted any HRA risk thresholds. Incremental cancer risk, HIC, and HIA results from Scenario 1 were compared to the cancer risk level of 10 in 1 million and the HIC and HIA level of 1.0, based on the SCAQMD Air Quality Significance Thresholds (SCAQMD, 2011a), to evaluate the potential health risk impacts of each alternative.

- **Scenario 2: Build Alternatives vs. No Build Alternative:** Scenario 2 used the No Build Alternative as the baseline, and compared the health risks of each build alternative to the No Build Alternative. Evaluation of the risks under Scenario 2 was based on the following MSAT emissions:
  - Cancer Risks: Instead of using a 70-year average emission rate for the build and no build alternatives, Scenario 2 analysis was performed based on constant MSAT emission rates equal to the opening year emissions for both the build and no build alternatives, assuming that the opening year emission levels would last for 70 years.
  - Non-cancer Chronic Risks: Chronic risks were evaluated based on opening year annual average emissions for both no build and build alternatives.
  - Non-cancer Acute Risks: Acute risks were evaluated based on opening year peak hour emissions for both no build and build alternatives.

  While the health risk results from Scenario 1 represent the combined impacts from the MSAT emission changes caused by the project and by implementation of more stringent emission standards and improvements of vehicle technology in future years regardless of the project, Scenario 2 results represent only the net increase or decrease of the health risks directly caused by the MSAT emission changes of the project, and provide the health risks results from another perspective. Scenario 2 analysis was not performed under NEPA or CEQA context and was provided for informational purposes only.

2.2 Emission Estimates

2.2.1 Emission Calculations Methodology

MSAT emissions for the existing condition and the no build and build alternatives were estimated using MSAT emission factors and VMT data for each analysis year. The development of emission factors and VMT data, as well as the emission calculation methodology, are discussed in more detail below. Detailed emission calculations are included in Appendix A.

2.2.1.1 Emission Factors

MSAT emission factors were generated using the Caltrans emission factor model CT-EMFAC (Version 5.0) that was developed based on EMFAC2011. EMFAC2011 is the CARB- and EPA-approved tool for estimating emissions from on-road vehicles.

Vehicle exhaust emission factors were generated by CT-EMFAC for acrolein, acetaldehyde, benzene, 1,3-butadiene, formaldehyde, naphthalene, POM, and DPM. In addition, vehicle fleet average running loss emission factors were generated for acetaldehyde, acrolein, benzene, 1,3-butadiene, formaldehyde, and naphthalene. As appropriate, each fleet average running loss emission factor was added to the corresponding exhaust emission factor to provide a complete emission factor representative of vehicle operation.

CT-EMFAC groups vehicles into three categories:

- Truck 1 includes light heavy-duty trucks (LHD).
- Truck 2 includes medium heavy-duty trucks (MHD) and heavy heavy-duty trucks (HHD).
- Non-Truck includes light-duty autos, light-duty vehicles, medium-duty vehicles, buses, motor homes, and motorcycles.

CT-EMFAC includes both gasoline and diesel vehicle types in each vehicle category. Based on the CT-EMFAC default settings, the percentage of diesel vehicles within each vehicle category varies with each analysis year. Table 2-4 presents the CT-EMFAC default diesel vehicle percentages for each vehicle category for Los Angeles County.

TABLE 2-4
Portion of Diesel Vehicle Types within Each Vehicle Category

Analysis Year	Vehicle Category		
	Truck 1 Diesel (Percent)	**Truck 2 Diesel (Percent)**	**Non-Truck Diesel (Percent)**
2012	21.7	90.6	0.7
2020	21.3	92.1	0.8
2025	21.3	92.5	0.8
2035	21.4	93.1	0.9

Separate CT-EMFAC runs were conducted for each analysis year to obtain the emission factors for each of the three vehicle categories. Although emission factors were dependent on vehicle speed, project-specific vehicle speed was not an input option in the CT-EMFAC tool. CT-EMFAC does, however, generate emission factors for speeds in increments of five from 5 mph to 75 mph. Therefore, when calculating the emission factors, the project-specific vehicle speeds were conservatively rounded down to the nearest increment of five to allow better correlation with the emission factors generated by CT-EMFAC.

2.2.1.2 Traffic Data

For the purpose of characterizing the emission sources, each highway or principal arterial was split into multiple roadway segments based on roadway configurations and traffic conditions. The following traffic data were provided for each of the segments on the highways and principal arterials analyzed for the existing condition (2012), opening year (2020 or 2025), and the project horizon year of 2035 (CH2M HILL, 2014).

- Segment length
- Morning (AM or a.m.) and afternoon (PM or p.m.) peak period and daily average vehicle volume of the segment
- AM and PM peak period and daily average VMT of the segment
- AM and PM peak period and daily average vehicle speed of the segment
- Percent distribution of bus, LHD, MHD, and HHD

The traffic data used for the existing condition and the no build and build alternatives in opening and horizon years are shown in Appendix A.

2.2.2 Emission Rates

2.2.2.1 General Emission Calculation Approach

MSAT emissions were estimated for the vehicles on the roadways and for the ventilation towers of the new freeway tunnel near the north and south portal areas (Freeway Tunnel Alternative only). Both the annual vehicle emissions and the maximum hourly emissions are needed to evaluate the long-term cancer/chronic risks and the short-term acute risks.

MSAT emissions from each roadway segment were the sum of the emissions from each vehicle category on this segment. The VMT for bus, LHD, MHD, and HHD was calculated by multiplying the segment VMT by the percent distribution for that vehicle category. The VMT for automobiles was assumed to equal the remainder of the segment VMT. LHD emission rates were calculated using CT-EMFAC Truck 1 emission factors. MHD and HHD emission rates were calculated using CT-EMFAC Truck 2 emission factors. Bus and auto emission rates were calculated using CT-EMFAC Non-Truck emission factors. The VMT for each vehicle category was calculated by multiplying the segmental VMT by the percentage of that vehicle type.

For the Freeway Tunnel Alternative, emissions from the freeway tunnel were adjusted to take into account the control efficiency of an air pollution control system. The particulate matter emissions from the SR 710 new freeway tunnel will be treated with particulate matter filters. Control efficiency of the particulate matter filter is dependent on the particle size distribution, and varies between a low of 80 percent to above 99 percent for the proposed particulate matter emission control system (ILF Consulting Engineers, 2013). To be conservative, the lowest control efficiency of 80 percent was used to estimate the emissions from the ventilation towers, such that 20 percent of total particulate matter emissions will be released to the atmosphere. It is assumed that both ventilation towers of the tunnel (that is, the south and north portal ventilation towers) will be equipped with particulate matter control systems. As such, emissions were separately calculated for each ventilation tower to most accurately represent controlled emissions associated with either the northbound or southbound traffic.

MSAT emissions were not estimated for the trains used for the LRT Alternative because the light rail would be electric powered.

2.2.2.2 Annual Average Emissions

Annual average MSAT emissions from each of the roadway segments were calculated for the project analysis year, including the existing condition year 2012, opening year 2020 or 2025, and horizon year 2035 for each alternative.

To calculate the annual emission rate for each project analysis year, the daily MSAT emission rates were estimated based on the average daily VMT of each vehicle category and the corresponding emission factors for that year. For 2020, 2025, and 2035, the emission factors took into account traffic growth and cleaner vehicles in the future years. The total segmental MSAT emissions are the sum of the emissions of the three vehicle categories from the segment. Annual average emissions were calculated by multiplying the daily emissions by 365 days.

The annual average emissions of MSAT were used in the cancer and chronic risk analyses for comparisons between the build and no build alternatives under Scenario 2, and for deriving the build and no build alternatives 70-year average emissions for Scenario 1.

2.2.2.3 70-Year Average Emissions

The 70-year average emissions of MSAT from each roadway segment were calculated for the purpose of calculating the cancer risks under Scenario 1 (comparison of cancer risks between the project and the existing condition).

The 70-year average emissions were calculated for the existing condition, the No Build Alternative, and the build alternatives for the period of 2012 through 2081, consistent with the Scenario 1 cancer risk exposure period.

- **70-year Average MSAT Emissions of the Existing Condition:** It was assumed that the emission factors and vehicle activity level (that is, VMT) would remain at the existing condition (2012) level throughout the 70 years. Therefore, the 70-year average MSAT emissions are the same as the annual average emissions calculated for 2012.
- **70-year Average MSAT Emissions of No Build and Build Alternatives:** Emissions of the no build and build alternatives were estimated for each year for 70 years starting in 2012; then, a 70-year average emission rate was calculated for each MSAT.

  Annual average emission rates were estimated for each analysis year (existing condition 2012, opening year 2020 or 2025, and horizon year of 2035) as described in Section 2.2.2.1. In order to calculate the 70-year average emission rate, the VMTs for each year between 2012 and 2035 were interpolated by defining data points between the existing condition in 2012 and the opening year (either 2020 or 2025, depending on the alternative), and between the opening year (2020 or 2025) and the horizon year (2035). The VMTs between 2012 and 2035 were multiplied by the corresponding emission factors of each year to obtain the annual emissions for these years. Emission factors were not provided in EMFAC2011 for the years beyond 2035. Emissions beyond 2035 (2036 through 2081) were assumed to be the same as in 2035 due to the lack of a traffic forecast for the years from 2036 to 2081 and the minimal information regarding regulatory drivers for further emissions reduction, and represented conservative estimates of the emissions beyond 2035. Emissions between 2012 and 2081 were averaged over the 70-year period to obtain the 70-year average emission rates to be used for the cancer risk analysis under Scenario 1.

2.2.2.4 Maximum Hourly Emissions

Maximum hourly emissions of MSAT were calculated for acute risk analysis for years 2012, opening year 2020 or 2025, and 2035. The maximum hourly emission rates were estimated using peak hourly traffic projections from the traffic study for each roadway segment. The traffic data are available for five time periods:

- AM Peak Period (6:00 a.m. to 9:00 a.m.)
- Midday Period (9:00 a.m. to 3:00 p.m.)
- PM Peak Period (3:00 p.m. to 7:00 p.m.)
- Evening Period (7:00 p.m. to 9:00 p.m.)
- Nighttime Period (9:00 p.m. to 6:00 a.m.)

Maximum hourly emission rates were estimated based on the traffic data of the AM and PM peak periods that coincide with the typical rush-hour traffic. Because the VMTs are not distributed evenly for each hour during the peak period, the peak hour VMT would be slightly higher than the average hourly VMT during the peak period. Based on the traffic information in the project area, a conversion factor of 38 percent was applied to convert the 3-hour AM Peak Period (6:00 a.m. to 9:00 a.m.) VMT to an AM Peak Hour VMT. A conversion factor of 27 percent was applied to convert the 4-hour PM Peak Period (3:00 p.m. to 7:00 p.m.) VMT to a PM Peak Hour VMT. For this HRA, AM Peak Hour emission rates were used as the maximum hourly emissions for the acute risk (HIA) analysis because the AM Peak Hour VMT is greater than the PM Peak Hour VMT, and therefore, will provide more conservative emission rates for the project operation. Maximum hourly MSAT emissions from each roadway segment were calculated for 2012, opening year, and 2035 for each alternative.

2.3 Air Dispersion Modeling

2.3.1 Model Selection and Description

The latest version of the EPA's AERMOD model (Version 12345) available at the time of the study was used to estimate annual average and maximum hourly ground-level concentrations of toxic air contaminants. AERMOD is a steady-state plume model that simulates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. This model is recommended for short-range (less than 50 kilometers) dispersion from the source. AERMOD was run with EPA default options and for the annual and 1-hour averaging periods. The annual averaging period is appropriate for estimating chronic, long-term exposure to toxic air contaminants. The maximum 1-hour averaging period is a conservative value for use in estimating acute, short-term exposures to toxic air contaminants.

This AERMOD modeling was conducted based on the EPA Guideline on Air Quality Models (40 Code of Federal Regulations [CFR] 52, Appendix W), SCAQMD modeling guidance (SCAQMD, 2005), and the *Air Toxics Hot Spots Program Risk Assessment Guidelines* (OEHHA, 2003).

2.3.2 Source Characterization

2.3.2.1 Modeling Area and Source Setup

The AERMOD model was set up for the entire study area. Roadways modeled with AERMOD include:

- Major interstates and state routes (highway mainlines)
- Highway and state route interchanges
- Principal arterials

In addition to the roadways, the modeling included the freeway tunnel ventilation towers at both the north and south portals. The subsections below describe each source type modeled in AERMOD. Figure 2-1 shows the general AERMOD model setup.

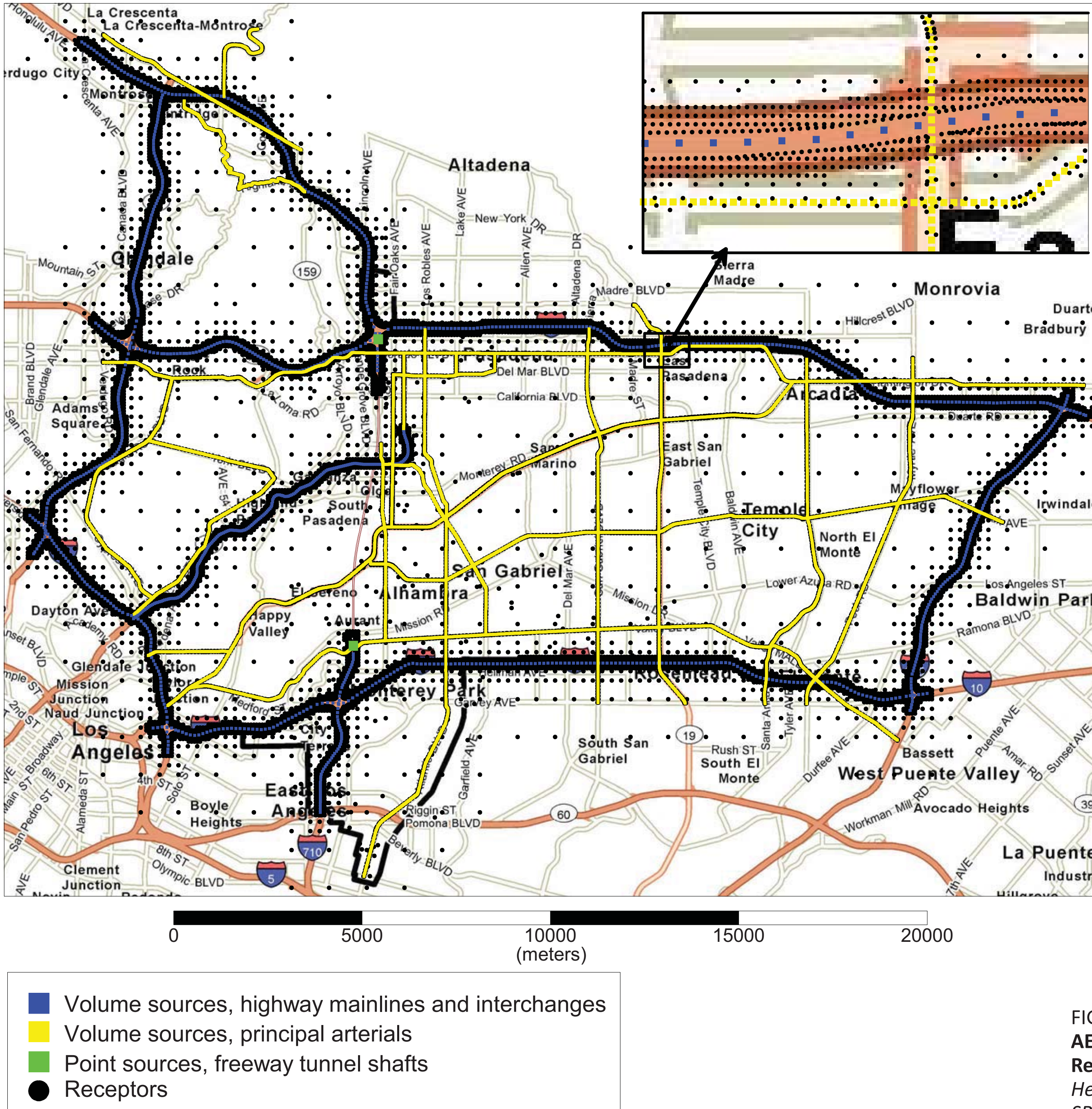

FIGURE 2-1
AERMOD Sources and Receptor Setup
Health Risk Assessment
SR-710 North Study

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2.3.2.2 Source Parameters

Vehicle emissions from highways and principal arterials were modeled as volume sources. Emissions from the freeway tunnel ventilation towers were modeled as point sources. A summary of the parameters used for each type of source is shown in Table 2-5 and explained further in the following sections. Selection of the source parameters followed the 40 CFR Appendix W to Part 51 – Guideline on Air Quality Models and AERMOD User's Guide (EPA, 2004), which are applicable for modeling emissions from roadways. The approach is consistent with the HRAs previously performed in the region, including the port projects and transportation projects such as the SR 47 South Study, that have been reviewed and generally accepted during the environmental review process by the related agencies.

TABLE 2-5
AERMOD Source Release Parameters for the HRA

Source Type	Source Description	AERMOD Source Type	Release Height (feet)	Source Width	Line Source Spacing	Exit Velocity (fpm)	Exit Temperature (°F)	Stack Diameter (feet)
Vehicle Emissions	Highway Mainlines	Volume	15[1]	Various[2]	Various[2]	-	-	-
	Highway Interchanges	Volume	30[3]	Various[2]	Various[2]	-	-	-
	Principal Arterials	Volume	3[4]	Various[2]	Various[2]	-	-	-
Tunnel Ventilation towers (Single Bore)	North and South Portal Exhaust	Point	50[5]	-	-	Various [5]	Ambient	22.97[6]
Tunnel Ventilation towers (Dual Bore)	North and South Portal Exhaust	Point	50[5]	-	-	Various [5]	Ambient	22.97[6]

Notes:

[1] Vehicle emissions from all highway mainlines were modeled with volume source dimensions corresponding to trucks. Initial release height of 15 feet is based on the review of recent EIR/EIS documents for projects near the Port of Los Angeles and Port of Long Beach. Selected values are consistent with parameters used in the Human Health Risk Assessment for the Schuyler-Heim Bridge Replacement and SR 47 Expressway Project (Western, 2008).

[2] Source width and line spacing are dependent on specific road width.

[3] Highway interchange release height of 30 feet was used to capture over and under passes of the interchange.

[4] Vehicle emissions from all principal arterials were modeled with source dimensions corresponding to cars. The initial release height of 3 feet is based on the review of recent EIR/EIS documents for projects near the Port of Los Angeles and Port of Long Beach. Selected values are consistent with parameters used in the Human Health Risk Assessment for the Schuyler-Heim Bridge Replacement and SR 47 Expressway Project (Western, 2008).

[5] Exhaust flow exit velocity is dependent on the tunnel design and traffic directions.

[6] Stack height and diameter were based on preliminary engineering design specifications.

fpm – feet per minute

°F – degrees Fahrenheit

Details on emission source parameters by roadway segment are included in Appendix B. For volume sources, initial horizontal and vertical dimensions (σ_{y0} and σ_{z0}, respectively) were based on Table 3-1 in the AERMOD User's Guide (EPA, 2004). The line source spacing, or separation of the volume sources, was twice the width of each individual volume source. The width of the volume source for each roadway segment was calculated based on the average width of the roadway. The initial horizontal dimensions σ_{y0} are equal to the source separation divided by 2.15. All sources were considered to be elevated sources not on or adjacent to a building, with initial vertical dimensions σ_{z0} equal to the vertical source extent divided by 4.3.

Highway Mainlines

The highway mainline roads modeled in AERMOD included existing roadways as well as new alignments to be constructed as part of the project. Roadway alignments, widths, and elevations were determined using engineering drawings, geographic information system (GIS) layers, and aerial photographs of the project. The operational vehicle exhaust emissions from roadways were modeled as a line of volume sources. Volume source representations of the highways were developed based on roadway configurations and assumed vertical dimensions for truck traffic. The major highways were modeled with the average width of each specific highway. Roadway volume source spacings were determined based on road widths. The initial release height relative to the road bed was 15 feet for trucks (Western, 2008). For both at-grade and elevated roadways, the final modeled release height was calculated relative to terrain elevation at the receptor location.

Highway Interchanges

Similar to the highway mainlines, a line of volume sources following the average centerline of the interchange was used. A release height of 30 feet was used to capture the various roadway heights of the over and under passes of the interchange. The width of the volume source and source spacing were adjusted to the average width of each specific highway intersection.

Principal Arterials

Principal arterials were modeled as a line of volume sources using the average centerline of the roadway. Most major arterials were modeled with the width of a four-lane roadway, with the exception of a few arterials that are mainly two-lane roadways. Due to the substantially less truck traffic on surface streets, principal arterials were modeled with an automobile exhaust initial release height of 3 feet.

Tunnel Ventilation Towers

The tunnel ventilation tower emissions for the north and south tunnel portals were modeled as point sources. The exhaust flow rate of the ventilation tower varies depending on the tunnel design. Exhaust flow rates vary depending on whether the tunnel is the single-bore or dual-bore design.

2.3.2.3 Source Emission Rate Characterization

For compatibility with the risk assessment models including HARP and the On-ramp program, the road segment source groups defined in AERMOD were each modeled with a unit emission rate of 1 gram per second (g/s). That is, each roadway segment was modeled in AERMOD as a separate source group and a total emission rate of 1.0 g/s (for example, the modeled emission rate of each source in a segment represented by 10 volume sources would be 0.1 g/s). The AERMOD resultant concentration is then expressed as micrograms per cubic meter per g/s [(μg/m^3)/(g/s)]. Actual emissions from each source were applied during the HARP modeling process to obtain the ground-level concentrations and the corresponding risks at each receptor.

2.3.3 Meteorological Data

The SCAQMD provided 5 years of meteorological data (2006, 2007, 2009, 2010, and 2011) preprocessed with the AERMET processor (Version 12345) for the Central Los Angeles meteorological station to be used with AERMOD. The meteorological data are publicly available and were downloaded from the SCAQMD Web site at http://www.aqmd.gov/smog/metdata/AERMOD (SCAQMD, 2014). The Central Los Angeles station is 3.8 miles southeast of the project corridor. Another meteorological station located near the project area is in Azusa, approximately 2 miles from the eastern boundary of the project study area (I-605) and 13 to 15 miles from the proposed freeway tunnel corridor. Although the project study area covers an approximately 10-mile by 10-mile area of the region, there are no significant terrain differences and the wind patterns are similar across the study area. While the data from both the Central Los Angeles and Azusa stations are representative of the project area conditions, the Central Los Angeles station data were selected for modeling because this station is located closer to the project corridors where the potential localized impacts might occur.

2.3.4 Regional Receptor Grid

The regional receptor grids within the study area for AERMOD were set up as follows:

- 25-meter grid spacing starting at the edge of all highways/interstates out to 75 meters
- 75-meter grid spacing at 150 meters from the edge of all highways/interstates
- 250-meter grid spacing between 250 meters and 500 meters from the edge of all highways/interstates
- 500-meter grid spacing between 500 meters and 1,000 meters from the edge of all highways/interstates
- 1,000-meter grid spacing between 1,000 meters and 5,000 meters from the edge of all highways/interstates; the grid ends approximately 1,500 meters outside the study area boundary
- 100-meter spacing on the edge of all arterials

All receptor coordinates used in AERMOD were expressed in Universal Transverse Mercator North American Datum 1983 (UTM NAD 83) meters.

2.3.4.1 Sensitive Receptors

Specific sensitive receptors within 1,000 feet of the SR 710 freeway tunnel alignment and the LRT and BRT routes—including kindergarten through 12th grade (K-12) schools, preschools, daycare centers, nursing homes, and hospitals—were modeled as discrete receptors in AERMOD. The sensitive receptors were compiled using regional GIS data. Appendix B contains the complete list and location of sensitive receptors used in the model.

2.3.4.2 Census Block Receptors

Census block receptor data for cancer burden calculations were compiled using the census block centroids for the Los Angeles area defined in HARP. Census block receptors within approximately 1,500 meters (4,921 feet) from the study area were included in the model.

2.3.5 Terrain Data

Terrain elevations were determined for existing roadways and receptors using the AERMAP terrain preprocessor (Version 11103) and United States Geological Survey (USGS) National Elevation Dataset (NED) data. For newly constructed roadway sources, engineering drawings were used for terrain elevations.

2.3.6 Urban Option

SCAQMD modeling guidance recommends that all sources in the South Coast Air Basin be modeled as urban sources within AERMOD. For urban sources, the AERMOD model requires the population of the urban area in order to estimate the magnitude of urban heat island effects. A population of 9,862,049 was used as representative of the local Los Angeles area population (AERMOD Modeling Guidance Web site: http://www.aqmd.gov/smog/metdata/AERMOD_ModelingGuidance.html; SCAQMD, 2014).

2.4 Exposure and Risk Evaluations

2.4.1 General Methodology

The HRA was performed to evaluate the potential cancer, chronic, and acute health impacts associated with the no build and build alternatives and their design/operational variations. The HRA followed the latest version of the *Air Toxics Hot Spots Program Risk Assessment Guidelines* (OEHHA, 2003). In addition, for predicted cancer risks for residential receptors where the inhalation pathway is the dominant exposure pathway for cancer risks, the Derived (Adjusted) Method outlined in *Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk* (CARB, 2003) was used for the cancer risk evaluation.

The HRA risk characterization for each alternative was conducted using HARP Version 1.4f (CARB, 2012), along with the CARB HARP On-ramp program (Version 1). The HARP On-ramp program converts the AERMOD output files to files compatible with the HARP modeling system. The HARP Risk Module predicts lifetime cancer risk, HIA, and HIC by factoring AERMOD-predicted pollutant concentrations by pollutant-specific cancer potency values and chronic/acute reference exposure levels (RELs) obtained from OEHHA (CARB, 2013).

2.4.1.1 Cancer Risk Evaluation

Cancer risks were evaluated for the project using the HARP program, based on the predicted MSAT ground-level concentrations, inhalation cancer potency, oral slope factor, frequency and duration of exposure at the receptor, and breathing rate of the exposed persons. Following the OEHHA guidance and SCAQMD guideline, cancer risk analysis included potential health impacts from multiple pathways including inhalation, homegrown produce, dermal absorption, soil ingestion, and mother's milk.

A summary of the MSATs included for the cancer risk analysis is presented in Table 2-6. Although acrolein would be emitted from the vehicles, it does not have OEHHA-approved cancer risk values. Therefore, acrolein was not included in the table. In addition, POM emits from diesel vehicles as particulate matter; therefore, the DPM emission and associated cancer risks calculated for the HRA already took into account the POM emissions and risks. Because MHD and HHD vehicles are primarily diesel-fueled, POM emissions from MHD and HHD vehicles were assumed to be accounted for by the DPM emissions from these two vehicle categories. To avoid double counting of the risks, POM emissions from MHD and HHD vehicles were not included in the cancer risk modeling. POM emissions from primarily gasoline-fueled LHD, buses, and autos were included in the cancer risk analysis. The emissions of the individual MSATs from each alternative and each vehicle category are included in Appendix A.

TABLE 2-6
Compounds Analyzed for Cancer Risks

Vehicle Type	Carcinogenic Compounds Evaluated
MHD and HHD	Acetaldehyde, Benzene, 1-3 Butadiene, Formaldehyde, Naphthalene, DPM
Auto/Bus/LHD	Acetaldehyde, Benzene, 1-3 Butadiene, Formaldehyde, Naphthalene, POM, DPM,

2.4.1.2 Exposure Assumptions

For the cancer risk evaluation, the frequency and duration of exposure to toxic air contaminants are assumed to be directly proportional to the risk. Cancer risks were estimated using a conservative assumption of a 70-year continuous exposure duration for residential receptors and a 40-year, 5-day-per-week, 8-hour-per-day exposure for commercial/industrial receptors. Student risks were evaluated based on an adjusted 9-year exposure for children. Specific exposure assumptions for each receptor type are described below.

1. **Residential and Sensitive Receptors (Except Student Receptors).** Cancer risks for residential and sensitive receptors were estimated using the breathing rates described in the *Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk* (CARB, 2003). The HRA estimated the residential and sensitive receptor cancer risks by using a breathing rate of 302 liters per kilogram body weight per day (L/kg body weight-day) (corresponding to an 80th percentile value) and an exposure of 24 hours per day, 350 days per year, for 70 years.
2. **Occupational (Worker) Impacts**. Workers generally do not spend as much time within the region of a project as do residents. Lifetime occupational exposure was based on a worker presence of 8 hours per day, 245 days per year, for 40 years as recommended by OEHHA (2003). The breathing rate for workers is equal to 447 L/kg-day, which equates to 149 L/kg-day over an 8-hour workday (OEHHA, 2003).
3. **Student Impacts**. Students spend a far more limited portion of their lives at a given school than 70 years. Student exposures were calculated based on children's 9-year exposure. The 9-year exposure duration was a conservative assumption for the student exposure duration, because a student would mostly likely stay in one school for about 4 to 9 years. The breathing rate of children is equal to the high-end breathing rate of

581 L/kg-day (OEHHA, 2003). It was assumed that a student would likely spend less than 8 hours per day and 180 days per year in a school. Therefore, the student cancer risks were adjusted by multiplying the 9-year children's risk with a factor of 0.1714 derived from (8 hours x 180 days)/(24 hours x 350 days).

2.4.1.3 Non-Carcinogenic Risks

OEHHA developed RELs for assessing potential non-cancer health impacts. Acute RELs are short-term exposure levels, typically defined as a 1-hour peak value. Chronic RELs are used for assessing long-term exposure, typically defined as 12 percent of a lifetime, or about 8 years for humans. Exposure to concentrations less than the RELs is not expected to cause substantial effects to the population. The comparison is done as a ratio of the ambient concentration to the REL, referred to as the HI. To assess chronic and acute non-cancer exposures, average annual and maximum 1-hour MSAT ground-level concentrations were compared to the appropriate REL to obtain an HIC or HIA.

2.4.2 Scenario 1 Risk Analysis (No Build and Build Alternatives vs. Existing Condition)

2.4.2.1 Cancer Risk and Cancer Burden

Scenario 1 compares the health risks of the no build and build alternatives to the existing condition of 2012. Under Scenario 1, cancer risks were modeled by using the HARP program with the 70-year average MSAT emissions that were estimated for the no build and build alternatives and the existing condition using the methodology described in Section 2.2.2.

Scenario 1 used a fixed 2012 emission rate as the baseline, assuming that the vehicle activity levels (VMT) and vehicle emission factor would remain constant for 70 years. Incremental cancer risks of the no build and build alternatives from the existing condition were evaluated for each roadway segment within the study area. Because FHWA and Caltrans have not adopted HRA thresholds for CEQA and NEPA analysis, for comparison purposes, the worst-case incremental cancer risk increases at residential, worker, and student receptors were summarized and compared with the cancer risk threshold of 10 in 1 million.

Cancer risk represents the probability of an individual developing cancer, whereas cancer burden estimates the number of individuals that would be expected to contract cancer by multiplying the cancer risk by the exposed population. The exposed population is defined as the number of persons within a zone of impact. For this HRA, cancer burden analysis would only be triggered if the project cancer risk increases over 10 in 1 million from the existing condition.

2.4.2.2 Non-cancer Chronic and Acute Risks

Non-cancer risks evaluated under Scenario 1 compare the chronic and acute risks in terms of HIC and HIA of the no build and build alternatives to the 2012 existing condition. Incremental HIC and HIA of an alternative were modeled using the HARP program, with the worst-case average annual emissions and maximum hourly emissions that were calculated using the methodology described in Section 2.2.2.

Due to improved fuel efficiency, newer emission-control technologies, and more stringent emission standards, vehicle MSAT emissions tend to decrease in future years even with increased traffic volume (FHWA, 2009). This conclusion is consistent with the emission calculation results of the project that the opening year is expected to have higher vehicle emissions than the horizon year of 2035, and thus represents the worst-case annual and hourly emission change of an alternative. Therefore, incremental HIC and HIA of the no build and build alternatives were estimated based on the corresponding opening year emissions of the alternatives (2025 for the LRT and Freeway Tunnel Alternative, and 2020 for the TSM/TDM and BRT Alternatives).

HIC and HIA at each roadway segment were analyzed for the project. The worst-case HIC and HIA at residential, worker, and student receptors were summarized and compared to the acute and chronic risk thresholds. An HIC or HIA of less than 1.0 indicates that the exposure would present an acceptable or insignificant health risk. An HIC or HIA above 1.0 represents the potential for an unacceptable or substantial health risk.

2.4.3 Scenario 2 Risk Analysis (Build Alternatives vs. No Build Alternative)

Scenario 2 compared the MSAT health risk impacts between the No Build Alternative and the build alternatives. Health risk changes under Scenario 2 represent the effects that are solely related to the alternative analyzed. Other factors affecting health risks from vehicles, such as regional VMT growth or the use of cleaner vehicles that would occur regardless of the project, were not included in the analysis. The health risk results from Scenario 2 were included to demonstrate the project impacts as well as overall regional benefits from another perspective. Scenario 2 analysis was not performed under NEPA or CEQA context and was provided for informational purposes only.

2.4.3.1 Cancer Risks

Incremental cancer risks under Scenario 2 were modeled with HARP using the average annual emission changes between the No Build Alternative and the build alternatives in the opening year (2020 or 2025). Vehicle MSAT emissions are expected to decrease in future years due to the improved technologies and more stringent emission standards. Therefore, opening year emissions represent the worst-case MSAT emissions in the reasonably foreseeable future for the project operation. Because cancer risks were evaluated based on a lifetime 70-year exposure, using a worst-case emission level throughout the 70 years would provide conservative risk values for the no build and build alternatives.

Incremental cancer risk changes between the No Build Alternative and each build alternative were evaluated; the worst-case residential, worker, and student impacts were identified and are summarized in this report. Health risk impacts and benefits for the region were evaluated for each alternative based on the risk results.

2.4.3.2 Non-cancer Chronic and Acute Risks

Incremental non-cancer chronic and acute risks (HIC and HIA) were analyzed for Scenario 2 using the worst-case annual and hourly emission rates. As discussed in the previous section, because the project opening year is expected to have higher emissions than the horizon year of 2035, incremental HIC and HIA were estimated based on the opening year emission changes on the roadway segments. The worst-case HIC and HIA at residential, worker, and student receptors were identified and are summarized in this report.

2.5 Conservative Nature and Uncertainties of Health Risk Assessment

By their nature, risk assessments are intended to be predictions of risk. Scientists, medical experts, regulators, and practitioners do not completely understand how toxic air pollutants harm human cells or how different pollutants might interact with each other in the human body. The exposure assessment often relies on computer models that are based on a multitude of assumptions, both in terms of present and future conditions.

When information is missing or uncertain, risk analysts generally make assumptions that tend to prevent them from underestimating the potential risk. These assumptions provide a margin of safety in the protection of human health and are very conservative. For example, most people do not stay in one place for 24 hours a day, 350 days a year, and for 70 years; yet the assumption is used in predicting residential cancer risks. For this HRA, conservative assumptions were made for the future year emission levels, ignoring the long history of progressive lower-emitting vehicles over time. For acute risk evaluation, the worst-case peak hour emission rates were used for the analysis instead of the time-varying emission rates from the roadways, and will result in conservative acute risks at receptors. As such, HRA results are primarily serving as a tool to compare relative impact levels of the build and no build alternatives, rather than as an accurate guide to characterize absolute risk levels.

Additionally, there is no single universal way of doing HRAs, leading to possible inconsistencies in comparing different risks. Assumptions also change over time, and even HRAs completed using the same models can produce different results, if the inputs differ.

OEHHA has provided a discussion of risk uncertainty, which is reiterated here (OEHHA, 2003):

> *There is a great deal of uncertainty associated with the process of risk assessment. The uncertainty arises from lack of data in many areas necessitating the use of assumptions. The assumptions used in these guidelines are designed to err on the side of health protection in order to avoid underestimation of risk to the public. Sources of uncertainty, which may either overestimate or underestimate risk, include: 1) extrapolation of toxicity data in animals to humans, 2) uncertainty in the estimation of emissions, 3) uncertainty in the air dispersion models, and 4) uncertainty in the exposure estimates. Uncertainty may be defined as what is not known and may be reduced with further scientific studies. In addition to uncertainty, there is a natural range or variability in the human population in such properties as height, weight, and susceptibility to chemical toxicants. Scientific studies with representative individuals and large enough sample size can characterize this variability.*
>
> *Interactive effects of exposure to more than one carcinogen or toxicant are also not necessarily quantified in the HRA. Cancer risks from all emitted carcinogens are typically added, and hazard quotients for substances impacting the same target organ system are added to determine the hazard index (HI). Many examples of additivity and synergism (interactive effects greater than additive) are known. For substances that act synergistically, the HRA could underestimate the risks. Some substances may have antagonistic effects (lessen the toxic effects produced by another substance). For substances that act antagonistically, the HRA could overestimate the risks.*
>
> *Other sources of uncertainty, which may underestimate or overestimate risk, can be found in exposure estimates where little or no data are available (e.g., soil half-life and dermal penetration of some substances from a soil matrix).*
>
> *The differences among species and within human populations usually cannot be easily quantified and incorporated into risk assessments. Factors including metabolism, target site sensitivity, diet, immunological responses, and genetics may influence the response to toxicants. The human population is much more diverse both genetically and culturally (e.g., lifestyle, diet) than inbred experimental animals. The intraspecies variability among humans is expected to be much greater than in laboratory animals. Adjustment for tumors at multiple sites induced by some carcinogens could result in a higher potency. Other uncertainties arise 1) in the assumptions underlying the dose-response model used, and 2) in extrapolating from large experimental doses, where, for example, other toxic effects may compromise the assessment of carcinogenic potential, to usually much smaller environmental doses. Also, only single tumor sites induced by a substance are usually considered. When epidemiological data are used to generate a carcinogenic potency, less uncertainty is involved in the extrapolation from workplace exposures to environmental exposures. However, children, a subpopulation whose hematological, nervous, endocrine, and immune systems, for example, are still developing and who may be more sensitive to the effects of carcinogens on their developing systems, are not included in the worker population and risk estimates based on occupational epidemiological data are more uncertain for children than adults. Finally, the quantification of each uncertainty applied in the estimate of cancer potency is itself uncertain.*
>
> *Thus, risk estimates generated by an HRA should not be interpreted as the expected rates of disease in the exposed population but rather as estimates of potential risk, based on current knowledge and a number of assumptions. Additionally, the uncertainty factors integrated within the estimates of noncancer RELs are meant to err on the side of public health protection in order to avoid underestimation of risk. Risk assessment is best used as a ruler to compare one source with another and to prioritize concerns. Consistent approaches to risk assessment are necessary to fulfill this function.*

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SECTION 3
Health Risk Assessment Results

3.1 Scenario 1: No Build and Build Alternatives vs. Existing Condition (2012)

Scenario 1 of the HRA compares the potential health risk impacts of the project to the 2012 existing condition. Incremental cancer, chronic, and acute risks of each alternative were summarized and compared to the cancer, HIC, and HIA thresholds to determine the impact levels of the health risks.

Generally speaking, when compared to the 2012 existing condition, regional vehicle MSAT emissions in future years, especially the DPM emissions that have the potential to cause cancer risks, are expected to decrease due to the implementation of more stringent emission standards, the improvements of emission-control technologies, and improved fuel efficiency (FHWA, 2009). The MSAT emission decrease trend would result in overall decreased cancer risks in the region in future years. Localized health impacts would be expected only in areas where the MSAT emission increase from the added VMT exceeds the level of the emission decrease from using cleaner and higher-efficiency vehicles. The localized MSAT emission increase would likely occur with roadways that have substantially increased vehicle traffic compared to the existing condition.

Detailed risk analysis of each alternative is provided below. The risk analysis of Scenario 1 showed health risk benefits consistent with the trend of decreasing DPM emissions. Because of the uncertainties discussed in Section 2.5 and the conservativeness of the HRA approach, risk values presented in this report are intended for comparison of relative impact levels of the alternatives.

3.1.1 Cancer Risks

3.1.1.1 Maximally Impacted Locations

Table 3-1 summarizes the results of the incremental cancer risks due to the build and no build alternatives, when compared to the 2012 existing condition. The 70-year lifetime cancer risk results were summarized for the point of maximum impact (PMI), maximally exposed individual resident (MEIR), maximally exposure individual worker (MEIW), and the maximally exposed sensitive receptors including daycare centers, preschools, nursing homes, and hospitals. Risks at the maximally exposed student receptors were analyzed using a 9-year children’s exposure duration and adjusted with the hours per day and number of days in a school year. The risk value listed for the PMI location was evaluated based on a 70-year residential exposure, even though the PMI could be either a resident receptor or a worker receptor. The risks for PMI are summarized in Table 3-1 for informational purposes only, and were not used for comparison with the risk thresholds of 10 in 1 million. The comparison to the risk thresholds was based on the risks at MEIR, MEIW, or a specific sensitive receptor.

TABLE 3-1
Incremental Cancer Risks: No Build and Build Alternatives (70-year Average Emissions) vs. 2012 Existing Condition (Units: in 1 Million)

		PMI	MEIR	MEIW	Sensitive Receptor Maximum	Student Maximum
No Build	Risk	-14.8	-14.8	-3.46	-17.6	-0.70
	Receptor	a	a	a	b	c
TSM/TDM	Risk	-14.9	-14.9	-3.46	-17.7	-0.70
	Receptor	a	a	a	b	c
BRT	Risk	-14.9	-14.9	-3.47	-17.6	-0.70
	Receptor	a	a	a	b	c
LRT	Risk	-14.9	-14.9	-3.48	-17.7	-0.70
	Receptor	a	a	a	b	c
Freeway Tunnel – Single-Bore with Express Bus (T1_V1)	Risk	-15.1	-15.1	-3.51	-17.6	-4.1
	Receptor	a	a	a	b	c
Freeway Tunnel – Single-Bore with Toll (T1_V6)	Risk	-15.1	-15.1	-3.51	-17.6	-0.70
	Receptor	a	a	a	b	c
Freeway Tunnel – Single-Bore with Toll without Trucks (T1_V7)	Risk	-15.4	-15.4	-3.59	-17.9	-0.71
	Receptor	a	a	a	b	c
Freeway Tunnel – Dual-Bore with Toll (T2_V2)	Risk	-15.5	-15.5	-3.59	-17.7	-0.71
	Receptor	a	a	a	b	c
Freeway Tunnel – Dual-Bore without Toll (T2_V4)	Risk	-14.7	-14.7	-3.51	-17.5	-0.70
	Receptor	d	a	a	b	c
Freeway Tunnel – Dual-Bore without Toll without Trucks (T2_V5)	Risk	-16.0	-16.0	-3.71	-18.0	-0.72
	Receptor	a	a	a	b	c

Notes:
Receptor Locations
a. (390229.3, 3782724.5): Approximately 520 meters (1,706 feet) east of Chevy Chase Drive, residential
b. (393309.8, 3765027.5): Opportunities for Learning, east of South Atlantic Boulevard, north of Whittier Boulevard
c. (395036.2, 3766585.1): Bella Vista Elementary, north of SR 60
d. (393604.3, 3778699.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex

Compared to the 2012 existing condition, the no build and all build alternatives would cause a cancer risk decrease at the PMI, MEIR, MEIW, and the worst-case student and sensitive receptor locations.

- The No Build Alternative takes into account the future vehicle volume change due to natural growth or other projects that were planned for future years in the region. The risk decrease from the No Build Alternative is consistent with the FHWA forecast of the future decreasing trend of MSAT emissions, and is mainly due to the implementation of more stringent regulations and improved vehicle technology.
- The TSM/TDM, BRT, and LRT Alternatives would cause a net decrease of cancer risks compared to the 2012 existing condition at the maximally impacted locations. Although these three alternatives would improve traffic conditions in the study area, they are not expected to change the regional or local VMT substantially. As a result, the vehicle emission decreases associated with the regulatory implementations and vehicle technology improvements would be the main driver of the cancer risk changes, and would result in net benefits to the cancer risks for the TSM/TDM, BRT, and LRT Alternatives. Cancer risks at PMI, MEIR, and MEIW receptors for these three alternatives would decrease by 3.47 to 14.9 compared to the existing condition.

- Similar to the non-Freeway Tunnel Alternatives, despite the increased vehicle travel to and from the newly built SR 710 freeway tunnel, the anticipated MSAT emission decrease due to more stringent emission standards and improved vehicle technologies over the years offsets the emission increase caused by the Freeway Tunnel Alternatives; all variations of the Freeway Tunnel Alternative would result in decreased cancer risks at their maximally impacted locations.

In summary, compared to the 2012 existing condition, the project would result in net health benefits to the entire study area for all the alternatives including all freeway tunnel variations.

The majority of cancer risk near freeways is attributed to vehicle DPM emissions. Due to the installation of the particulate matter control system at the tunnel ventilation system, vehicle emissions from the tunnel ventilation towers contribute minimally (approximately 2 percent) to the MEIR or MEIW cancer risks.

3.1.1.2 Overview of the Regional Health Risk Impacts

Unlike most of the transportation projects that focus on improving the traffic conditions at a specific location or strip of a roadway corridor, the SR 710 project is targeted to improve the traffic conditions and efficiency of a much larger area by providing new transit or freeway options, and redistributing vehicle travel within the 100-square-mile study area that includes several major highways and many main arterials.

While Table 3-1 identifies the worst-case impacted locations of each alternative, it only provides information on where the maximally impacted locations would be; it does not provide an overall picture of the project impacts and benefits in other locations, especially those along the major highways and arterials in the study area due to the traffic redistribution. To illustrate the geographical extent of the potential cancer risk impacts and benefits associated with the project, a series of cancer risk isopleths (cancer risk contours) showing the incremental cancer risks of the alternatives were prepared. The cancer risk results are discussed below; the contour maps (Figures 3-1 through 3-19) are presented at the end of this section.

Cancer risks of the 2012 existing condition are greater than 100 in 1 million along most of the highways and principal arterials in the study area. In the vicinity of major highways and interchanges, especially in the north along I-210 and in the west along I-5, cancer risks are over 250 in 1 million. Higher cancer risks of greater than 250 in 1 million can be found along Fremont Avenue between Valley Boulevard and Huntington Drive. The maximum cancer risk of the existing condition is 623 in 1 million, occurring near the I-5/I-110 interchange. The areas with higher cancer risks indicate heavier traffic and potentially more-congested traffic conditions than the other areas with lower risks.

Figures 3-1 through 3-10 present the cancer risk contour maps of the no build and build alternatives. The risk contour maps show conservative cancer risk results, because the cancer risk levels in the maps were based on 70-year lifetime exposure, regardless of the receptor types at a location. As shown in the figures, the No Build Alternative and all of the build alternatives showed similar cancer risk changes over the study area when compared to the 2012 existing condition, demonstrating an overall regional health benefit. Cancer risks would decrease by less than 10 in 1 million around principal arterials across the study area. Cancer risk decreases near the major highways are usually over 100 in 1 million, and are more prominent along I-210 and I-5. Cancer risk decreases of over 100 in 1 million can be found along Fremont Avenue and Garfield Avenue near the southern end of the SR 710 project corridor.

Because DPM is the cancer risk driver for this project, the overall decreased cancer risk from the existing condition is consistent with the FHWA-forecasted nationwide trend of a decrease in DPM emissions attributed to the implementation of more stringent emission standards, the improvements of vehicle emission-control technologies, and improved fuel efficiency, regardless of the project and regional VMT increase in future years.

3.1.1.3 Population Cancer Burden

Because the no build and all build alternatives of the project would have net health benefits in the region, evaluation of the population cancer burden is not necessary.

3.1.2 Chronic and Acute Risks

Tables 3-2 and 3-3 summarize the results of the incremental HIC and HIA due to MSAT emissions from the build and no build alternatives, respectively, when compared to the 2012 existing condition. Emissions used for the HIC and HIA analysis were from the project opening year (2020 or 2025). The HIC and HIA results were summarized for the PMI, MEIR, MEIW, and maximally exposed sensitive receptors (including K-12 schools, daycare centers, preschools, nursing homes, and hospitals). Comparison to the HIC and HIA thresholds was based on the risks at MEIR, MEIW, or sensitive receptors.

The HIC and HIA for all build and no build alternatives are either less than zero (net benefits), or have HIC and HIA values much lower than the HIC and HIA threshold of 1.0 compared to the existing condition. The worst-case HIC of 0.039 would occur with the Freeway Tunnel Alternative Dual-Bore without Toll (T2_V4) variation at the eastern boundary of the SR 710 ROW near the freeway tunnel north portal. The worst-case HIA of 0.0047 would occur with T2_V4 at the eastern boundary of the SR 710 ROW near the freeway tunnel south portal area.

TABLE 3-2
Incremental HIC: No Build and Build Alternatives (Opening Year) vs. 2012 Existing Condition

		HIC PMI	HIC MEIR	HIC MEIW	HIC Sensitive
No Build	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
TSM/TDM	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
BRT	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
LRT	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Single-Bore with Express Bus (T1_V1)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Single-Bore with Toll (T1_V6)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Single-Bore with Toll without Trucks (T1_V7)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Dual-Bore with Toll (T2_V2)	Risk	0.00032	<0	<0	0.00032
	Receptor	a	NA	NA	a
Freeway Tunnel – Dual-Bore without Toll (T2_V4)	Risk	0.039	0.019	0.039	<0
	Receptor	a	b	a	NA
Freeway Tunnel – Dual-Bore without Toll without Trucks (T2_V5)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA

Notes:
Receptor Locations
a. (393604.3, 3778699.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex
b. (393629.3, 3778524.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex

TABLE 3-3
Incremental HIA: No Build and Build Alternatives (Opening Year) vs. 2012 Existing Condition

		HIA PMI	HIA MEIR	HIA MEIW	HIA Sensitive
No Build	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
TSM/TDM	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
BRT	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
LRT	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Single-Bore with Express Bus (T1_V1)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Single-Bore with Toll (T1_V6)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Single-Bore with Toll without Trucks (T1_V7)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Dual-Bore with Toll (T2_V2)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA
Freeway Tunnel – Dual-Bore without Toll (T2_V4)	Risk	0.0047	0.0047	0.0047	<0
	Receptor	a	a	a	NA
Freeway Tunnel – Dual-Bore without Toll without Trucks (T2_V5)	Risk	<0	<0	<0	<0
	Receptor	NA	NA	NA	NA

Notes:
Receptor Locations
a. (392922.8, 3771272.9): Next to the eastern boundary of the SR 710 ROW near the south portal, residential

3.2 Scenario 2: Build Alternatives vs. No Build Alternative (Opening Year)

Scenario 2 of the HRA compares the potential health risk impacts of the build alternatives to the No Build Alternative. Because the vehicle MSAT emissions would decrease in future years, the HRA under Scenario 2 used the worst-case emissions during project operation—emissions from the project opening year (2020 or 2025). As such, the Scenario 2 HRA results represent conservative estimates of the risks.

Incremental cancer, chronic, and acute risks of the project were evaluated and summarized for each of the build alternatives and their design variations. Scenario 2 risk analysis only took into account the factors that directly related to the implementation of the build alternatives. Factors that affect both the build and no build alternatives in future years, such as the VMT increase related to natural regional VMT growth and the vehicle emission decrease due to implementation of vehicle emission-reduction measures, would cause the same health risk impacts for both the no build and build alternatives, and thus were cancelled out when comparing the risks of the build alternatives to the No Build Alternative.

3.2.1 Cancer Risks

3.2.1.1 Maximally Impacted Locations

Cancer risks were estimated based on a 70-year exposure, and assumed that the opening year MSAT emission level would remain the same for the next 70 years. Incremental changes of the 70-year lifetime cancer risks at the PMI, MEIR, MEIW, and maximally exposed sensitive receptors including daycare centers, nursing homes, and hospitals, as well as the adjusted 9-year exposure at student receptors, were evaluated and are summarized in Table 3-4. The incremental cancer risk values listed for the PMI location were evaluated based on a 70-year residential exposure, even though the PMI could be either a resident receptor or a worker receptor.

TABLE 3-4
Incremental Cancer Risks: Build Alternatives vs. No Build Alternative (Opening Year) (Units: in 1 Million)

		PMI	MEIR	MEIW	Sensitive Receptor Maximum	Student Maximum
TSM/TDM	Risk	8.65	7.87	1.61	1.77	0.059
	Receptor	a	b	a	c	d
BRT	Risk	10.5	9.52	1.97	1.97	0.081
	Receptor	a	b	a	c	d
LRT	Risk	11.0	9.23	2.04	4.02	0.058
	Receptor	e	f	e	g	h
Freeway Tunnel – Single-Bore with Express Bus (T1_V1)	Risk	77.1	68.0	15.1	9.53	1.40
	Receptor	i	j	i	k	l
Freeway Tunnel – Single-Bore with Toll (T1_V6)	Risk	77.7	69.1	15.2	11	1.41
	Receptor	i	j	i	k	l
Freeway Tunnel – Single-Bore with Toll without Trucks (T1_V7)	Risk	11	10.4	1.99	0.53	0.13
	Receptor	m	n	o	c	l
Freeway Tunnel – Dual-Bore with Toll (T2_V2)	Risk	120	104	23.3	8.24	2.11
	Receptor	i	j	i	k	l
Freeway Tunnel – Dual-Bore without Toll (T2_V4)	Risk	170	149	33.1	17	3.02
	Receptor	i	j	i	k	l
Freeway Tunnel – Dual-Bore without Toll without Trucks (T2_V5)	Risk	39.8	33.6	7.26	0.87	0.61
	Receptor	i	j	i	p	l

Table 3-4 Notes:

Receptor Locations

a. (393731.9, 3773290.1): Near the southeast corner of North Fremont Avenue and West Main, commercial
b. (393730.3, 3774123): Near the northeast corner of Fremont Avenue and Beech Street, residential
c. (399267.8, 3776690.7): Success Education Institute, southwest corner of Bellhaven Road and Huntington Drive
d. (393626.2, 3774060.5): The Almansor Center, southwest corner of Fremont Avenue and Huntington Lane
e. (393705, 3771336.7): Near the northwest corner of South Fremont Avenue and West Valley Boulevard
f. (393730.6, 3771460.9): Near the northeast corner of South Fremont Avenue and Front Street, residential
g. (400920.6, 3772636.0): Little People Preschool, northwest corner of Rosemead Boulevard and Lower Azusa Road
h. (393842.7, 3771787.3): Sherman School, northeast corner of South Fremont Avenue and West Mission Road
i. (393604.3, 3778699.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex
j. (393604.3, 3778799.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex
k. (393160.1, 3779656.0): Scott United Methodist Preschool, northwest of the SR 710 and I-210 interchange
l. (393355.9, 3778502.6): Maranatha High School, west of the SR 710 near north portal
m. (388060.9, 3769056.8): Near the northeast corner of the I-5 and I-10 interchange
n. (388054.3, 3769149.5): Near the northeast corner of the I-5 and I-10 interchange, residential
o. (388054.3, 3769074.5): Near the northeast corner of the I-5 and I-10 interchange
p. (395776.8, 3779345.1): Lindamood-Bell Learning Processes, northeast corner of North Mentor Avenue and West Walnut Street

According to Table 3-4, cancer risk would increase at the maximally impacted locations for all the build alternatives when compared to the No Build Alternative. Detailed risk changes at MEIR, MEIW, and sensitive receptors are discussed below.

- The worst-case cancer risk increase of the TSM/TDM, BRT, and LRT Alternatives at MEIR, MEIW, and sensitive receptors is less than the risk increase from the Freeway Tunnel Alternative variations. The highest incremental cancer risks at MEIR, MEIW, and sensitive receptors due to TSM/TDM, BRT, and LRT Alternatives are in the range of 0.058 in 1 million (at a student receptor) to 9.52 in 1 million (at MEIR), while the incremental risks at MEIR or MEIW due to the Freeway Tunnel Alternative could reach over 100 in 1 million for some of the variations.

- Two of the single-bore variations of the Freeway Tunnel Alternative (T1_V1 and T1_V6) would result in similar incremental cancer risks at the maximally impacted locations. The incremental cancer risks at MEIR are 68.0 and 69.1 in 1 million for T1_V1 and T1_V6, respectively. The incremental cancer risks at MEIW are 15.1 and 15.9 in 1 million, respectively. The MEIR and MEIW locations are near the north portal, east of the new freeway tunnel alignment. The maximum student cancer risk based on an adjusted 9-year exposure is 1.4 in 1 million, and is located at Maranatha High School, west of the SR 710 near the north portal.
- The Freeway Tunnel Alternative Single-Bore with Toll without Trucks (T1_V7) variation has lower diesel vehicle emissions along the new freeway tunnel alignment than the other two single-bore variations (T1_V1 and T1_V6) that allow truck traffic. The incremental cancer risks at MEIR and MEIW are 10.4 and 1.99 in 1 million, respectively, lower than the incremental cancer risks of the other two single-bore variations. The MEIR and MEIW locations are near the northeast corner of the I-5 and I-10 interchange. The maximum student cancer risk based on a 9-year exposure is 0.13 at Maranatha High School, west of the SR 710 near the north portal.
- The Freeway Tunnel Alternative Dual-Bore without Toll (T2_V4) variation has the highest vehicle volume on the new freeway tunnel alignment. The incremental cancer risk at MEIR and MEIW for T2_V4 is 149 and 33.1 in 1 million, respectively, located near the north portal, east of the new freeway tunnel alignment. The maximum student cancer risk based on an adjusted 9-year exposure is 3.02 in 1 million, and is located at Maranatha High School, west of the SR 710 near the north portal.
- The Dual-Bore with Toll (T2_V2) variation has lower incremental cancer risks than T2_V4 at the maximally impacted locations, because fewer vehicles would take the new freeway tunnel with a toll. The incremental cancer risks at MEIR and MEIW for T2_V2 are 104 and 23.3 in 1 million, respectively. The MEIR and MEIW locations are the same for all Freeway Tunnel Alternative dual-bore variations that are near the north portal area next to the eastern boundary of the SR 710.
- The Freeway Tunnel Alternative Dual-Bore without Trucks (T2_V5) variation would restrict truck access to the freeway tunnel. With decreased diesel truck emissions, this variation has a much lower cancer risk increase at the MEIR and MEIW locations than the other two dual-bore variations that allow truck access. Incremental cancer risks at MEIR and MEIW are 33.6 and 7.26, respectively, at the SR 710 eastern boundary near the north portal area.

In summary, compared to the No Build Alternative, incremental cancer risks at maximally impacted locations of the TSM/TDM, BRT, and LRT Alternatives are lower than the Freeway Tunnel Alternative. MEIR and MEIW locations of the TSM/TDM, BRT, and LRT Alternatives are near the I-5 and I-10 interchange. Because the majority of the cancer risk near the freeways is attributed to vehicle DPM emissions, the design variations that restrict truck access to the new freeway tunnel would have lower cancer risks at MEIR and MEIW locations than the operational variations that allow trucks.

3.2.1.2 Overview of the Regional Cancer Risk Impacts and Health Benefits

Cancer risks are typically in the range of 10 to 100 in 1 million in most of the study area under the No Build Alternative. In the vicinity of highways including I-210, I-5, I-605, and the major interchanges, cancer risks are over 100 in 1 million.

To demonstrate the regional cancer risk impacts and benefits of the project, contour maps showing the incremental cancer risk changes caused by each build alternative are shown in Figures 3-11 through 3-19. The cancer risk contours indicate that although there would be localized areas of increased cancer risks for the build alternatives, each alternative would result in overall regional health benefits that reduce cancer risk in the majority of the study area.

Non-Freeway-Tunnel Alternatives: Figures 3-11 through 3-13 are the incremental cancer risk isopleths for the TSM/TDM, BRT, and LRT Alternatives. The TSM/TDM Alternative includes strategies and improvements to increase efficiency and capacity of existing facilities of the transportation system. The BRT and LRT Alternatives provide additional bus or light rail transit options to the region. Implementation of these alternatives would increase the travel efficiency and relieve congestion in the study area. As shown in Figures 3-13 through 3-15, these alternatives would result in overall health benefits in the study area by reducing cancer risks by less than 10 in 1 million along the majority of the highways and surface streets. Localized cancer risk increases of less than 10 in 1 million can be found at various locations that are scattered in the study area, likely caused by the vehicle volume or vehicle fleet mix change on some roadways due to the shift of travel routes. For example, while the LRT and BRT Alternatives would provide higher ridership and reduce the regional VMT, roadways on route to the LRT or BRT stations may experience increased traffic and increased MSAT emissions and cancer risks. Under the TSM/TDM Alternative, roadways with improved traffic conditions may attract more vehicles from other routes and cause increased MSAT emissions and cancer risks.

Freeway Tunnel Alternative: The Freeway Tunnel Alternative provides a new freeway connecting SR 710 between Alhambra and Pasadena. The six variations of the Freeway Tunnel Alternative showed similar cancer risk impact and benefit trends within the study area, as shown in Figures 3-14 through 3-19. Cancer risks in the majority of the study area would slightly decrease by less than 10 in 1 million from the no build condition. A higher level of risk reductions (10 to 100 in 1 million) can be found in the vicinity along the I-5 between I-10 and SR 2, and along Fremont Avenue and Garfield Avenue between Valley Boulevard and Huntington Drive. Regional health benefits of the Freeway Tunnel Alternative are attributed to the new freeway corridor, which will attract a large volume of vehicles from existing roadways and relieve traffic congestion in the study area.

The Freeway Tunnel Alternative also has the potential to cause a localized cancer risk increase due to the added vehicle emissions from the new freeway corridor and the roadways directly connected to it. Localized cancer risk increases occur mostly near the tunnel portal areas and extend to the nearby interchanges and highways that vehicles would use as the main routes to or from the new freeway tunnel. In the north, the risks would increase near the north portal and the I-210/SR 710/SR 134 interchange, along I-210 north of the I-210/SR 710/SR 134 interchange, and along SR 134. In the south, cancer risks would increase near the south portal and extend south to the SR 710/I-10 interchange. Increased cancer risks also can be found along I-10 between the I-10/SR 710 interchange and Rosemead Boulevard, and along I-605 at the east side of the project area. Most of these areas would have a minimal cancer risk increase of less than 10 in 1 million. Cancer risk increases, especially cancer risk increase over 10 in 1 million, are usually attributed to increased MSAT emissions from increased VMT; a slight increase of cancer risks also may occur on segments with increased vehicle speed but with similar VMT to the No Build Alternative. Because DPM emissions would increase with vehicle speed once the vehicle speed exceeds 40 to 45 mph, sometimes the DPM emission increase due to increased vehicle speed may offset the DPM emission decrease from the VMT decrease, and results in slightly elevated cancer risks on some of the highway segments. In some cases, because DPM emissions would increase with vehicle speed once the vehicle speed exceeds 35 to 45 mph, a slight increase of cancer risks also may occur on segments with increased vehicle speed but with similar VMT when compared to the No Build Alternative.

The area with cancer risk increases greater than 10 in 1 million is a narrow strip around the north and south portals and the adjacent interchanges. This localized risk increase is consistent with the projected traffic pattern change from the traffic analysis of the project (CH2M HILL, 2014), which indicates that vehicles traveling between the Pasadena/La Cañada/Flintridge area and the Alhambra area would choose to use the new SR 710 freeway tunnel, causing substantial vehicle volume increase in areas near the I-710/I-210 interchange and the I-710 segment leading to the north portal, and the areas near the I-710/I-10 interchanges and the I-710 segment leading to the south portal.

The extent of the areas and the level of cancer risk decrease or increase are different for each of the freeway tunnel variations depending on:

- Tunnel configuration (single or dual bore)
- Tunnel operation (with or without toll)
- Whether or not the tunnel would allow truck access

Near the tunnel portals, single-bore variations have a lower level of risk increase and smaller impact areas with cancer risk increase greater than 10 in 1 million than the dual-bore variations with similar operational features. The Dual-Bore without Toll (T2_V4) variation has the worst-case localized impacts near the freeway tunnel portal areas of all the alternatives and their variations. Variation T2_V4 has the largest cancer risk impact areas with greater than 10 in 1 million risk increase near each portal. However, T2_V4 showed a higher level of cancer risk reduction that covers larger areas along the I-5 between I-10 and SR 2, and along Fremont Avenue and Garfield Avenue between Valley Boulevard and Huntington Drive, In addition, it reduces the cancer risks along SR 2 all the way to the SR 2/I-210 near the northern boundary of the study area, while none of the other alternatives has cancer risk reductions at a similar level in this area.

The Freeway Tunnel Alternative no-truck variations (T1_T7 and T2_V5) have a lower potential of localized cancer risk impacts than the variations that allow trucks, especially near the two portal areas, due to the greatly reduced diesel truck DPM emissions from the new corridor. Minimal areas would have a cancer risk increase over 10 in 1 million; in addition, the size of the areas with a cancer risk increase is much smaller and the areas are sparser than the variations that allow truck access to the tunnel. However, the no-truck variations also would result in less risk benefits in other areas of the region. As shown in Figure 3-18 (for T1_V7) and Figure 3-21 (for T2_V5), the majority of the study area would have a cancer risk reduction of less than 10 in 1 million. Although the no-truck variations still provide traffic relief and risk reduction along the arterials of Fremont Avenue and Garfield Avenue, there would be no risk reduction along I-5.

3.2.2 Chronic and Acute Risks

Tables 3-5 and 3-6 summarize the results of the incremental HIC and HIA, respectively, comparing the build and no build alternatives. Emissions used for the HIC and HIA are from the project opening year (2020 or 2025). The HIC and HIA results were summarized for the PMI, MEIR, MEIW, and the maximally exposed sensitive receptors including K-12 schools, preschools, daycare centers, nursing homes, and hospitals.

All of the build alternatives would cause a minimal HIC and HIA increase compared to the No Build Alternative condition. The Dual-Bore without Toll (T2_4) variation has the worst-case HIC increase of 0.11 and the worst-case HIA increase of 0.047 at a residential receptor located near the south portal.

TABLE 3-5
Incremental HIC: Build Alternatives (Opening Year) vs. No Build Alternative

		HIC PMI	HIC MEIR	HIC MEIW	HIC Sensitive
TSM/TDM	Risk	0.0043	0.0037	0.0043	0.00078
	Receptor	a	b	a	c
BRT	Risk	0.0059	0.0051	0.0059	0.0012
	Receptor	a	b	a	c
LRT	Risk	0.0056	0.0047	0.0056	0.0014
	Receptor	d	e	d	f
Freeway Tunnel – Single-Bore with Express Bus (T1_V1)	Risk	0.056	0.049	0.056	0.024
	Receptor	g	h	g	i
Freeway Tunnel – Single-Bore with Toll (T1_V6)	Risk	0.056	0.049	0.056	0.024
	Receptor	g	h	g	i
Freeway Tunnel – Single-Bore with Toll without Trucks (T1_V7)	Risk	0.0083	0.0078	0.0083	0.00066
	Receptor	j	k	j	j
Freeway Tunnel – Dual-Bore with Toll (T2_V2)	Risk	0.075	0.065	0.075	0.032
	Receptor	g	h	g	j
Freeway Tunnel – Dual-Bore without Toll (T2_V4)	Risk	0.11	0.099	0.11	0.048
	Receptor	g	h	g	j
Freeway Tunnel – Dual-Bore without Toll without Trucks (T2_V5)	Risk	0.014	0.013	0.014	0.0043
		j	k	j	J

Notes:
Receptor Location

a. (393731.9, 3773290.1): Near the southeast corner of North Fremont Avenue and West Main, commercial
b. (393730.3, 3774123): Near the northeast corner of Fremont Avenue and Beech Street, residential
c. (393626.2, 3774060.5): The Almansor Center, southwest corner of Fremont Avenue and Huntington Lane
d. (393705, 3771336.7): Near the northwest corner of South Fremont Avenue and West Valley Boulevard
e. (393730.6, 3771460.9): Near the northeast corner of South Fremont Avenue and Front Street, residential
f. (400920.6, 3772636.0): Little People Preschool, northwest corner of Rosemead Boulevard and Lower Azusa Road
g. (393604.3, 3778699.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex
h. (393604.3, 3778799.5): Next to eastern boundary of SR 710 ROW near north portal, mixed commercial/residential complex
i. (393355.9, 3778502.6): Maranatha High School, west of the SR 710 near north portal
j. (388060.9, 3769056.8): Near the northeast corner of the I-5 and I-10 interchange
k. (388054.3, 3769149.5): Near the northeast corner of the I-5 and I-10 interchange, residential

TABLE 3-6
Incremental HIA: Build Alternatives (Opening Year) vs. No Build Alternative

		HIA PMI	HIA MEIR	HIA MEIW	HIA Sensitive
TSM/TDM	Risk	0.0017	0.0014	0.0017	0.00030
	Receptor	a	b	a	c
BRT	Risk	0.0015	0.0010	0.0015	0.00019
	Receptor	a	d	a	e
LRT	Risk	0.0043	0.0043	0.0043	0.0016
	Receptor	f	g	f	h
Freeway Tunnel – Single-Bore with Express Bus (T1_V1)	Risk	0.020	0.017	0.020	0.0084
	Receptor	i	j	i	k
Freeway Tunnel – Single-Bore with Toll (T1_V6)	Risk	0.021	0.018	0.021	0.0091
	Receptor	i	j	i	k
Freeway Tunnel – Single-Bore with Toll without Trucks (T1_V7)	Risk	0.0098	0.0065	0.0098	0.0036
	Receptor	i	l	i	m
Freeway Tunnel – Dual-Bore with Toll (T2_V2)	Risk	0.032	0.032	0.032	0.013
	Receptor	j	j	j	k
Freeway Tunnel – Dual-Bore without Toll (T2_V4)	Risk	0.047	0.047	0.047	0.019
	Receptor	j	j	j	k
Freeway Tunnel – Dual-Bore without Toll without Trucks (T2_V5)	Risk	0.021	0.021	0.021	0.0078
		j	j	j	K

Notes:

Receptor Location

a. (392404.3, 3769149.5): Near the southwest corner of SR 710 and I-10 interchange
b. (393715.6, 3772384.3): Near the northwest corner of South Fremont Avenue and Concord Avenue, residential
c. (393910.2, 3771277.7): Little Sunshine Preschool, near the corner of South Primrose Avenue and West Valley Boulevard
d. (392604.3, 3768974.5): Near the northeast corner of Corporate Center Drive and Casuda Canyon Drive, residential
e. (392348.1, 3770245.6): Los Angeles County High School for the Arts, near northwest corner of SR 710 and I-10 interchange
f. (395602, 3774051.5): Near the south corner of North Garfield Avenue and East McLean Street
g. (395703.6, 3773875.6): Near the south corner of North Garfield Avenue and West Alhambra Road, residential
h. (395444.3, 3779684.1): Lake Avenue Church, near the northwest corner of North Lake Avenue and East Maple Street
i. (393629.3, 3779299.5): Near the southeast corner of I-210 and SR 710 interchange
j. (392922.8, 3771272.9): Next to the eastern boundary of the SR 710 ROW near the south portal, residential
k. (393260.1, 3779508.1): Roosevelt (Theodore) Elementary School, northwest corner of I-210 and SR 710 interchange
l. (393629.3, 3779649.5): Near the northeast corner of SR 710 and I-210 interchange, residential
m. (394008.8, 3779399.8): St. Andrew Elementary School, near the northeast corner of North Fair Oaks Avenue and East Walnut Street

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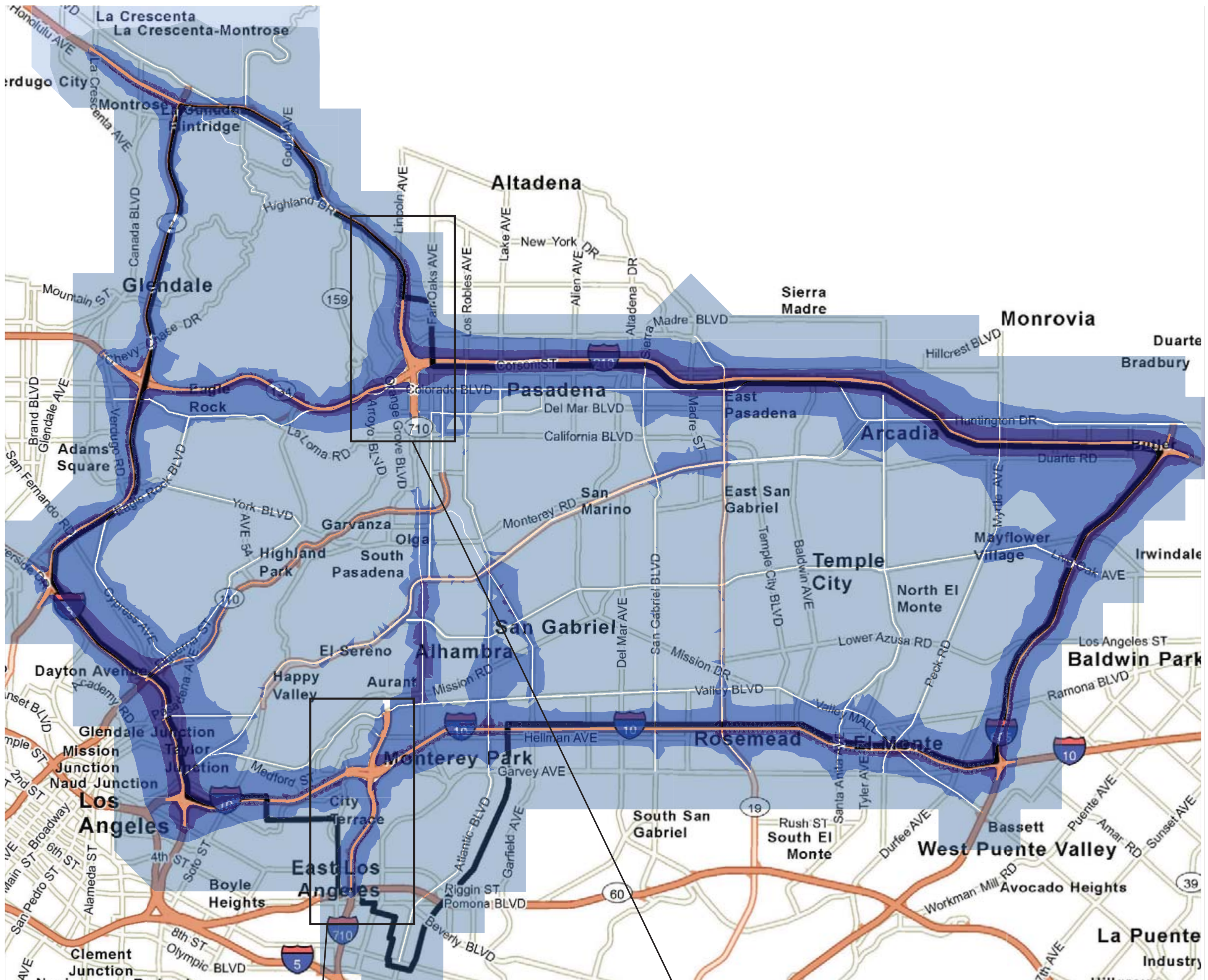

Project Study Area

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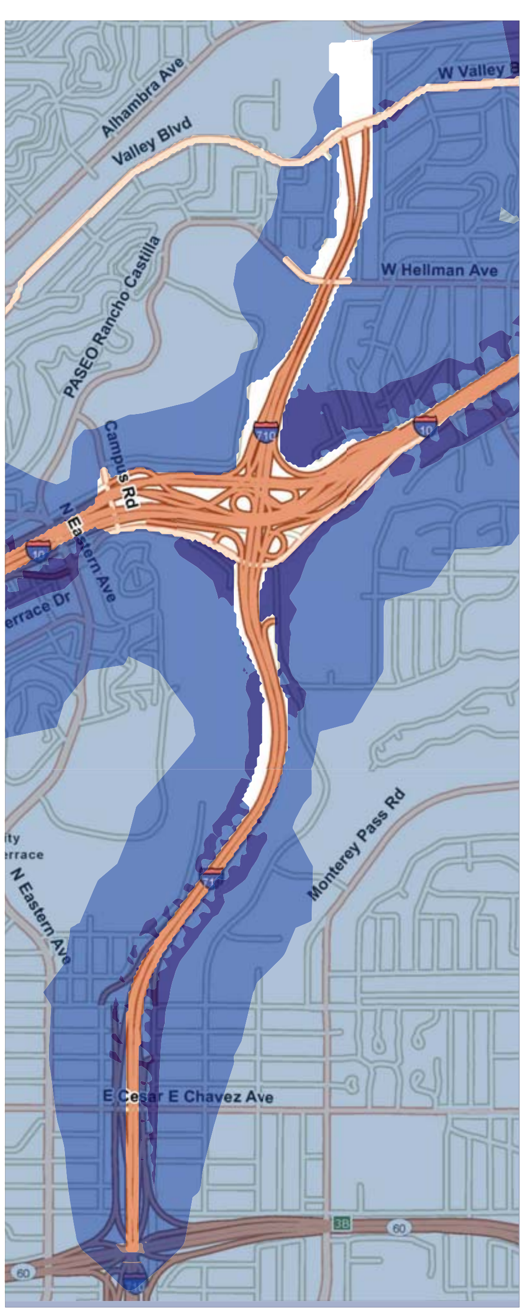
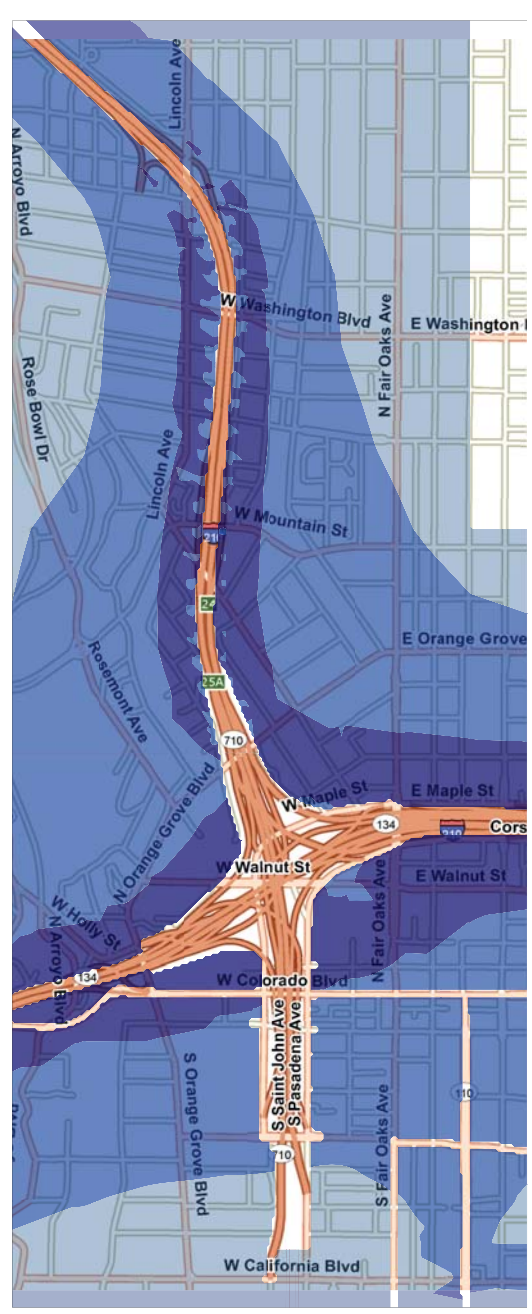


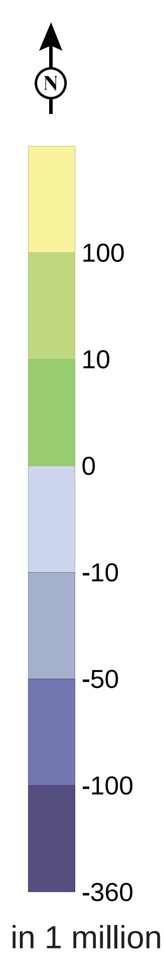
0 500 1000 (meters) 1500 2000

South Portal Area



0 500 1000 (meters) 1500 2000

North Portal Area



Legend

Project Study Area

FIGURE 3-1
Incremental Cancer Risk
No Build Alternative vs.
2012 Existing Condition
Health Risk Assessment
SR 710 North Study

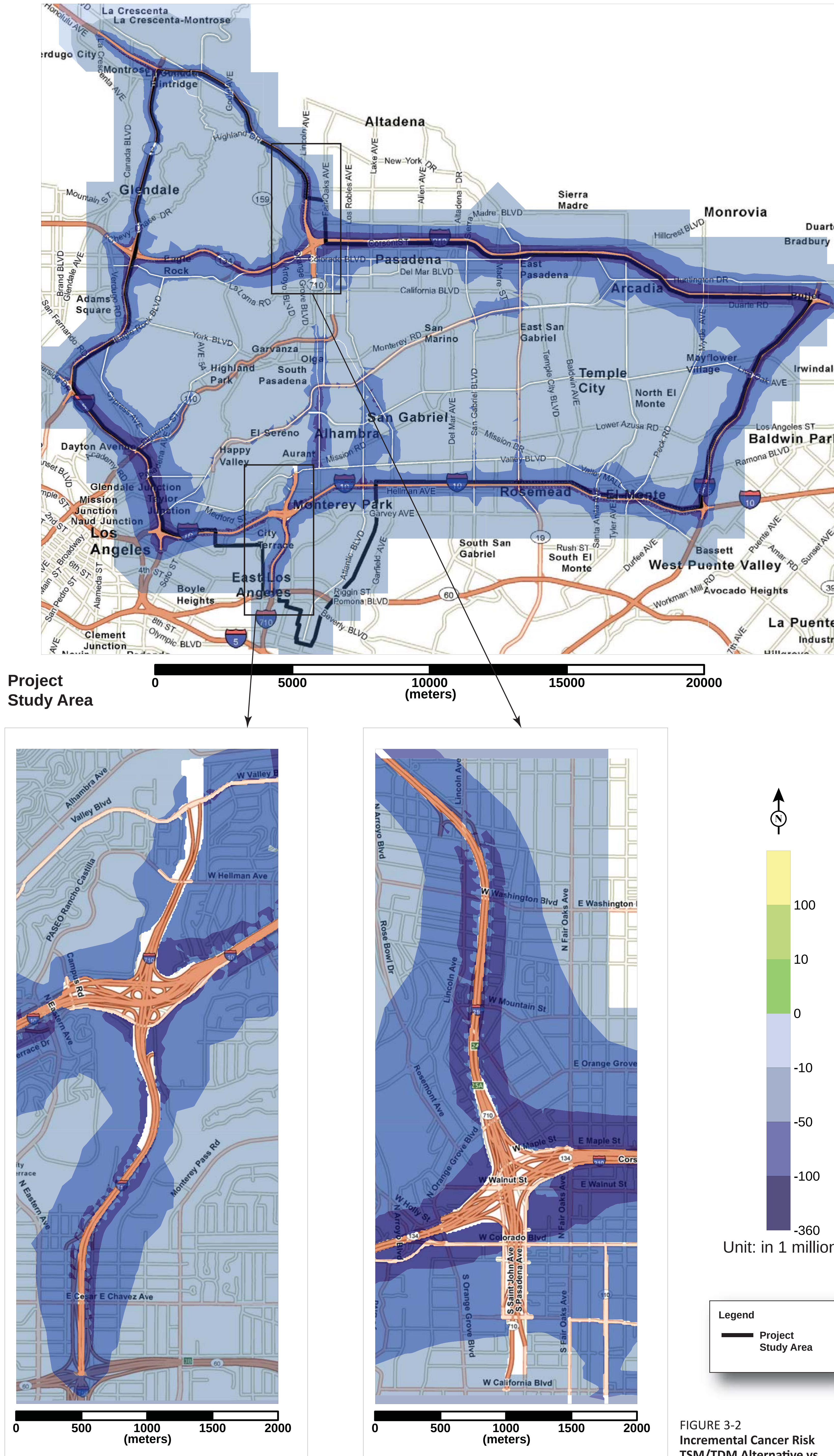


FIGURE 3-2
Incremental Cancer Risk
TSM/TDM Alternative vs.
2012 Existing Condition
Health Risk Assessment
SR 710 North Study

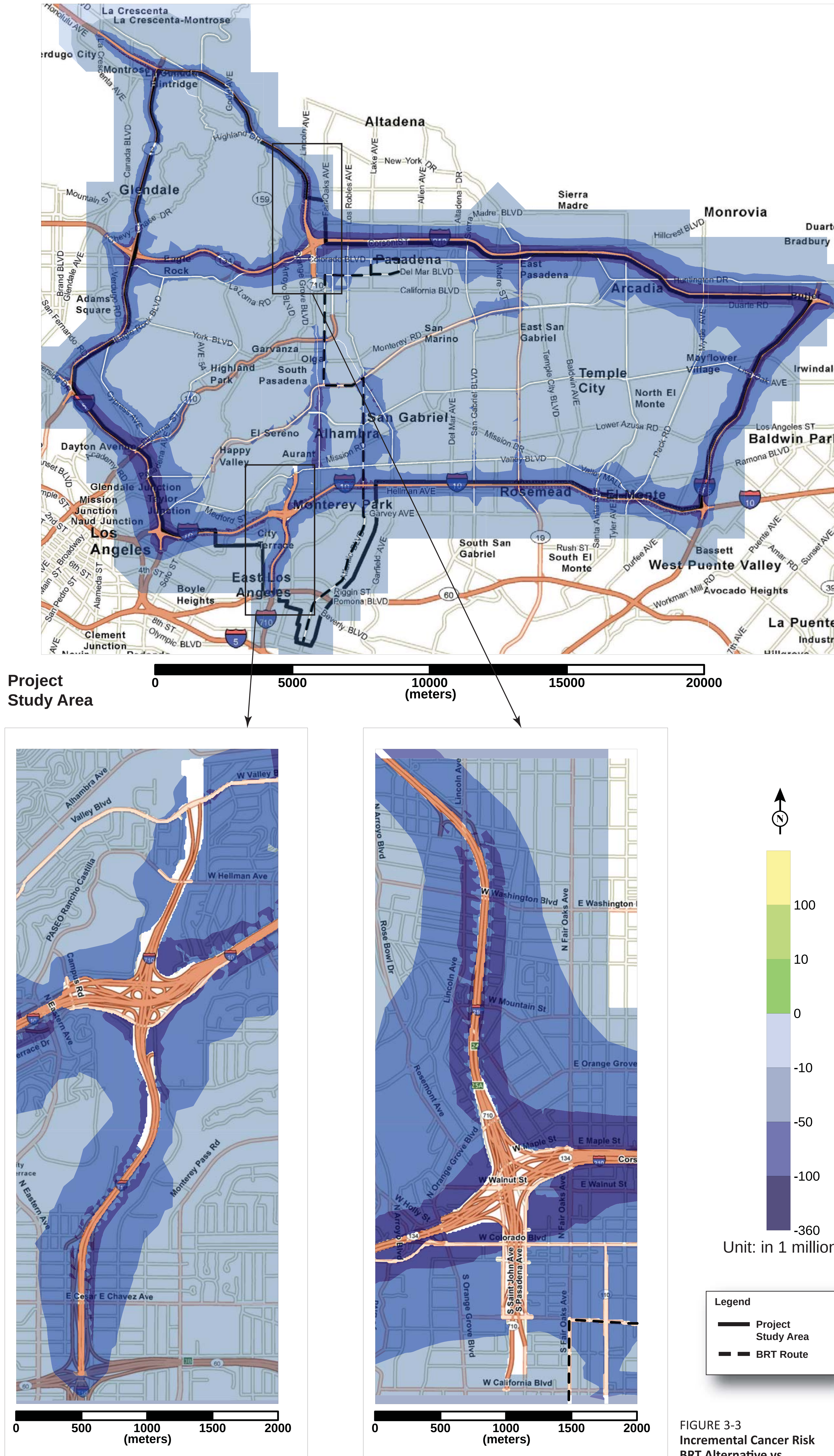
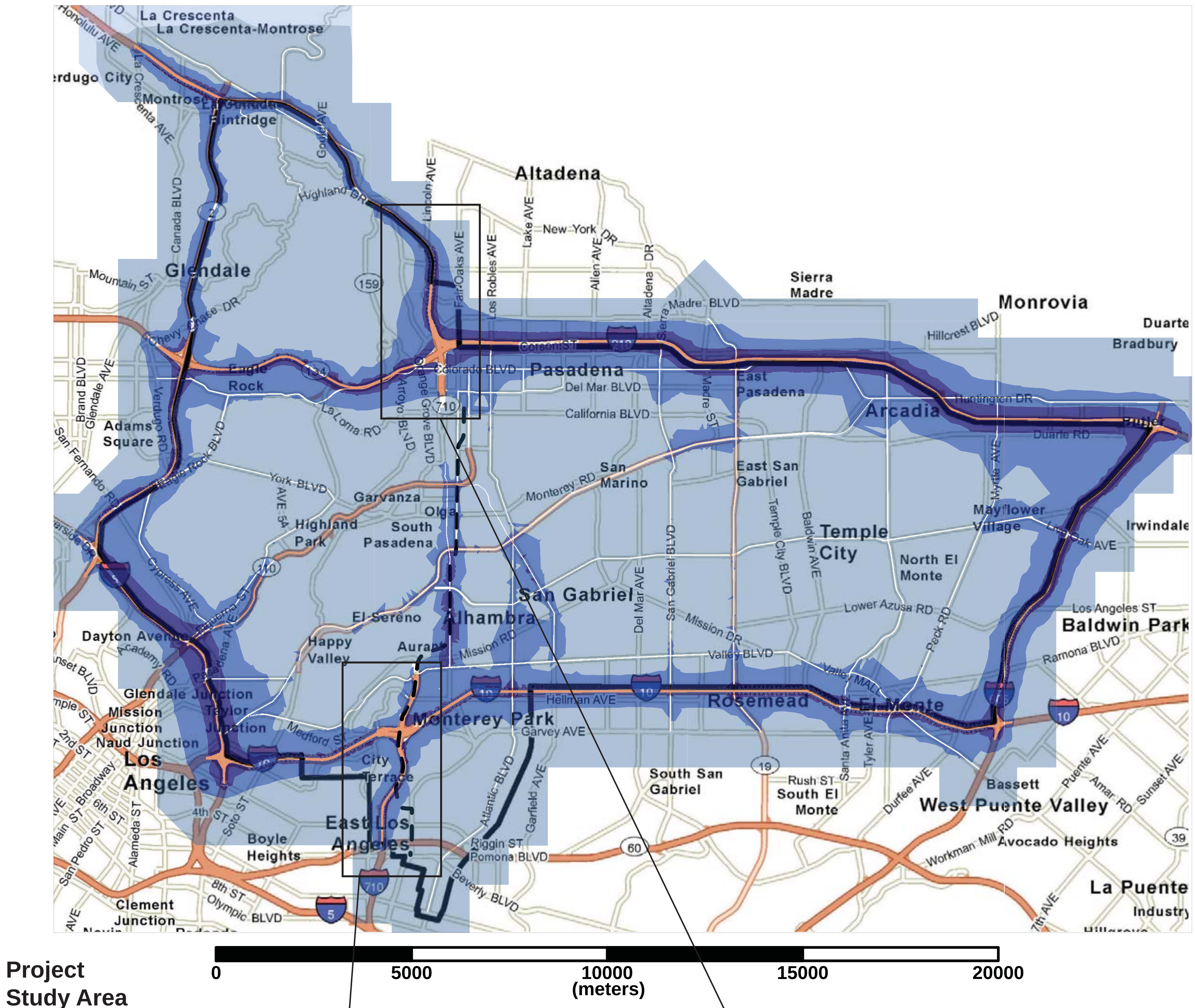
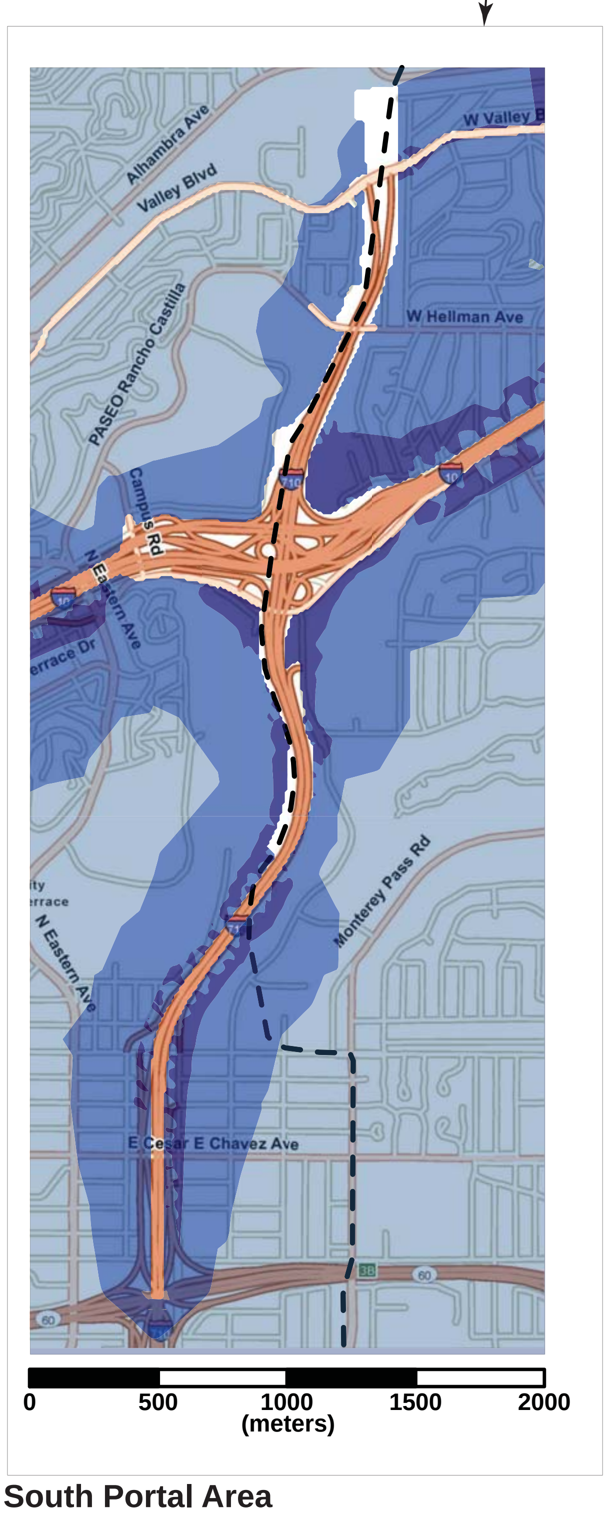
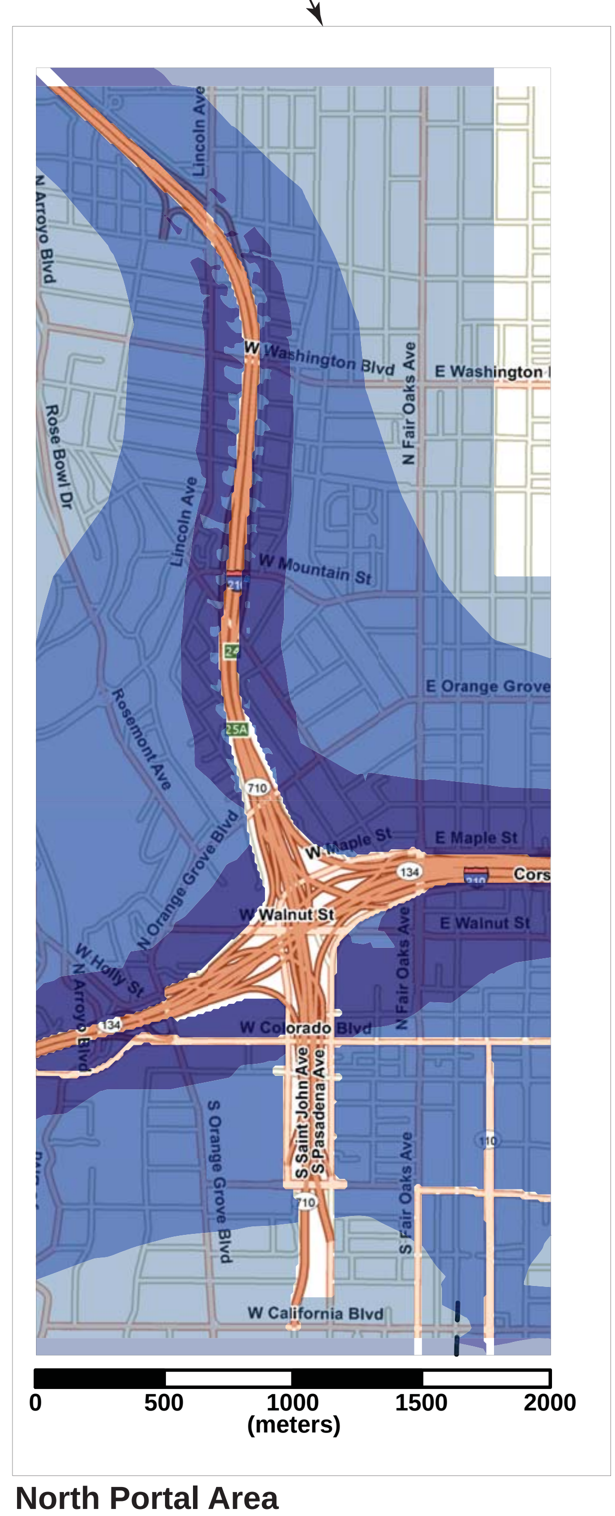


FIGURE 3-3
Incremental Cancer Risk BRT Alternative vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study







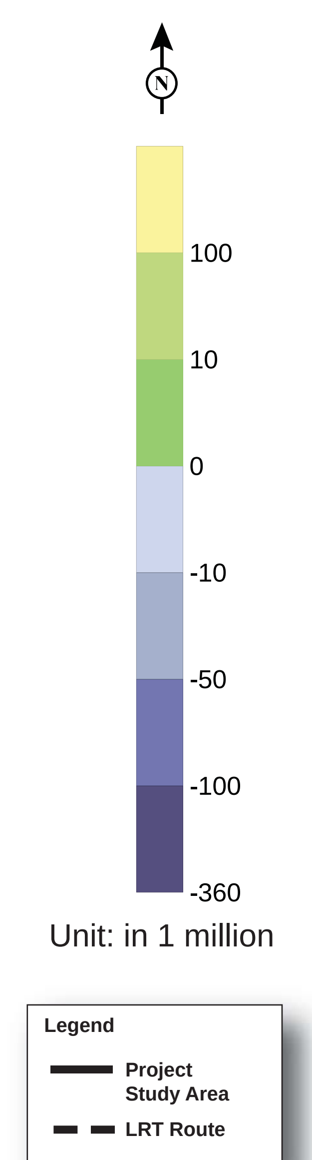


FIGURE 3-4
Incremental Cancer Risk LRT Alternative vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study

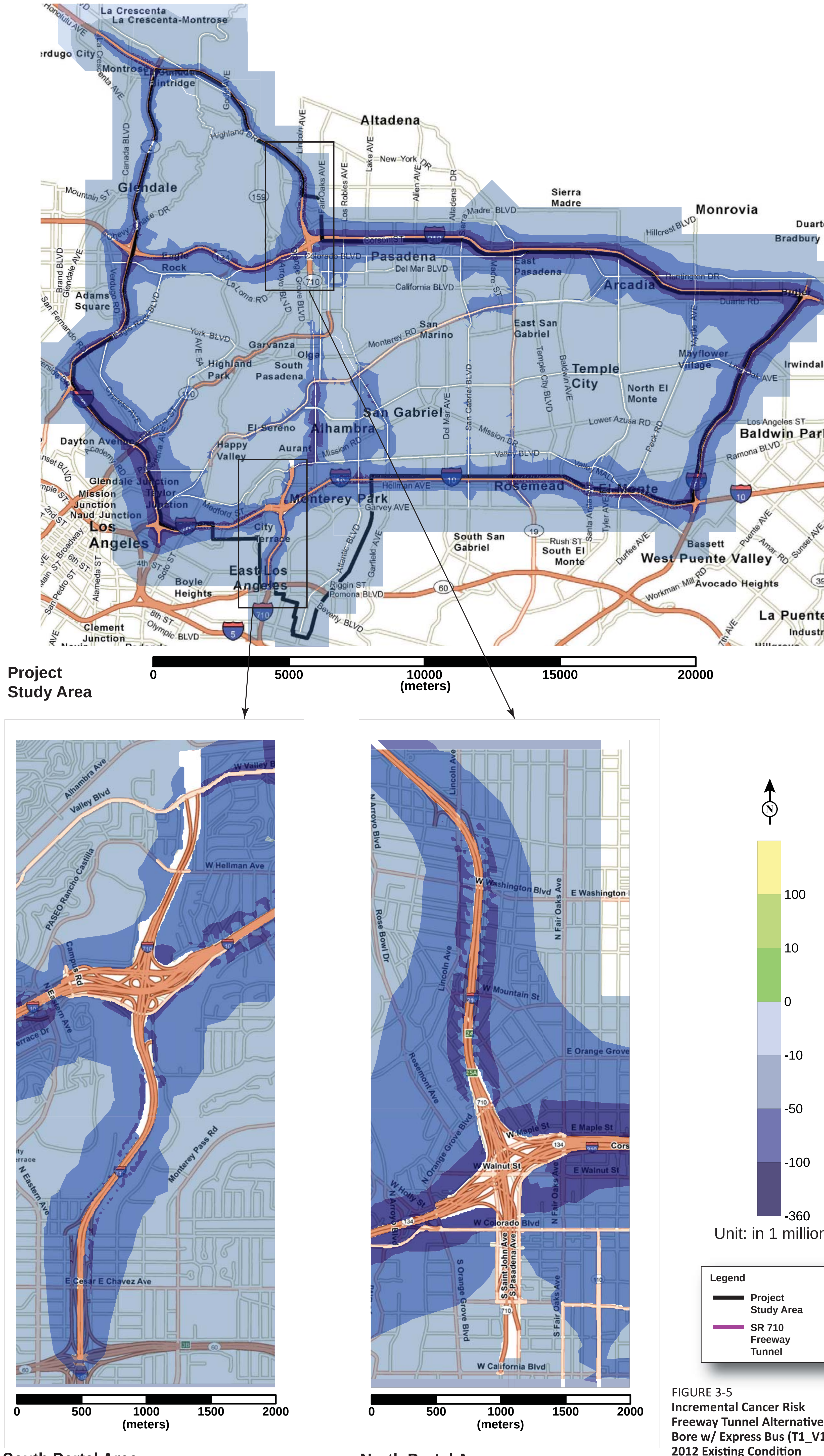


FIGURE 3-5
Incremental Cancer Risk
Freeway Tunnel Alternative - Single Bore w/ Express Bus (T1_V1) vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study

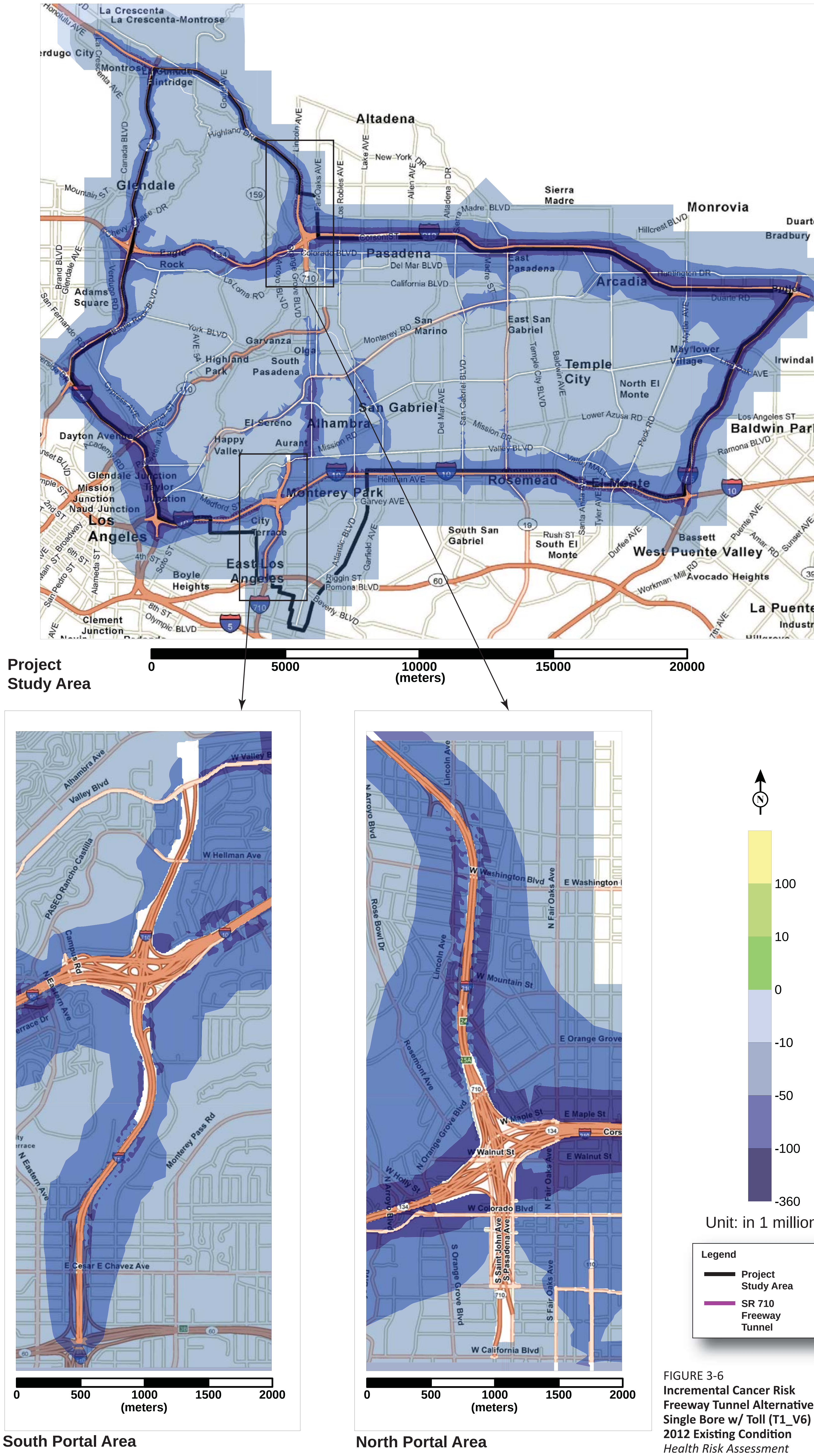
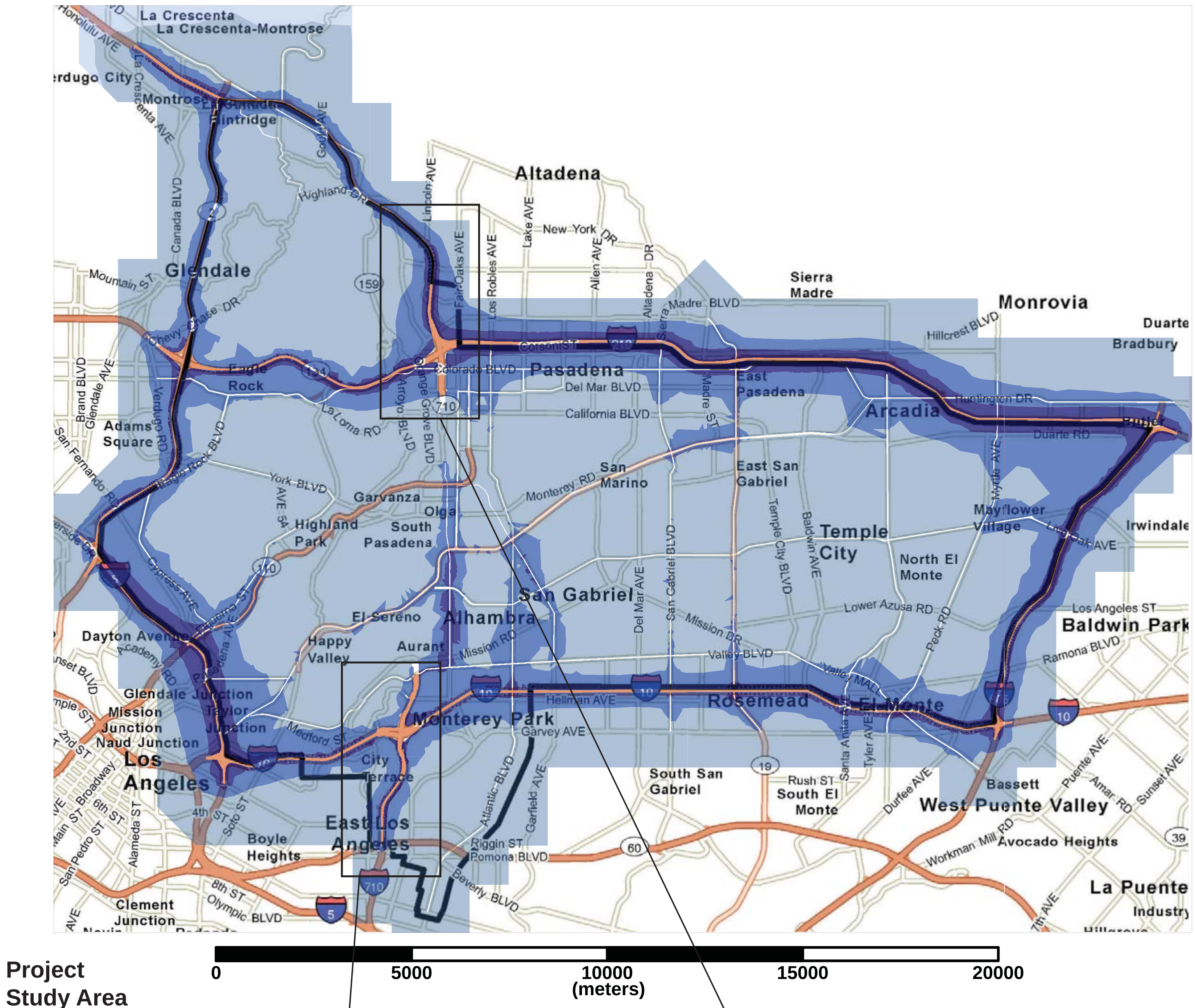
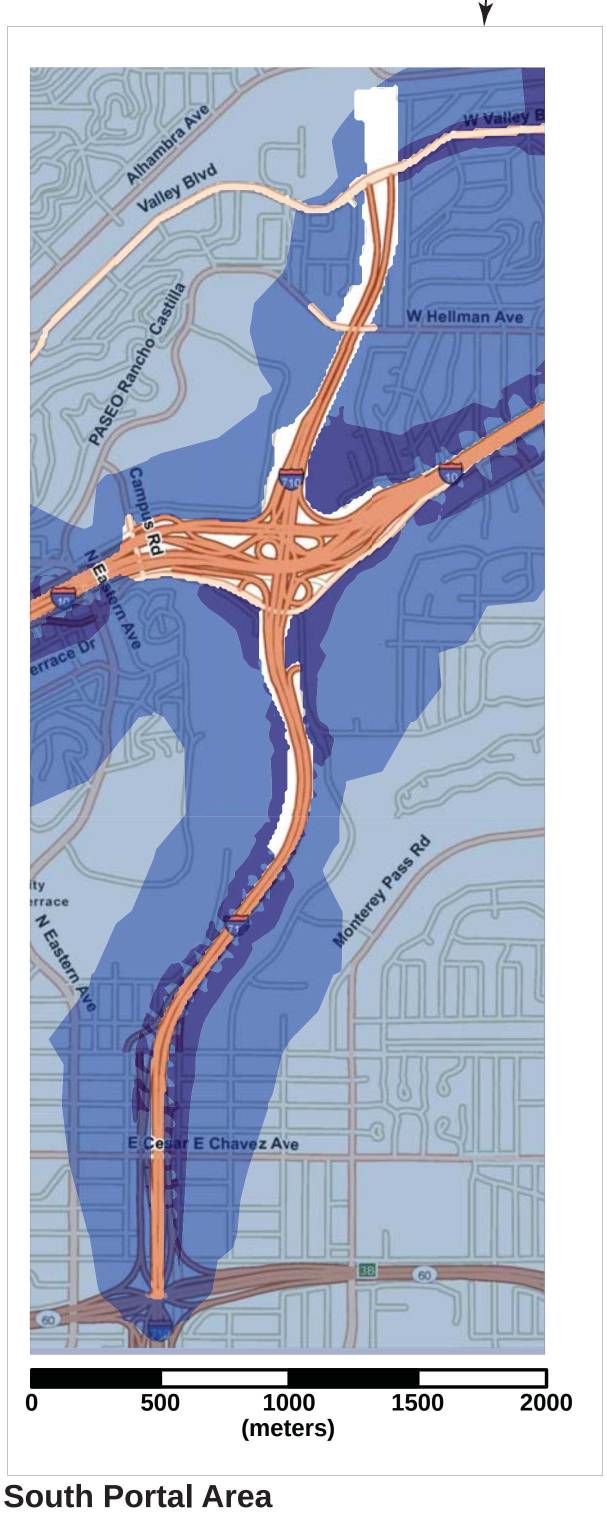
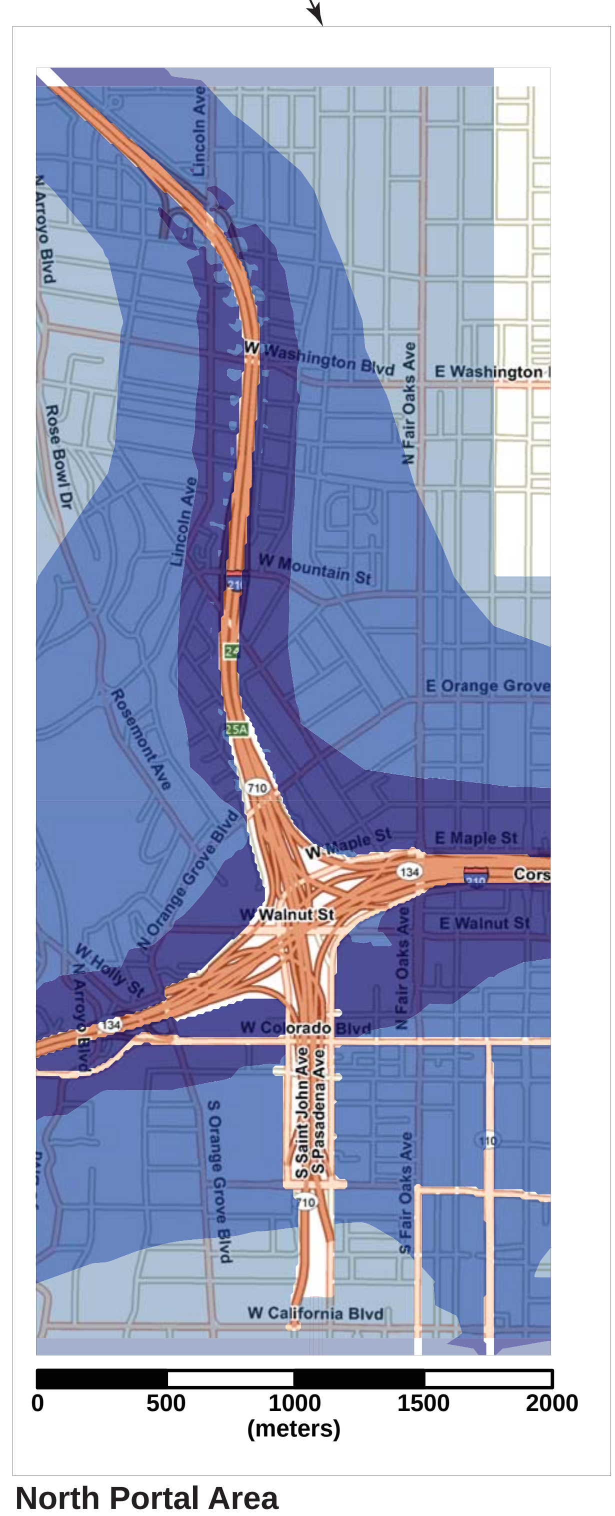


FIGURE 3-6
Incremental Cancer Risk Freeway Tunnel Alternative - Single Bore w/ Toll (T1_V6) vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study







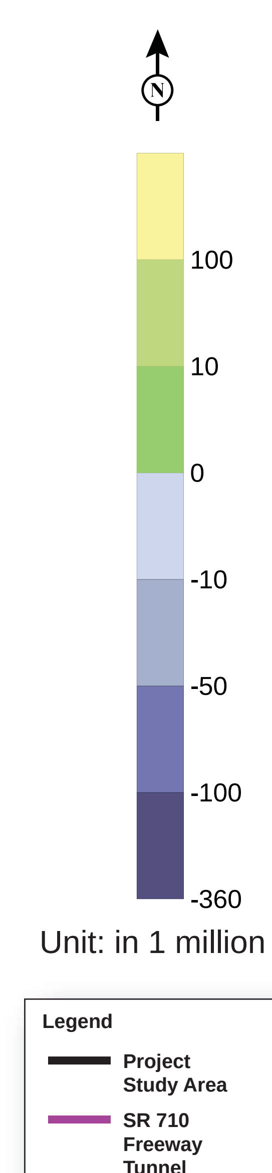


FIGURE 3-7
Incremental Cancer Risk Freeway Tunnel Alternative - Single Bore w/ Toll w/o Truck (T1_V7) vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study

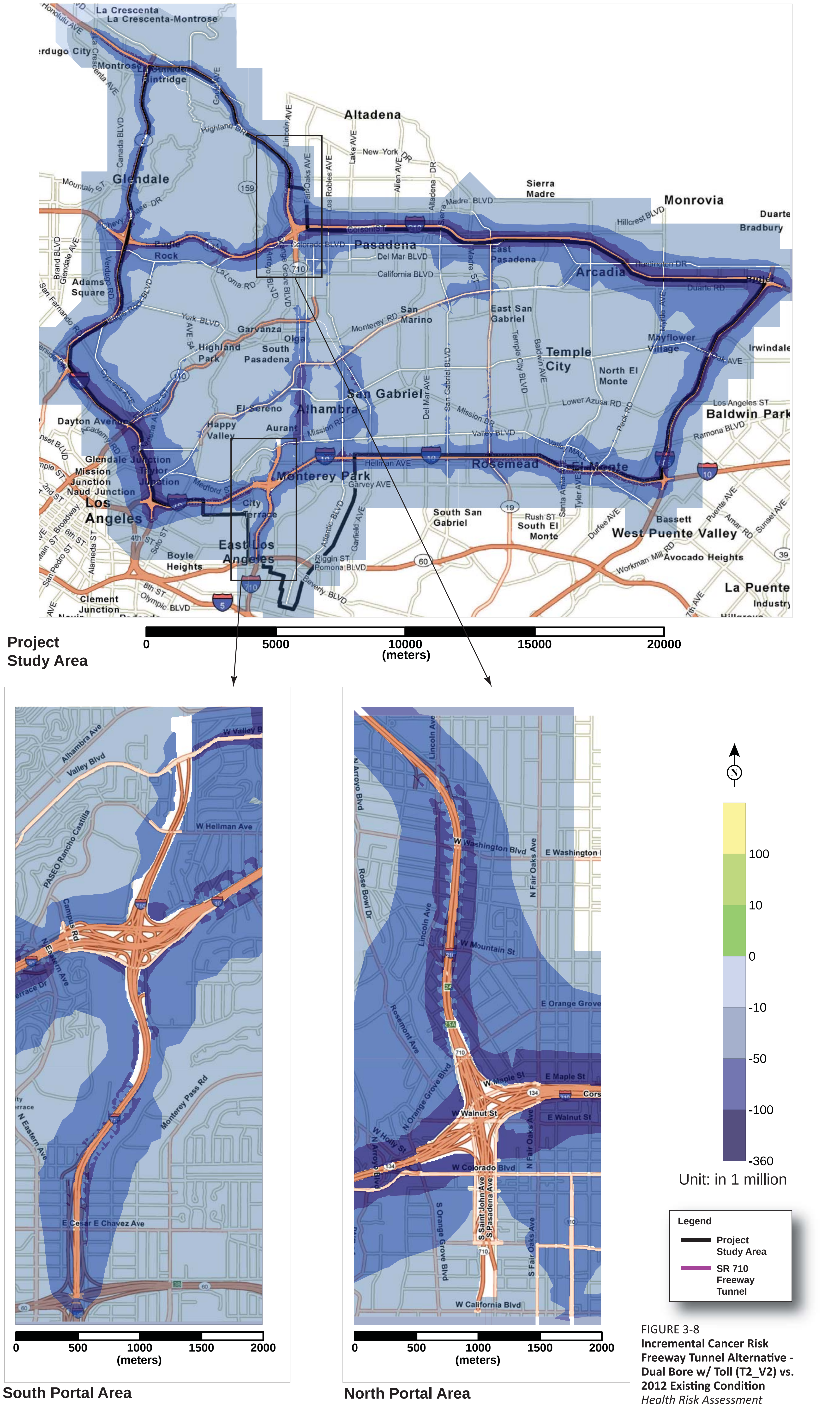


FIGURE 3-8
Incremental Cancer Risk Freeway Tunnel Alternative - Dual Bore w/ Toll (T2_V2) vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study

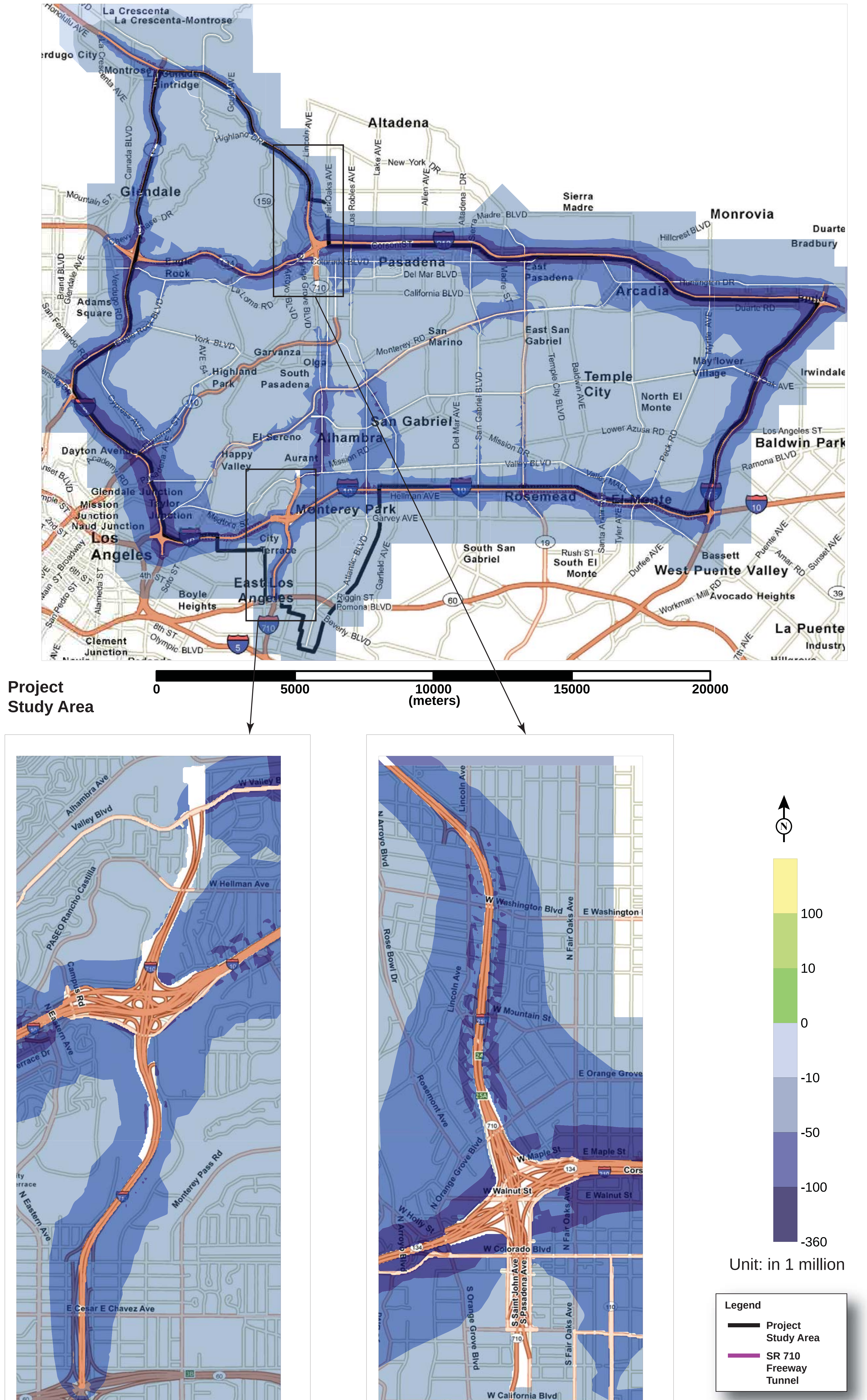


FIGURE 3-9
Incremental Cancer Risk Freeway Tunnel Alternative - Dual Bore w/o Toll (T2_V4) vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study

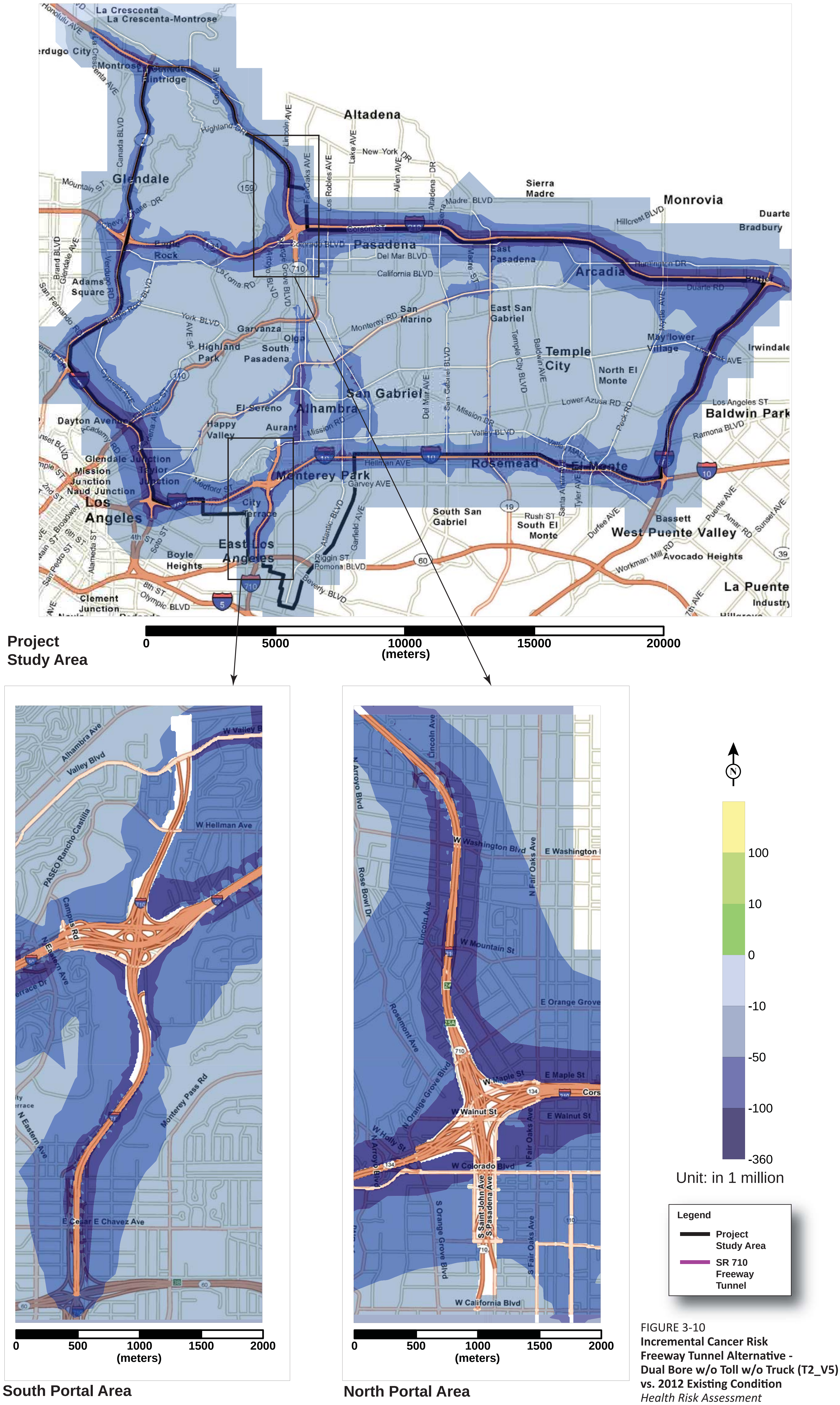
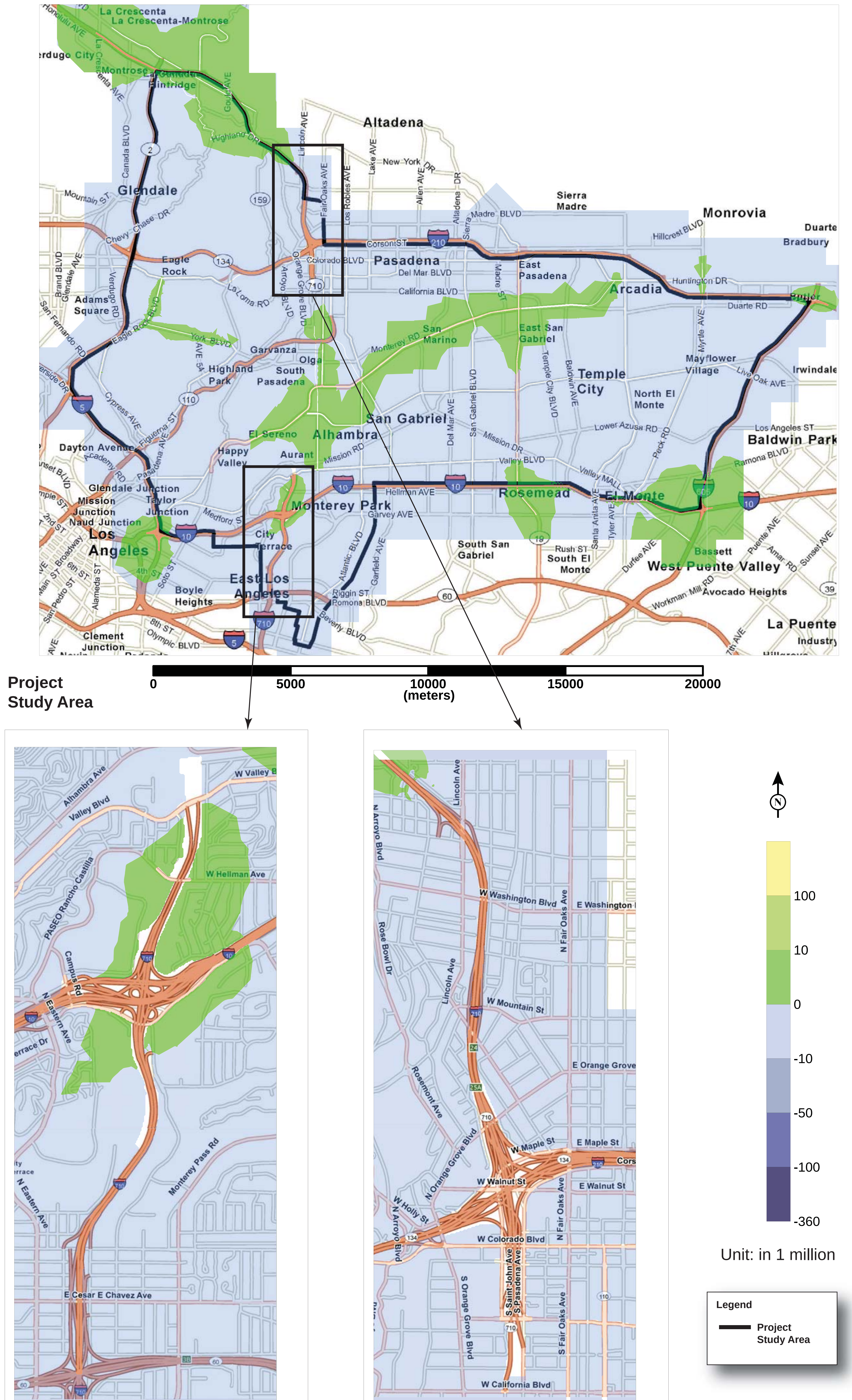


FIGURE 3-10
Incremental Cancer Risk
Freeway Tunnel Alternative -
Dual Bore w/o Toll w/o Truck (T2_V5)
vs. 2012 Existing Condition
Health Risk Assessment
SR 710 North Study



South Portal Area

North Portal Area

FIGURE 3-11
Incremental Cancer Risk TSM/TDM Alternative vs. No Build Alternative (2020)
Health Risk Assessment
SR 710 North Study

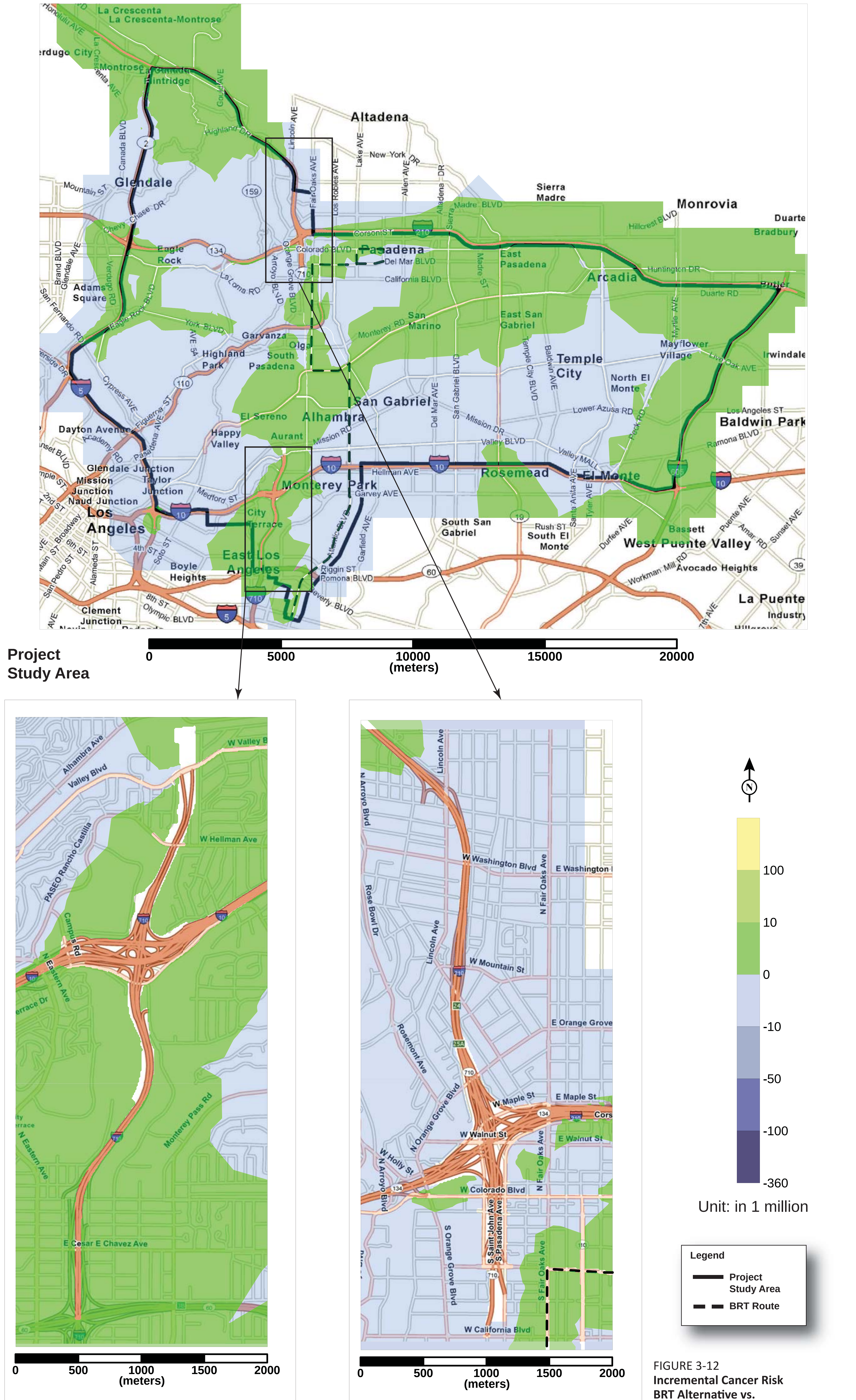


FIGURE 3-12
Incremental Cancer Risk
BRT Alternative vs.
No Build Alternative (2020)
Health Risk Assessment
SR 710 North Study

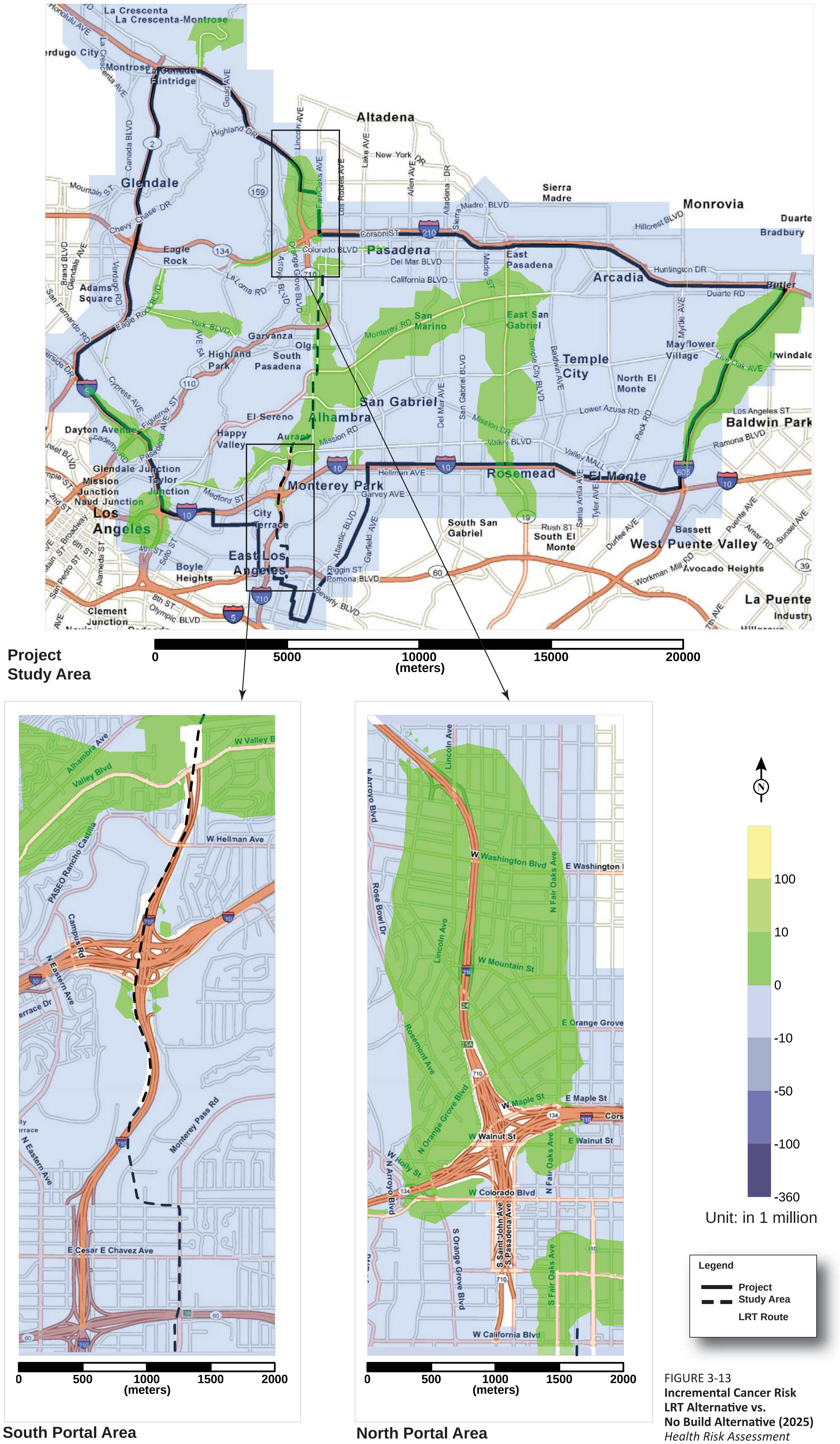
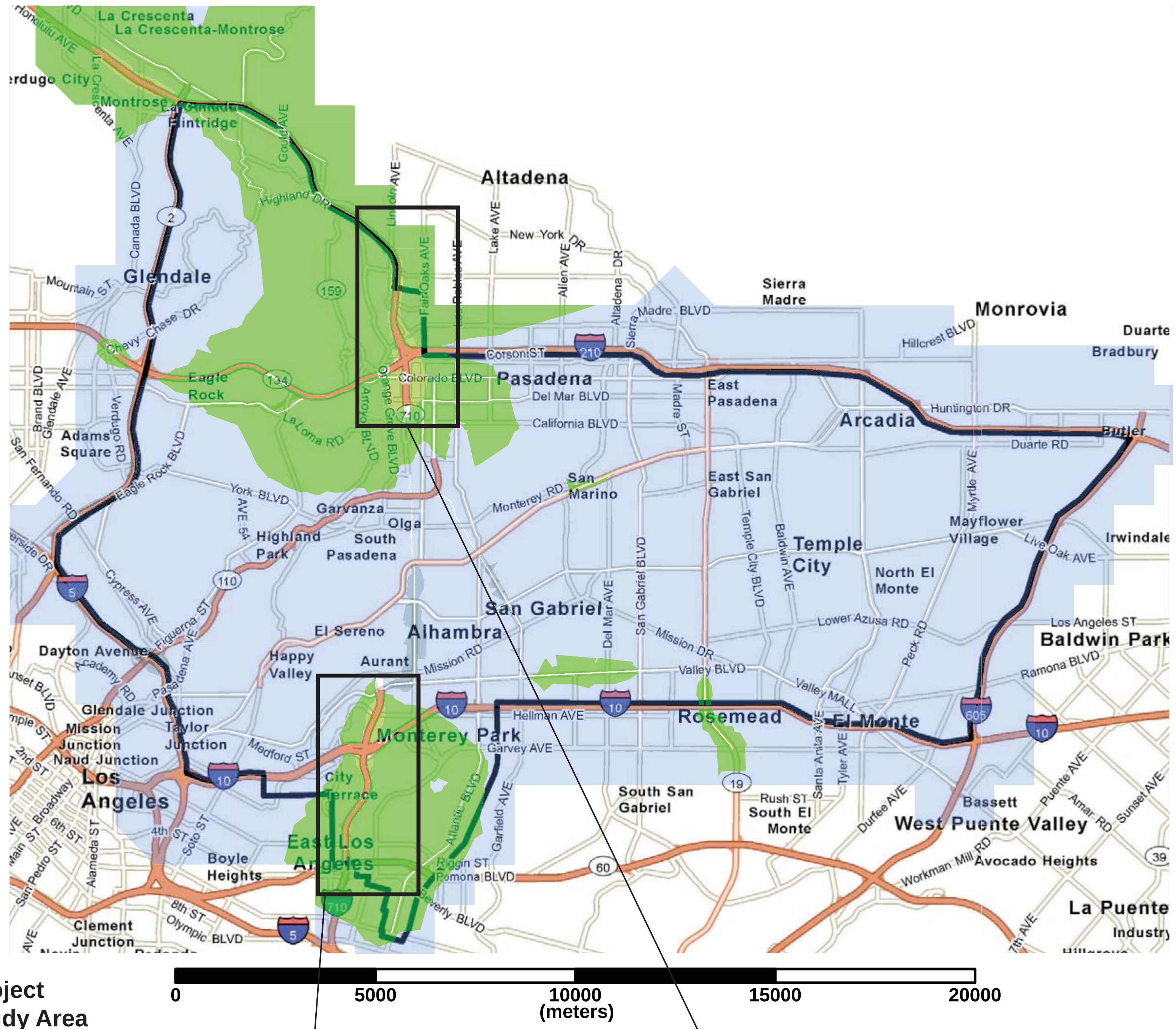
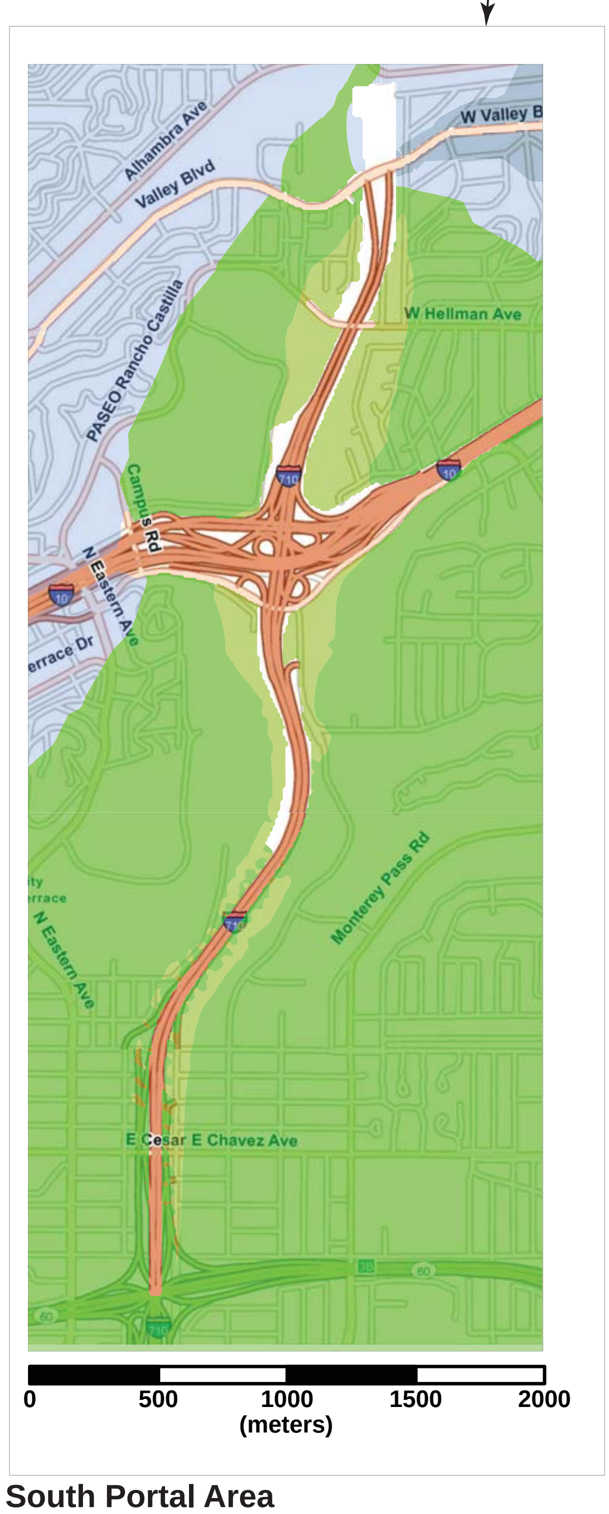
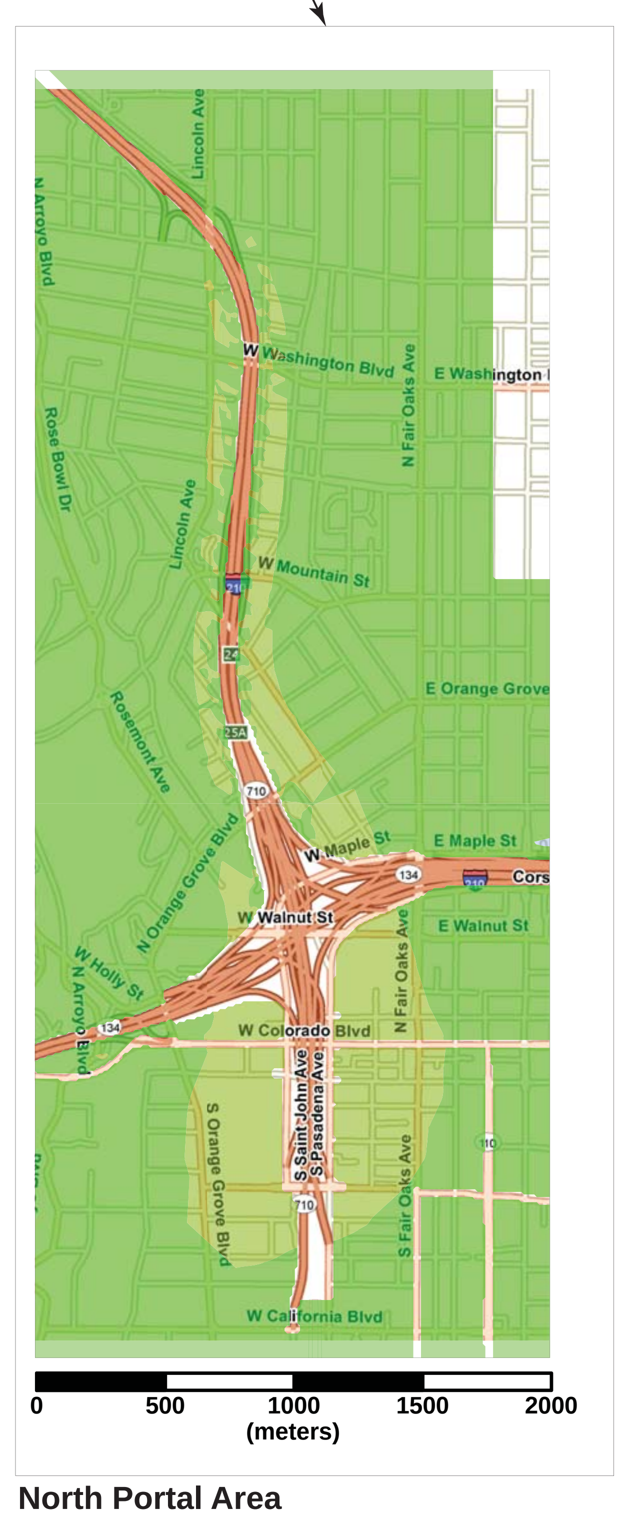


FIGURE 3-13
Incremental Cancer Risk
LRT Alternative vs.
No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study







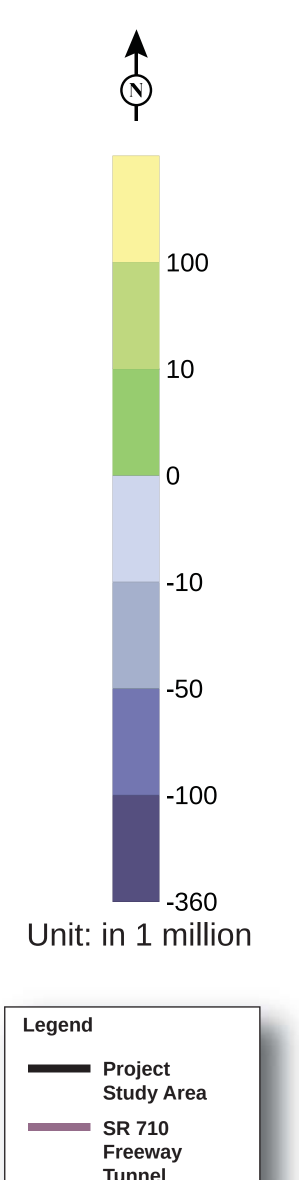


FIGURE 3-14
Incremental Cancer Risk Freeway Tunnel Alternative - Single Bore w/ Express Bus (T1_V1) vs. No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study

CH2MHILL

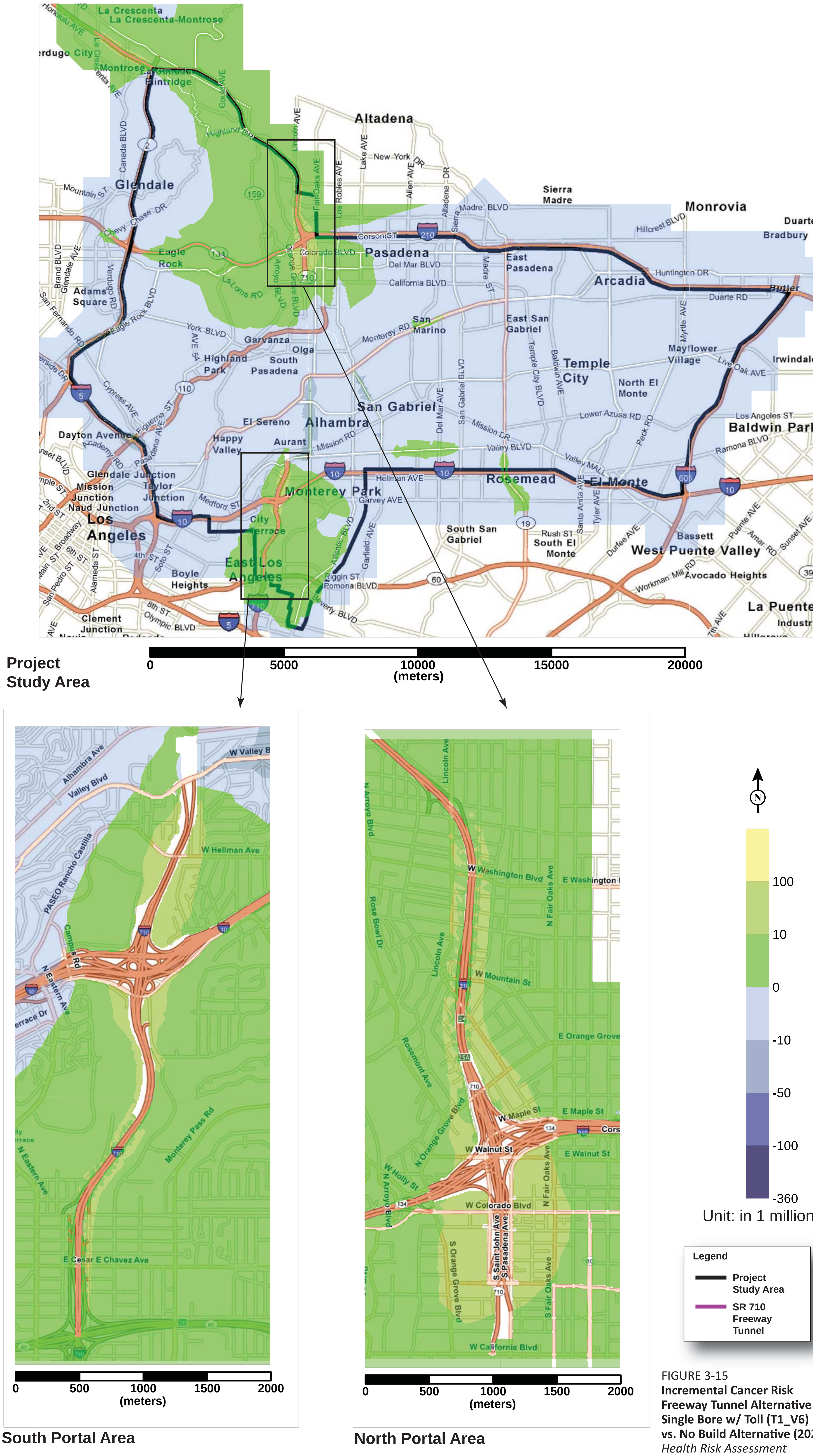
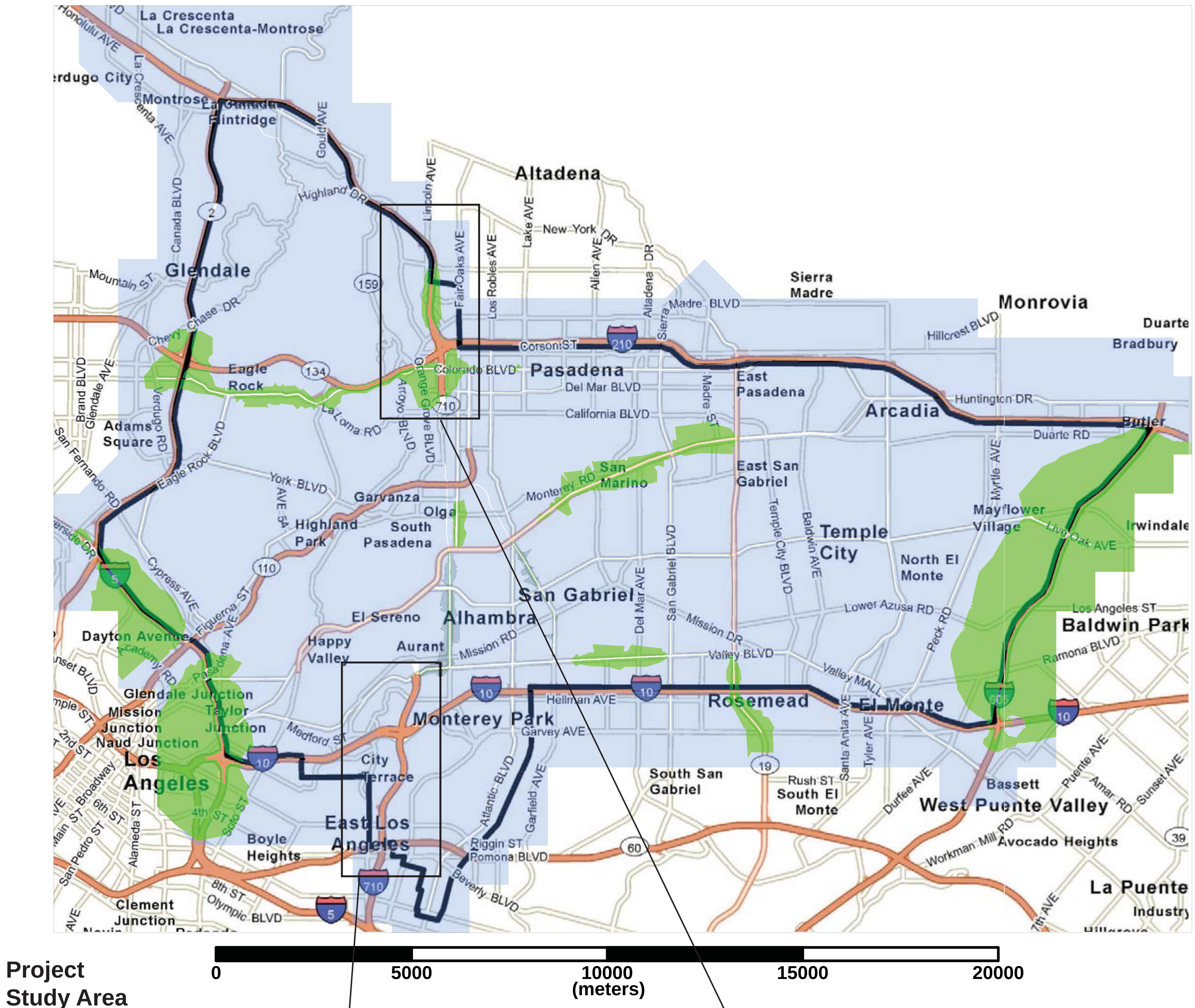
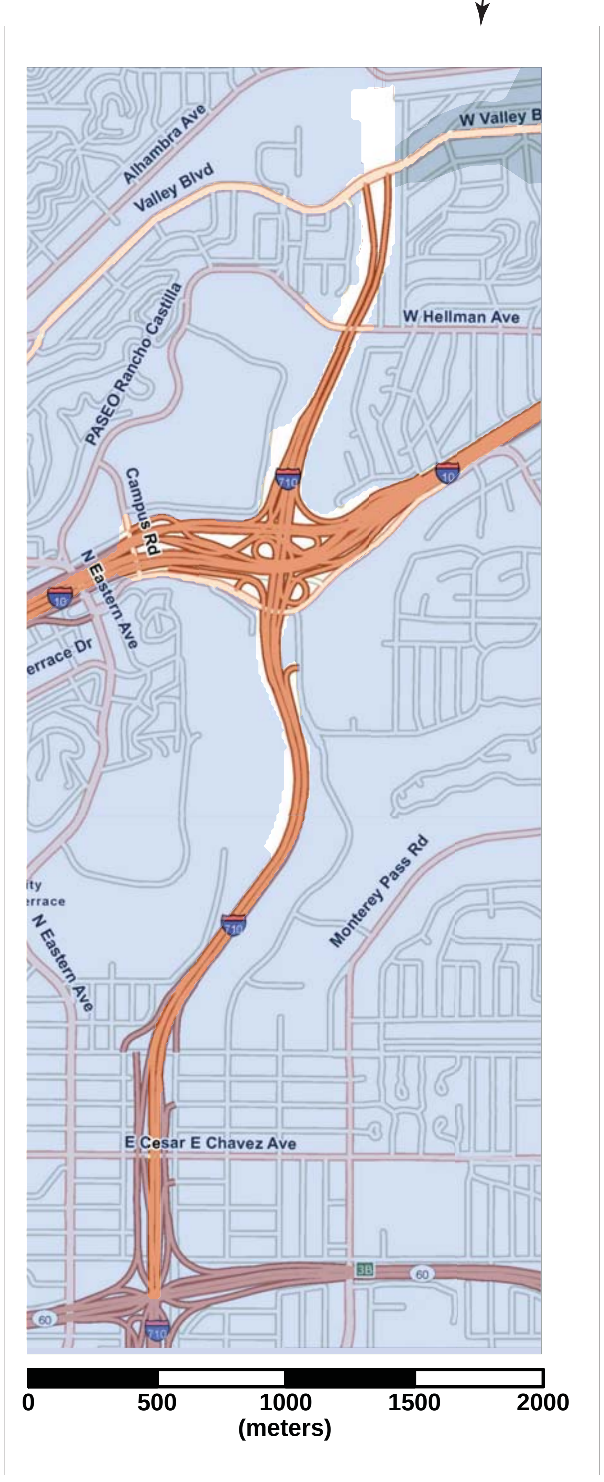


FIGURE 3-15
Incremental Cancer Risk Freeway Tunnel Alternative - Single Bore w/ Toll (T1_V6) vs. No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study





South Portal Area

North Portal Area

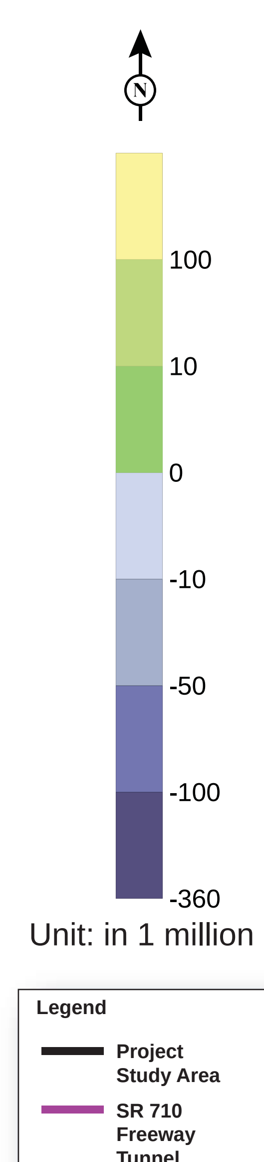


FIGURE 3-16
Incremental Cancer Risk Freeway Tunnel Alternative - Single Bore w/ Toll w/o Truck (T1_V7) vs. No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study

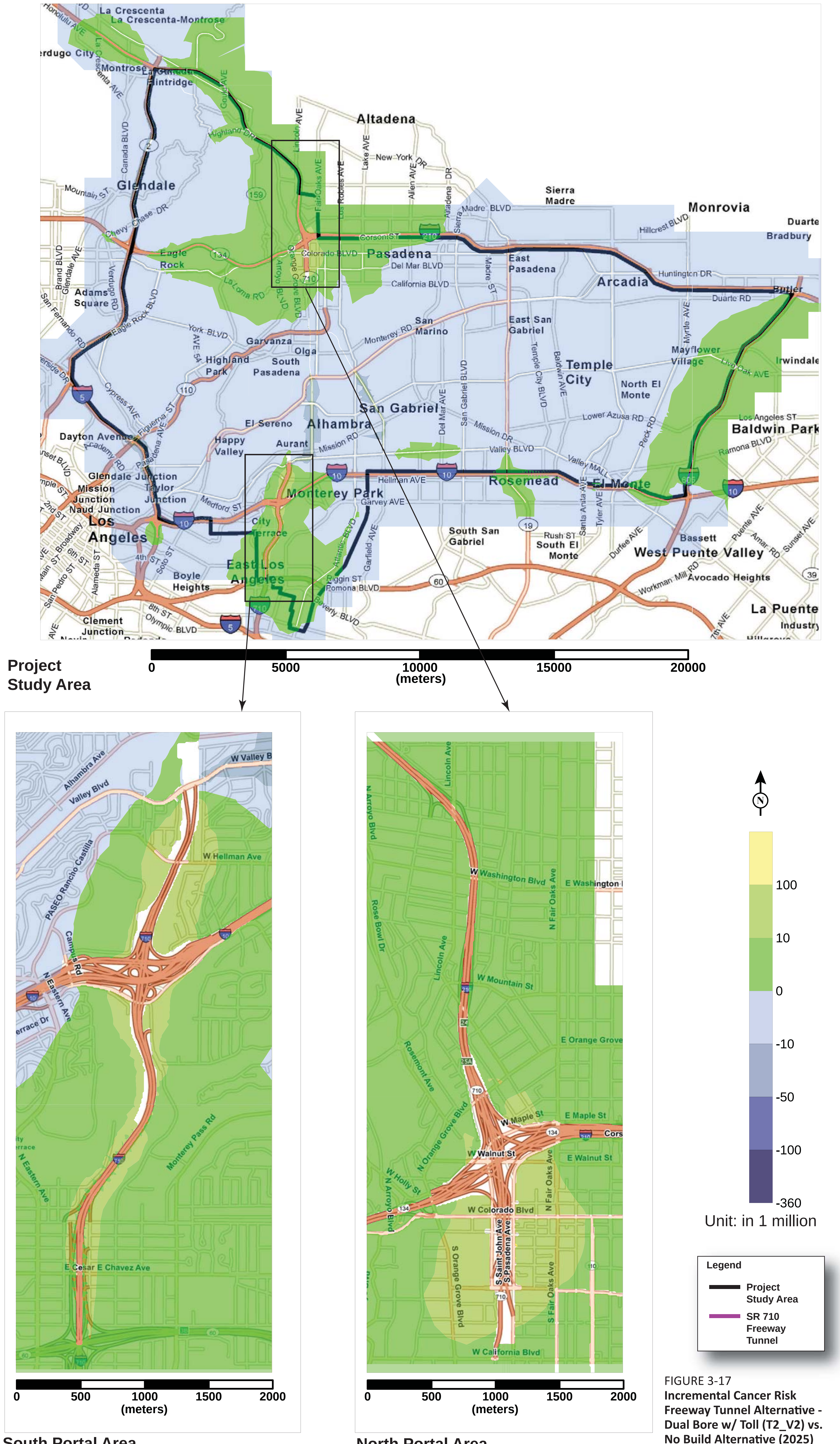


FIGURE 3-17
Incremental Cancer Risk Freeway Tunnel Alternative - Dual Bore w/ Toll (T2_V2) vs. No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study

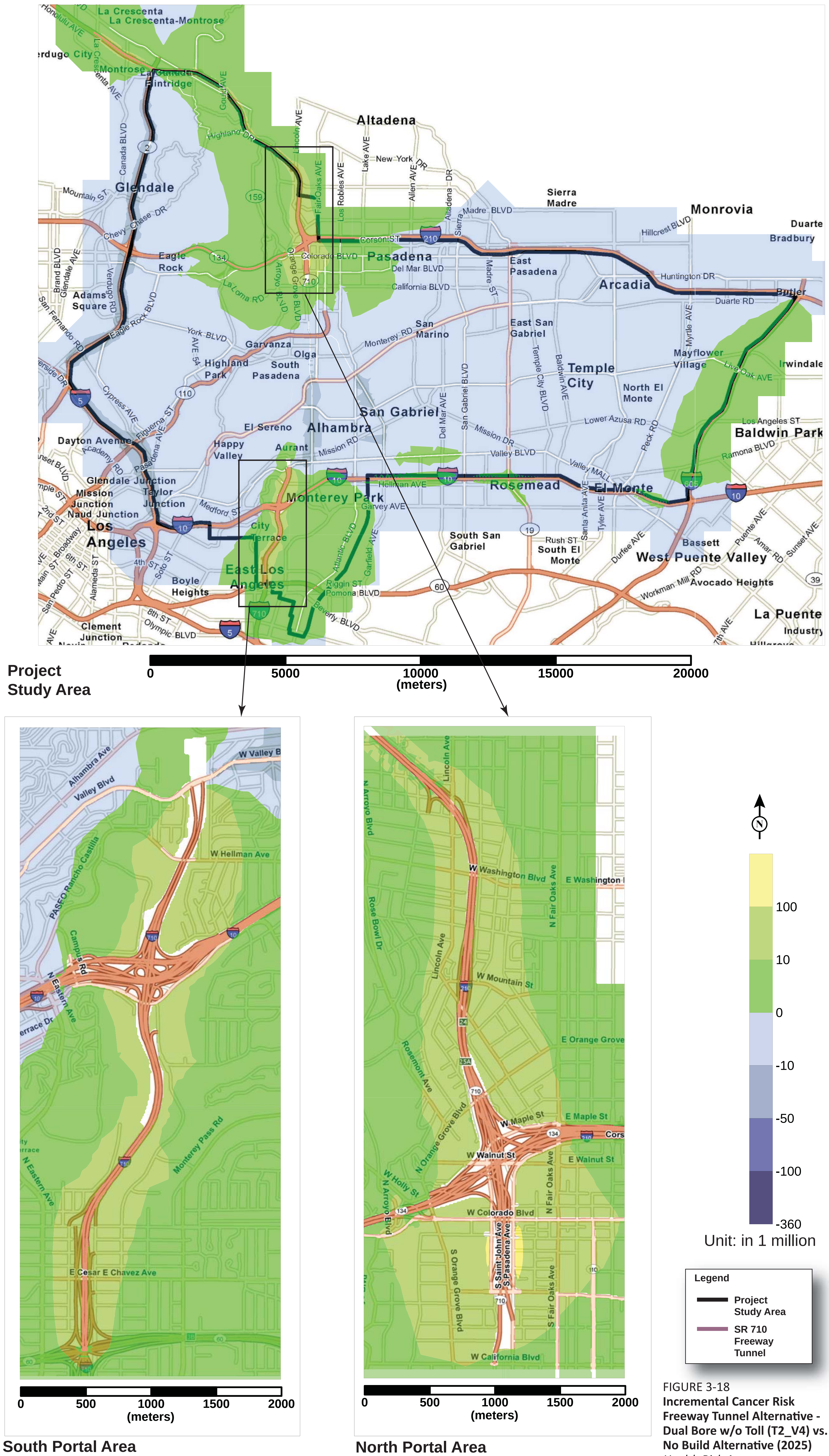
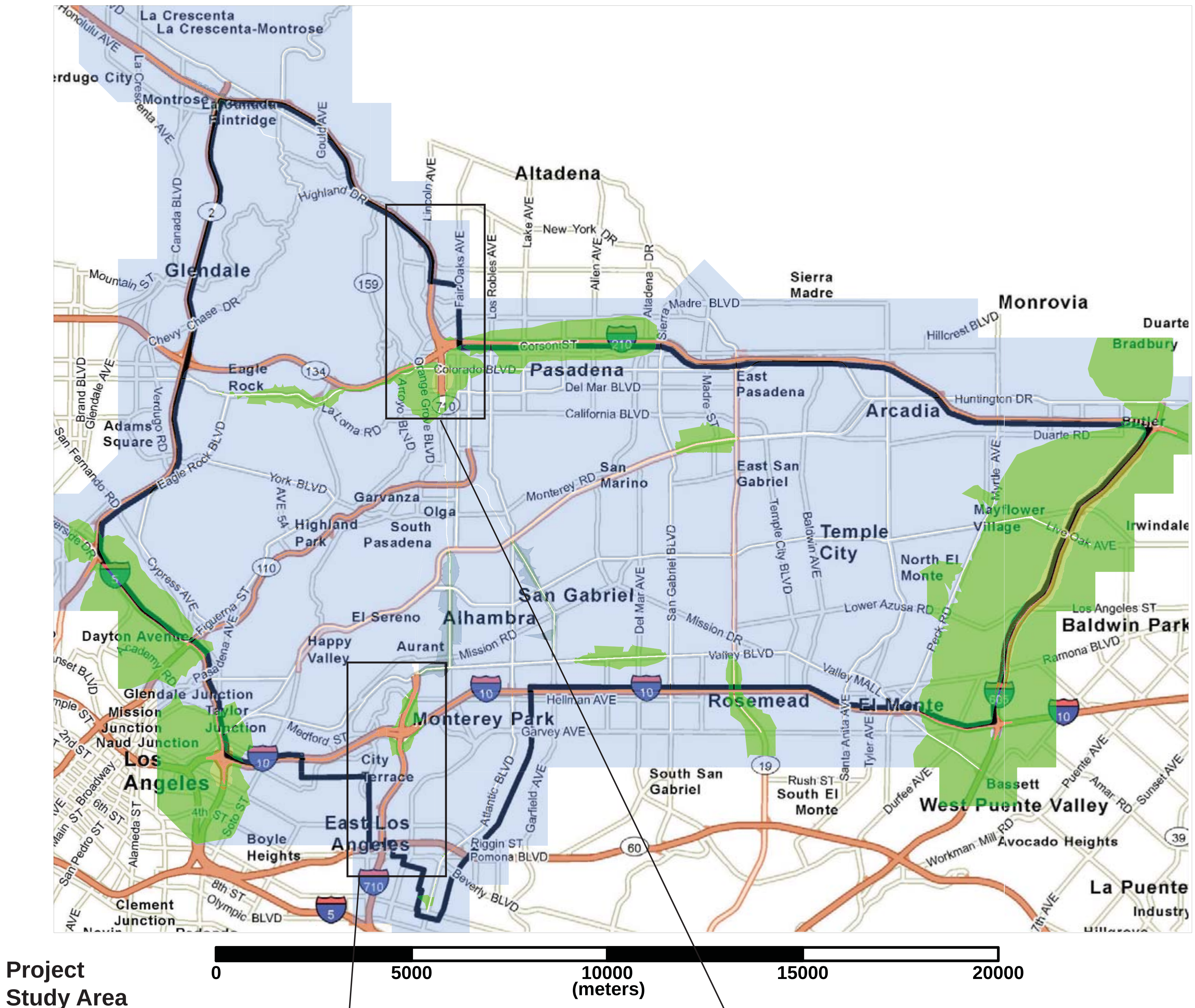
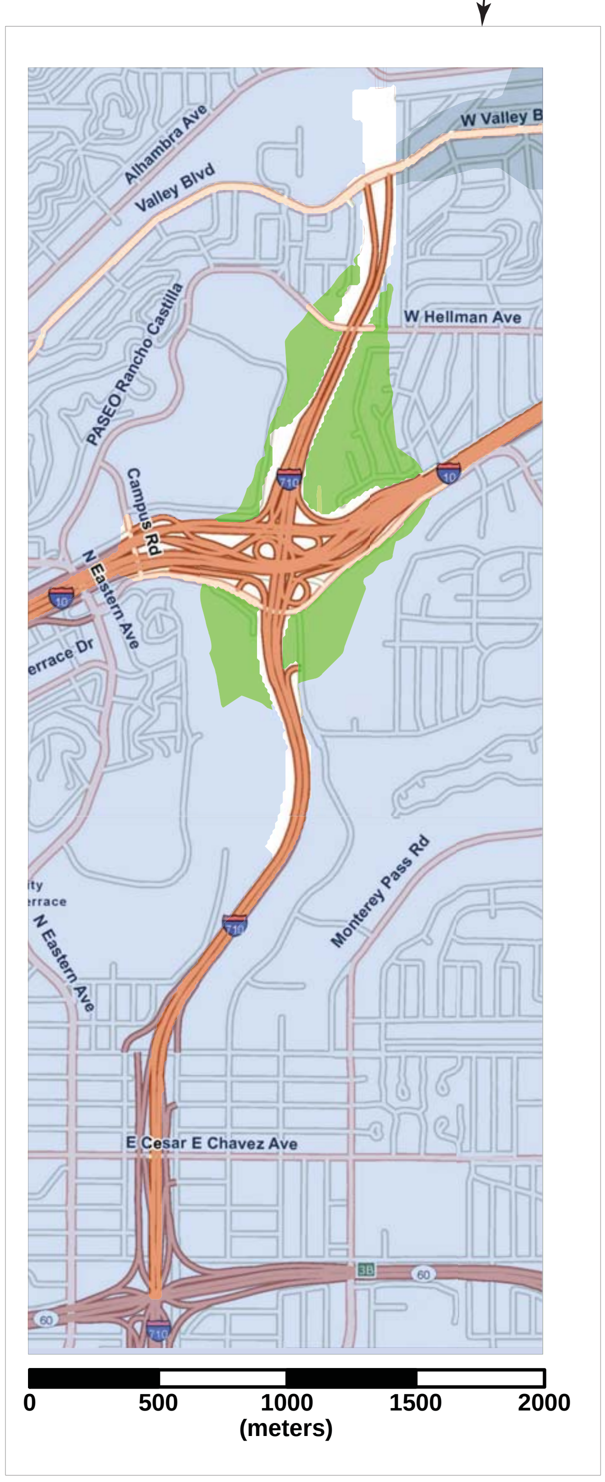


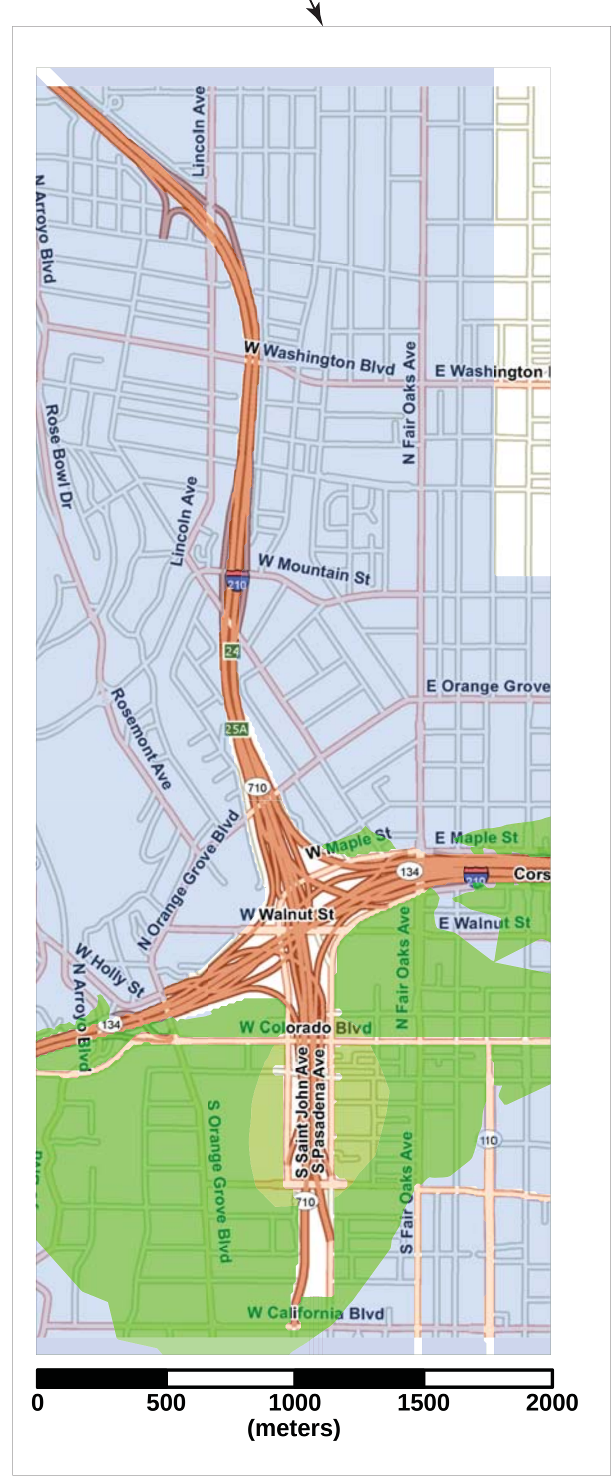
FIGURE 3-18
Incremental Cancer Risk Freeway Tunnel Alternative - Dual Bore w/o Toll (T2_V4) vs. No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study

CH2MHILL.





South Portal Area



North Portal Area

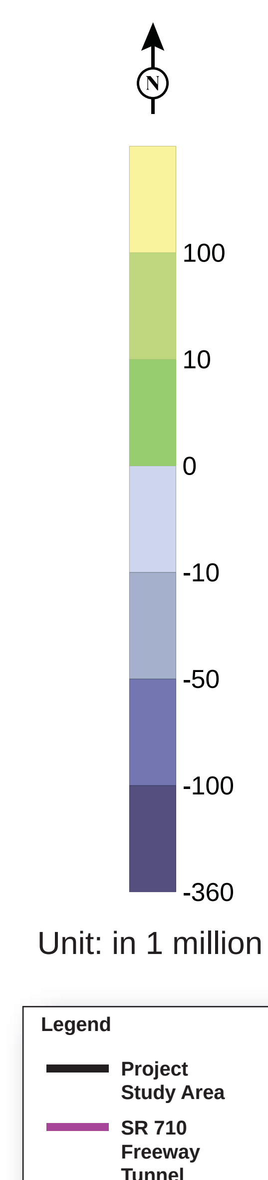


FIGURE 3-19
Incremental Cancer Risk
Freeway Tunnel Alternative -
Dual Bore w/o Toll w/o Truck (T2_V5)
vs. No Build Alternative (2025)
Health Risk Assessment
SR 710 North Study

SECTION 4

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Appendix A
Emission Calculations and Summaries (CD ROM)

A-1: CT-EMFAC Emission Factors

A-2: Existing Condition Emission Calculations

A-3: No Build Emission Calculations (2020, 2025, 2035, and 70-year Average Emissions)

A-4: TSM/TDM Emission Calculations (2020, 2035, and 70-year Average Emissions)

A-5: BRT Emission Calculations (2020, 2035, and 70-year Average Emissions)

A-6: LRT Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-7: Freeway Tunnel (T1_V1) – Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-8: Freeway Tunnel (T1_V6) – Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-9: Freeway Tunnel (T1_V7) – Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-10: Freeway Tunnel (T2_V2) – Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-11: Freeway Tunnel (T2_V4) – Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-12: Freeway Tunnel (T2_V5) – Emission Calculations (2025, 2035, and 70-year Average Emissions)

A-13: Incremental Emission Increases Scenario 1 – No Build and Build Alternatives vs. Existing Condition 2012

A-14: Incremental Emission Increases Scenario 2 – Build Alternative vs. No Build

Appendix B
AERMOD Air Dispersion Modeling Documentation
(CD ROM)