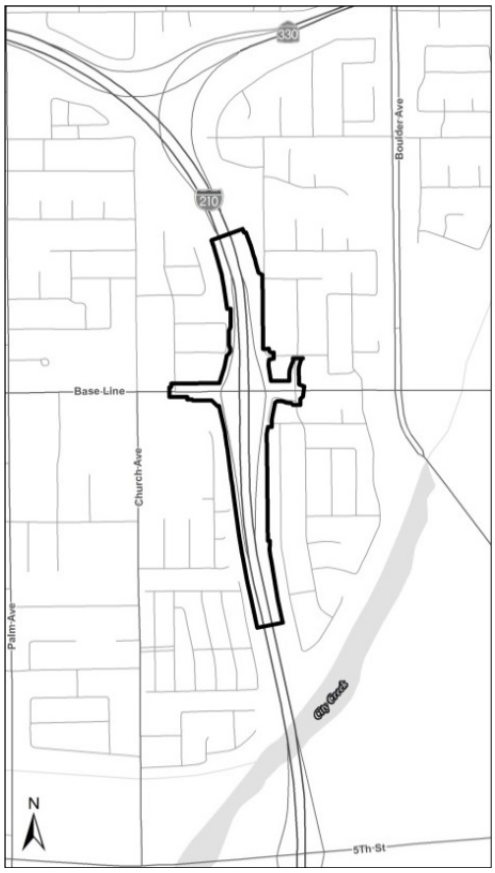
State Route 210/Base Line Interchange

CITY OF HIGHLAND, SAN BERNARDINO COUNTY, CALIFORNIA
DISTRICT 8–SBD–210 (PM R28.3/R30.3)
EA 1C970/PN 08-13000105

Air Quality Report



Prepared by the
State of California Department of Transportation
in coordination with the San Bernardino Associated Governments

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Acronyms and Abbreviations

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
AADT	annual average daily traffic
AB	Assembly Bill
AQMP	Air Quality Management Plan
ARB	California Air Resources Board
ARB Land Use Handbook	*Air Quality and Land Use Handbook: A Community Health Perspective*
ATCMs	Airborne Toxic Control Measures
Basin	South Coast Air Basin
CAA	Clean Air Act
CAAA 1990	1990 amendments to the Clean Air Act
CAAQS	California Ambient Air Quality Standards
California CAA	California Clean Air Act
Caltrans	California Department of Transportation
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
City	City of Highland
CH_4	methane
Clean Air Plan	air quality attainment plan
CO Protocol	Transportation Project-level Carbon Monoxide Protocol
CO	carbon monoxide
CO_2	carbon dioxide
CO-CAT	Coastal Ocean Climate Action Team
CVC	California Vehicle Code
DOT	U.S. Department of Transportation
DP	Caltrans Director's Policy
DPM	diesel particulate matter
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESAs	Environmentally Sensitive Areas
FHWA	Federal Highway Administration
FR	Federal Register
FTIP	Federal Transportation Improvement Program
GHG	greenhouse gas
H_2S	Hydrogen Sulfide
HAP	hazardous air pollutants
HFC	hydrofluorocarbons
HFC-23	fluoroform
HFC-134a	s, s, s, 2-tetrafluoroethane
HFC-152a	difluoroethane
IAC	Interagency Consultation
IGR	Intergovernmental Review
IPCC	Intergovernmental Panel on Climate Change
ITS	Intelligent Transportation System
LOS	level of service
mpg	miles per gallon
MPO	metropolitan planning agency

MSAT	mobile-source air toxics
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHTSA	National Highway Traffic Safety Administration
NO	nitric oxide
NO_2	nitrogen dioxide
NOA	naturally occurring asbestos
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxide
O_3	ozone
OPR	Governor's Office of Planning and Research
OSTP	Office of Science and Technology Policy
Pb	lead
PFC	perfluorocarbons
PM	particulate matter
PM	post miles
PM_{10}	particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter
POAQC	Projects of Air Quality Concern
POM	polycyclic organic matter
ppb	parts per billion
ppm	parts per million
R	Revised
Resources Agency	California Natural Resources Agency
ROG	reactive organic gas
RTIP	Regional Transportation Improvement Program
RTP	Regional Transportation Plan
SANBAG	San Bernardino Associated Governments
SB	Senate Bill
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SF_6	sulfur hexafluoride
SIP	State Implementation Plan
SMAQMD	Sacramento Metropolitan Air Quality Management District
SO_2	sulfur dioxide
SO_X	sulfur oxides
SR	State Route
TAC	toxic air contaminant
TCE	temporary construction easement
TCMs	Transportation Control Measures
TCWG	Transportation Conformity Working Group
TIP	transportation improvement program
U.S. EPA	U.S. Environmental Protection Agency
VMT	vehicle miles traveled
VOC	volatile organic compounds
VRP	Visibility Reducing Particles

Chapter 1 Introduction

This technical report has been prepared to assess the air quality effects of a proposal by the San Bernardino Associated Governments (SANBAG), in cooperation with the California Department of Transportation (Caltrans), District 8 and the City of Highland (City), to improve the State Route 210 (SR-210)/Base Line Interchange in the City of Highland, San Bernardino County, California by widening Base Line from Buckeye Street to Seine Avenue and widening three of the four existing SR-210 interchange ramps. Please refer to Chapter 2, "Project Description," for a detailed description of the proposed project.

For the proposed project, Caltrans is the California Environmental Quality Act (CEQA) lead agency and the National Environmental Policy Act (NEPA) lead agency, under authority delegated by Federal Highway Administration (FHWA).

This report evaluates the effects of the proposed project on air quality resources according to the measures of effectiveness and traffic volumes under the baseline/existing year 2012 condition, project Opening Year 2020 condition, and project Horizon Year 2040 condition.

1.1 Scope and Content of the Report

This report describes the environmental and regulatory setting, the transportation conformity conclusions and potential effects of the project, and the measures to minimize the potential effects of the proposed project. This report is organized as described below.

- Chapter 1, "Introduction," introduces the report and describes its purpose, scope, and content. It also provides a summary of the key findings of the air quality analysis.
- Chapter 2, "Project Description," describes the location, purpose and need, project characteristics and alternatives, phasing, schedule, and required permits and approvals associated with the proposed project.
- Chapter 3, "Affected Environment, Environmental Consequences, and Minimization Measures," describes the physical and regulatory setting, discloses the potential effects of the proposed project, identifies minimization measures to avoid or minimize adverse effects, and provides a summary of federal conformity determinations associated with the proposed project.
- Chapter 4, "Climate Change (CEQA)," provides an analysis of potential climate change effects according to CEQA requirements and identifies minimization measures.
- Chapter 5, "References Cited," lists the printed references and personal communications used in writing this report.

1.2 Summary and Conclusions

This section summarizes the key findings of the air quality and climate change analyses presented in Chapter 3, "Affected Environment, Environmental Consequences, and Minimization Measures," and Chapter 4, "Climate Change (CEQA)." This air quality evaluation is the basis for the determination that the proposed project would not result in adverse air quality impacts.

1.2.1 Transportation Conformity

For the proposed project to be approved, it must meet federal transportation conformity requirements. It also must meet regional and project-level conformity requirements.

1.2.1.1 Regional Transportation Conformity

To be determined as regionally conforming, a project must be listed and accounted for in the modeling associated with the Regional Transportation Plan (RTP) and the Federal Transportation Improvement Program (FTIP). In accordance with Section 93.114 of the U.S. Environmental Protection Agency (EPA) transportation conformity regulations, the proposed project is included in both the Southern California Association of Governments (SCAG) 2012 RTP Amendment #1 under project number REG0701, and the SCAG 2013 FTIP Amendment #17 under project number 201186.

Within the SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19 documents, the proposed project is described as follows: "AT SR-210/BASE LINE IC: RECONSTRUCT/WIDEN BASE LINE BETWEEN CHURCH AVE AND BOULDER AVE FROM 4 TO 6 THROUGH LANES AND EXTEND LEFT TURN LANES, WIDEN RAMPS – WB EXIT 1 TO 3 LANES, WB AND EB ENTRANCES 1 TO 3 LANES INCLUDING HOV PREFERENTIAL LANES (EA 1C970)."

The 2012 RTP Amendment #1 was both adopted by SCAG on June 12, 2013, and approved by FHWA on July 15, 2013. The 2013 FTIP Amendment #13-19 was adopted by SCAG on June 16, 2014, and approved by FHWA on July 17, 2014.

In addition, the project is also included in the latest SCAG 2012 RTP Amendment #2 approved by SCAG on September 11, 2014 and SCAG's 2015 FTIP (RTP ID# REG0701 and FTIP ID# 201186). The 2015 Final FTIP was approved by SCAG's Regional Council on September 11, 2014. . Conformity determinations for both documents are forthcoming and anticipated in late 2014.

Because both the currently conforming SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19 model lists include the proposed project (2012 RTP Amendment #1 project number REG0701 and 2013 FTIP Amendment #13-19 Project Number 201186), its regional conformity requirements have been satisfied. Please refer to Appendix A for conformity documentation related to the SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19 (Southern California Associations of Governments 2014a, 2014b).

1.2.1.2 Project-level Transportation Conformity

Project-level carbon monoxide (CO) and particulate matter (PM) emissions were evaluated to determine if the proposed project has the potential to contribute to localized exceedances of the National Ambient Air Quality Standards (NAAQS) or California Ambient Air Quality Standards (CAAQS) for CO, PM less than or equal to 10 microns in diameter (PM_{10}), or PM less than or equal to 2.5 microns in diameter ($PM_{2.5}$). It was determined that project implementation would not result in higher CO concentrations than those existing within the region at the time of attainment demonstration, according to Caltrans' *Transportation Project-level Carbon Monoxide Protocol* (Garza et al. 1997). Furthermore, no violations of the CAAQS or NAAQS for CO are anticipated to occur with implementation of the proposed project.

In accordance with the *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (Federal Highway Administration and U.S. Environmental Protection Agency 2010), it was determined that the proposed project would represent a Project of Air Quality Concern (POAQC). As such, quantitative $PM_{2.5}$ and PM_{10} hot-spot evaluations are required.

A $PM_{2.5}$ and PM_{10} hot-spot evaluation was performed for the project, and is presented in Appendix D. The analysis concluded that it is unlikely that the proposed project would generate new air quality violations, worsen existing violations, or delay attainment of the NAAQS for $PM_{2.5}$ or PM_{10}. The SCAG Transportation Conformity Working Group (TCWG) concurred with this determination following its August 26, 2014 meeting..

1.2.2 Mobile-Source Air Toxics

The evaluation of potential mobile-source air toxic (MSAT) effects was performed in accordance with FHWA's *Interim Guidance Update on Mobile-source Air Toxic Analysis in NEPA Documents* (2012). The traffic impact analysis conducted for the project suggests that under the proposed project, there would be no meaningful impacts to MSAT emissions because future Build and No Build traffic volumes are expected to be identical. This impact analysis concluded that project-related MSAT emissions would not pose an adverse risk at any sensitive receptor location.

1.2.3 Criteria Pollutants

1.2.3.1 Construction

According to federal transportation conformity requirements, construction projects lasting less than five years are considered temporary. Therefore, they are not considered part of the transportation conformity determination analysis.

Construction-period criteria pollutant emissions were estimated using the Roadway Construction Emissions Model, Version 7.1.5.1. A summary of emissions estimates is provided in Table 3-5. Implementation of the exhaust and fugitive dust emission control measures identified in Section 3.3, "Minimization Measures," would avoid and/or minimize any impacts related to air quality.

1.2.3.2 Operation

Operational criteria pollutant (ozone precursors, CO, PM_{10}, and $PM_{2.5}$) and CO_2 exhaust emissions, as well as re-entrained dust emissions, were not quantified. This is because Traffic Operations Analysis indicates roadway volumes between No Build and Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040) are identical, as the project would neither impact operations on SR-210, nor would it affect regional traffic demand or distribution (URS 2014).

CEQA

CEQA requires proposed project emissions at the opening year to be compared with existing conditions. As previously indicated, the project would not impact operations on SR-210, nor would it affect regional traffic demand or distribution, and traffic volumes along the project roadways are expected to remain the same between Build and No Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040). The Traffic Study prepared for the proposed project concluded that the proposed project would improve traffic flow along Base Line between Buckeye Street and Seine Avenue and along the SR-210/Base Line freeway ramps at opening year (2020) and Horizon Year (2040). While volumes are expected to increase from the existing year to future years, this is attributed to regional population growth and other factors external to the operation of the proposed project. Therefore, while emissions in the region of the project area would increase between existing year and future (Opening Year and Horizon Year) conditions, the proposed project would not directly have an effect on criteria pollutants nor greenhouse gas (GHG) emissions from the roadways within the project area. Improved vehicle efficiencies through reduced queuing and congestion due to the proposed project could result in slight reductions in criteria pollutants and greenhouse gas emissions.

NEPA

NEPA requires that proposed project emissions be compared with no-build conditions for the Opening and Horizon Years. The proposed project would not impact operations on SR-210, nor would it affect regional traffic demand or distribution, and traffic volumes along the project roadways are expected to remain the same between Build and No Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040). The Traffic Study prepared for the proposed project concluded that the proposed project would improve traffic flow along Base Line between Buckeye Street and Seine Avenue and along the SR-210/Base Line freeway ramps at Opening Year (2020) and Horizon Year (2040). Consequently, the proposed project would not directly have an effect on criteria pollutants nor GHG emissions from the roadways within the project area. Improved vehicle efficiencies through reduced queuing and congestion due to the proposed project could result in slight reductions in criteria pollutants and greenhouse gas emissions.

Chapter 2 Project Description

2.1 Introduction

SANBAG, in cooperation with Caltrans District 8 and the City of Highland, is proposing to improve the SR-210/Base Line Interchange (Post Miles [PM] Revised [R] 28.3/R30.3) in the City of Highland, San Bernardino County, California. Specifically, the project would widen Base Line from Buckeye Street to Seine Avenue and widen three of the four existing SR-210 interchange ramps. The widening would occur between PM R28.3 and R30.3, for a distance of two miles. The majority of the work would occur within the existing Caltrans right-of-way and temporary construction easements; however, minor amounts of right-of-way would be needed along Base Line to accommodate the roadway widening. Figures 2-1 and 2-2 show the regional vicinity map and the project location map, respectively.

The proposed project is included in SCAG's 2012 RTP Amendment #1 (which was adopted by SCAG on June 12, 2013, and approved by FHWA on July 15, 2013) and the 2013 FTIP Amendment #13-19 adopted by SCAG on June 16, 2014, and approved by FHWA on July 17, 2014. Both the SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19 include the proposed project as 2012 RTP project number REG0701 and 2013 FTIP Project Number 201186. The proposed project is being funded with San Bernardino Sales Tax Measure I funds. In addition, the project is also included in the latest SCAG 2012 RTP Amendment #2 approved by SCAG on September 11, 2014 and SCAG's 2015 FTIP (RTP ID# REG0701 and FTIP ID# 201186). The 2015 Final FTIP was approved by SCAG's Regional Council on September 11, 2014. Conformity determinations for both documents are forthcoming and anticipated in late 2014.

2.2 Purpose and Need

The purpose of the proposed project is to reduce congestion and improve operational efficiency at the interchange and throughout the Base Line corridor. This area of southwestern San Bernardino County in the City of Highland has grown significantly over the past ten years and is experiencing continued population and employment growth. In particular, commercial and residential development is occurring along Base Line near SR-210. For example, new retail centers are planning on vacant land northwest of the interchange and on vacant parcels northeast of the interchange. The SR-210/Base Line interchange is an important component of the City of Highland's traffic circulation system. By the future year of 2040, traffic volumes on Base Line and the interchange ramps will increase substantially. The increasing demand for freeway access at Base Line is causing, and will continue to cause, congestion at the interchange ramp terminal intersections and along this segment of the Base Line arterial corridor.

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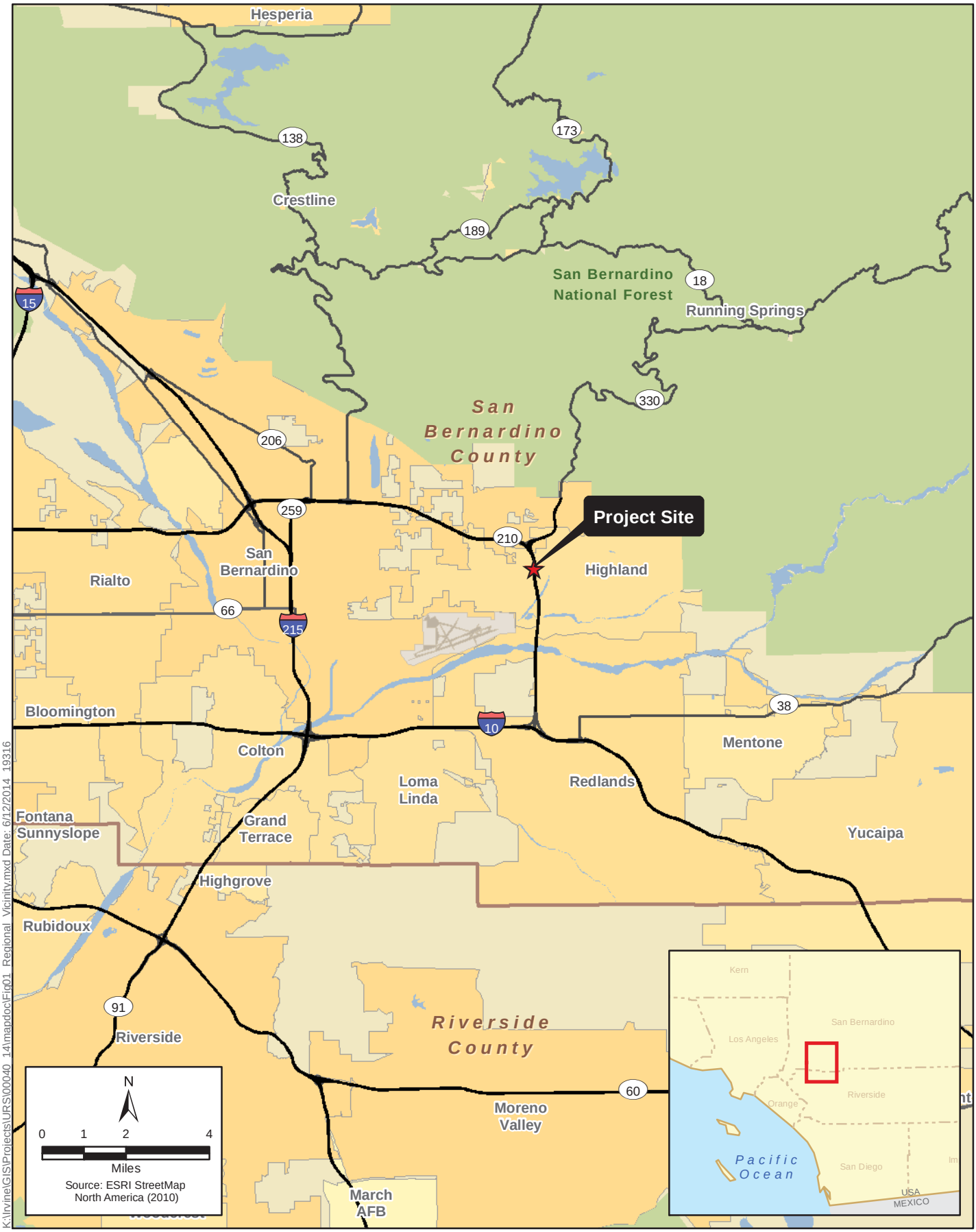

Figure 2-1
Regional Vicinity Map
SR-210/Base Line Interchange Project

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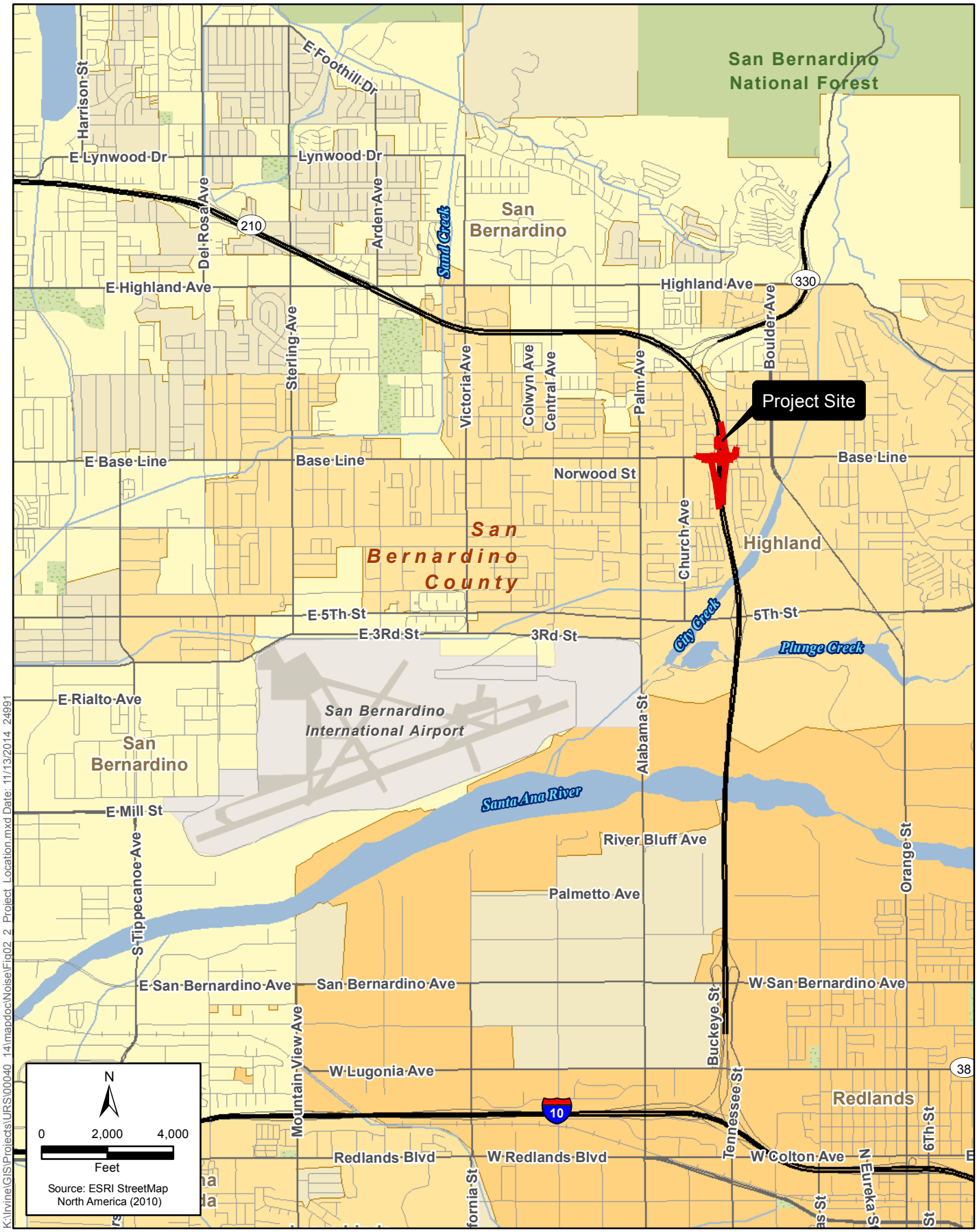

Figure 2-2
Project Location Map
SR-210/Base Line Interchange Project

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Both of the ramp terminal intersections at Base Line would experience increases in delay between existing and future year conditions. In particular, the evening peak hour level of service (LOS) for the westbound ramp terminal intersection will degrade from LOS B to LOS[1] D by 2040. Refer to Table 2-1 for peak hour LOS analysis results for Existing Year (baseline) 2013 conditions compared to Future Year 2040 No Build conditions.

Table 2-1. Peak Hour Intersection Level of Service for Existing (2013) and Horizon Year (2040) No Build

	Peak Hour Level of Service (LOS) Analysis							
	Existing (2013)				Horizon Year 2040 No Build			
	AM Peak		PM Peak		AM Peak		PM Peak	
Intersection	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Church Avenue/Base Line	18.8	B	20.2	C	17.7	B	17.8	B
SR-210 EB Ramps/Base Line	18.5	B	17.1	B	24.8	C	20.8	C
SR-210 WB Ramps/Base Line	25.6	C	18.4	B	50.2	D	48.8	D
Seine Avenue/Base Line	20.1	C	24.3	C	28.7	C	32.2	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2040 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and San Bernardino County Transportation Analysis Model demand model.
Source: URS 2014
Delay = Average delay in seconds per vehicle.
EB = Eastbound
WB = Westbound

In addition to intersection LOS, historical accident data appear to indicate that existing congestion and poor interchange operations may be factors contributing to higher than average accident rates on some elements at the SR-210/Base Line interchange. The expected increase in demand for freeway access will create additional safety concerns if improvements to the interchange are not implemented.

Accident data for the SR-210/Base Line interchange within the project limits for a 36-month period between May 1, 2009 and April 30, 2012 was obtained from the Traffic Accident Surveillance and Analysis System (TASAS) – Transportation Systems Network (TSN). The actual accident rates are compared with average accident rates for similar highway facilities throughout California. Table 2-2 presents a summary of the TASAS-TSN data.

[1] The ability of a highway to accommodate traffic is typically measured in terms of level of service (LOS). Traffic flow is classified by LOS, ranging from LOS A (free-flow traffic with low volumes and high speeds) to LOS F (traffic volume exceeds design capacity, with forced-flow and substantial delays).

Table 2-2. SR-210/Base Line – Accident Rates (05/01/09 through 04/30/12)

Post Mile	Location	Actual Accident Rates			Average Accident Rates		
		Total	Fatal	Fatal +Injury	Total	Fatal	Fatal + Injury
R29.20 to R29.56	EB SR-210[1]	0.90	0.000	0.57	0.67	0.008	0.22
R29.20 to R29.56	WB SR-210[1]	0.29	0.000	0.05	0.67	0.008	0.22
R29.22	EB Off-Ramp[2]	4.56	0.000	0.91	1.01	0.003	0.35
R29.23	WB On-Ramp[2]	0.91	0.000	0.00	0.63	0.002	0.22
R29.49	EB On-Ramp[2]	2.74	0.000	0.00	0.63	0.002	0.22
R29.54	WB Off-Ramp[2]	3.56	0.000	0.91	1.01	0.003	0.35

Notes:
Shaded cell indicates locations with higher than average accident rates.
EB = Eastbound
WB = Westbound
[1]Accident rates for SR-210 mainline expressed as number of accidents per Million Vehicle Miles.
[2]Accident rates for ramps expressed as number of accidents per million vehicles.

The table above indicates that each of the four diamond interchange ramps have actual accident rates that are higher than the statewide averages. The fatal plus injury accident rates on the two exit ramps are also greater than the statewide averages. The higher than average accident rates may be indicative of congestion issues and lack of adequate storage capacity for queuing at intersections. The purpose of the proposed project is to reduce congestion and improve operational efficiency at the SR-210/Base Line interchange and along the Base Line corridor.

2.2.1 Existing Conditions

The SR-210/Base Line interchange is in the City of Highland and serves growing residential and commercial development in the City. SR-210 is an east/west freeway, and it travels in a generally northwest/southeast direction, diagonally through the western portion of the City. To the north and west, SR-210 continues through San Bernardino County and is the link to the I-215 and I-15 Freeways and State Routes 18 and 57, and the greater Los Angeles area. To the south, SR-210 continues through San Bernardino County and connects to the I-10 Freeway. Adjacent interchanges exist on SR-210 at SR-330 to the north and at 5th Street–Greenspot Road to the south.

SR-210 in San Bernardino County is included in the National Highway System, the California Freeway and Expressway System, and the “12 foot Wide Arterial System.” SR-210, within the project limits, is classified as a Principal Arterial highway.

The City of Highland General Plan Circulation Element designates Base Line within the limits of the project as a Primary Arterial. Within the study area, Base Line is designated as a Truck Route with a Class II Bike Lane (on-street) in the City of Highland General Plan. The existing Base Line overcrossing consists of two lanes in each direction plus westbound and eastbound double left turn lanes.

2.3 Project Description

This section describes the proposed action and the design alternative that was developed by a multi-disciplinary team to achieve the project purpose and need while avoiding or minimizing environmental impacts. For the proposed project, one Build Alternative and a No Build Alternative are being considered.

The proposed project would widen Base Line from Buckeye Street to Seine Avenue and widen the existing SR-210 interchange ramps. Within the limits of the proposed project, Base Line is generally a four-lane arterial with turn lanes at intersections. The purpose of the proposed project is to reduce congestion and improve operational efficiency at the SR-210/Base Line interchange and along the Base Line corridor.

2.3.1 Build Alternative

The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and improve three of the four existing interchange ramps within the limits of the project. These three ramps may be reconstructed or rehabilated depending on the condition of the existing pavement at the time of construction.

The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and three of the four existing interchange ramps would be widened to add through lanes, turn lanes, and storage for vehicle queues.
- Existing pavement adjacent to pavement widening would be rehabilitated or reconstructed, as needed.
- A two-lane exit would be created at the westbound exit ramp.
- The entrance ramps would be widened to accommodate high occupancy vehicle (HOV) preferential lanes.
- The existing Base Line overcrossing would be widened to accommodate the new lanes.
- Retaining walls would be constructed, as needed, in areas of widening.
- The proposed project would require the acquisition of new permanent right-of-way and temporary construction easements (TCEs) would be needed during the construction period to facilitate access to the construction work areas.
- Drainage system improvements would be constructed to address storm water runoff.
- Ramp metering would be installed on the entrance ramps at the interchange.
- Utilities would be relocated, as needed, to accommodate the improved facility.
- TCEs would be needed along Base Line during the construction period.

2.3.2 No Build Alternative

Under the No Build Alternative, Base Line would not be widened through the interchange, and improvements to the existing ramps would not occur. Segments of Base Line west (Church Avenue to Buckeye Street) and east (Seine Avenue to Boulder Highway) of the interchange project limits could still be widened by the City.

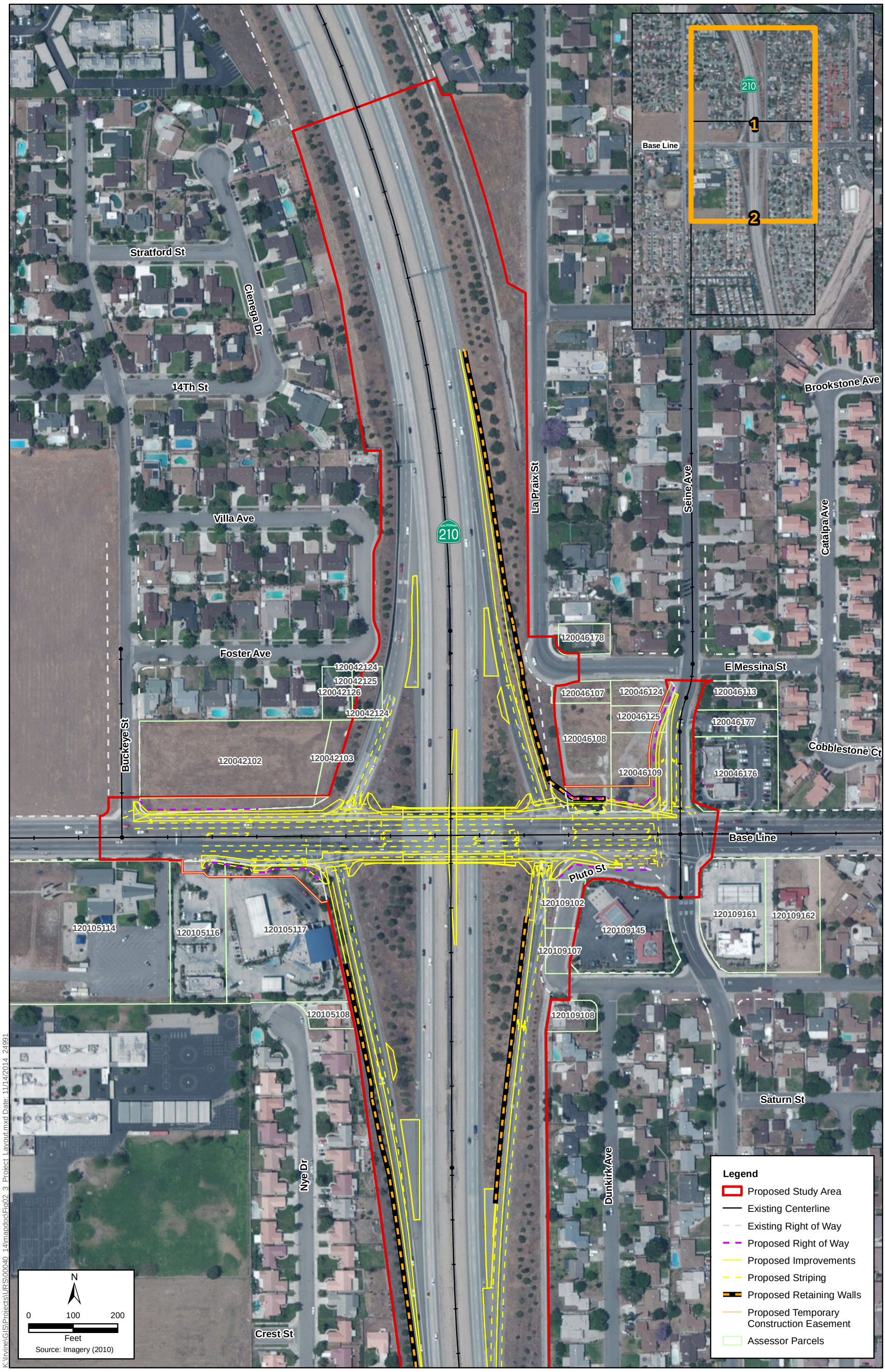

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Figure 2-3 - Sheet 1
Project Layout Map
SR-210/Base Line Interchange Project

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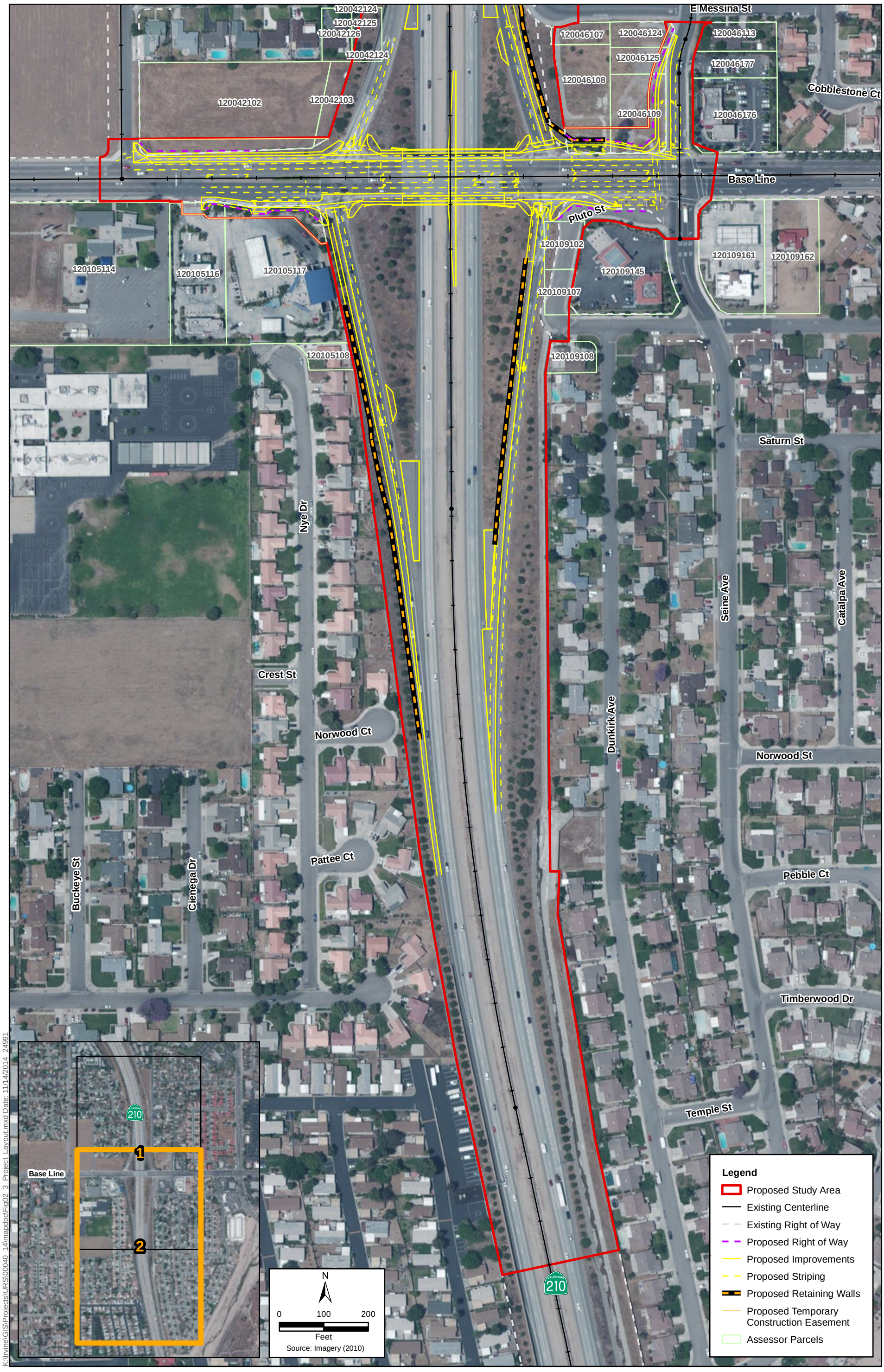

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Figure 2-3 - Sheet 2
Project Layout Map
SR-210/Base Line Interchange Project

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Chapter 3 Affected Environment, Environmental Consequences, and Minimization Measures

This chapter describes the affected environment (existing conditions and regulatory setting) for air quality as it relates to the proposed project, the potential environmental consequences with respect to local and regional air quality, and minimization measures to reduce potential effects, where applicable.

3.1 Affected Environment

3.1.1 Regulatory Setting

The proposed project is in the San Bernardino County portion of the South Coast Air Basin (SCAB or Basin) that is under the jurisdiction of the South Coast Air Quality Management District (SCAQMD). SCAQMD administers air quality regulations developed at the federal, state, and local levels. These regulations are described below.

3.1.1.1 Federal Air Quality Standards

The federal Clean Air Act (CAA), enacted in 1963 and amended several times thereafter (including the 1990 amendments, known as the Clean Air Act Amendments of 1990 [CAAA 1990], which are the current governing regulations for air quality), establishes the framework for modern air pollution control. In addition, EPA established the NAAQS for criteria pollutants (see Table 3-1), which include CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), PM_{10}, $PM_{2.5}$, and lead (Pb). "Primary" standards have been set to protect public health. For some pollutants, "secondary" standards have been set to protect crops or other protection of materials, as well as avoidance of nuisance conditions.

3.1.1.2 Federal Conformity Requirements

The concept of *transportation conformity* was introduced in the 1977 federal CAA, which includes a provision to ensure that transportation investments conform to the State Implementation Plan (SIP) for meeting the NAAQS; however, the conformity requirements were made substantially more rigorous with the CAAA 1990. Under CAAA 1990, the U.S. Department of Transportation (DOT) cannot fund, authorize, or approve federal actions to support programs or projects that are not first found to conform to an EPA-approved SIP for achieving NAAQS goals. CAAA 1990 requires states to address in the SIP how federal standards will be achieved for areas designated as nonattainment areas for the NAAQS. DOT and EPA developed the transportation conformity regulation, which details requirements for determining conformity of transportation plans, programs, and projects (Code of Federal Regulations [CFR], title 40, sections 51 and 93).

Table 3-1. State and Federal Criteria Air Pollutant Standards, Effects, and Sources

Pollutant	Averaging Time	State[1] Standard	Federal[1] Standard	Principal Health and Atmospheric Effects	Typical Sources	Project Area Attainment Status
Ozone (O_3)[2]	1 hour 8 hours	0.09 ppm 0.070 ppm	--[3] 0.075 ppm (4th highest in 3 years)	High concentrations irritate lungs. Long-term exposure may cause lung tissue damage and cancer. Long-term exposure damages plant materials and reduces crop productivity. Precursor organic compounds include many known toxic air contaminants. Biogenic volatile organic compounds (VOC) may also contribute.	Low-altitude ozone is almost entirely formed from reactive organic gases (ROG) or VOC and nitrogen oxide (NO_X) in the presence of sunlight and heat. Common precursor emitters include motor vehicles and other internal combustion engines, solvent evaporation, boilers, furnaces, and industrial processes.	Federal: Non-attainment State: Non-attainment
Carbon Monoxide (CO)	1 hour 8 hours 8 hours (Lake Tahoe)	20 ppm 9.0 ppm[4] 6 ppm	35 ppm 9 ppm --	CO interferes with the transfer of oxygen to the blood and deprives sensitive tissues of oxygen. CO also is a minor precursor for photochemical ozone. Colorless, odorless.	Combustion sources, especially gasoline-powered engines and motor vehicles. CO is the traditional signature pollutant for on-road mobile sources at the local and neighborhood scale.	Federal: Attainment/ Maintenance State: Attainment
Respirable Particulate Matter (PM_{10})[2]	24 hours Annual	50 µg/m^3 20 µg/m^3	150 µg/m^3 -- [2] (expected number of days above standard ≤1)	Irritates eyes and respiratory tract. Decreases lung capacity. Associated with increased cancer and mortality. Contributes to haze and reduced visibility. Includes some toxic air contaminants. Many toxic and other aerosol and solid compounds are part of PM_{10}.	Dust- and fume-producing industrial and agricultural operations; combustion smoke and vehicle exhaust; atmospheric chemical reactions; construction and other dust-producing activities; unpaved road	Federal: Attainment/ Maintenance State: Non-attainment

Pollutant	Averaging Time	State[1] Standard	Federal[1] Standard	Principal Health and Atmospheric Effects	Typical Sources	Project Area Attainment Status
					dust and re-entrained paved road dust; natural sources.	
Fine Particulate Matter ($PM_{2.5}$)[2]	24 hours Annual 24 hours (conformity process[5]) Secondary Standard (annual; also for conformity process[5])	-- 12 µg/m^3 -- --	35 µg/m^3 12.0 µg/m^3 65 µg/m^3 15 µg/m^3 (98th percentile over 3 years)	Increases respiratory disease, lung damage, cancer, and premature death. Reduces visibility and produces surface soiling. Most diesel exhaust particulate matter is in the $PM_{2.5}$ size range. Many toxic and other aerosol and solid compounds are part of $PM_{2.5}$.	Combustion including motor vehicles, other mobile sources, and industrial activities; residential and agricultural burning; also formed through atmospheric chemical and photochemical reactions involving other pollutants including NO_X, sulfur oxides (SO_X), ammonia, and ROG.	Federal: Non-attainment State: Non-attainment
Nitrogen Dioxide (NO_2)	1 hour Annual	0.18 ppm 0.030 ppm	0.100 ppm[6] (98th percentile over 3 years) 0.053 ppm	Irritating to eyes and respiratory tract. Colors atmosphere reddish-brown. Contributes to acid rain and nitrate contamination of stormwater. Part of the "NO_X" group of ozone precursors.	Motor vehicles and other mobile or portable engines, especially diesel; refineries; industrial operations.	Federal: Attainment/ Maintenance State: Attainment
Sulfur Dioxide (SO_2)	1 hour 3 hours 24 hours Annual	0.25 ppm -- 0.04 ppm	0.075 ppm[7] (99th percentile over 3 years) 0.5 ppm[8] 0.14 ppm[7] (for certain areas) 0.030 ppm[7] (for certain areas)	Irritates respiratory tract; injures lung tissue. Can yellow plant leaves. Destructive to marble, iron, and steel. Contributes to acid rain. Limits visibility.	Fuel combustion (especially coal and high-sulfur oil), chemical plants, sulfur recovery plants, metal processing; some natural sources such as active volcanoes. Limited contribution possible from heavy-duty diesel vehicles if ultra-low sulfur	Federal: Attainment State: Attainment

Pollutant	Averaging Time	State[1] Standard	Federal[1] Standard	Principal Health and Atmospheric Effects	Typical Sources	Project Area Attainment Status
					fuel not used.	
Lead (Pb)[9]	Monthly Calendar quarter Rolling 3-month average	1.5 μg/m^3 --	-- 1.5μg/m^3 [10, 11] 0.15 μg/m^3 [10,11]	Disturbs gastrointestinal system. Causes anemia, kidney disease, and neuromuscular and neurological dysfunction. Also a toxic air contaminant and water pollutant.	Lead-based industrial processes such as battery production and smelters. Lead paint, leaded gasoline. Aerially deposited lead from older gasoline use may exist in soils along major roads.	Federal: Attainment State: Attainment
Sulfate	24 hours	25 μg/m^3	--	Premature mortality and respiratory effects. Contributes to acid rain. Some toxic air contaminants attach to sulfate aerosol particles.	Industrial processes, refineries and oil fields, mines, natural sources such as volcanic areas, salt-covered dry lakes, and large sulfide rock areas.	Federal: n/a State: Attainment
Hydrogen Sulfide (H_2S)	1 hour	0.03 ppm	--	Colorless, flammable, poisonous. Respiratory irritant. Neurological damage and premature death. Headache, nausea. Strong odor.	Industrial processes such as refineries and oil fields, asphalt plants, livestock operations, sewage treatment plants, and mines. Some natural sources such as volcanic areas and hot springs.	Federal: n/a State: Unclassified
Visibility Reducing Particles (VRP)	8 hours	Visibility of 10 miles or more (Tahoe: 30 miles) at relative humidity less than 70%	--	Reduces visibility. Produces haze. Note: not directly related to the Regional Haze program under the federal CAA, which is oriented primarily toward visibility issues in National Parks and other “Class I” areas. However, some issues and measurement	See particulate matter above. May be related more to aerosols than to solid particles.	Federal: n/a State: Unclassified

Pollutant	Averaging Time	State[1] Standard	Federal[1] Standard	Principal Health and Atmospheric Effects	Typical Sources	Project Area Attainment Status
				methods are similar.		
Vinyl Chloride[9]	24 hours	0.01 ppm	--	Neurological effects, liver damage, cancer. Also considered a toxic air contaminant.	Industrial processes	Federal: n/a State: Unclassified

Source: California Air Resources Board 2013a, California Air Resources Board 2013b, U.S. Environmental Protection Agency 2014a

Notes: ppm = parts per million; μg/m^3 = micrograms per cubic meter; ppb=parts per billion (thousand million); n/a = not applicable

[1] State standards are "not to exceed" or "not to be equaled or exceeded" unless stated otherwise. Federal standards are "not to exceed more than once a year" or as described above.

[2] Annual PM_{10} NAAQS revoked October 2006; was 50 μg/m^3. The 24-hour $PM_{2.5}$ NAAQS were tightened in October 2006; was 65 μg/m^3. Annual $PM_{2.5}$ NAAQS were tightened from 15 μg/m^3 to 12 μg/m^3 in December 2012, and the secondary annual standard was set at 15 μg/m^3.

[3] Prior to June 2005, the 1-hour ozone NAAQS was 0.12 ppm. Emission budgets for 1-hour ozone are still in use in some areas where 8-hour ozone emission budgets have not been developed, such as the San Francisco Bay area.

[4] Rounding to an integer value is not allowed for the state 8-hour CO standard. A violation occurs at or above 9.05 ppm.

[5] The 65 μg/m^3 $PM_{2.5}$ (24-hour) NAAQS was not revoked when the 35 μg/m^3 NAAQS was promulgated in 2006. The 15 μg/m^3 annual $PM_{2.5}$ standard was not revoked when the 12 μg/m^3 standard was promulgated in 2012. The 0.08 ppm 1997 ozone standard is revoked FOR CONFORMITY PURPOSES ONLY when area designations for the 2008 0.75 ppm standard become effective for conformity use (July 20, 2013). Conformity requirements apply for all NAAQS, including revoked NAAQS, until emission budgets for newer NAAQS are found adequate, SIP amendments for the newer NAAQS are approved with a emission budget, EPA specifically revokes conformity requirements for an older standard, or the area becomes attainment/unclassified. SIP-approved emission budgets remain in force indefinitely unless explicitly replaced or eliminated by a subsequent approved SIP amendment. During the "Interim" period prior to availability of emission budgets, conformity tests may include some combination of build vs. no build, build vs. baseline, or compliance with prior emission budgets for the same pollutant.

[6] Final 1-hour NO_2 NAAQS published in the *Federal Register* on February 9, 2010, effective March 9, 2010. Initial area designation for California (2012) was attainment/unclassifiable throughout. Project-level hot-spot analysis requirements do not currently exist. Near-road monitoring starting in 2013 may cause redesignation to nonattainment in some areas after 2016.

[7] EPA finalized a 1-hour SO_2 standard of 75 ppb in June 2010. Nonattainment areas have not yet been designated as of September 2012. The 1971 SO_2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved.

[8] Secondary standard, set to protect public welfare rather than health. Conformity and environmental analysis address both primary and secondary NAAQS.

[9] The California Air Resources Board (ARB) has identified vinyl chloride and the particulate matter fraction of diesel exhaust as toxic air contaminants. Diesel exhaust particulate matter is part of PM_{10} and, in larger proportion, $PM_{2.5}$. Both ARB and EPA have identified lead and various organic compounds that are precursors to ozone and $PM_{2.5}$ as toxic air contaminants. There are no exposure criteria for adverse health effects due to toxic air contaminants, and control requirements may apply at ambient concentrations below any criteria levels specified above for these pollutants or the general categories of pollutants to which they belong.

[10] Lead NAAQS are not considered in the transportation conformity analysis.

[11] The national standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 μ g/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

Failing to submit a SIP that addresses nonattainment or to secure approval could lead to denial of federal funding and permits (in cases where a state-submitted SIP fails to demonstrate achievement of the federal standards, EPA prepares a federal implementation plan).

In addition to the SIP, Section 93.114 of the EPA transportation conformity regulations requires a currently conforming RTP and transportation improvement program (TIP) to be in place at the time of project approval. The RTP and TIP are comprehensive listings of all transportation

projects planned for a region over a period of years, usually about 20 years, that will receive federal funds or be subject to a federally required action, such as a review for effects on air quality. The TIP also lists non-federal, regionally significant projects for information and air quality modeling purposes. The RTP and TIP include projects whose emissions are within the budget planned in the SIP, with the goal of attaining the NAAQS.

Using the projects included in the RTP, an air quality model is run to determine whether the implementation of those projects would conform to emission budgets or other tests showing that federal CAA attainment requirements would be met. If the conformity analysis is successful, regional planning organizations and the appropriate federal agencies, such as FHWA, make the determination that the RTP is in conformity with the SIP for achieving the goals of the NAAQS. Otherwise, the projects in the RTP must be modified until conformity is attained.

If the design and scope of the proposed transportation project are the same as the design and scope described in the RTP, the proposed project is deemed to be a project that meets the regional conformity requirements for purposes of project-level analysis. Conformity with the NAAQS goals of the federal CAA is determined at both the regional and project level. The proposed project must conform at both the regional and project level to be approved.

Typically, a regional transportation conformity determination is made by evaluating whether a project is included in a conforming RTP and/or TIP. Any project listed in an RTP and/or TIP must demonstrate conformity with the SIP because the SIP demonstrates how federal standards will be achieved for the region. The design and scope of the proposed project being evaluated must match the design and scope of the project listed in the RTP and/or TIP. Regional-level conformity in California is concerned with how well the region is meeting the standards set for CO, NO_2, ozone, and particulate matter. Project-level conformity determinations for CO, PM_{10}, and $PM_{2.5}$ are made to verify that a project would not exacerbate an existing NAAQS violation or create a new exceedance and trigger the requirement for a hot-spot analysis.

Conformity at the project level requires hot-spot analysis if a region is designated a nonattainment or maintenance area for CO and/or particulate matter. Hot-spot analysis is essentially the same, for technical purposes, as a CO or particulate matter analysis performed for NEPA purposes. In general, projects must not cause the CO standard to be violated, and in nonattainment regions, the project must not cause any increase in the number and severity of violations. If known CO or particulate matter violations are located in the project vicinity, the project must include measures to reduce or eliminate the existing violations as well.

In California, the federal EPA has delegated authority to prepare SIPs to the ARB, which in turn has delegated that authority to individual air districts and planning entities. SCAG is the designated metropolitan planning agency (MPO) and state Regional Transportation Planning Agency for San Bernardino County. As such, SCAG coordinates the region's major transportation projects and programs and develops the RTP and FTIP. Previous transportation improvement programs were called Regional Transportation Improvement Programs (RTIPs). The FTIP sets forth SCAG's investment priorities for transit and transit-related improvements, highways and roadways, and other surface transportation improvements in the South Coast region. The FTIP is in accord with EPA's Transportation Conformity Rule as it pertains to attainment of air quality standards in the South Coast area.

3.1.1.3 Mobile Source Air Toxics

The federal CAA has identified 188 pollutants as being air toxics, which are also known as hazardous air pollutants (HAP). From this list, EPA identified a group of 93 compounds as MSATs in its latest rule, *Control of Emissions of Hazardous Air Pollutants from Mobile Sources* (*Federal Register* [FR], volume 72, No. 37, page 8430) on February 26, 2007. In addition, EPA identified seven priority MSATs: acrolein, benzene, 1,3-butidiene, diesel particulate matter/diesel exhaust organic gases, formaldehyde, naphthalene, and polycyclic organic matter (POM). To address emissions of MSATs, EPA has issued a number of regulations that will dramatically decrease MSATs through cleaner fuels and cleaner engines.

The area of air toxics analysis is a new and emerging issue and is an area of continuing research. Although much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques available for assessing project-specific health impacts from MSATs are limited. Given the emerging state of the science and of project-level analysis techniques, there are no established criteria for determining when MSAT emissions should be considered a significant issue in the NEPA context. FHWA is preparing guidance as to how mobile-source health risks should factor into project-level decision-making under NEPA. In addition, EPA has not established regulatory concentration targets for the priority MSAT pollutants appropriate for use in the project development process. In light of the recent development regarding MSATs, FHWA has issued interim guidance for the assessment of MSATs in NEPA documents (*Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA, December 2012*) (Federal Highway Administration 2012).

3.1.1.4 State Air Quality Standards

Responsibility for achieving the CAAQS, which for certain pollutants and averaging periods are more stringent than federal standards, is placed on ARB and local air pollution control districts (see Table 3-1). State standards are to be achieved through district-level air quality management plans that are incorporated into the SIP. Traditionally, ARB has established state air quality standards, maintained oversight authority in air quality planning, developed programs for reducing emissions from motor vehicles, developed air emissions inventories, collected air quality and meteorological data, and approved SIPs developed by the individual air districts.

Responsibilities of air districts include overseeing stationary source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality–related sections of environmental documents required under CEQA. It should be noted, however, that Caltrans considers the use of locally adopted CEQA thresholds of significance for construction emissions as being not mandatory and help serve as guidance for scoping air quality studies. However, Caltrans Standard Specification Section 14-9.02 requires compliance by the contractor with all applicable laws and regulations related to air quality, including air pollution control district and air quality management district regulations and local ordinances. In addition, Caltrans does not have the authority to require use of specific equipment or to apply other direct restrictions on contractor equipment fleet emissions in excess of EPA, ARB, and possibly local air district regulations.

The California Clean Air Act (California CAA) of 1988 substantially added to the authority and responsibilities of air districts. The California CAA designates air districts as lead air quality planning agencies, requires air districts to prepare air quality plans, and grants air districts authority to implement transportation control measures.

The California CAA focuses on attainment of the state ambient air quality standards and requires designation of attainment and nonattainment areas with respect to these standards. The California CAA also requires that local and regional air districts expeditiously adopt and prepare an air quality attainment plan (Clean Air Plan) if the district violates state air quality standards for ozone, CO, SO_2, or NO_2. These plans are specifically designed to attain state standards and must be designed to achieve an annual five percent reduction in district-wide emissions of each nonattainment pollutant or its precursors. No locally prepared attainment plans are required for areas that violate the state PM_{10} standards; ARB is responsible for developing plans and projects that achieve compliance with the state PM_{10} standards.

The California CAA requires the state air quality standards to be met as expeditiously as practicable but, unlike the federal CAA, does not set precise attainment deadlines. Instead, it establishes increasingly stringent requirements for areas that will require more time to achieve the standards.

The California CAA emphasizes the control of *indirect* and *area-wide sources* of air pollutant emissions. The California CAA gives local air pollution control districts explicit authority to regulate indirect sources of air pollution and establish Transportation Control Measures (TCMs). The California CAA does not define the terms *indirect [sources]* and *area-wide sources*. However, Section 110 of the federal CAA defines an indirect source as

> …a facility, building, structure, installation, real property, road, or highway that attracts, or may attract, mobile sources of pollution. Such terms include parking lots, parking garages, and other facilities subject to any measure for management of parking supply….

TCMs are defined in the California CAA as "any strategy to reduce trips, vehicle use, vehicle miles traveled, vehicle idling, or traffic congestion for the purpose of reducing vehicle emissions."

3.1.1.5 Local and Regional Implementation of Federal Requirements

The air quality management agencies of direct importance in San Bernardino County include EPA, ARB, and SCAQMD. EPA has established federal standards for which ARB and SCAQMD have primary implementation responsibility. ARB and SCAQMD also are responsible for ensuring that state standards are met. SCAQMD is responsible for implementing strategies for air quality improvement and recommending mitigation measures for new growth and development. At the local level, air quality is managed through land use and development planning practices, which are implemented in the county through the general planning process. SCAQMD is responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws.

The SCAB is classified as an attainment/maintenance and moderate non-attainment area for PM_{10} for federal and state standards, respectively, and a nonattainment area for $PM_{2.5}$ for both federal and state standards (see Table 3-1). SCAQMD Rule 403 (Fugitive Dust) is intended to reduce the amount of particulate matter in the ambient air resulting from anthropogenic fugitive dust sources by requiring projects to prevent, reduce, or mitigate fugitive dust emissions. All construction activity sources of fugitive dust are required to implement the best available control measures indicated in Rule 403 and summarized in Table 3-2.

SCAG develops the FTIP in consultation with local air management districts. The FTIP includes projects that strive to meet the goals and objectives of the NAAQS. The FTIP is also in accord with EPA's Transportation Conformity Rule as it pertains to air quality standards in the Basin.

In addition, the project is also included in the latest SCAG 2012 RTP Amendment #2 and SCAG Draft 2015 FTIP (RTP ID# REG0701 and FTIP ID# 201186). The public comment period for the SCAG 2012 RTP Amendment #2 and the Draft 2015 FTIP closed on July 31, 2014. Conformity determinations for both documents are forthcoming and anticipated in late 2014.

Because both the currently conforming SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19 model lists include the proposed project (2012 RTP Amendment #1 project number REG0701 and 2013 FTIP Amendment #13-19 Project Number 201186), the proposed project's regional conformity requirements have been satisfied (Southern California Association of Governments 2013, Southern California Association of Governments 2014). Please refer to Appendix A for conformity documentation related to the SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19. The proposed project must undergo a project-level but not a regional conformity-level air quality analysis.

3.1.2 Physical Setting

Ambient air quality is affected by climatological conditions, topography, and the types and amounts of pollutants emitted. The following discussion describes relevant characteristics of the SCAB and offers an overview of conditions affecting ambient air concentrations of pollutants in the Basin.

3.1.2.1 Climate and Topography

The project site is located within the SCAB, an approximately 6,745-square-mile area bounded by the Pacific Ocean to the west and the San Gabriel, San Bernardino, and San Jacinto Mountains to the north and east. The SCAB includes all of Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino Counties in addition to the San Gorgonio Pass area in Riverside County. The terrain and geographical location determine the distinctive climate of the SCAB, which is a coastal plain with connecting broad valleys and low hills.

Table 3-2. South Coast Air Quality Management District's Best Available Control Measures

Source Category	Control Measure	Guidance
Backfilling	01-1 Stabilize backfill material when not actively handling; and 01-2 Stabilize backfill material during handling; and 01-3 Stabilize soil at completion of activity.	✓ Mix backfill soil with water prior to moving ✓ Dedicate water truck or high-capacity hose to backfilling equipment ✓ Empty loader bucket slowly so that no dust plumes are generated ✓ Minimize drop height from loader bucket
Clearing and grubbing	02-1 Maintain stability of soil through pre-watering of site prior to clearing and grubbing; and 02-2 Stabilize soil during clearing and grubbing activities; and 02-3 Stabilize soil immediately after clearing and grubbing activities.	✓ Maintain live perennial vegetation where possible ✓ Apply water in sufficient quantity to prevent generation of dust plumes
Clearing forms	03-1 Use water spray to clear forms; or 03-2 Use sweeping and water spray to clear forms; or 03-3 Use vacuum system to clear forms.	✓ Use of high-pressure air to clear forms may cause exceedance of rule requirements
Crushing	04-1 Stabilize surface soils prior to operation of support equipment; and 04-2 Stabilize material after crushing.	✓ Follow permit conditions for crushing equipment ✓ Pre-water material prior to loading into crusher ✓ Monitor crusher emissions opacity ✓ Apply water to crushed material to prevent dust plumes
Cut and fill	05-1 Pre-water soils prior to cut-and-fill activities; and 05-2 Stabilize soil during and after cut-and-fill activities.	✓ For large sites, pre-water with sprinklers or water trucks and allow time for penetration ✓ Use water trucks/pulls to water soils to depth of cut prior to subsequent cuts
Demolition – mechanical/manual	06-1 Stabilize wind erodible surfaces to reduce dust; and 06-2 Stabilize surface soil where support equipment and vehicles will operate; and 06-3 Stabilize loose soil and demolition debris; and 06-4 Comply with SCAQMD Rule 1403.	✓ Apply water in sufficient quantities to prevent the generation of visible dust plumes
Disturbed soil	07-1 Stabilize disturbed soil throughout the construction site; and 07-2 Stabilize disturbed soil between structures	✓ Limit vehicular traffic and disturbances on soils where possible ✓ If interior block walls are planned, install as early as possible ✓ Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes
Earthmoving activities	08-1 Pre-apply water to depth of proposed cuts; and 08-2 Re-apply water as necessary to maintain soils in a damp condition and to ensure that visible emissions do not exceed 100 feet in any direction; and 08-3 Stabilize soils once earthmoving activities are complete.	✓ Grade each project phase separately, timed to coincide with construction phase ✓ Upwind fencing can prevent material movement on site ✓ Apply water or a stabilizing agent in sufficient quantities to prevent the generation of visible dust plumes

Source Category	Control Measure	Guidance
Importing/ exporting of bulk materials	09-1 Stabilize material while loading to reduce fugitive dust emissions; and 09-2 Maintain at least 6 inches of freeboard on haul vehicles; and 09-3 Stabilize material while transporting to reduce fugitive dust emissions; and 09-4 Stabilize material while unloading to reduce fugitive dust emissions; and 09-5 Comply with California Vehicle Code (CVC) Section 23114.	✓ Use tarps or other suitable enclosures on haul trucks ✓ Check seals on belly dump trucks regularly and remove any trapped rocks to prevent spillage ✓ Comply with track-out prevention/mitigation requirements ✓ Provide water while loading and unloading to reduce visible dust plumes
Landscaping	10-1 Stabilize soils, materials, slopes.	✓ Apply water to materials to stabilize ✓ Maintain materials in a crusted condition ✓ Maintain effective cover over materials ✓ Stabilize sloping surfaces using soil binders until vegetation or ground cover can effectively stabilize the slopes ✓ Hydroseed prior to rainy season
Road shoulder Maintenance	11-1 Apply water to unpaved shoulders prior to clearing; and 11-2 Apply chemical dust suppressants and/or washed gravel to maintain a stabilized surface after completing road shoulder maintenance.	✓ Install curbing and/or paving ✓ Shoulders can reduce recurring maintenance costs ✓ Use of chemical dust suppressants can inhibit vegetation growth and reduce future road shoulder maintenance costs
Screening	12-1 Pre-water material prior to screening; and 12-2 Limit fugitive dust emissions to opacity and plume length standards; and 12-3 Stabilize material immediately after screening.	✓ Dedicate water truck or high-capacity hose to screening operation ✓ Drop material through the screen slowly and minimize drop height ✓ Install wind barrier with a porosity of no more than 50% upwind of screen to the height of the drop point
Staging areas	13-1 Stabilize staging areas during use; and 13-2 Stabilize staging area soils at project completion.	✓ Limit size of staging area ✓ Limit vehicle speeds to 15 miles per hour ✓ Limit number and size of staging area entrances/exists
Stockpiles/ bulk material handling	14-1 Stabilize stockpiled materials; and 14-2 Stockpiles within 100 yards of off-site occupied buildings must not be greater than 8 feet in height or must have a road bladed to the top to allow water truck access or must have an operational water irrigation system that is capable of complete stockpile coverage.	✓ Add or remove material from the downwind portion of the storage pile ✓ Maintain storage piles to avoid steep sides or faces
Traffic areas for construction activities	15-1 Stabilize all off-road traffic and parking areas; and 15-2 Stabilize all haul routes; and 15-3 Direct construction traffic over established haul routes.	✓ Apply gravel/paving to all haul routes as soon as possible to all future roadway areas ✓ Barriers can be used to ensure vehicles are used only on established parking areas/haul routes

Source Category	Control Measure	Guidance
Trenching	16-1 Stabilize surface soils where trencher or excavator and support equipment will operate; and 16-2 Stabilize soils at the completion of trenching activities.	✓ Pre-watering of soils prior to trenching is an effective preventive measure. For deep trenching activities, pre-trench to 18 inches, soak soils via the pre-trench, and resuming trenching ✓ Washing mud and soils from equipment at the conclusion of trenching activities can prevent crusting and drying of soil on equipment
Truck loading	17-1 Pre-water material prior to loading; and 17-2 Ensure that freeboard exceeds 6 inches (CVC 23114)	✓ Empty loader bucket so no visible dust plumes are created ✓ Ensure that the loader bucket is close to the truck to minimize drop height while loading
Turf overseeding	18-1 Apply sufficient water immediately prior to conducting turf vacuuming activities to meet opacity and plume length standards; and 18-2 Cover haul vehicles prior to exiting the site.	✓ Haul waste material immediately off-site
Unpaved roads/parking lots	19-1 Stabilize soils to meet the applicable performance standards; and 19-2 Limit vehicular travel to established unpaved roads (haul routes) and unpaved parking lots.	✓ Restricting vehicular access to established unpaved travel paths and parking lots can reduce stabilization requirements
Vacant land	20-1 In instances where vacant lots are 0.10 acre or larger and have a cumulative area of 500 square feet or more that are driven over and/or used by motor vehicles and/or off-road vehicles, prevent motor vehicle and/or off-road vehicle trespassing, parking, and/or access by installing barriers, curbs, fences, gates, posts, signs, shrubs, trees or other effective control measures.	
Source: South Coast Air Quality Management District 2005.		

The greatest air pollution effects occur throughout the SCAB from June through September. This condition is generally attributed to the large amount of pollutant emissions, light winds, and shallow vertical atmospheric mixing. This frequently reduces pollutant dispersion, thus causing elevated air pollution levels. Pollutant concentrations in the SCAB vary with location, season, and time of day. Ozone concentrations, for example, tend to be lower along the coast, higher in the near inland valleys, and lower in the far inland areas of the SCAB and adjacent desert.

The average project area summer (August) high and low temperatures are 96 degrees Fahrenheit (°F) and 64 °F, respectively. The average project area winter (December) high and low temperatures are 68 °F and 41 °F, respectively. Annual average rainfall for the project area is 16.56 inches (Weather Channel 2014).

Wind patterns in the project vicinity (San Bernardino) display a unidirectional flow, with winds arising primarily from the southwest at an average speed of 1.67 meters per second. Calm wind conditions are present 0.05 percent of the time over the period of record (2007–2011) (South Coast Air Quality Management District 2014).

3.1.2.2 Description of Relevant Air Pollutants

The following is a general description of the pollutants for which there are standards (criteria pollutants) and ambient measurements. A description of toxic air contaminants (TACs) and naturally occurring asbestos (NOA), for which there are no standards, is also included. Ozone, and its precursors, ROG and NO_X; sulfates; visibility reducing particles; NO_2; and PM_{10} and $PM_{2.5}$ are considered to be regional pollutants because they or their precursors affect air quality on a regional scale. NO_2 reacts photochemically with ROGs to form ozone, while PM_{10} and $PM_{2.5}$ can form from the chemical reaction of atmospheric chemicals, including NO_X, sulfates, nitrates, and ammonia. These processes can occur at some distance downwind of the source of pollutants. Pollutants such as CO, SO_2, lead, and particulate matter are considered to be local pollutants because they tend to disperse rapidly with distance from the source. Although PM_{10} and $PM_{2.5}$ are considered to be regional pollutants, they can also be localized pollutants because direct emissions of particulate matter from automobile exhaust can accumulate in the air locally near the emission source. Table 3-1 provides references for the state and federal standards and the SCAB's attainment status for the pollutants.

Ozone

Ozone is a respiratory irritant that increases susceptibility to respiratory infections. It is also an oxidant that can cause substantial damage to vegetation and other materials.

Ozone is not emitted directly into the air but is formed by a photochemical reaction in the atmosphere. Ozone precursors (ROG and NO_X) react in the atmosphere in the presence of sunlight to form ozone. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, ozone is primarily a summer air pollution problem.

State and federal standards for ozone have been set for one- and eight-hour averaging times. The state one-hour ozone standard is 0.09 part per million (ppm), not to be exceeded. EPA revoked

the one-hour ozone standard on June 15, 2005. The federal eight-hour standard of 0.075 ppm went into effect on January 30, 2006. The California one-hour standard remains in effect. In addition, the state eight-hour standard is 0.070 ppm, not to be exceeded.

The SCAB is designated as a nonattainment area for the state's one- and eight-hour ozone standards. For the federal eight-hour ozone standard, the SCAB is designated as a severe nonattainment area.

Carbon Monoxide

CO is a public health concern because it combines readily with hemoglobin and reduces the amount of oxygen transported in the bloodstream. CO can cause health problems such as fatigue, headache, confusion, dizziness, and even death.

Motor vehicles are the dominant source of CO emissions in most areas. High CO levels develop primarily during winter when periods of light winds combine with the formation of ground-level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

State and federal CO standards have been set for one- and eight-hour averaging times. The state one-hour standard is 20 ppm, not to be exceeded, whereas the federal one-hour standard is 35 ppm, not to be exceeded more than one day per year. The state eight-hour standard is 9.0 ppm, while the federal standard is 9 ppm. This means that a monitored eight-hour CO concentration from 9.1 to 9.4 ppm violates the state but not the federal standard.

The SCAB is designated as an attainment area for the state one- and eight-hour CO standards and an attainment/maintenance area for both the federal one- and eight-hour CO standards.

Inhalable Particulate Matter

Particulates can damage human health and retard plant growth. Health concerns associated with suspended particulate matter focus on those particles small enough to reach the lungs when inhaled. Particulates also reduce visibility and corrode materials.

PM_{10} sources in Los Angeles County comprise both rural and urban sources, including agricultural burning, tilling of agricultural fields, industrial emissions, dust suspended by vehicle traffic, and secondary aerosols formed by reactions in the atmosphere.

The federal and state ambient air quality standard for particulate matter applies to two classes of particulates: $PM_{2.5}$ and PM_{10}. The state PM_{10} standards are 50 micrograms per cubic meter ($\mu g/m^3$) as a 24-hour average and 20 $\mu g/m^3$ as an annual arithmetic mean. The federal PM_{10} standard is 150 $\mu g/m^3$ as a 24-hour average. For $PM_{2.5}$, the state has adopted a standard of 12 $\mu g/m^3$ for the annual arithmetic mean. The federal $PM_{2.5}$ standards are 35 $\mu g/m^3$ for the 24-hour average and 12.0 $\mu g/m^3$ for the annual arithmetic mean.

The SCAB is designated as a nonattainment area for both the state 24-hour and arithmetic mean PM_{10} standards and an attainment/maintenance area for the federal 24-hour PM_{10} standard. In

addition, the SCAB is designated as a nonattainment area for the state annual arithmetic mean $PM_{2.5}$ standard and a moderate nonattainment area for both the federal 24-hour and annual arithmetic $PM_{2.5}$ standards.

Nitrogen Dioxide

NO_X is part of a family of highly reactive gases—the primary precursors to the formation of ground-level ozone—that react in the atmosphere to form acid rain. NO_X, a mixture of nitric oxide (NO) and NO_2, is produced from natural sources, motor vehicles, and other fuel combustion processes. NO, which is colorless and odorless, is oxidized in the atmosphere to form NO_2. NO_2 is an odorous, brown, acidic, highly corrosive gas that can affect human health and the environment. NO_X is a critical component of photochemical smog. NO_2 produces the yellowish-brown color of the smog. EPA has set a NAAQS for NO_2 but not for NO.

NO_X can irritate the lungs, cause lung damage, and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidences of acute respiratory illness in children. Health effects associated with NO_X are increased incidences of chronic bronchitis and lung irritation. Chronic exposure to NO_2 may lead to eye and mucus membrane aggravation along with pulmonary dysfunction. NO_X can cause fading of textile dyes and additives, deterioration of cotton and nylon, and corrosion of metals due to the production of particulate nitrates. Airborne NO_X can impair visibility.

NO_X, a major component of acid deposition in California, may affect both terrestrial and aquatic ecosystems. NO_X in the air is a potentially significant contributor to a number of environmental effects, such as acid rain and eutrophication in coastal waters. Eutrophication occurs when a body of water suffers an increase in nutrients that reduces the amount of oxygen in the water, producing an environment that is destructive to fish and other animal life.

The state NO_2 standards are 0.18 ppm as a one-hour average and 0.030 ppm as an annual arithmetic mean. The federal NO_2 standards are 0.100 ppm as a one-hour average and 0.053 ppm as an annual arithmetic mean.

The SCAB is designated as an attainment area for both the state one-hour and annual arithmetic mean NO_2 standards and an unclassifiable/attainment area for the federal one-hour and annual arithmetic mean NO_2 standard.

Sulfur Oxide

SO_X is a family of colorless, pungent gases, including SO_2, that form primarily through the combustion of sulfur-containing fossil fuels (mainly coal and oil), metal smelting, and other industrial processes. SO_X can react to form sulfates, which significantly reduce visibility. SO_X is a precursor to particulate matter formation, which is considered to be in nonattainment status in the project area.

The major health concerns associated with exposure to high concentrations of SO_X include effects related to breathing, respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Major subgroups of the population that are most sensitive to SO_X include individuals with cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) as well as children and the elderly. SO_X emissions can also damage tree foliage and agricultural crops. Together, SO_X and NO_X are the major precursors to acid rain, which is associated with the acidification of lakes and streams and accelerated corrosion of buildings and monuments.

There are state and federal ambient air quality standards for SO_2 but not for SO_X. The state standards are 0.25 ppm as a one-hour average and 0.04 ppm as a 24-hour average. The federal standard is 0.075 ppm as a one-hour average.

The SCAB is designated as an attainment area for both the one- and 24-hour state SO_2 standards and an attainment/unclassified area for the federal one-hour standard.

Lead

Lead is a natural constituent of air, water, and the biosphere. Lead is neither created nor destroyed in the environment, so it essentially persists forever. Automobiles were once a major source of airborne lead because, prior to being phased out, lead was used as a gasoline additive to increase the octane rating. However, in recent years, ambient concentrations of lead have dropped dramatically.

Short-term exposure to high levels of lead can cause vomiting, diarrhea, convulsions, coma, or even death. However, even small amounts of lead can be harmful, especially to infants, young children, and pregnant women. Symptoms of long-term exposure to lower levels of lead may be less noticeable but still serious. Anemia is common, and damage to the nervous system may cause impaired mental function. Other symptoms are appetite loss, abdominal pain, constipation, fatigue, sleeplessness, irritability, and headache. Continued excessive exposure, as in an industrial setting, can affect the kidneys.

Lead exposure is most serious for young children because they absorb lead more easily than adults and are more susceptible to its harmful effects. Even low-level exposure may harm the intellectual development, behavior, size, and hearing of infants. During pregnancy, and especially in the last trimester, lead can cross the placenta and affect the fetus. Female workers exposed to high lead levels have more miscarriages and stillbirths.

The state lead standard is 1.5 $\mu g/m^3$ over a 30-day average; the federal lead standards are 1.5 $\mu g/m^3$ averaged over a calendar quarter and 0.15 $\mu g/m^3$ as a rolling three-month average.

The Los Angeles County portion of the SCAB is designated as a nonattainment area for the federal rolling three-month average lead standard. All other areas of the SCAB, including the project area, are designated attainment with respect to lead for the federal standard. The SCAB and San Bernardino County are designated as an attainment area for the state standard with respect to lead.

Hydrogen Sulfide

Hydrogen Sulfide (H_2S) is a colorless, flammable, and poisonous gas which is a respiratory irritant. It can cause headaches, nausea, and can result in neurological damage and premature death. It is produced from industrial processes such as refineries and oil fields, asphalt plants, livestock operations, sewage treatment plants, and mines. It can also come from natural sources such as volcanic areas and hot springs. No federal standards are available for hydrogen sulfide. The state air quality standard for hydrogen sulfide is 0.03 ppm as a one-hour average. At this level individuals may experience headaches and nausea.

Visibility Reducing Particles

Visibility-reducing particles (VRP) consist of suspended particulate matter, which is a complex mixture of tiny particles that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. These particles vary greatly in shape, size, and chemical composition, and can be made up of many different materials such as metals, soot, soil, dust, and salt.

Vinyl Chloride

The sources for vinyl chloride emissions are from industrial process and manufacturing of plastic products, hazardous waste sites, and landfills. Vinyl chloride can cause neurological effects, liver damage, and cancer. It is also considered a toxic air contaminant. The state standard is 0.01 ppm as a 24-hour average.

Mobile-source Air Toxics/Toxic Air Contaminants

TACs are pollutants that may result in an increase in mortality or serious illness, or pose a present or potential hazard to human health. Health effects of TACs include cancer, birth defects, neurological damage, damage to the body's natural defense system, and diseases that lead to death. In 1998, following a ten-year scientific assessment process, ARB identified particulate matter from diesel-fueled engines as a TAC. Compared with other air toxics ARB has identified and controlled, diesel particulate matter (DPM) emissions are estimated to be responsible for about 70 percent of the total ambient air toxics risk (California Air Resources Board 2000).

EPA in its latest final rule (2007) on the control of HAPs from mobile sources (72 FR 8430), requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using EPA's MOVES2010b model, even if vehicle activity (i.e., vehicle miles traveled [VMT]) increases by 102 percent, as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emission rate for the priority MSATs is projected for the same time period (Federal Highway Administration 2012).

Naturally Occurring Asbestos

NOA is a fibrous material found in certain types of rock formations. It is the result of natural geologic processes and is commonly found near earthquake faults in California. Some rock types known to produce asbestos fibers are varieties of chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite.

Asbestos is harmless when it is left undisturbed under the soil, but if it becomes airborne, it can cause serious health problems. Human disturbance or natural weathering can break down asbestos into microscopic fibers that are easily inhaled. Inhalation of asbestos fibers can cause lung cancer, mesothelioma (a rare form of cancer found in the lining of internal organs), and asbestosis (a progressive, non-cancer disease of the lungs involving a buildup of scar tissue, which inhibits breathing) (U.S. Environmental Protection Agency n.d., 2014c).

Both EPA and ARB have issued guidance for reducing exposure to NOA. EPA's suggested measures include leaving NOA material undisturbed, covering or capping NOA material, limiting dust-generating activities, or excavating and disposing of NOA material (U.S. Environmental Protection Agency 2008). ARB has adopted Airborne Toxic Control Measures (ATCMs), which are required for road construction and maintenance projects, unless the project is found to be exempt. These ATCMs include stabilizing unpaved surfaces subject to vehicle traffic, reducing vehicle speeds, wetting or chemically stabilizing storage piles, and eliminating track-out material from equipment (California Air Resources Board 2013c).

Although NOA is common in certain counties of California, it is not likely to be found in San Bernardino County (California Department of Conservation 2000).

3.1.2.3 Existing Air Quality Conditions

Existing air quality conditions in the project area can be characterized in terms of the ambient air quality standards that the federal and state governments have established for various pollutants (see Table 3-1) and the monitoring data collected in the region. Monitoring data concentrations are typically expressed in terms of ppm or $\mu g/m^3$. The nearest air quality monitoring station in the vicinity of the project area is the San Bernardino-4th Street monitoring station, which is approximately four miles southwest of the project area. The San Bernardino-4th Street station monitors for ozone, CO, PM_{10}, and $PM_{2.5}$.

Air quality monitoring data from the San Bernardino-4th Street monitoring station is summarized in Table 3-3. These data represent air quality monitoring results for the last three years (2011–2013) from which complete data are available.

Table 3-3. Ambient Air Quality Monitoring Data Measured at the San Bernardino-4th Street Monitoring Station

Pollutant Standards	2011	2012	2013
1-Hour Ozone			
Maximum 1-hour concentration (ppm)	0.135	0.124	0.139
Number of days standard exceeded[1]			
CAAQS 1-hour (> 0.09 ppm)	40	41	22
8-Hour Ozone			
National maximum 8-hour concentration (ppm)	0.121	0.109	0.113
National fourth -highest 8-hour concentration (ppm)	0.101	0.100	0.097
State maximum 8-hour concentration (ppm)	0.121	0.109	0.113
Number of days standard exceeded[1]			
NAAQS 8-hour (> 0.075 ppm)	39	54	36
CAAQS 8-hour (> 0.070 ppm)	66	77	53
Carbon Monoxide (CO)			

Pollutant Standards	2011	2012	2013
National[2] maximum 8-hour concentration (ppm)	1.7	1.7	1.7
California[3] maximum 8-hour concentration (ppm)	1.74	1.65	--
Maximum 1-hour concentration (ppm)	1.9	3.1	3.8
Number of days standard exceeded[1]			
NAAQS 8-hour (≥ 9 ppm)	0	0	0
CAAQS 8-hour (≥ 9.0 ppm)	0	0	0
NAAQS 1-hour (≥ 35 ppm)	0	0	0
CAAQS 1-hour (≥ 20 ppm)	0	0	0
Particulate Matter (PM10)[4]			
National[2] maximum 24-hour concentration ($\mu g/m^3$)	128.4	68.1	177.3
State[3] maximum 24-hour concentration ($\mu g/m^3$)	54.0	51.0	98.0
State annual average concentration ($\mu g/m^3$)[5]	30.1	--	30.1
Number of days standard exceeded[1]			
NAAQS 24-hour (> 150 $\mu g/m^3$)[6]	0.0	0.0	0.0
CAAQS 24-hour (> 50 $\mu g/m^3$)	2	1	2
Particulate Matter (PM2.5)			
National[2] maximum 24-hour concentration ($\mu g/m^3$)	65.0	34.8	55.3
National annual 98th Percentile value ($\mu g/m^3$)	--	27.1	33.4
National annual average concentration ($\mu g/m^3$)	--	11.7	11.4
State annual designation value ($\mu g/m^3$)	--	--	--
State annual average concentration ($\mu g/m^3$)[5]	--	11.7	11.4
Number of days standard exceeded[1]			
NAAQS 24-hour (> 35 $\mu g/m^3$)	2	0	1

Sources: California Air Resources Board 2014, U.S Environmental Protection Agency 2014b
See Appendix B for climate and monitoring data
Notes: CAAQS = California Ambient Air Quality Standards.
NAAQS = National Ambient Air Quality Standards.
— = insufficient data available to determine the value.
[1] An exceedance is not necessarily a violation.
[2] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.
[3] State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, state statistics are based on California-approved samplers.
[4] Measurements usually are collected every 6 days.
[5] State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.
[6] Mathematical estimate of how many days concentrations would have been measured as higher than the level of the standard had each day been monitored.

As shown in Table 3-3, the San Bernardino-4th Street monitoring station has experienced multiple violations of the state one-hour ozone standard, federal and state eight-hour ozone standards, state PM_{10} standards, and federal $PM_{2.5}$ standards during over the previous three years.

Attainment Status

EPA has classified the SCAB as an extreme nonattainment area for the federal eight-hour ozone standard. For both the one-hour and eight-hour federal CO standard, EPA has classified the SCAB as an attainment/maintenance area. EPA has classified the SCAB as an attainment/maintenance area for the federal PM_{10} standard and as a nonattainment area for the federal $PM_{2.5}$ standard. ARB has classified the SCAB as a nonattainment area for the state one-

hour ozone standard and as a nonattainment area for the state eight-hour ozone standard. For the state CO standard, ARB has classified the SCAB as an attainment area. ARB has classified the SCAB as a nonattainment area for the state PM_{10} and $PM_{2.5}$ standards. The SCAB's attainment status for each of these pollutants relative to the NAAQS and CAAQS is summarized in Table 3-1.

3.1.2.4 Sensitive Receptors

Caltrans defines *sensitive receptors* (aka *sensitive land uses*) as schools, medical centers and similar health care facilities, child care facilities, parks, and playgrounds (California Department of Transportation 2012). The area immediately surrounding the project site consists of residential uses, schools (elementary and nursery schools), and churches. Analyses performed by ARB indicate that providing a separation of 1,000 feet from high-traffic areas would substantially reduce the exposure to air contaminant concentrations and a decrease in asthma symptoms in children (California Air Resources Board 2005). The closest sensitive receptors are residences located approximately 60 feet from the existing northwest section of the freeway mainline and directly adjacent to the proposed limits of disturbance. Sensitive receptors located within 1,000 feet of the proposed project alignment include single family residences, the First United Methodist Nursery School, and Thompson Elementary School (refer to Figure 3-1)

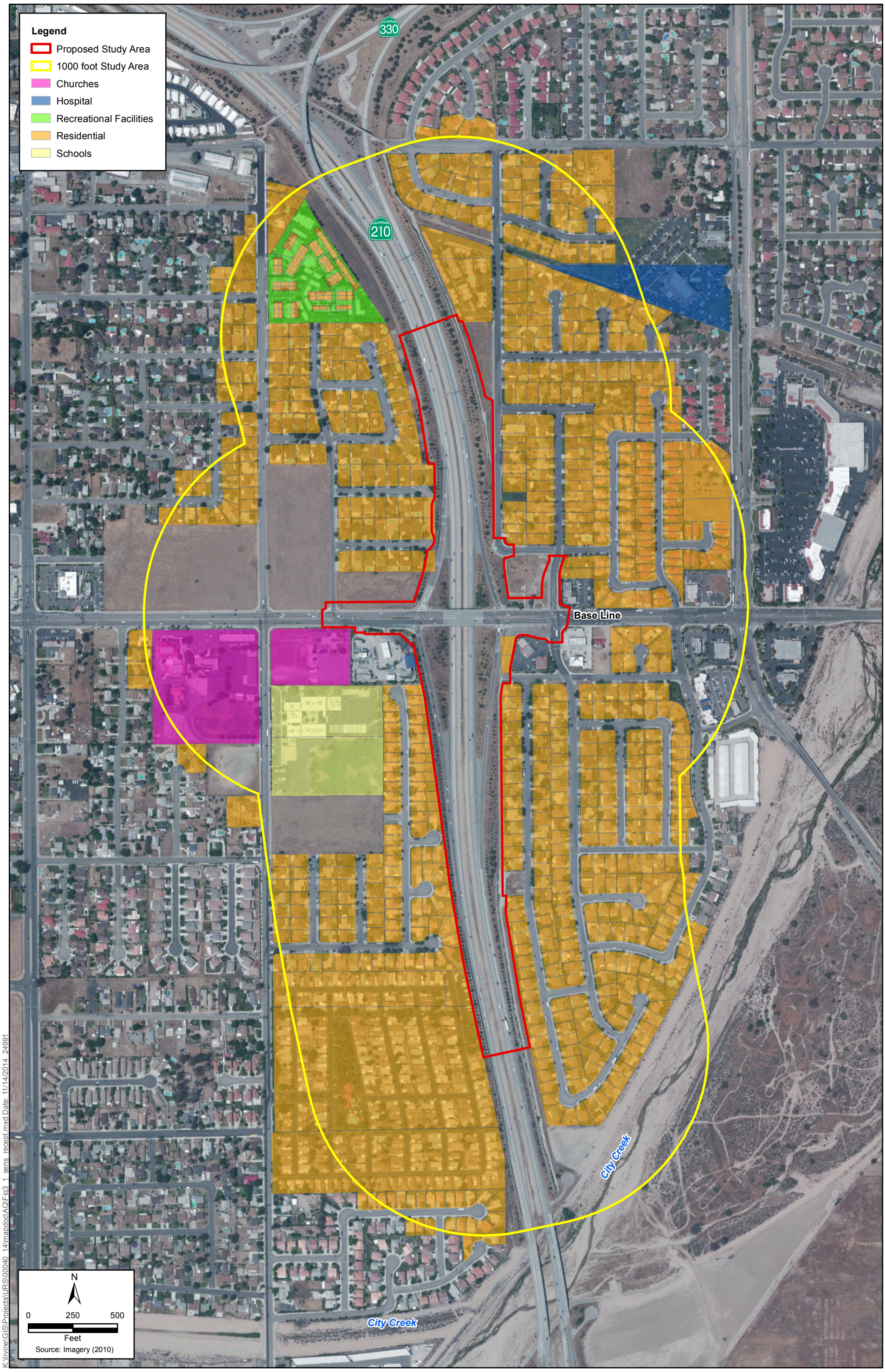

Figure 3-1
Sensitive Receptor Map
SR-210/Base Line Interchange Project

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3.2 Environmental Consequences

3.2.1 Methods

The proposed project would generate construction-related and operational emissions. The methodology used to evaluate construction and operational effects is described below.

3.2.1.1 Construction Effect Assessment Methodology

Construction of the proposed project would be a source of fugitive dust and exhaust emissions that could have temporary effects on local air quality (i.e., exceed state air quality standards for $PM_{2.5}$ and PM_{10}). Such emissions would result from earthmoving and the use of heavy equipment as well as land clearing, ground excavation, cut-and-fill operations, and the construction of roadways. Dust emissions can vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing weather. A major portion of dust emissions for the proposed project would most likely be caused by construction traffic in temporary construction areas. A quantitative analysis of construction emissions is provided in Section 3.2.2.1, below, to disclose potential air quality effects that may result from the proposed project.

3.2.1.2 Operational Effect Assessment Methodology

The primary operational emissions associated with the proposed project are CO, PM_{10}, $PM_{2.5}$, ozone precursors (ROG and NO_X), and CO_2 emitted as vehicle exhaust. In addition to emissions from vehicle exhaust, PM_{10} and $PM_{2.5}$ can result from vehicular travel on paved roads (entrained dust). With respect to criteria pollutants, the evaluation of transportation conformity was done by affirming that the proposed project is included in the currently conforming RTP and FTIP modeling lists, as currently proposed.

The potential impacts related to localized CO hot-spot emissions were evaluated following the methodology prescribed in the *Transportation Project-level Carbon Monoxide Protocol* (CO Protocol) developed for Caltrans by the Institute of Transportation Studies at the University of California, Davis (Garza et al. 1997). The potential impacts related to localized particulate matter were evaluated using the EPA and FHWA's guidance manual, *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (Federal Highway Administration and U.S. Environmental Protection Agency 2010). MSAT emissions were evaluated using the FHWA's *Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents* (Federal Highway Administration 2012) and California-specific guidance from Caltrans (California Department of Transportation 2014a; California Air Resources Board 2005).

Transportation Conformity

Regional Conformity

The proposed project is located in an extreme nonattainment area for the federal eight-hour ozone standard (Table 3-1). Because ozone and its precursors are regional pollutants, the

proposed project must be evaluated under the transportation conformity requirements described earlier. An affirmative regional conformity determination must be made before the proposed project can proceed. A determination of conformity can be made if the proposed project is described, as currently proposed, in an EPA-approved RTP and TIP.

Project-level Conformity

Carbon Monoxide

The proposed project is located in an attainment/maintenance area for the federal CO standard (Table 3-1). Consequently, the evaluation of transportation conformity for CO is required. The CO transportation conformity analysis is based on the CO Protocol developed for Caltrans by the Institute of Transportation Studies at the University of California, Davis (Garza et al. 1997). The CO Protocol details a qualitative step-by-step procedure to determine whether project-related CO concentrations have the potential to generate new air quality violations, worsen existing violations, or delay attainment of the CAAQS or NAAQS for CO. If the screening procedure reveals that such a potential may exist, then the CO protocol details a quantitative method to ascertain project-related CO impacts.

Particulate Matter

The proposed project is located in a serious nonattainment area for the federal PM_{10} standard and a nonattainment area for the federal $PM_{2.5}$ standard (Table 3-1). On March 10, 2006, EPA published a final rule that establishes the transportation conformity criteria and procedures for determining which transportation projects must be analyzed for local air quality effects in $PM_{2.5}$ and PM_{10} nonattainment and maintenance areas. The final rule requires PM_{10} and $PM_{2.5}$ hot-spot analyses to be performed only for any POAQC or any other project identified by the $PM_{2.5}$ SIP as a localized air quality concern.

For the assessment of PM_{10} hot spots, the final rule has separate requirements for PM_{10} nonattainment/maintenance areas with and without approved conformity SIPs. For areas without approved conformity SIPs, the assessment methodology is similar to the $PM_{2.5}$ analysis in that a hot-spot analysis is to be performed only for POAQCs. For areas with an approved conformity SIP, the final rule does not apply (i.e., when a state withdraws the existing provisions from its approved conformity SIP and EPA approves the withdrawal or when a state includes the revised PM_{10} hot-spot requirements in a SIP revision and EPA approves that SIP revision), and an analysis must be performed that meets the requirements in the approved PM_{10} SIP.

In December 2010, FHWA and EPA issued a guidance document titled *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (Federal Highway Administration and U.S. Environmental Protection Agency 2010). This guidance identifies examples of projects that are most likely POAQCs and details a qualitative step-by-step screening procedure to determine whether project-related particulate emissions have the potential to generate new air quality violations, worsen existing violations, or delay attainment of the NAAQS for $PM_{2.5}$ or PM_{10}.

POAQCs are certain highway and transit projects that involve significant levels of diesel traffic or any other project identified in the $PM_{2.5}$ or PM_{10} SIP as a localized air quality concern. The following list provides examples of POAQCs.

- A project on a new highway or expressway that serves a significant volume of diesel truck traffic, such as facilities with annual average daily traffic (AADT) greater than 125,000 where eight percent or more of such AADT is diesel truck traffic.
- New exit ramps and other highway facility improvements to connect a highway or expressway to a major freight, bus, or intermodal terminal.
- Expansion of an existing highway or other facility that affects a congested intersection (operating at LOS D, E, or F) that has a significant increase in the number of diesel trucks.
- Similar highway projects that involve a significant increase in the number of diesel transit buses and/or diesel trucks.

The list below provides examples of projects that are not an air quality concern.

- Any new or expanded highway project that services primarily gasoline-powered vehicle traffic (i.e., does not involve a significant number or increase in the number of diesel-powered vehicles), including such projects involving congested intersections operating at LOS D, E, or F.
- An intersection channelization project or interchange configuration project that involves either turn lanes or slots or lanes or movements that are physically separated. These kinds of projects improve freeway operations by smoothing traffic flow and vehicle speeds by improving weave and merge operations, which would not be expected to create or worsen $PM_{2.5}$ or PM_{10} violations.
- Intersection channelization projects, traffic circles or roundabouts, intersection signalization projects at individual intersections, and interchange reconfiguration projects that are designed to improve traffic flow and vehicle speeds, do not involve any increases in idling, and are expected to have a neutral or positive influence on $PM_{2.5}$ or PM_{10} emissions as a result.

For projects identified as not being a POAQC, qualitative $PM_{2.5}$ and PM_{10} (for regions without an approved conformity SIP) hot-spot analyses are not required. For these types of projects, state and local project sponsors should briefly document in their project-level conformity determinations that CAA and 40 CFR 93.116 requirements were met without a hot-spot analysis because such projects have been found to not be of air quality concern under 40 CFR 93.123(b)(1).

For areas with an approved conformity SIP, the final rule does not apply (i.e., when a state withdraws the existing provisions from its approved conformity SIP and EPA approves the withdrawal or when a state includes the revised PM_{10} hot-spot requirements in a SIP revision and EPA approves that SIP revision). For these areas, the assessment should continue to follow the PM_{10} hot-spot procedures in their existing conformity SIPs, rather than EPA's 2010 guidance, until the SIP is updated and subsequently approved by EPA.

The guidance for conducting a PM_{10} hot-spot analysis for conformity purposes has separate requirements for PM_{10} nonattainment/maintenance areas with and without approved conformity

SIPs. The CFR indicates that a conformity SIP for particulate matter has not been approved for the SCAB by EPA (40 CFR 52.223). Consequently, if the project is a POAQC, it must undergo a PM_{10} (and $PM_{2.5}$) hot-spot conformity determination. Projects identified as not being a POAQC do not require qualitative $PM_{2.5}$ and PM_{10} hot-spot analyses. Because the proposed project would be located in an area classified as a nonattainment area for the federal PM_{10} and $PM_{2.5}$ standards, a determination must be made as to whether it would result in a PM_{10} or $PM_{2.5}$ hot spot.

Mobile-source Air Toxics

MSAT emissions were evaluated using a combination of FHWA's *Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents* (Federal Highway Administration 2012) and preliminary California-specific guidance from Caltrans. At this time, the California-specific guidance is identical to the FHWA's guidance, except for California-specific criteria for performing qualitative and quantitative analysis (California Department of Transportation 2014a). The California-specific criteria are found in ARB's *Air Quality and Land Use Handbook: A Community Health Perspective* (ARB Land Use Handbook) (California Department of Transportation 2014a; California Air Resources Board 2005). FHWA's interim guidance uses a tiered approach regarding how MSATs should be addressed in NEPA documents for highway projects (Federal Highway Administration 2012). Depending on the specific project circumstances, FHWA has identified three levels of analysis:

1. No analysis for exempt projects or projects with no potential for meaningful MSAT effects.
2. Qualitative analysis for projects with low potential MSAT effects.
3. Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

Exempt Projects or Projects with No Meaningful Potential MSAT Effects

The types of projects included in this category are as follows:

- Projects qualifying for a categorical exclusion under 23 CFR 771.117(c).
- Projects exempt under the CAA conformity rule under 40 CFR 93.126.
- Other projects with no meaningful effects on traffic volumes or vehicle mix.

Projects that are categorically excluded under 23 CFR 771.117(c), or are exempt under the CAA pursuant to 40 CFR 93.126, require no analysis or discussion of MSATs. Documentation sufficient to demonstrate that the project qualifies for a categorical exclusion and/or is exempt will suffice. For other projects with no or negligible traffic effects, regardless of the class of NEPA environmental document, no MSAT analysis is required.[1] However, the project record must document the basis for the determination of "no meaningful potential effects" with a brief description of the factors considered.

[1] The types of projects categorically excluded under 23 CFR 771.117(d) or exempt from certain conformity requirements under 40 CFR 93.127 do not warrant an automatic exemption from an MSAT analysis, but they usually will have no meaningful impact.

Projects with Low Potential MSAT Effects

This category covers a broad range of projects because projects included in this category are those that serve to improve operations of highway, transit, or freight without adding substantial new capacity or without creating a facility that is likely to increase emissions meaningfully.

FHWA anticipates that most highway projects will fall into this category. Any projects not meeting the criteria for higher potential effects should be included in this category. Examples of these types of projects are minor widening projects and new interchanges, such as those that replace a signalized intersection on a surface street or where design-year AADT is projected to be less than 150,000. In California, the corresponding AADT criteria under which a project is considered to have low potential MSAT effects are 100,000 for urban non-freeways and 50,000 for rural non-freeways. In addition, California has a third criterion, which states that if freeway modifications are to be completed more than 500 to 1,000 feet from a sensitive land use (e.g., residences, schools, day care centers, playgrounds, and medical facilities), the project is anticipated to result in low potential MSAT effects (California Department of Transportation 2014a; California Air Resources Board 2005). A qualitative assessment of emissions projections should be conducted for these projects. The qualitative assessment would compare, in narrative form, the expected effect of the proposed project on traffic volumes, vehicle mix, or routing of traffic and the associated changes in MSATs for the project alternatives, based on VMT, vehicle mix, and speed. The assessment would also discuss national trend data projecting substantial overall reductions in emissions due to stricter engine and fuel regulations issued by EPA. Because the emission effects of these projects would be low, FHWA expects that there would be no appreciable difference in overall MSAT emissions among the various alternatives. In addition, quantitative emissions analysis of these types of projects will not yield credible results that are useful to project-level decision-making because of the limited capabilities of the transportation and emissions forecasting tools.

Projects with Higher Potential MSAT Effects

Projects included in this category have the potential for meaningful differences among project alternatives. FHWA expects only a limited number of projects to meet this two-pronged test. To fall into this category, projects must create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of DPM in a single location or create new or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes where the AADT volumes are projected to be in the range of 140,000 to 150,000,[2] or greater, by the design year. Projects in this category must also be proposed to be located in proximity to populated areas or in rural areas in proximity to concentrations of vulnerable populations (i.e., people in schools, nursing homes, hospitals). In California, the corresponding AADT criteria over which a project is considered to have higher potential for MSAT effects are 100,000 for urban non-freeways and 50,000 for rural non-freeways. In addition, California considers a project to have higher potential MSAT effects if modifications to

[2] Using EPA's MOBILE6.2 emissions model, FHWA technical staff determined that this range of AADT would be roughly equivalent to the CAA definition of a major HAP source (i.e., 25 tons per year for all HAPs or ten tons per year for any single HAP). Significant variations in conditions such as congestion or vehicle mix could warrant a different range for AADT.

freeways are proposed to take place within 500 to 1,000 feet of sensitive land uses (e.g., residences, schools, day care centers, playgrounds, and medical facilities) (California Department of Transportation 2014a; California Air Resources Board 2005).

Projects falling in this category should be more rigorously assessed for effects, and FHWA should be contacted for assistance in developing a specific approach for assessing effects. This approach would include a quantitative analysis that would attempt to measure the level of emissions for the seven priority MSATs for each alternative for use as a basis of comparison. This analysis also may address the potential for cumulative effects, where appropriate, based on local conditions. How and when cumulative effects should be considered would be addressed as part of the assistance outlined above. If the analysis for a project in this category indicates meaningful differences in levels of MSAT emissions, mitigation options should be identified and considered.

Applicable Project MSAT Category Assessment

The Traffic Operations Analysis Report indicates roadway volumes between No Build and Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040) will be identical, as the project would neither impact operations on SR-210, nor would it affect regional traffic demand or distribution (URS 2014). Thus, this project will have no meaningful effect on traffic volumes or vehicles mix and is considered a project with no meaningful potential of MSAT effects.

Criteria Pollutant and Greenhouse Gas Emissions

In addition, estimates of criteria pollutant (ozone precursors, CO, PM_{10}, and $PM_{2.5}$) and CO_2 exhaust emissions, as well as re-entrained dust emissions, were not quantified. This is because Traffic Operations Analysis indicates roadway volumes between No Build and Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040) will be identical, as the project would neither impact operations on SR-210, nor would it affect regional traffic demand or distribution (URS 2014). Consequently, implementation of the proposed project would not have a meaningful effect on criteria pollutant and greenhouse gas emissions.

3.2.2 Impact Evaluation

The evaluation of project construction and operations impacts is provided below.

3.2.2.1 Construction Impacts

Implementation of the proposed project would result in the construction of widened roads, overcrossings, interchange reconfigurations, and bypass connectors. Construction is anticipated to begin during 2017 and end during 2020 (assumed to be 30 months). Temporary construction emissions would result from grubbing/land clearing, grading/excavation, drainage/utility/ subgrade construction, paving, and the commuting patterns of construction workers. Pollutant emissions would vary daily, depending on the level of activity, specific operations, and prevailing weather conditions.

During construction, short-term degradation of air quality may occur because of the release of particulate emissions (airborne dust) generated by excavation, grading, hauling, and other activities related to construction. Emissions from construction equipment also are anticipated and would include CO, NO_X, ROG, directly emitted particulate matter (PM_{10} and $PM_{2.5}$), and toxic air contaminants (aka MSATs), such as diesel exhaust particulate matter. Ozone is a regional pollutant that is derived from NO_X and ROG in the presence of sunlight and heat.

Site preparation and roadway construction would involve clearing, cut-and-fill activities, grading, removing or improving existing roadways, and paving roadway surfaces. Construction-related effects on air quality from most highway projects would be greatest during the site preparation phase because most engine emissions are associated with the excavation, handling, and transport of soils to and from the site. If not properly controlled, these activities would temporarily generate PM_{10}, $PM_{2.5}$, and small amounts of CO, SO_2, NO_X, and ROG. Sources of fugitive dust would include disturbed soils at the construction site and the trucks that carry uncovered loads of soil. Unless properly controlled, vehicles leaving the site would deposit mud on local streets, which could be an additional source of airborne dust after it dries. PM_{10} emissions would vary from day to day, depending on the nature and magnitude of construction activity and local weather conditions. PM_{10} emissions would depend on soil moisture, silt content of soil, wind speed, and the amount of equipment operating. Larger dust particles would settle near the source, while fine particles would be dispersed greater distances from the construction site.

In addition to dust-related PM_{10} and $PM_{2.5}$ emissions, heavy trucks and construction equipment powered by gasoline and diesel engines would generate CO, SO_2, NO_X, ROG, and some soot particulate (PM_{10} and $PM_{2.5}$) in exhaust emissions. If construction activities were to increase traffic congestion in the area, CO and other emissions from traffic would increase slightly while vehicles are delayed. These emissions would be temporary and limited to the immediate area surrounding the construction site.

SO_2 is generated by oxidation during combustion of organic sulfur compounds contained in diesel fuel. Off-road diesel fuel meeting federal standards can contain up to 5,000 ppm of sulfur, whereas on-road diesel is restricted to less than 15 ppm of sulfur. However, under California law and ARB regulations, off-road diesel fuel used in California must meet the same sulfur and other standards as on-road diesel fuel; therefore, SO_2-related issues due to diesel exhaust would be minimal. Some phases of construction, particularly asphalt paving, would result in short-term odors in the immediate area of each paving site. Such odors would be quickly dispersed below detectable thresholds as distance from the site increases.

Construction-period criteria pollutant emissions were estimated using the Sacramento Metropolitan Air Quality Management District's (SMAQMD) Roadway Construction Emissions Model, version 7.1.5.1 (Sacramento Metropolitan Air Quality Management District 2013). Although the model was developed for Sacramento-area conditions in terms of fleet emission factors, silt loading, and other modeling assumptions, it is considered adequate by jurisdictions outside of the Sacramento-area, such as the San Joaquin Valley Air Pollution Control District, for estimating road construction emissions under its indirect source regulations and SCAQMD in its CEQA guidance. Caltrans also indicates SMAQMD's Roadway Construction Emissions Model is available to quantify construction-related emissions from roadway projects (California Department of Transportation 2014b). As such, it is used for that purpose in this project analysis.

A summary of emissions estimates is provided in Table 3-4. Modeling assumptions are detailed in Appendix E. The implementation of the exhaust and fugitive dust emission control measures identified below in Section 3.3 would avoid and/or minimize any impacts on air quality.

Table 3-4. Estimate of Criteria Pollutant Emissions during Construction (pounds per day)

Construction Phase	ROG	CO	NO_X	PM_{10}	$PM_{2.5}$
Grubbing and Clearing	3	15	22	11	3
Grading/Excavation	10	54	101	15	7
Drainage/Utilities/Sub-Grade	5	33	47	13	4
Paving	3	19	20	1	1
Daily Maximum Regional Emissions[1]	10	54	101	15	7
SCAQMD Regional Emissions Daily Significance Threshold	*75*	*550*	*100*	*150*	*55*
SCAQMD Localized Emissions Daily Significance[2]	*n/a*	*1,746*	*270*	*14*	*8*

Source: ICF International, August 2014. Detailed calculation assumptions provided in Appendix E.
[1] ROG emissions have no SCAQMD localized emissions threshold.
[2] SCAQMD SRA 34, 5-acre site, 25-meter receptor distance.

Diesel Particulate-Related Health Risk during Construction

SCAQMD does not consider diesel-related cancer risks from construction equipment to be an issue because of the short-term nature of construction activities. Construction activities associated with the proposed project would be sporadic, transitory, and short-term in nature (i.e., less than five years). The assessment of cancer risk typically is based on a 70-year exposure period. Because exposure to diesel exhaust would be well below the 70-year exposure period, construction of the proposed project is not anticipated to result in an elevated cancer risk to exposed persons due to the short-term nature of construction.

3.2.2.2 Operations Impacts

Regional Transportation Conformity

In accordance with Section 93.114 of the EPA transportation conformity regulations, the proposed project is included in both the SCAG 2012 RTP Amendment #1 (Project ID Number REG0701) and the SCAG 2013 FTIP Amendment #13-19 (Project ID Number 201186). Within the SCAG 2012 RTP Amendment #1 and SCAG 2013 FTIP Amendment #13-19 documents, the proposed project is described as follows:

"AT SR-210/BASE LINE IC: RECONSTRUCT/WIDEN BASE LINE BETWEEN CHURCH AVE AND BOULDER AVE FROM 4 TO 6 THROUGH LANES AND EXTEND LEFT TURN LANES, WIDEN RAMPS – WB EXIT 1 TO 3 LANES, WB AND EB ENTRANCES 1 TO 3 LANES INCLUDING HOV PREFERENTIAL LANES (EA 1C970)"

The 2012 RTP Amendment #1 was adopted by SCAG on June 21, 2013, and approved by FHWA on July 15, 2013. The 2013 FTIP Amendment #13-19 was approved by SCAG on June 16, 2014, and approved by FHWA on July 17, 2014. Because both the 2012 RTP Amendment #1 and the currently approved 2013 FTIP model lists include the proposed project, the proposed project's regional conformity requirements have been satisfied. Please refer to Appendix A for

conformity documentation, including project listings and FHWA's conformity determinations related to the 2012 RTP Amendment #1 and the 2013 FTIP Amendment #13-19.

In addition, the project is also included in the latest SCAG 2012 RTP Amendment #2 approved by SCAG on September 11, 2014 and SCAG 2015 FTIP (RTP ID# REG0701 and FTIP ID# 201186). The 2015 Final FTIP was approved by SCAG's Regional Council on September 11, 2014. Conformity determinations for both documents are forthcoming and anticipated in late 2014.

Project-Level Conformity for Carbon Monoxide

The proposed project was evaluated using the CO Protocol described earlier. The CO Protocol includes two flowcharts that illustrate when a detailed CO analysis needs to be prepared. The first flowchart, Figure 1 of the CO Protocol (also provided in Appendix C), is used to ascertain the CO modeling requirements for new projects. The questions (shown in the first flowchart) relevant to the proposed project, and the answers to those questions are as follows:

3.1.1: Is the project exempt from all emissions analyses?

Response: No, the proposed project does not qualify for an exemption. As shown in Table 1 of the CO protocol (provided in Appendix C), the proposed project does not fall into a project category that is exempt from all emissions analysis (proceed to 3.1.2).

3.1.2: Is the project exempt from regional emissions analyses?

Response: No, the proposed project is not exempt from a regional emissions analysis. As shown in Table 2 of the CO Protocol (provided in Appendix C), the proposed project does not meet the criteria of any of the project categories identified as exempt from regional emissions analysis (proceed to 3.1.3).

3.1.3: Is the project locally defined as regionally significant?

Response: No, the proposed project is not considered a regionally significant transportation project according to 40 CFR 93.101 (proceed to 3.1.9).

3.1.9: The conclusion from this series of questions and answers is that the project needs to be examined for its local air impacts (proceed to Section 4, Figure 3 of the CO Protocol).

On the basis of the answers to the first flowchart, a second flowchart, Figure 3 of the CO Protocol (see Appendix C), is used to determine the level of local CO effect analysis required for the project.

The questions applicable to the proposed project in the second flowchart (also provided in Appendix C) and the answers to those questions are as follows:

Level 1: Is the project in a CO nonattainment area?

Response: No, the SCAB is classified as an attainment/maintenance area for the federal CO standards (Table 3-1).

Level 1: Was the area redesignated as an attainment area after the 1990 Clean Air Act?

Response: Yes, the SCAB was reclassified to attainment/maintenance status from serious nonattainment, effective June 11, 2007.

Level 1: Has "continued attainment" been verified with the local air district, if appropriate?

Response: Yes, based on ambient air monitoring data collected by SCAQMD, the SCAB has continually met the federal ambient air quality standards for CO since 2003 (South Coast Air Quality Management District 2007) (Proceed to Level 7).

Level 7: Does project worsen air quality?

Response: No. According to Section 4.7.1 of the CO Protocol, the following criteria provide a basis for determining if a project has potential to worsen localized air quality:

- *The project significantly increases the percentage of vehicles operating in the cold start mode. Increasing the number of vehicles in cold-start mode by as little as 2% should be considered potentially significant.*

  Given the nature of the proposed project, which is to widen existing interchange ramps and add through lanes and turn lanes on Base Line (no parking lots would be constructed), there would be no measurable effect on the percentage of vehicles operating in the cold-start mode.

- *The project significantly increases traffic volumes. Increases in traffic volumes in excess of 5% should be considered potentially significant. Increasing the traffic volume by less than 5% may still be potentially significant if there is also a reduction in average speeds.*

  Traffic volumes are not expected to increase between the No Build and Build Alternatives at Opening Year (2020) or the Horizon Year (2040). As such, the project will not increase traffic volumes.

- *The project worsens traffic flow. For uninterrupted roadway segments, a reduction in average speeds (within a range of 3 to 50 mph) should be regarded as worsening traffic flow. For intersection segments, a reduction in average speed or an increase in average delay should be considered a worsening of traffic flow.*

  Base Line mainline and SR-210 ramp operation data for the proposed project was provided by the project traffic engineer and is included in Appendix F. As shown therein, the proposed project would improve traffic flow along Base

Line between Buckeye Street and Seine Avenue and along the SR-210/Base Line freeway ramps at Opening Year (2020) and Horizon Year (2040).

Level 7: Is the project suspected of resulting in higher CO concentrations than those existing within the region at the time of attainment demonstration?

Note: The *2007 Air Quality Management Plan* (AQMP) is the most recent EPA-approved AQMP, but no additional regional or hot-spot CO modeling was conducted to demonstrate further attainment of the eight-hour average ozone standard (South Coast Air Quality Management District 2012). This is because SCAQMD submitted a request to EPA to redesignate the SCAB as an attainment area for the eight-hour federal CO standard (South Coast Air Quality Management District 2007). Therefore, the 2003 AQMP is used as the basis for the following analysis. In addition, the 2003 AQMP did not provide model input assumptions. Instead, it refers to the 1992 CO Plan, where a general description of input assumptions was provided (South Coast Air Quality Management District 2003).

Response: No. According to Section 4.7.2 of the CO Protocol, project sponsors are encouraged to use the following criteria to determine the potential for the project to result in higher CO concentrations than those existing within the region at the time of attainment demonstration:

a. *The receptors at the location under study are at the same distance or farther from the traveled roadway than the receptors at the location where attainment has been demonstrated.*

   A receptor distance of three meters from the traveled roadway was used in the CO attainment demonstration prepared for the 2003 AQMP. With respect to the proposed project, all sensitive receptors are located more than three meters from the traveled roadway.

b. *The roadway geometry of the two locations is not significantly different. An example of a significant difference would be a larger number of lanes at the location under study compared with the location where attainment has been demonstrated*.

   In the CO attainment demonstration prepared for the 2003 AQMP, four approach lanes in all directions were used to model the intersections at Wilshire/Veteran and La Cienega/Century, while three approach lanes in all directions were used to model the intersections at Sunset/Highland and Long Beach/Imperial.

   It is worth noting that in the CO attainment demonstration all modeled intersections were four-leg intersections, which differ from the proposed project, which affects freeway on- and off-ramp and overpass lane configuration. The freeway ramps would be widened from one to two lanes in each direction except for the east bound off-ramp. Base Line will also be widened between Buckeye St. and Seine Ave. from four to six lanes. Therefore, the greatest number of travel lanes would be six (three mainline lanes in each direction). In comparing the total number of intersection approach lanes, the attainment demonstration intersections had 12 to 16 approach lanes each. As such, the maximum number of approach lanes under

the Build Alternative would be equal to or less than the 16 lanes used in the attainment demonstration.

c. *Expected worst-case meteorology at the location under study is the same or better than the worst-case meteorology at the location where attainment has been demonstrated. Relevant meteorological variables include wind speed, wind direction, temperature, and stability class.*

In the CO attainment demonstration prepared for the 2003 AQMP, a wind speed of one meter per second, stability class D, and worst-case wind angle were used as modeling assumptions. These assumptions are considered worst-case; as such, the expected worst-case meteorology at the location under study would be the same or better. In addition, there is no meaningful difference in temperature between the attainment demonstration intersection locations and the proposed project intersection location.

d. *Traffic lane volumes at the location under study are the same or lower than those at the location where attainment has been demonstrated.*

Traffic volumes per lane used for modeling in the attainment plan demonstration are provided in Table 3-5. According to the Traffic Operations Analysis Report, Opening Year (2020) and Horizon Year (2040) peak-hour intersection lane segment volumes (Table 3-6) would be generally the same or lower than the peak-hour lane volumes used in the 2003 SCAQMD AQMP Attainment demonstration (Table 3-5). In addition, Tables 3-5 and 3-6 indicate the project intersection with the greatest traffic volumes (SR-210 WB Ramps/Base Line) would have less average lane and total lane volumes than the intersection with the greatest traffic volume from the 2003 SCAQMD AQMP Attainment demonstration (Wilshire/Veteran).

Table 3-5. Peak-hour Approach Lane Volumes Used in the 2003 AQMP Attainment Demonstration

Location	Eastbound (AM/PM)	Westbound (AM/PM)	Southbound AM/PM)	Northbound (AM/PM)	Average Lane Volume (AM/PM)	Total Lane Volumes (AM/PM)
Wilshire and Veteran (four lanes, all directions)	1,238/517	458/829	180/350	140/233	504/482	8,064/7,716
Sunset and Highland (three lanes, all directions)	472/588	447/513	768/611	517/746	551/615	6,612/7,374
La Cienega and Century (four lanes, all directions)	635/561	473/682	346/507	205/419	415/542	6,636/8,676
Long Beach and Imperial (three lanes, all directions)	406/673	587/467	160/315	252/383	351/460	4,215/5,514
Source: South Coast Air Quality Management District 2003.						

Table 3-6. Proposed Project Peak-hour Approach Lane Volumes for Intersection with Greatest Total Volume

Alternative/Roadway Intersection	Eastbound[a] (AM/PM)	Westbound[a] (AM/PM)	Southbound[a] (AM/PM)	Northbound[a] (AM/PM)	Average Lane Volume (AM/PM)	Total Lane Volumes (AM/PM)
Opening Year (2020)						
SR-210 WB Ramps/Base Line	480/596	391/495	150/206	173/179	299/362	4453/5411
Lanes: four eastbound, four westbound, three southbound, and three northbound (total lanes = 14)						
Horizon Year (2040)						
SR-210 WB Ramps/Base Line	713/736	567/609	210/238	302/247	448/458	6,656/6,835
Lanes: four eastbound, four westbound, three southbound, and three northbound (total lanes = 14)						

[a] AM/PM volumes were calculated by summing all volumes associated with the quadrant (e.g., the sum of all lanes in the eastbound quadrant, including left-turn, through, and right-turn lanes). The total volume was then divided by the total number of lanes for the quadrant and rounded to the nearest whole number.

[b] Source: SR-210 Base Line Traffic Operations Analysis (URS 2014)

e. *Percentage of vehicles operating in cold-start mode at the location under study is the same or lower than the percentage at the location where attainment has been demonstrated.*

The proposed project would not increase the percentage of vehicles operating in cold-start mode in the project area because no parking facilities would be constructed as part of the proposed project.

f. *Percentage of heavy-duty gas trucks at the location under study is the same or lower than the percentage at the location where attainment has been demonstrated*.

The attainment area demonstration intersections (Table 3-5) are located along urban arterial roadways with a similar mix of urban land uses (mainly commercial and residential, with some industrial) within the SCAB, and the project area serves as a main thoroughfare for vehicles and trucks bypassing other congested highways in the region. Therefore, the proposed project area is anticipated to have a similar percentage of heavy-duty gas trucks as the attainment demonstration intersections.

g. *For projects involving intersections, average delay and queue length figures for each approach are the same or smaller for the intersection under study compared with those found in the intersection where attainment has been demonstrated*.

As shown above in Tables 3-5 and 3-6, Opening Year (2020) and Horizon Year (2040) approach-lane traffic volumes during AM and PM peak hours for eastbound, westbound, and northbound traffic under the proposed project would be at the same levels or lower than the volumes at all intersection locations where attainment has been demonstrated. The proposed project's eastbound lane volumes for the PM peak hour would be lower than the volumes at the Long Beach/Imperial intersection but higher than the volumes at the Wilshire/Veteran, La Cienega/Century, and Sunset/Highland intersections.

However, Tables 3-5 and 3-6 indicate the project intersection with the greatest traffic volumes (SR-210 WB Ramps/Base Line) would have less average lane and total lane volumes than the intersection with the greatest traffic volume from the 2003 SCAQMD AQMP Attainment demonstration (Wilshire/Veteran). Therefore, it is assumed that average delay and queue length for each approach would be the same or smaller at the proposed project's intersection compared with the intersections where attainment has been demonstrated.

h. *Background concentration at the location under study is the same or lower than the background concentration at the location where attainment has been demonstrated*.

As shown earlier in Table 3-3, the national maximum background CO concentration in the project area has been 1.7 ppm during the past three years for the eight-hour averaging period. These values compare with the eight-hour average maximum background concentration of 7.8 ppm (2005) used for the 2003 AQMP attainment demonstration.

Because the answer to the second Level 7 question is "no," per the CO Protocol, the project is satisfactory, and no further analysis is needed. Because project implementation would not result in CO concentrations that exceed the one- or eight-hour ambient air quality standards, on the basis of CO Protocol analysis methodology, the Build Alternative is not expected to result in a new or more severe exceedance of either the NAAQS or CAAQS.

As previously indicated, the proposed project was evaluated using Figures 1 and 3 of the CO Protocol (also provided in Appendix C). Through this process, it was determined the Build Alternative is not expected to result in a new or more severe exceedance of either the NAAQS or CAAQS.

Project-level Conformity for Particulate Matter

While most projects create particulate emissions during construction, construction activities lasting less than five years are considered temporary impacts under the EPA Transportation Conformity Rule and are exempt. It is expected that the proposed project would be completed in less than two years. As such, hot-spot review is therefore limited to operational impacts.

EPA released a guidance document titled *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* in December 2010 and released a superseding update in November 2013. A project-level $PM_{2.5}$ and PM_{10} conformity review based on this most-recent EPA guidance is provided below.

EPA specifies in 40 CFR 93.123(b)(1) that only "projects of air quality concern" (POAQC) are required to undergo a $PM_{2.5}$ and PM_{10} hot-spot analysis. EPA defines projects of air quality concern as certain highway and transit projects that involve significant levels of diesel traffic or any other project that is identified by the $PM_{2.5}$ SIP as a localized air quality concern. A discussion of the proposed project compared to projects of air quality concern, as defined by 40 CFR 93.123(b)(1), is provided below:

1. **New or expanded highway projects that have a significant number of or significant increase in diesel vehicles**.[3] The proposed project is not a new or expanded highway project. The project proposes improvements to an existing local arterial, and geometric improvements at existing interchange ramp termini. No significant traffic volume increases are anticipated to occur under the Build Alternative, when compared to the No Build Alternative. The proposed project has undergone Interagency Consultation (IAC), and IAC participants concurred that the proposed project is a not POAQC (see Appendix D).

2. **Projects affecting intersections that are at level-of-service (LOS) D, E, or F with a significant number of diesel vehicles or those that will change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project**. All intersections and ramps associated with the proposed project operate a LOS of C or better under existing and Build conditions. Only the SR-210 westbound ramps at Base Line are expected to operate at less than LOS C under the No Build conditions in the Horizon Year (2040), but will improve from LOS D to LOS B under the proposed project.

3. **New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location**. The proposed project has no bus or rail terminal component, nor would it alter travel patterns to/from any existing bus or rail terminal.

4. **Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location**. The proposed project would not expand any bus terminal, rail terminal, or related transfer point that would increase the number of diesel vehicles congregating at any single location.

5. **Projects in or affecting locations, areas, or categories of sites that are identified in the $PM_{2.5}$- or PM_{10}-applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation**. The proposed project site is not in or affecting an area or location identified in any PM_{10} or $PM_{2.5}$

[3] *Significant number* is defined as greater than 125,000 AADT volumes and eight percent or more of such AADT is diesel truck traffic, or in practice 10,000 truck AADT or more regardless of total AADT. *Significant increase* is defined in practice as a ten percent increase in heavy duty truck traffic.

implementation plan. The immediate project area is not considered to be a site of violation or possible violation.

The proposed project meets the CAA requirements and 40 CFR 93.116 without any explicit hot-spot analysis and would not create a new, or worsen an existing, PM_{10} or $PM_{2.5}$ violation. The SCAG TCWG concurred with this determination following its August 26, 2014 meeting. Clean Air Act, 40 CFR Part 93.116, requirements are met, and, as such, the proposed project can be screened from further analysis.

Mobile-source Air Toxics

As discussed above under Section 3.2.1.2, the proposed project is considered a project with no meaningful potential of MSAT effects due to there being no effect of the proposed project on traffic volume, which would not affect MSAT emissions between the no-build and build conditions.

The purpose of the proposed project is to improve the operations and reduce congestion at the existing interchange by reconstructing and improving the existing diamond interchange by widening Base Line and the interchange ramps. This project has been determined to generate minimal air quality impacts for CAAA criteria pollutants and has not been linked with any special MSAT concerns. As such, the proposed project will not result in changes in traffic volumes, vehicle mix, basic project location, or any other factor that would cause an increase in MSAT impacts of the Build Alternative from that of the No Build Alternative.

Moreover, EPA regulations for vehicle engines and fuels will cause overall MSAT emissions to decline significantly over the next several decades. Based on regulations now in effect, an analysis of national trends with EPA's MOVES model forecasts a combined reduction of over 80 percent in the total annual emission rate for the priority MSAT from 2010 to 2050 while vehicle-miles of travel are projected to increase by over 100 percent. This will both reduce the background level of MSAT as well as the possibility of even minor MSAT emissions from this project.

3.2.2.3 Criteria Pollutants

As discussed above under Section 3.2.1.2, the proposed project is considered a project with no meaningful impact on criteria pollutants emissions due to there being no effect of the proposed project on traffic volumes. However, improved vehicle efficiencies through reduced queuing and congestion due to the proposed project could result in slight reductions in criteria pollutants and greenhouse gas emissions.

3.3 Minimization Measures

Implementation of the following measures would minimize air quality effects from construction activities.

3.3.1 Construction

3.3.1.1 Implement California Department of Transportation Standard Specifications

Most of the construction impacts on air quality are short-term in duration and therefore will not result in long-term adverse conditions. Implementation of the following measures, some of which may also be required for other purposes such as stormwater pollution control, will reduce any air quality impacts resulting from construction activities.

- The construction contractor shall comply with Caltrans' Standard Specifications in Section 14 (2010).
  - Section 14-9.01 specifically requires compliance by the contractor with all applicable laws and regulations related to air quality, including air pollution control district and air quality management district rules, regulations, ordinances, and statutes.
  - Section 14-9.02 is directed at controlling dust. Section 17 discusses the application of water to suppress dust. If dust palliative materials other than water are to be used, material specifications are contained in Section 18.
- Apply water or dust palliative to the site and equipment as frequently as necessary to control fugitive dust emissions. Fugitive emissions generally must meet a "no visible dust" criterion either at the point of emission or at the right-of-way line, depending on local regulations.
- Spread soil binder on any unpaved roads used for construction purposes and all project construction parking areas.
- Wash off trucks as they leave the right-of-way as necessary to control fugitive dust emissions.
- Properly tune and maintain construction equipment and vehicles. Use low-sulfur fuel in all construction equipment, as provided in California Code of Regulations, Title 17, Section 93114.
- Develop a dust control plan documenting sprinkling, temporary paving, speed limits, and expedited revegetation of disturbed slopes as needed to minimize construction impacts on existing communities.
- Locate equipment and material storage sites as far away from residential and park uses as practical. Keep construction areas clean and orderly.
- Establish Environmentally Sensitive Areas (ESAs) or their equivalent near sensitive air receptors where construction activities involving extended idling of diesel equipment would be prohibited, to the extent feasible.
- Use track-out reduction measures such as gravel pads at project access points to minimize dust and mud deposits on roads affected by construction traffic.
- Cover all transported loads of soils and wet materials prior to transport or provide adequate freeboard (space from the top of the material to the top of the truck) to minimize emissions of dust (particulate matter) during transportation.

- Promptly and regularly remove dust and mud on paved public roads from construction activity and traffic to decrease particulate matter.
- Route and schedule construction traffic to avoid peak travel times as much as possible to reduce congestion and related air quality impacts caused by idling vehicles along local roads.
- Install mulch or plant vegetation as soon as practical after grading to reduce windblown particulate in the area. Be aware that certain methods of mulch placement, such as straw blowing, may themselves cause dust and visible emission issues; controls, such as dampened straw, may be needed.

3.3.1.2 Comply with SCAQMD's Rule 403 Requirements to Control Construction Emissions of Fugitive Dust

To control the generation of construction-related fugitive dust emissions, Caltrans will require construction contractors to comply with SCAQMD's Rule 403 requirements, which are summarized in Table 3-2. Compliance with SCAQMD's Rule 403 is required for all construction projects.

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Chapter 4 Climate Change (CEQA)

4.1 Climate Change

Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other elements of the earth's climate system. An ever-increasing body of scientific research attributes these climatological changes to greenhouse gas (GHG) emissions, particularly those generated from the production and use of fossil fuels.

While climate change has been a concern for several decades, the establishment of the Intergovernmental Panel on Climate Change (IPCC) by the United Nations and World Meteorological Organization in 1988, has led to increased efforts devoted to GHG emissions reduction and climate change research and policy. These efforts are primarily concerned with the emissions of GHGs generated by human activity including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), tetrafluoromethane, hexafluoroethane, sulfur hexafluoride (SF_6), HFC-23 (fluoroform), HFC-134a (s, s, s, 2-tetrafluoroethane), and HFC-152a (difluoroethane).

In the U.S., the main source of GHG emissions is electricity generation, followed by transportation. In California, however, transportation sources (including passenger cars, light-duty trucks, other trucks, buses, and motorcycles make up the largest source of GHG emitting sources. The dominant GHG emitted is CO_2, mostly from fossil fuel combustion.

There are typically two terms used when discussing the impacts of climate change: “Greenhouse Gas Mitigation” and “Adaptation.” “Greenhouse Gas Mitigation” is a term for reducing GHG emissions in order to reduce or “mitigate” the impacts of climate change. “Adaptation,” refers to the effort of planning for and adapting to impacts resulting from climate change (such as adjusting transportation design standards to withstand more intense storms and higher sea levels).

There are four primary strategies for reducing GHG emissions from transportation sources: 1) improving the transportation system and operational efficiencies, 2) reducing travel activity, 3) transitioning to lower GHG-emitting fuels, and 4) improving vehicle technologies/efficiency. To be most effective, all four strategies should be pursued cooperatively. The following Regulatory Setting section outlines state and federal efforts to comprehensively reduce GHG emissions from transportation sources.

4.1.1 Regulatory Setting

4.1.1.1 State

With the passage of several pieces of legislation including State Senate and Assembly bills and Executive Orders, California launched an innovative and proactive approach to dealing with GHG emissions and climate change.

Assembly Bill 1493 (AB 1493), Pavley, Vehicular Emissions: Greenhouse Gases, 2002: This bill requires the California Air Resources Board (ARB) to develop and implement regulations to reduce automobile and light truck GHG emissions. These stricter emissions standards were designed to apply to automobiles and light trucks beginning with the 2009-model year.

Executive Order (EO) S-3-05 (June 1, 2005): The goal of this EO is to reduce California's GHG emissions to 1) year 2000 levels by 2010, 2) year 1990 levels by 2020, and 3) 80 percent below the year 1990 levels by 2050. In 2006, this goal was further reinforced with the passage of Assembly Bill 32.

Assembly Bill 32 (AB 32), Núñez and Pavley, The Global Warming Solutions Act of 2006: AB 32 sets the same overall GHG emissions reduction goals as outlined in EO S-3-05, while further mandating that ARB create a scoping plan and implement rules to achieve "real, quantifiable, cost-effective reductions of greenhouse gases."

Executive Order S-20-06 (October 18, 2006): This order establishes the responsibilities and roles of the Secretary of the California Environmental Protection Agency (Cal/EPA) and state agencies with regard to climate change.

Executive Order S-01-07 (January 18, 2007): This order set forth the low carbon fuel standard for California. Under this EO, the carbon intensity of California's transportation fuels is to be reduced by at least 10 percent by 2020.

Senate Bill 97 (SB 97) Chapter 185, 2007, Greenhouse Gas Emissions: This bill required the Governor's Office of Planning and Research (OPR) to develop recommended amendments to the California Environmental Quality Act (CEQA) Guidelines for addressing GHG emissions. The amendments became effective on March 18, 2010.

Senate Bill 375 (SB 375), Chapter 728, 2008, Sustainable Communities and Climate Protection: This bill requires the California Air Resources Board (CARB) to set regional emissions reduction targets from passenger vehicles. The Metropolitan Planning Organization (MPO) for each region must then develop a "Sustainable Communities Strategy" (SCS) that integrates transportation, land-use, and housing policies to plan for the achievement of the emissions target for their region.

Senate Bill 391 (SB 391) Chapter 585, 2009 California Transportation Plan: This bill requires the State's long-range transportation plan to meet California's climate change goals under AB 32.

4.1.1.2 Federal

Although climate change and GHG reduction are a concern at the federal level, currently no regulations or legislation have been enacted specifically addressing GHG emissions reductions and climate change at the project level. Neither the United States Environmental Protection Agency (U.S. EPA) nor the Federal Highway Administration (FHWA) has issued explicit

guidance or methods to conduct project-level GHG analysis.[1] FHWA supports the approach that climate change considerations should be integrated throughout the transportation decision-making process–from planning through project development and delivery. Addressing climate change mitigation and adaptation up front in the planning process will assist in decision-making and improve efficiency at the program level, and will inform the analysis and stewardship needs of project-level decision-making. Climate change considerations can be integrated into many planning factors, such as supporting economic vitality and global efficiency, increasing safety and mobility, enhancing the environment, promoting energy conservation, and improving the quality of life.

The four strategies outlined by FHWA to lessen climate change impacts correlate with efforts that the state is undertaking to deal with transportation and climate change; these strategies include improved transportation system efficiency, cleaner fuels, cleaner vehicles, and a reduction in travel activity.

Climate change and its associated effects are also being addressed through various efforts at the federal level to improve fuel economy and energy efficiency, such as the "National Clean Car Program" and EO 13514 - Federal Leadership in Environmental, Energy and Economic Performance.

Executive Order 13514 (October 5, 2009): This order is focused on reducing greenhouse gases internally in federal agency missions, programs and operations, but also directs federal agencies to participate in the Interagency Climate Change Adaptation Task Force, which is engaged in developing a national strategy for adaptation to climate change.

U.S. EPA's authority to regulate GHG emissions stems from the U.S. Supreme Court decision in *Massachusetts v. EPA* (2007). The Supreme Court ruled that GHGs meet the definition of air pollutants under the existing Clean Air Act and must be regulated if these gases could be reasonably anticipated to endanger public health or welfare. Responding to the Court's ruling, U.S. EPA finalized an endangerment finding in December 2009. Based on scientific evidence it found that six greenhouse gases constitute a threat to public health and welfare. Thus, it is the Supreme Court's interpretation of the existing Act and EPA's assessment of the scientific evidence that form the basis for EPA's regulatory actions. U.S. EPA in conjunction with NHTSA issued the first of a series of GHG emission standards for new cars and light-duty vehicles in April 2010.[2]

The U.S. EPA and the National Highway Traffic Safety Administration (NHTSA) are taking coordinated steps to enable the production of a new generation of clean vehicles with reduced GHG emissions and improved fuel efficiency from on-road vehicles and engines. These next steps include developing the first-ever GHG regulations for heavy-duty engines and vehicles, as well as additional light-duty vehicle GHG regulations.

[1] To date, no national standards have been established regarding mobile-source GHGs, nor has U.S. EPA established any ambient standards, criteria, or thresholds for GHGs resulting from mobile sources.
[2] Center for Climate and Energy Solutions. n.d. *EPA Greenhouse Gas Regulation FAQ*. Available: <http://www.c2es.org/federal/executive/epa/greenhouse-gas-regulation-faq>.

The final combined standards that made up the first phase of this national program apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles, covering model years 2012 through 2016. The standards implemented by this program are expected to reduce GHG emissions by an estimated 960 million metric tons and 1.8 billion barrels of oil over the lifetime of the vehicles sold under the program (model years 2012-2016).

On August 28, 2012, U.S. EPA and NHTSA issued a joint Final Rulemaking to extend the National Program for fuel economy standards to model year 2017 through 2025 passenger vehicles. Over the lifetime of the model year 2017-2025 standards this program is projected to save approximately four billion barrels of oil and two billion metric tons of GHG emissions.

The complementary U.S. EPA and NHTSA standards that make up the Heavy-Duty National Program apply to combination tractors (semi trucks), heavy-duty pickup trucks and vans, and vocational vehicles (including buses and refuse or utility trucks). Together, these standards will cut greenhouse gas emissions and domestic oil use significantly. This program responds to President Barack Obama's 2010 request to jointly establish greenhouse gas emissions and fuel efficiency standards for the medium- and heavy-duty highway vehicle sector. The agencies estimate that the combined standards will reduce CO_2 emissions by about 270 million metric tons and save about 530 million barrels of oil over the life of model year 2014 to 2018 heavy duty vehicles.

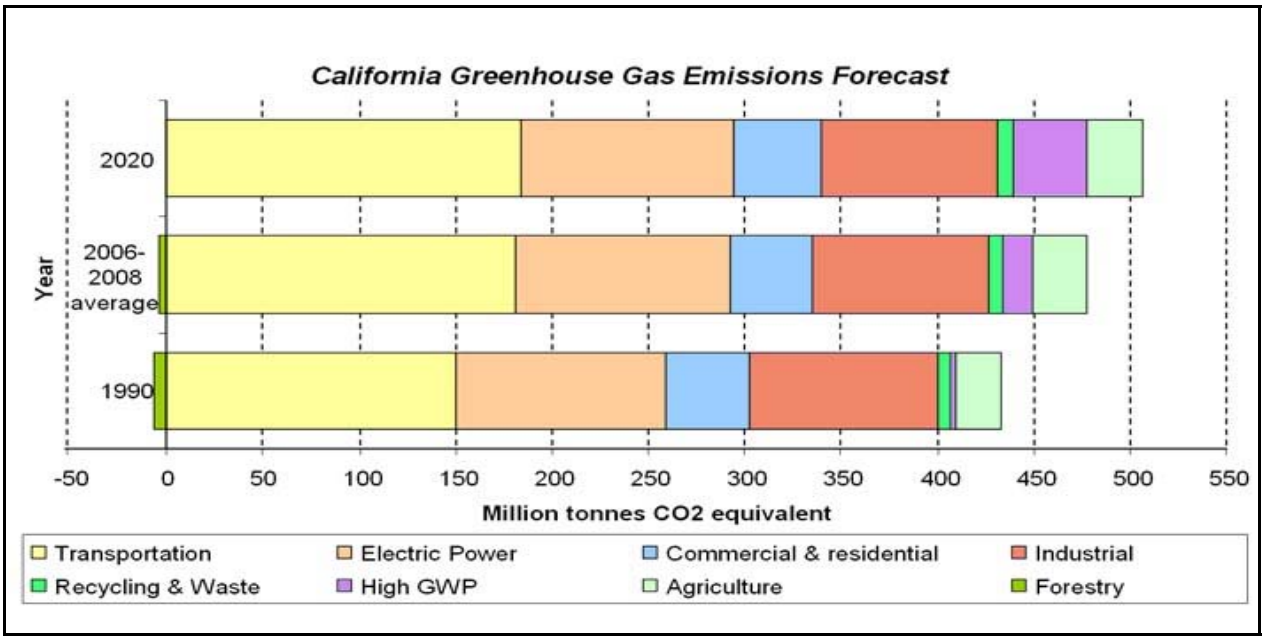
4.1.2 Project Analysis

An individual project does not generate enough GHG emissions to significantly influence global climate change. Rather, global climate change is a cumulative impact. This means that a project may contribute to a potential impact through its *incremental* change in emissions when combined with the contributions of all other sources of GHG.[3] In assessing cumulative impacts, it must be determined if a project's incremental effect is "cumulatively considerable" (CEQA Guidelines Sections 15064(h)(1) and 15130). To make this determination, the incremental impacts of the project must be compared with the effects of past, current, and probable future projects. To gather sufficient information on a global scale of all past, current, and future projects to make this determination is a difficult, if not impossible, task.

The AB 32 Scoping Plan mandated by AB 32 includes the main strategies California will use to reduce GHG emissions. As part of its supporting documentation for the Draft Scoping Plan, the ARB released the GHG inventory for California (forecast last updated: October 28, 2010) (see Figure 4-1). The forecast is an estimate of the emissions expected to occur in 2020 if none of the foreseeable measures included in the Scoping Plan were implemented. The base year used for forecasting emissions is the average of statewide emissions in the GHG inventory for 2006, 2007, and 2008.

[3] This approach is supported by the Association of Environmental Professionals (*Recommendations by the Association of Environmental Professionals on How to Analyze GHG Emissions and Global Climate Change in CEQA Documents* [March 5, 2007]) as well as the South Coast Air Quality Management District (Chapter 6: The CEQA Guide, April 2011) and the U.S. Forest Service (Climate Change Considerations in Project-Level NEPA Analysis, July 13, 2009).

Figure 4-1: California Greenhouse Gas Inventory

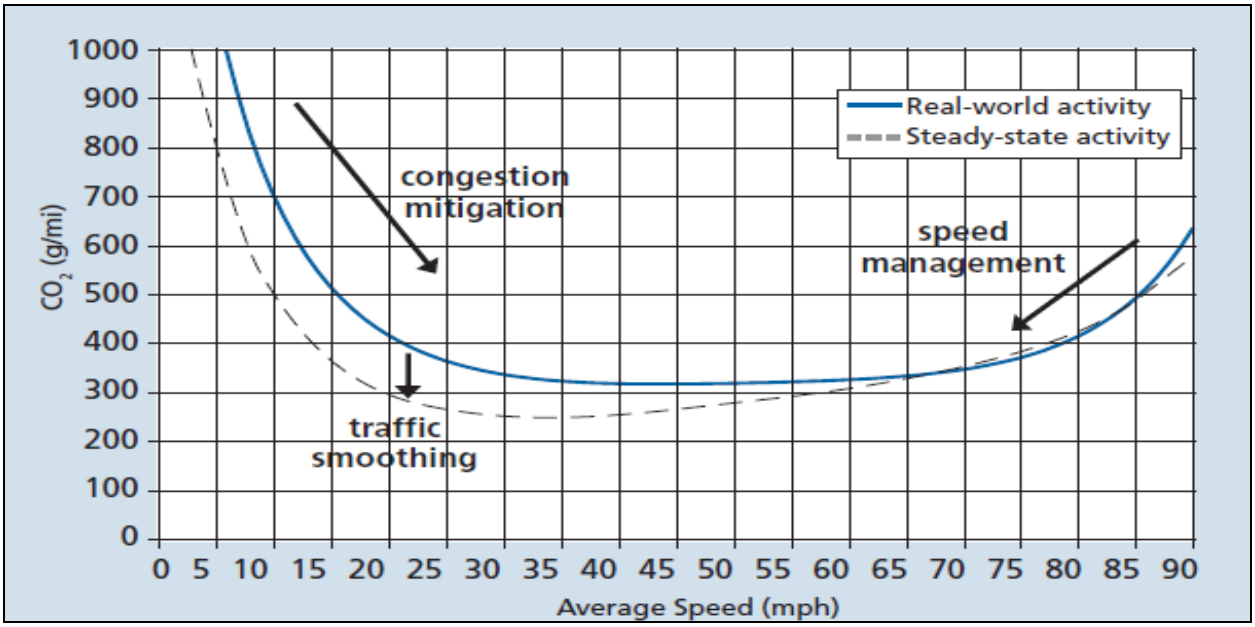


Source: California Air Resources Board 2013d

The Department and its parent agency, the Transportation Agency, have taken an active role in addressing GHG emission reduction and climate change. Recognizing that 98 percent of California's GHG emissions are from the burning of fossil fuels and 40 percent of all human made GHG emissions are from transportation, the Department has created and is implementing the Climate Action Program at Caltrans that was published in December 2006 (California Department of Transportation 2006).

One of the main strategies in Caltrans' Climate Action Program to reduce GHG emissions is to make California's transportation system more efficient. The highest levels of CO_2 from mobile sources, such as automobiles, occur at stop-and-go speeds (0–25 miles per hour) and speeds over 55 miles per hour; the most severe emissions occur at 0–25 miles per hour (see Figure 4-2 below). To the extent that a project relieves congestion by enhancing operations and improving travel times in high-congestion travel corridors, GHG emissions, particularly CO_2, may be reduced.

Figure 4-2: Possible Effect of Traffic Operation Strategies in Reducing On-Road CO_2 Emissions



Source: Barth and Boriboonsomsin 2010.

According to the Traffic Operations Analysis (URS Corporation 2014), traffic volumes along the project roadways are expected to remain the same between Build and No Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040), as the project would neither impact operations on SR-210, nor would it affect regional traffic demand or distribution. While volumes are expected to increase from the existing year to future years, this is attributed to regional population growth and other factors external to the operation of the proposed project. Thus, the proposed project will not have an effect on GHG emissions from the roadways within the project area. Nonetheless, the 2012–2035 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) includes strategies to reduce VMT and associated per capita energy consumption from the transportation sector as well as mitigation measures related to energy that are designed to reduce consumption and increase the use and availability of renewable sources of energy in the region. Potential mitigation programs identified in the 2012–2035 RTP/SCS to reduce GHG emissions include construction of infrastructure and automobile fuel efficiency to accommodate increased use of alternative-fuel motor vehicles as well as coordinating transportation, land use, and air quality planning to reduce VMT, energy use, and GHG emissions.

The EIR for the 2012–2035 RTP/SCS performed a GHG emission reduction strategy consistency analysis to evaluate impacts related to climate change associated with the 2012–2035 RTP/SCS. This consistency analysis evaluated consistency with the ARB; Public Utilities Commission; Business, Transportation, and Housing Agency; State and Consumer Services Agency; and EPA GHG reduction strategies and found that impacts on climate change are considered significant even with implementation of mitigation measures. To help mitigate impacts associated with the 2012–2035

RTP/SCS, SCAG identified mitigation measures to mitigate the impacts of growing transportation energy demand associated with the RTP.

4.1.3 Construction Emissions

Greenhouse gas emissions for transportation projects can be divided into those produced during construction and those produced during operations. Construction GHG emissions include emissions produced as a result of material processing, emissions produced by onsite construction equipment, and emissions arising from traffic delays due to construction. These emissions will be produced at different levels throughout the construction phase; their frequency and occurrence can be reduced through innovations in plans and specifications and by implementing better traffic management during construction phases.

A quantitative analysis of construction-related emissions was provided in Section 3.2.2.1 of Chapter 3. As stated in Chapter 3, construction emissions of criteria pollutants are considered temporary emissions. This is not the case with GHGs because of the cumulative nature of GHGs, which remain in the earth's atmosphere long after the time of emission. As detailed in the construction emissions calculation worksheet provided in Appendix E, approximately 2,315 metric tons of CO_2 emissions associated with proposed project construction would endure in the atmosphere with construction of the Build Alternative.

In addition, with innovations such as longer pavement lives, improved traffic management plans, and changes in materials, the GHG emissions produced during construction can be mitigated to some degree by longer intervals between maintenance and rehabilitation events.

4.1.4 CEQA Conclusion

As discussed in Chapter 3, roadway volumes between No Build and Build Alternatives for both the Opening Year (2020) and the Horizon Year (2040) are identical, as the proposed project would neither impact operations on SR-210, nor would it affect regional traffic demand or distribution (URS 2014). Although volumes are expected to increase from the existing year to future years, this is attributed to regional population growth and other factors external to the operation of the proposed project. While emissions in the region of the project area will increase between existing year and future (Opening Year and Horizon Year) conditions, the proposed project will not directly have an effect on GHG emissions from the roadways within the project area. However, it is Caltrans' determination that in the absence of further regulatory or scientific information related to GHG emissions and CEQA significance, it is too speculative to make a determination regarding the significance of the project's direct impact and its contribution on the cumulative scale to climate change. However, Caltrans is firmly committed to implementing measures to help reduce the potential effects of the project. These measures are outlined in the following section. Nonetheless, Caltrans is taking further measures to help reduce energy consumption and GHG emissions. These measures are outlined below under the Assembly Bill 32 Compliance subheading.

4.1.5 Greenhouse Gas Reduction Strategies

4.1.5.1 AB 32 Compliance

The Department continues to be involved on the Governor's Climate Action Team as the ARB works to implement Executive Orders S-3-05 and S-01-07 and help achieve the targets set forth in AB 32. Many of the strategies the Department is using to help meet the targets in AB 32 come from then-Governor Arnold Schwarzenegger's Strategic Growth Plan for California. The Strategic Growth Plan targeted a significant decrease in traffic congestion below 2008 levels and a corresponding reduction in GHG emissions, while accommodating growth in population and the economy. The Strategic Growth Plan relies on a complete systems approach to attain CO2 reduction goals: system monitoring and evaluation, maintenance and preservation, smart land use and demand management, and operational improvements as shown in Figure 4-3, The Mobility Pyramid.

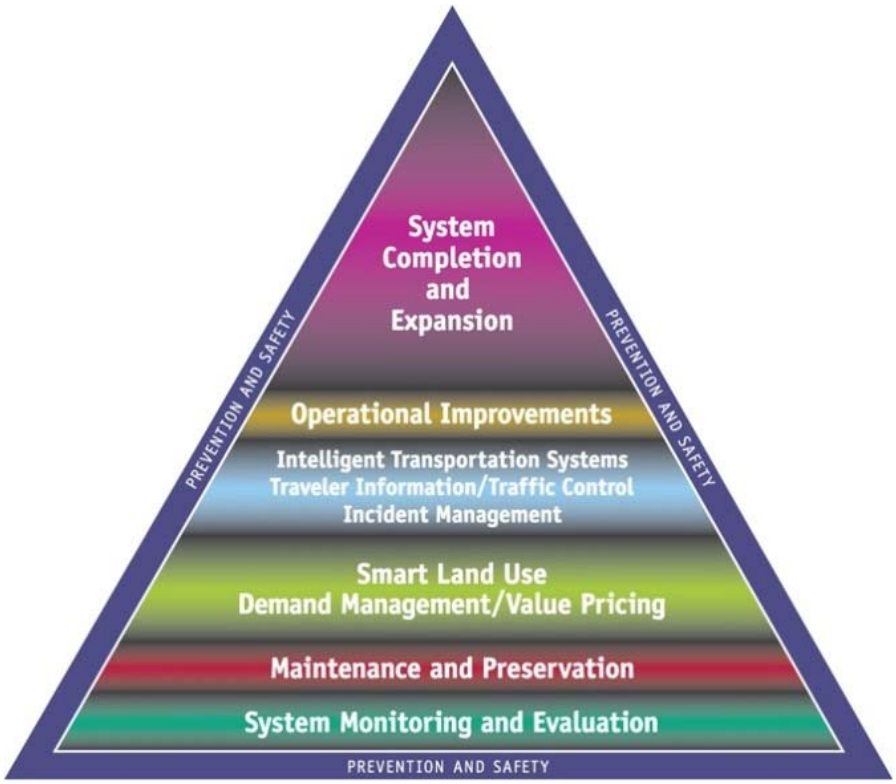


Figure 4-3: The Mobility Pyramid

The Department is supporting efforts to reduce vehicle miles traveled by planning and implementing smart land use strategies: job/housing proximity, developing transit-oriented communities, and high-density housing along transit corridors. The Department works closely with local jurisdictions on planning activities, but does not have local land use planning authority. The Department assists efforts to improve the energy efficiency of the transportation sector by increasing vehicle fuel economy in new cars, light and heavy-duty trucks; the Department is doing this by supporting ongoing research efforts at universities, by supporting legislative efforts to increase fuel economy, and by participating on the Climate Action Team. It

is important to note, however, that control of fuel economy standards is held by the U.S. EPA and ARB.

The Department is also working towards enhancing the State's transportation planning process to respond to future challenges. Similar to requirements for regional transportation plans under Senate Bill (SB) 375 (Steinberg 2008), SB 391(Liu 2009) requires the State's long-range transportation plan to meet California's climate change goals under Assembly Bill (AB) 32.

The California Transportation Plan (CTP) is a statewide, long-range transportation plan to meet our future mobility needs and reduce greenhouse gas (GHG) emissions. The CTP defines performance-based goals, policies, and strategies to achieve our collective vision for California's future, statewide, integrated, multimodal transportation system.

The purpose of the CTP is to provide a common policy framework that will guide transportation investments and decisions by all levels of government, the private sector, and other transportation stakeholders. Through this policy framework, the CTP 2040 will identify the statewide transportation system needed to achieve maximum feasible GHG emission reductions while meeting the State's transportation needs.

Table 4-1 summarizes the Department and statewide efforts that it is implementing to reduce GHG emissions. More detailed information about each strategy is included in the Climate Action Program at Caltrans (December 2006).

Caltrans Director's Policy 30 (DP-30) Climate Change (June 22, 2012): is intended to establish a Department policy that will ensure coordinated efforts to incorporate climate change into Departmental decisions and activities.

Caltrans Activities to Address Climate Change (April 2013)[4] provides a comprehensive overview of activities undertaken by Caltrans statewide to reduce greenhouse gas emissions resulting from agency operations.

[4] California Department of Transportation. 2013. *Current Projects and Studies: Caltrans' Climate Change Report.* Final. April. Available: <http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/projects_and_studies.shtml>.

Table 4-1. Climate Change/CO_2 Reduction Strategies

Strategy	Program	Partnership		Method/Process	Estimated CO_2 Savings Million Metric Tons(MMT)	
		Lead	Agency		2010	2020
Smart Land Use	Intergovernmental Review (IGR)	Caltrans	Local governments	Review and seek to mitigate development proposals	Not Estimated	Not Estimated
	Planning Grants	Caltrans	Local and regional agencies & other stakeholders	Competitive selection process	Not Estimated	Not Estimated
	Regional Plans and Blueprint Planning	Regional Agencies	Caltrans	Regional plans and application process	.975	7.8
Operational Improvements & Intelligent Transportation System (ITS) Deployment	Strategic Growth Plan	Caltrans	Regions	State ITS; Congestion Management Plan	.07	2.17
Mainstream Energy & GHG into Plans and Projects	Office of Policy Analysis & Research; Division of Environmental Analysis	Interdepartmental effort		Policy establishment, guidelines, technical assistance	Not Estimated	Not Estimated
Educational & Information Program	Office of Policy Analysis & Research	Interdepartmental, CalEPA, ARB, CEC		Analytical report, data collection, publication, workshops, outreach	Not Estimated	Not Estimated
Fleet Greening & Fuel Diversification	Division of Equipment	Department of General Services		Fleet Replacement B20 B100	.0045	.0065 .045 .0225
Non-vehicular Conservation Measures	Energy Conservation Program	Green Action Team		Energy Conservation Opportunities	.117	.34
Portland Cement	Office of Rigid Pavement	Cement and Construction Industries		2.5 % limestone cement mix 25% fly ash cement mix > 50% fly ash/slag mix	1.2 .36	4.2 3.6
Goods Movement	Office of Goods Movement	Cal EPA, ARB, BT&H, MPOs		Goods Movement Action Plan	Not Estimated	Not Estimated
Total					**2.72**	**18.18**

The following measures will also be included in the project to reduce the GHG emissions and potential climate change impacts from the project:

1. Caltrans and the California Highway Patrol are working with regional agencies to implement intelligent transportation systems (ITS) to manage the efficiency of the existing highway system. ITS is commonly referred to as electronics, communications, or information processing, used singly or in combination, to improve the efficiency or safety of a surface transportation system.
2. The project would incorporate the use of energy-efficient lighting, such as LED traffic signals. LED bulbs—or balls, in the stoplight vernacular—cost $60 to $70 apiece but last five to six years compared with the one-year average lifespan of the incandescent bulbs that were previously used. The LED balls themselves consume 10 percent of the electricity of traditional lights, which will also help reduce the project's CO_2 emissions (Brass 2008).
3. According to Caltrans Standard Specification Provisions, the contractor must comply with all South Coast Air Quality Management District rules, ordinances, and regulations regarding air quality restrictions.

4.1.6 Adaptation Strategies

"Adaptation strategies" refer to how the Department and others can plan for the effects of climate change on the state's transportation infrastructure and strengthen or protect the facilities from damage. Climate change is expected to produce increased variability in precipitation, rising temperatures, rising sea levels, variability in storm surges and intensity, and the frequency and intensity of wildfires. These changes may affect the transportation infrastructure in various ways, such as damage to roadbeds from longer periods of intense heat; increasing storm damage from flooding and erosion; and inundation from rising sea levels. These effects will vary by location and may, in the most extreme cases, require that a facility be relocated or redesigned. There may also be economic and strategic ramifications as a result of these types of impacts to the transportation infrastructure.

At the federal level, the Climate Change Adaptation Task Force, co-chaired by the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA), released its interagency task force progress report on October 28, 2011[5], outlining the federal government's progress in expanding and strengthening the Nation's capacity to better understand, prepare for, and respond to extreme events and other climate change impacts. The report provides an update on actions in key areas of federal adaptation, including: building resilience in local communities, safeguarding critical natural resources such as freshwater, and providing accessible climate information and tools to help decision-makers manage climate risks.

Climate change adaptation must also involve the natural environment as well. Efforts are underway on a statewide-level to develop strategies to cope with impacts to habitat and

[5] The White House. n.d. *Climate Change Resilience*. Council on Environmental Quality. Available: <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>.

biodiversity through planning and conservation. The results of these efforts will help California agencies plan and implement mitigation strategies for programs and projects.

On November 14, 2008, former Governor Arnold Schwarzenegger signed EO S-13-08, which directed a number of state agencies to address California's vulnerability to sea level rise caused by climate change. This EO set in motion several agencies and actions to address the concern of sea level rise.

In addition to addressing projected sea level rise, the California Natural Resources Agency (Resources Agency) was directed to coordinate with local, regional, state and federal public and private entities to develop The California Climate Adaptation Strategy (Dec 2009)[6,] which summarizes the best-known science on climate change impacts to California, assesses California's vulnerability to the identified impacts, and then outlines solutions that can be implemented within and across state agencies to promote resiliency.

The strategy outline is in direct response to EO S-13-08 that specifically asked the Resources Agency to identify how state agencies can respond to rising temperatures, changing precipitation patterns, sea level rise, and extreme natural events. Numerous other state agencies were involved in the creation of the Adaptation Strategy document, including the California Environmental Protection Agency; Business, Transportation and Housing; Health and Human Services; and the Department of Agriculture. The document is broken down into strategies for different sectors that include: Public Health; Biodiversity and Habitat; Ocean and Coastal Resources; Water Management; Agriculture; Forestry; and Transportation and Energy Infrastructure. As data continues to be developed and collected, the state's adaptation strategy will be updated to reflect current findings.

The National Academy of Science was directed to prepare a Sea Level Rise Assessment Report to recommend how California should plan for future sea level rise (National Academy of Science 2012). The report was released in June 2012 and included:

- Relative sea level rise projections for California, Oregon, and Washington taking into account coastal erosion rates, tidal impacts, El Niño and La Niña events, storm surge and land subsidence rates.
- The range of uncertainty in selected sea level rise projections.
- A synthesis of existing information on projected sea level rise impacts to state infrastructure (such as roads, public facilities and beaches), natural areas, and coastal and marine ecosystems.
- A discussion of future research needs regarding sea level rise.

In 2010, interim guidance was released by The Coastal Ocean Climate Action Team (CO-CAT) as well as Caltrans as a method to initiate action and discussion of potential risks to the states infrastructure due to projected sea level rise. Subsequently, CO-CAT updated the Sea Level Rise guidance to include information presented in the National Academies Study.

[6] California Natural Resources Agency. 2009. *2009 California Climate Adaptation Strategy*. Available: <http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF>.

All state agencies that are planning to construct projects in areas vulnerable to future sea level rise are directed to consider a range of sea level rise scenarios for the years 2050 and 2100 to assess project vulnerability and, to the extent feasible, reduce expected risks and increase resiliency to sea level rise. Sea level rise estimates should also be used in conjunction with information on local uplift and subsidence, coastal erosion rates, predicted higher high water levels, storm surge and storm wave data.

All projects that have filed a Notice of Preparation as of the date of EO S-13-08, and/or are programmed for construction funding from 2008 through 2013, or are routine maintenance projects may, but are not required to, consider these planning guidelines. The proposed project is programmed for construction funding after 2013. As such, it is not exempt at this time from requirements to analyze the impacts of sea-level rise directed in Executive Order S-13-08. The *Vulnerability of Transportation Systems to Sea-Level Rise* (Caltrans 2009) report suggests that by 2100, sea-level rise along the California coast could be as much as 55 inches. Given the proposed project's distance from the coastal zone, impacts related to sea-level rise are not expected.

Executive Order S-13-08 also directed the Business, Transportation, and Housing Agency to prepare a report to assess vulnerability of transportation systems to sea level rise affecting safety, maintenance and operational improvements of the system, and economy of the state. The Department continues to work on assessing the transportation system vulnerability to climate change, including the effect of sea level rise.

Currently, the Department is working to assess which transportation facilities are at greatest risk from climate change effects. However, without statewide planning scenarios for relative sea level rise and other climate change effects, the Department has not been able to determine what change, if any, may be made to its design standards for its transportation facilities. Once statewide planning scenarios become available, the Department will be able review its current design standards to determine what changes, if any, may be warranted in order to protect the transportation system from sea level rise.

Climate change adaptation for transportation infrastructure involves long-term planning and risk management to address vulnerabilities in the transportation system from increased precipitation and flooding; the increased frequency and intensity of storms and wildfires; rising temperatures; and rising sea levels. The Department is an active participant in the efforts being conducted in response to EO S-13-08 and is mobilizing to be able to respond to the National Academy of Science Sea Level Rise Assessment Report.

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Chapter 5 Preparers and References Cited

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APPENDIX A REGIONAL CONFORMITY DOCUMENTATION

- 2012 RTP/SCS and FHWA Approval Letters
- 2013 FTIP References and FHWA Approval Letters

REGIONAL TRANSPORTATION PLAN
2012–2035 RTP
SUSTAINABLE COMMUNITIES STRATEGY
Towards a Sustainable Future

Southern California Association of Governments

ADOPTED JUNE 2013

Amendment No. 1

and Amendment No. 13-04 to the 2013 Federal Transportation Improvement Program

County	System	Lead Agency	RTP ID	FTIP ID	Begin PM	End PM	Route #	Route Name	From	To	Description	Roadway Segment: Route Name	Roadway Segment: Length	Roadway Segment: From	Roadway Segment: To	Roadway Segment: Description	Roadway Segment: Existing Lanes	Roadway Segment: Proposed Lanes	Transit Segment: Route	Additional Details	RTP Baseline	Project Comple-tion By*
San Bernardino	Local Highway	HIGHLAND	4A07308	20082402	0	0	0				WIDEN BASE LINE BETWEEN CHURCH AVE. AND SEINE AVE. FROM 4-6 LANES (EXCLUDING FREEWAY BRIDGE OVER SR210)	BASELINE	0.3 MILES	CHURCH	SEINE AVE.	WIDEN BASELINE RD. EXCLUDING WIDENING OF FREEWAY BRIDGE OVER SR 210 FROM 4 - 6 LANES	4	6				2014
San Bernardino	Local Highway	HIGHLAND	4OM0701	201191	0	0	0				BASE LINE FROM SEINE AVENUE TO STONEY CREEK DRIVE - WIDEN FROM 4-6 LANES (0.2 MILES)	BASE LINE	0.2 MILES	SEINE AVENUE	STONEY CREEK DRIVE	WIDEN	4	6				2015
San Bernardino	Local Highway	HIGHLAND	REG0701	201186	0	0	0				SR 210 RAMPS AT BASE LINE-RAMP WIDENING - ADD LANES WIDEN ON AND OFF RAMPS AT SOUTHBOUND SR-210/BASE LINE I/C	SR210 RAMPS	ABOUT 0.5 MILES ALL TOTAL	SR210	BASELINE	WIDEN	2	3				2018
San Bernardino	Local Highway	HIGHLAND	REG0701	201187	0	0	0				BASE LINE BETWEEN SR-210 RAMPS - WIDEN FROM 4 LANES TO 6 LANES (0.1 MILES)WIDEN SR-210 BRIDGE ON BASE LINE FROM 4 LANES TO 6 LANES	BASELINE	0.1 MILES	BETWEEN SR 210 RAMPS	n/a	BASELINE BETWEEN SR 210 RAMPS, WIDEN 4-6 LANES INCLUDING THE BRIDGE	4	6				2014
San Bernardino	Local Highway	HIGHLAND	SBD55031	SBD55031	0	0	0				ALABAMA STREET FROM 3RD STREET TO SOUTH CITY LIMITS - WIDEN FROM 2 TO 3 S/B LANES (0.25 MILES)	ALABAMA STREET	0.25 MILES	3RD STREET	SOUTH CITY LIMITS	WIDEN	2	3				2018
San Bernardino	Local Highway	HIGHLAND	SBD55033	SBD55033	0	0	0				BOULDER AVE. FROM GREENSPOT TO SOUTH CITY LIMITS - WIDEN FROM 2-4 LANES (0.60 MILES)	BOULDER AVENUE	0.7 MILES	GREENSPOT ROAD/5TH ST	SOUTH CITY LIMITS	WIDEN	2	4				2018
San Bernardino	Local Highway	LOMA LINDA	200403	200403	0	0	0				EVANS/WEST STREET FROM REDLANDS BLVD TO BARTON -CONSTRUCT 4 NEW LANES, A N/S ARTERIAL ROADWAY FROM REDLANS BLVD TO BARTON, WEST OF ANDERSON ST.	EVANS/WEST STREET	n/a	REDLANDS BLVD	BARTON	CONSTRUCT 4 NEW LANE ROAD WEST OF ANDERSON ST.	n/a	4				2015
San Bernardino	Local Highway	LOMA LINDA	SBD031295	SBD031295	0	0	0				BARTON ROAD EAST CITY LIMITS TO WEST CITY LIMITS WIDEN FROM 4 LANES TO 6 LANES SPOT WIDENINGS	BARTON RD	n/a	EAST CITY LIMITS	WEST CITY LIMITS	WIDEN	4	6				2020
San Bernardino	Local Highway	LOMA LINDA	SBD031296	SBD031296	0	0	0				REDLANDS BOULEVARD EAST CITY LIMITS TO WEST CITY LIMITS WIDEN FROM 4 LANES TO 6 LANES	REDLANDS BLVD	n/a	EAST CITY LIMITS	WEST CITY LIMITS	WIDEN	4	6				2014
San Bernardino	Local Highway	LOMA LINDA	SBD31876	SBD31876	0	0	0				CALIFORNIA STREET BARTON ROAD TO REDLANDS BOULEVARD WIDEN FROM 2 TO 4 LANES	CALIFORNIA STREET	n/a	REDLANDS BOULEVARD	BARTON ROAD	WIDENING	2	4			X	2015
San Bernardino	Local Highway	ONTARIO	4A01210	200404	0	0	0				HOLT BLVD CORRIDOR WIDENING FROM BENSON AVE. TO VINEYARD AVE. WIDEN ROAD FROM 4-6 LANES INCLUDING TRAFFIC SIGNAL MODIFICATIONS AND RESTRIPING	HOLT BLVD.	n/a	BENSON AVE.	VINEYARD AVE.	WIDEN ROAD 4-6 LANES INCLUDING TRAFFIC SIGNAL MODIFICATIONS AND RESTRIPING	4	6			X	2020
San Bernardino	Local Highway	ONTARIO	SBD59004	SBD59004	0	0	0				FRANCIS ST. FROM BON VIEW AVE TO GROVE WIDENING 2 TO 4 LANES (STORM DRAIN FROM BON VIEW TO PARCO)	FRANCIS ST	n/a	BON VIEW AVE.	GROVE AVE.	WIDEN	2	4				2015
San Bernardino	Local Highway	ONTARIO	SBD59006	SBD59006	0	0	0				GROVE AVENUE FROM STATE ST. TO 350""""" NORTH OF HOLT BLVD. WIDENING FROM 4 TO 6 LANES WIDENING RAILROAD BRIDGE ALSO (1,450""""),LANDSCAPE RESTORATION, LEFT TURN LANES AT HOLT	GROVE AVE.	.27 MILES	STATE ST	HOLT BLVD	WIDEN FROM 4-6 LANES, WIDEN EXISTING RR BRIDGE, RESTORE LANDSCPE AND IMPROVE INTERSECTION AT HOLT TO INCLUDE L/R DUAL TURN LANES	4	6			X	2015
San Bernardino	Local Highway	RANCHO CUCAMONGA	200023	200023	0	0	0				CHERRY AV FROM SOUTH CITY LIMITS TO WILSON AV - WIDEN FROM 2 TO 4 LANES	CHERRY AVE	0	SOUTH CITY LIMITS	WILSON AVE	WIDENING	2	4			X	2018
San Bernardino	Local Highway	RANCHO CUCAMONGA	20010133	201136	0	0	0				WIDEN FOOTHILL BOULEVARD (OLD STATE ROUTE 66) BETWEEN SAN BERNARDINO ROAD AND VINEYARD AVENUE. REMOVE THE EAST UPLAND UNDERPASS BRIDGE ALSO KNOWN AS THE PACIFIC ELECTRIC RAILROAD BRIDGE, CONSTRCT A NEW PUBLIC TRAIL BRIDGE ALONG THE RAILROAD ALIGNMENT AND	FOOTHILL BOULEVARD	n/a	SAN BERNARDINO ROAD	VINEYARD	WIDENING, BRIDGE REMOVAL, PEDESTRIAN OVERPASS CONSTRUCTION	4	6			X	2012
San Bernardino	Local Highway	RANCHO CUCAMONGA	20020134	20020134	0	0	0				IN RANCHO CUCAMONGA - ON ARROW RTE. FROM ETIWANDA AVENUE TO EAST STREET - WIDEN FROM 2-4 LANES (3,200 FEET)	ARROW ROUTE	n/a	ETIWANDA AVE	EAST AVE	WIDEN	2	4			X	2014
San Bernardino	Local Highway	RANCHO CUCAMONGA	4AL04	201135	0	0	0				WILSON AVE FROM EAST AVE. TO WARDMAN BULLOCK RD. CONSTRUCTION OF A 2 LANE ROAD (ONE LANE EACH DIRECTION) WITH CURB AND GUTTER, AND STREET LIGHTS.	WILSON AVE	n/a	EAST AVE.	WARDMAN BULLOCK	CONSTRUCTION OF 2 LANE ROAD	n/a	2			X	2012
San Bernardino	Local Highway	RANCHO CUCAMONGA	4RL04	201138	0	0	0				YOUNGS CANYON RD. FROM SAN SEVAINE TO CHERRY AVE. CONSTRUCT NEW 4 LANE DIVIDED STREET	YOUNGS CANYON RD.	n/a	SAN SEVAINE RD.	CHERRY AVE.	NEW ROAD	n/a	4				2014
San Bernardino	Local Highway	REDLANDS	200035	200035	0	0	0				WABASH AV FROM 5TH ST TO I-10 - CONSTRUCT NEW 2 LANE STREET TO I-10 TO MATCH ON AND OFF RAMPS-CONSTRUCT MISSING LINK (2 LANE IN EACH DIRECTION)-1 MILE	WABASH AVE	n/a	5TH AVE	I-10 FREEWAY	CONSTRUCT 2 LANE MISSING LINK	n/a	2			X	2018

* Represents the Plan network year for which the project was analyzed for the RTP/SCS modeling and regional emissions analysis

U.S. Department of Transportation
Federal Highway Administration

California Division

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Sacramento, CA 95814
(916) 498-5001
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July 15, 2013

In Reply Refer To:
HDA-CA

Mr. Hasan Ikhrata
Executive Director
Southern California Association of Governments
818 West 7th Street, 12th Floor
Los Angeles, CA 90017

SUBJECT: Conformity Determination for SCAG's 2012-2035 RTP/ SCS through Amendment No. 1 and the 2013 FTIP through Amendment No. 13-04

Dear Mr. Ikhrata:

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) have completed our review of the conformity determination for Southern California Association of Governments' (SCAG's) 2012-2035 Regional Transportation Plan (RTP)/ Sustainable Communities Strategy (SCS) through Amendment No. 1 and the 2013 Federal Transportation Improvement Program (FTIP) through Amendment No. 13-04. A FHWA/FTA air quality conformity determination is required pursuant to the Environmental Protection Agency's (EPA) *Transportation Conformity Rule,* 40 CFR Parts 51 and 93, and the United States Department of Transportation's *Metropolitan Planning Rule,* 23 CFR Part 450.

On June 6, 2013, SCAG adopted Amendment No. 1 to the 2012-2035 RTP/ SCS, Amendment No. 13-04 to the 2013 FTIP, and the corresponding conformity determination. The conformity analysis submitted by SCAG indicates that all air quality conformity requirements have been met. Based on our review, we find that Amendment No. 1 to the 2012-2035 RTP/ SCS and Amendment No. 13-04 to the 2013 FTIP conform to the applicable state implementation plan in accordance with the provisions of 40 CFR Parts 51 and 93. In accordance with the July 15, 2004, *Memorandum of Understanding (MOU) between the Federal Highway Administration, California Division and the Federal Transit Administration, Region IX,* FTA has concurred with this conformity determination. Additionally, this conformity determination was made after consultation with the EPA Region 9 office.

If you have questions or need additional information concerning this conformity determination, please contact Mr. Stew Sonnenberg of the FHWA California Division office at (916) 498-5889 or by email at Stew.Sonnenberg@dot.gov.

Sincerely,

/s/ Leslie T. Rodgers

Leslie T. Rogers
Regional Administrator
Federal Transit Administration

For: Vincent P. Mammano
Division Administrator
Federal Highway Administration

SOUTHERN CALIFORNIA
ASSOCIATION of GOVERNMENTS

EXECUTIVE SUMMARY
Volume I of III

FINAL FEDERAL TRANSPORTATION IMPROVEMENT PROGRAM

2013

FY 2012/13–2017/18
September 2012

2013 Federal Transportation Improvement Program

San Bernardino County
Local Highway
Including Amendments 1-20
(In $000`s)

ProjectID	County	Air Basin	Model	RTP ID	Program	Route	Begin	End	System	Conformity Category	Amendment
2011151	San Bernardino	MDAB		4RL04	TDM20				L	TCM Committed	20
Description:							PTC	3,746	Agency	SANBAG	

MOJAVE DESERT AIR BASIN RIDESHARE PROGRAM (Toll Credits are being used as match for CMAQ in FY 2013/14 for $133)

Fund	ENG	R/W	CON	Total	Prior	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	Total
CMAQ	2,320		1,160	3,480	2,320		1,160					3,480
SBD CO MEASURE I	266			266	266							266
2011151 Total	2,586		1,160	3,746	2,586		1,160					3,746

ProjectID	County	Air Basin	Model	RTP ID	Program	Route	Begin	End	System	Conformity Category	Amendment
201186	San Bernardino	SCAB		REG0701	NCR88				L	NON-EXEMPT	19
Description:							PTC	6,536	Agency	SANBAG	

SR 210 RAMPS AT BASE LINE-RAMP WIDENING - ADD LANES WIDEN ON AND OFF RAMPS AT SOUTHBOUND SR-210/BASE LINE I/C

Fund	ENG	R/W	CON	Total	Prior	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	Total
DEVELOPER FEES	3,268			3,268				327	2,941			3,268
SBD CO MEASURE I	3,268			3,268				327	2,941			3,268
201186 Total	6,536			6,536				654	5,882			6,536

ProjectID	County	Air Basin	Model	RTP ID	Program	Route	Begin	End	System	Conformity Category	Amendment
SBD031505	San Bernardino	SCAB		SBD031505	NCN25				L	TCM Committed	0
Description:							PTC	10,900	Agency	SANBAG	

GROUPED PROJECTS FOR LTF ARTICLE 3 PROJECTS LTF, ARTICLE 3 BICYCLE/PEDESTRIAN PROJECTS AT VARIOUS LOCATIONS (PROJECTS ARE CONSISTENT WITH 40 CFR PART 93.126, 127,128, EXEMPT TABLES 2 & 3)

Fund	ENG	R/W	CON	Total	Prior	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	Total
TDA ARTICLE #3			10,900	10,900	7,900	3,000						10,900
SBD031505 Total			10,900	10,900	7,900	3,000						10,900

ProjectID	County	Air Basin	Model	RTP ID	Program	Route	Begin	End	System	Conformity Category	Amendment
SBD41427	San Bernardino	MDAB		SBD41427	CAN66				L	NON-EXEMPT	0
Description:							PTC	550	Agency	TWENTYNINE PALMS	

AMBOY ROAD - LEAR AVE TO ADOBE RD. (5.5 MILES) CONSTRUCT NEW 2 LANE ROAD (ONE LANE IN EACH DIRECTION)

Fund	ENG	R/W	CON	Total	Prior	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	Total
SBD CO MEASURE I	40	110	400	550		40	510					550
SBD41427 Total	40	110	400	550		40	510					550

DEV FEE				1,000	1,000
	12/13			8,715	8,715
	13/14			-8,715	-8,715
LOC-AC					
	12/13			1,000	1,000
SLP				1,000	1,000
	12/13			670	670
STPE-R				670	670

Agency:	HIGHLAND					ProjTotal	Prior	FY12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18
	Fund Totals:	1,040	198	13,376		14,614	1,138	13,476					

Co.	Sys	RTPID	Project ID	Amd	Ver	Program	Rt	PMB	PMA	Total Project Cost
SBD	L	REG0701	201186	0	3	NCR88		.	.	6,536

Description: SR 210 RAMPS AT BASE LINE-RAMP WIDENING - ADD LANES WIDEN ON AND OFF RAMPS AT SOUTHBOUND SR-210/BASE LINE I/C

Fund	Fiscal Year	ENG	ROW	CON	Fund Total
	14/15	327			327
	15/16	2,941			2,941
DEV FEE		3,268			3,268
	14/15	327			327
	15/16	2,941			2,941
XSBD		3,268			3,268

Agency:	HIGHLAND					ProjTotal	Prior	FY12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18
	Fund Totals:	6,536				6,536				654	5,882		

Co.	Sys	RTPID	Project ID	Amd	Ver	Program	Rt	PMB	PMA	Total Project Cost
SBD	L	REG0701	201186	19	5	NCR88		.	.	6,536

Description: SR 210 RAMPS AT BASE LINE-RAMP WIDENING - ADD LANES WIDEN ON AND OFF RAMPS AT SOUTHBOUND SR-210/BASE LINE I/C

Fund	Fiscal Year	ENG	ROW	CON	Fund Total
	14/15	327			327
	15/16	2,941			2,941
DEV FEE		3,268			3,268
	14/15	327			327
	15/16	2,941			2,941
XSBD		3,268			3,268

Agency:	SANBAG					ProjTotal	Prior	FY12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18
	Fund Totals:	6,536				6,536				654	5,882		

Co.	Sys	RTPID	Project ID	Amd	Ver	Program	Rt	PMB	PMA	Total Project Cost
SBD	L	200018	20131501	15	1	NCN46		.	.	2,500

Description: IN HIGHLAND: BOULDER AVE FROM ATLANTIC AVE TO SOUTH CITY LIMITS; STREET AND LANDSCAPING IMPROVEMENTS (non-capacity enhancements)

Fund	Fiscal Year	ENG	ROW	CON	Fund Total
	13/14	40			40
	14/15			460	460
CITY		40		460	500
	13/14	160			160
	14/15			1,840	1,840
PNRS		160		1,840	2,000

Agency:	HIGHLAND					ProjTotal	Prior	FY12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18
	Fund Totals:	200		2,300		2,500			200	2,300			

Co.	Sys	RTPID	Project ID	Amd	Ver	Program	Rt	PMB	PMA	Total Project Cost
SBD	L	200018	20131501	19	2	NCN46		.	.	2,500

Description: IN HIGHLAND: ON BOULDER AVE FROM SAN MANUEL VILLAGE ENTRANCE TO GREENSPOT ROAD; STREET AND LANDSCAPING IMPROVEMENTS (non-capacity enhancements)

Fund	Fiscal Year	ENG	ROW	CON	Fund Total
	14/15	41			41
	15/16			459	459
CITY		41		459	500
	14/15	164			164
	15/16			1,836	1,836
PNRS		164		1,836	2,000

Agency:	HIGHLAND					ProjTotal	Prior	FY12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18
	Fund Totals:	205		2,295		2,500				205	2,295		

Co.	Sys	RTPID	Project ID	Amd	Ver	Program	Rt	PMB	PMA	Total Project Cost
SBD	L	4TR0101	20131902	19	1			.	.	1,100

Description: ON PACIFIC ST FROM PALM AVE TO CHURCH AVE: SHOULDER IMPROVMENTS (non-capacity enhancing)

Fund	Fiscal Year	ENG	ROW	CON	Fund Total
	14/15	100			100
	16/17			1,000	1,000
CITY		100		1,000	1,100

Agency:	HIGHLAND					ProjTotal	Prior	FY12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18
	Fund Totals:	100		1,000		1,100				100		1,000	

Co.	Sys	RTPID	Project ID	Amd	Ver	Program	Rt	PMB	PMA	Total Project Cost
SBD	L	RRC0702	20010135	17	3	NCN31		.	.	20,262

Description: MONTE VISTA AVENUE @ UNION PACIFIC RAILROAD CROSSING - GRADE SEPARATION PART OF ALAMEDA CORRIDOR GRADE SEPARATION PROJECTS FUNDED WITH TCRP #55.1(CA505)

Fund	Fiscal Year	ENG	ROW	CON	Fund Total
	Prior	2,500			2,500
PVT		2,500			2,500
	13/14	700			700
	14/15			1,786	1,786

U.S. Department of Transportation
Federal Highway Administration

California Division

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July 17, 2014

In Reply Refer To:
HDA-CA

Ms. Rachel Falsetti, Division Chief
Transportation Programming Federal Resources Office, M.S. 82
California Department of Transportation
1120 N Street
Sacramento, CA 95814

Dear Ms. Falsetti:

SUBJECT: SCAG 2013 FTIP AMENDMENT NO. 13-19 AND CONFORMITY DETERMINATION

The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) have completed our reviews of Amendment No. 13-19 to the Southern California Association of Governments' (SCAG) 2012/13 – 2015/16 Federal Transportation Improvement Program (FTIP), which was submitted by your letter dated June 25, 2014. As detailed in your letter's enclosure, this amendment requests to add twenty-eight (28) new individual and one (1) grouped project listings to SCAG's FTIP, and to modify forty-six (46) individual and thirty (30) grouped project listings with removal of seven (7) individual project listing previously approved for California Federal Statewide Transportation Improvement Program (FSTIP) inclusion.

We have determined the modified project listings from this amendment are from SCAG's adopted 2012/2035 Regional Transportation Plan (RTP)/Sustainable Communities Strategy (SCS), and that the modifications requested rely on a previous regional emissions analysis. Acceptance of this amendment and the air quality conformity determination have been coordinated with Region IX of the Environmental Protection Agency (EPA) in accordance with the procedures outlined in the *National Memorandum of Understanding (MOU) between the Department of Transportation (DOT) and EPA on Transportation Conformity*, dated April 25, 2000. Accordingly, we find that SCAG's FTIP – including Amendment No. 13-19 – conforms to the applicable State Implementation Plan (SIP) for air quality.

Pursuant the July 15, 2004 *MOU, between the FHWA – California Division and FTA – Region IX*, and based on our review of information submitted with the State's proposed 2012/13 – 2015/16 FSTIP, which includes revenues, proposed project funding information to demonstrate financial constraint, and statewide and metropolitan planning process documentation, we accept this FSTIP modification proposed for the SCAG region in accordance with the Final Rule on Statewide and Metropolitan Transportation Planning that was published in the February 14, 2007 Federal Register. We have determined the amended SCAG FTIP, including Amendment No. 13-19, is financially constrained as required by the Federal surface transportation programs authorizing legislation and statewide planning, metropolitan planning, and programming

regulations. SCAG's FTIP was developed through a continuing, cooperative, and comprehensive transportation planning process in accordance with the metropolitan transportation planning provisions of 23 United States Code (U.S.C.) § 134 and 49 U.S.C. Chapter 53.

Approval is provided with understanding that eligibility determination of individual projects for funding must be met, and the applicant must ensure satisfaction of all administrative and statutory requirements. If you would have questions or need additional information concerning our FSTIP approval for this amendment, please contact Michael Morris of the FHWA California Division's Cal-South office at (213) 894-4014, or by email at michael.morris@dot.gov; or Ted Matley of the FTA Region IX office at (415) 744-2590, or by email at ted.matley@dot.gov.

Sincerely,

/s/ Leslie T. Rogers

Leslie T. Rogers
Regional Administrator
Federal Transit Administration

For
Vincent P. Mammano
Division Administrator
Federal Highway Administration

cc: (email)
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cc:
SCAG 2012/13 FTIP Binder

MM/lm

CONFORMITY ANALYSIS

Introduction

Federal Transportation Improvement Program

The Federal Transportation Improvement Program (FTIP) is the federally required multimodal list of capital improvement projects to be implemented over a six year period. The biennial FTIP update, produced on a two year cycle, implements the long-range Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). The 2013 FTIP implements the transportation projects and programs of the 2012-2035 RTP/SCS as previously amended included in the fiscal years (2012/13 – 2017/18).

Federal Conformity Requirements

Federal and state regulations provide that the Southern California Association of Governments (SCAG), as the designated Metropolitan Planning Organization, may rely on a previous regional emissions analysis when processing amendments, in the event that certain conditions are met. The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) and SCAG have identified the following type of 2013 FTIP amendments for which SCAG may rely on the existing regional emissions analysis:

"Category 3. Formal Amendment – Relying on the Existing Conformity Determination.
This amendment may include adding a project or a project phase to the program. This amendment category consists of projects that are modeled and are included in the regional emissions analysis."[1]

Amendment #13-19 relies on the regional emissions analysis for the 2012-2035 RTP/SCS and 2013 FTIP as previously amended [Section 93.122(g) is the relevant part of the *Transportation Conformity Regulations* for this amendment].

FTIP Amendment #13-19 Project Description

FTIP Amendment #13-19 includes only two projects for which conformity needs to be reaffirmed (see the Conformity Determination Project Listing). Both projects are located in the South Coast Air Basin (SCAB).

Conformity Status of Current RTP and FTIP

The conformity determination for the 2012-2035 RTP/SCS and the 2013 FTIP received federal approval on June 4 and December 13, 2012 respectively.

The FHWA and FTA approved the conformity determination for the 2012-2035 RTP/SCS through Amendment No. 1 and the 2013 FTIP through Amendment No. 13-04 on July 15, 2013.

[1] *SCAG, Final 2013 Federal Transportation Improvement Program Guidelines, October 2011, page 121.*

Summary of Conformity Analysis and Findings

SCAG reaffirms the latest applicable conformity findings for both the 2012-2035 RTP/SCS and the 2013 FTIP as previously amended which can be found at: http://www.scag.ca.gov/programs/Pages/RegionalConformity.aspx.

This reaffirmation covers the findings for all applicable pollutants, including regional emissions analyses, financial constraint test, timely implementation of Transportation Control Measures (TCMs), applying the use of the latest planning assumptions and the latest approved emissions model, reaffirming consistency between the 2013 FTIP and the 2012-2035 RTP/SCS, and reaffirming the process for interagency consultation and public participation.

SCAG has completed its analysis of the proposed changes to the 2013 FTIP. SCAG's findings for the approval of this amendment are as follows:

Consistency with Current RTP/SCS and FTIP

The projects needing conformity reaffirmation in Amendment #13-19 are from the adopted 2012-2035 RTP/SCS as previously amended, which is a conforming Plan. Amendment #13-19 does not include any new regionally significant projects beyond those currently included in the 2012-2035 RTP/SCS, nor does it move a project across any modeling years currently assumed in the 2012-2035 RTP/SCS and 2013 FTIP as previously amended. Furthermore, the design, concept and scope of the projects do not differ significantly from what were described in the 2012-2035 RTP/SCS and 2013 FTIP as previously amended.

Finding: The 2013 FTIP Amendment #13-19 is consistent with the 2012-2035 RTP/SCS and 2013 FTIP as previously amended.

Regional Emissions Analysis

This conformity analysis relies on the regional emissions analysis from the 2013 FTIP as previously amended which updated the 2012-2035 RTP/SCS. The emissions analysis was performed with the SCAG Regional Travel Demand Model and utilizes the planning, socioeconomic and model assumptions from the 2012-2035 RTP/SCS and 2013 FTIP as previously amended. FTIP Amendment #13-19 does not result in any modeling changes.

The regional emissions analysis methodology for this amendment to the 2013 FTIP uses currently applicable budgets to determine conformity for all criteria pollutants. Specifically, this conformity reaffirmation is being made for all criteria pollutants and precursors in the MDAB, the SCCAB, the SCAB, and the SSAB.

Finding: The 2013 FTIP Amendment #13-19 regional emissions for 2008 Ozone precursors (NOx, ROG/VOC) are consistent with all applicable emission budgets for all milestone, attainment, and planning horizon years in the Morongo Band of Mission Indians (Morongo), Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation (Pechanga), SCAB excluding Morongo and Pechanga, South Central Coast Air Basin ([SCCAB], Ventura County portion), Western Mojave Desert Air Basin ([MDAB], Los Angeles County Antelope Valley portion and San Bernardino County western portion of MDAB), and the Salton Sea Air Basin ([SSAB], Riverside County Coachella Valley and Imperial County portions).

Finding: The 2013 FTIP Amendment #13-19 regional emissions for CO are consistent with all applicable emissions budgets for all milestone, maintenance, and planning horizon years in the SCAB.

Finding: The 2013 FTIP Amendment #13-19 regional emissions for NO_2 are consistent with all applicable emissions budgets for all milestone, maintenance, and planning horizon years in the SCAB.

Finding: The 2013 FTIP Amendment #13-19 regional emissions for direct 1997 and 2006 $PM_{2.5}$ and its precursors are consistent with all applicable emissions budgets for all milestone, attainment, and planning horizon years in the SCAB.

Finding: The 2013 FTIP Amendment #13-19 regional emissions for PM_{10} and its precursors are consistent with all applicable emissions budgets for all milestone, attainment, and planning horizon years in the SCAB and the SSAB (Riverside County Coachella Valley portion).

Finding: The 2013 FTIP Amendment #13-19 regional emissions analysis for 2006 $PM_{2.5}$ meet the interim emission test (build/no-build test) for all milestone, attainment and planning horizon years in the SSAB (Imperial County portion).

Finding: The 2013 FTIP Amendment #13-19 regional emissions for PM_{10} meet the interim emission test (build/no-build test) for all milestone, attainment and planning horizon years in the MDAB (two nonattainment areas: San Bernardino County portion excluding Searles Valley portion and Searles Valley portion of San Bernardino County) and the SSAB (Imperial County portion).

Timely Implementation of TCMs

Finding: There is no committed TCM project in the 2013 FTIP Amendment #13-19. The 2013 FTIP Amendment #13-19 does not change timely implementation of the SCCAB and SCAB TCM projects.

Fiscal Constraint Analysis

Finding: FTIP Amendment #13-19 includes the most recent financial plan for the 2013 FTIP as previously amended. All projects listed in the 2013 FTIP (including the proposed amendment) are financially constrained for all fiscal years.

Interagency Consultation and Public Involvement Analysis

The prior regional conformity analysis leading to FHWA and FTA's approval of the 2013 FTIP complied with all federal and state requirements for interagency consultation and public involvement as documented in Section V of Technical Appendix, Volume II of the 2013 FTIP. For 2013 FTIP Amendment #13-19, SCAG will undergo additional public involvement including solicitation via email for comments from the Transportation Conformity Working Group. In addition, Amendment #13-19 will be posted on SCAG's website (www.scag.ca.gov) for a 10-day public comment period.

Finding: The 2013 FTIP Amendment #13-19 complies with all federal and state requirements for interagency consultation and public involvement.

Overall

Finding: SCAG has determined that the 2013 FTIP Amendment #13-19 is consistent with all federal conformity requirements and regulations.

APPENDIX B LOCAL CLIMATE AND AMBIENT MONITORING DATA

FORECASTS MAPS VIDEO PHOTOS NEWS TV Sign In

The Weather Channel + Add a Location Search Zip, City, or Place (Disney

Local Weather Alerts
> See all CA alerts
Flood Advisory (Alert #1) Flood Advisory (Alert #2)

Right Now | Today | Hourly | Tomorrow | Weekend | 5 day | 10 day | Monthly | Map

Monthly Averages for
Highland, CA
[English | Metric]

Monthly Averages Table Display Graph Display

Temperature (°F)
- ☑ Avg High
- ☑ Avg Low
- ☐ Record High
- ☐ Record Low

Precipitation
- ◉ Avg Precip.

Legend: Record High · Average High · Average Low · Record Low · Precip

Today's Top Picks
- Will to Live: Take on Nature, Struggle to Survive This Sunday 9/8c
- Gorgeous Photos of Hearst Castle
- BIZARRE Homes You Have to See to Believe (PHOTOS)
- White House Lawns Throughout the Years (PHOTOS)
- Top 10 World's Best Airports
- Tornado Alert! Find Out Who's at Risk
- America's Morning Headquarters with Sam Champion
- Highway Thru Hell: Electrifying Tow

Highland, CA Weather Facts

- July is the average warmest month.
- The highest recorded temperature was 117°F in 1971.
- On average, the coolest month is December.
- The lowest recorded temperature was 17°F in 1937.
- February is the average wettest month.

Details | Video | Text | **Averages**

More Resources

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Near Highland, CA
OR
Enter Course Name GO!

- Golf Tips: Beat the Weather
- Top 10 Golf Destinations
- Local Pollen Levels
- Surf Conditions

Right Now | Today | Hourly | Tomorrow | Weekend | 5 day | 10 day | Monthly | Map

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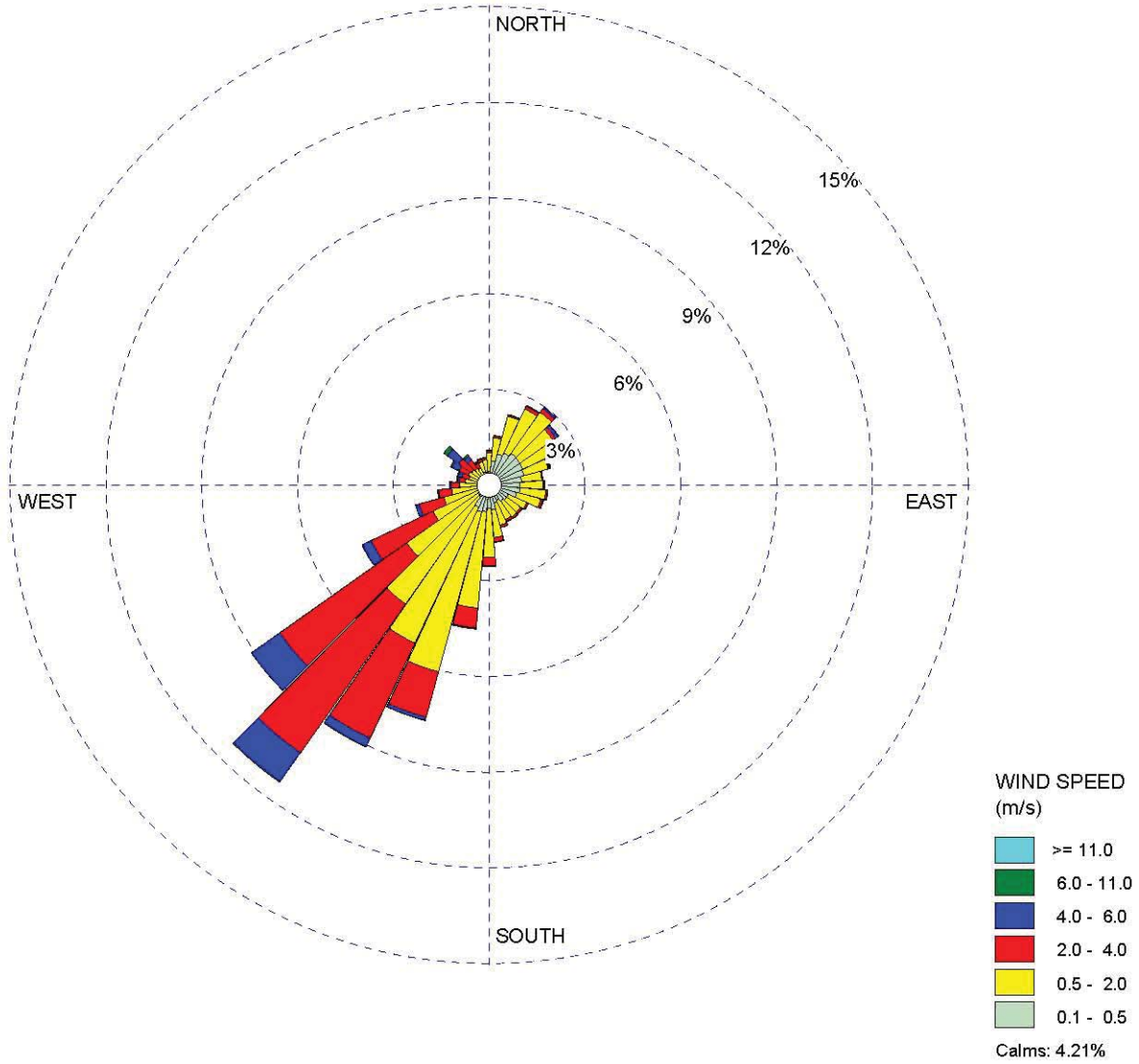
WIND ROSE PLOT:

snbo

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2005-2007 **Jan 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **4.21%**	TOTAL COUNT: **26126 hrs.**	
	AVG. WIND SPEED: **1.44 m/s**	DATE: **1/28/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

California Environmental Protection Agency
Air Resources Board

Top 4 Summary: Highest 4 Daily Maximum 8-Hour Ozone Averages

at San Bernardino-4th Street

iADAM

	2011		2012		2013	
	Date	8-Hr Average	Date	8-Hr Average	Date	8-Hr Average
National:						
First High:	Jul 2	0.121	Aug 12	0.109	Jun 29	0.112
Second High:	Aug 14	0.104	Aug 5	0.102	Jun 1	0.103
Third High:	Aug 13	0.101	Jul 11	0.100	Sep 14	0.102
Fourth High:	Aug 27	0.101	Aug 8	0.100	Sep 15	0.097
California:						
First High:	Jul 2	0.121	Aug 12	0.109	Jun 29	0.113
Second High:	Aug 14	0.105	Aug 5	0.103	Jun 1	0.104
Third High:	Aug 13	0.102	Jul 11	0.100	Sep 14	0.103
Fourth High:	Aug 27	0.102	Aug 8	0.100	Sep 15	0.098
National:						
# Days Above the Standard:		39		54		36
Nat'l Standard Design Value:		0.099		0.098		0.099
National Year Coverage:		93		93		92
California:						
# Days Above the Standard:		66		77		53
California Designation Value:		0.105		0.109		0.113
Expected Peak Day Concentration:		0.116		0.113		0.116
California Year Coverage:		92		91		90

Notes:

Eight-hour ozone averages and related statistics are available at San Bernardino-4th Street between 1986 and 2013. Some years in this range may not be represented.
All averages expressed in parts per million.
An exceedance of a standard is not necessarily related to a violation of the standard.
Year Coverage indicates the extent to which available monitoring data represent the time of the year when concentrations are expected to be highest. 0 means that data represent none of the high period; 100 means that data represent the entire high period. A high Year Coverage does not mean that there was sufficient data for annual statistics to be considered valid.
* means there was insufficient data available to determine the value.

Available Pollutants:

8-Hour Ozone | Hourly Ozone | PM2.5 | PM10 | Carbon Monoxide | Nitrogen Dioxide | State Sulfur Dioxide | Hydrogen Sulfide

California Environmental Protection Agency
Air Resources Board

Top 4 Summary: Highest 4 Daily Maximum Hourly Ozone Measurements

at San Bernardino-4th Street

iADAM

	2011		2012		2013	
	Date	Measurement	Date	Measurement	Date	Measurement
First High:	Jul 2	0.135	Aug 12	0.124	Jun 29	0.139
Second High:	Aug 14	0.125	Aug 8	0.121	Jun 1	0.125
Third High:	Jun 27	0.119	Jul 11	0.119	Sep 14	0.122
Fourth High:	Aug 27	0.119	Aug 7	0.118	Jul 8	0.113
California:						
# Days Above the Standard:		40		41		22
California Designation Value:		0.13		0.13		0.13
Expected Peak Day Concentration:		0.133		0.129		0.130
National:						
# Days Above the Standard:		*2*		*0*		*2*
Nat'l Standard Design Value:		*0.129*		*0.124*		*0.125*
Year Coverage:		94		93		92

Notes:

Hourly ozone measurements and related statistics are available at San Bernardino-4th Street between 1986 and 2013. Some years in this range may not be represented.
All concentrations expressed in parts per million.
The national 1-hour ozone standard was revoked in June 2005 and is no longer in effect. Statistics related to the revoked standard are shown in *italics* or *italics* .
An exceedance of a standard is not necessarily related to a violation of the standard.
Year Coverage indicates the extent to which available monitoring data represent the time of the year when concentrations are expected to be highest. 0 means that data represent none of the high period; 100 means that data represent the entire high period. A high Year Coverage does not mean that there was sufficient data for annual statistics to be considered valid.
* means there was insufficient data available to determine the value.

Available Pollutants:

8-Hour Ozone | Hourly Ozone | PM2.5 | PM10 | Carbon Monoxide | Nitrogen Dioxide | State Sulfur Dioxide | Hydrogen Sulfide

California Environmental Protection Agency
Air Resources Board

Top 4 Summary: Highest 4 Daily Maximum 8-Hour Carbon Monoxide Averages

at San Bernardino-4th Street

	2011		2012		2013	
	Date	8-Hr Average	Date	8-Hr Average	Date	8-Hr Average
National:						
First High:	Dec 11	1.74	Jan 15	1.64		*
Second High:	Nov 29	1.48	Jan 7	1.37		*
Third High:	Dec 30	1.48	Jan 15	1.31		*
Fourth High:	Dec 31	1.42	Jan 20	1.27		*
California:						
First High:	Dec 11	1.74	Jan 14	1.64		*
Second High:	Nov 29	1.48	Jan 1	1.55		*
Third High:	Dec 30	1.48	Jan 7	1.37		*
Fourth High:	Dec 31	1.42	Jan 20	1.27		*
National:						
# Days Above the Standard:		0		0		0
California:						
# Days Above the Standard:		0		0		0
Expected Peak Day Concentration:		1.72		1.69		
Year Coverage:		98		41		*

Notes:

Eight-hour carbon monoxide averages and related statistics are available at San Bernardino-4th Street between 1986 and 2012. Some years in this range may not be represented.

All averages expressed in parts per million.

An exceedance of a standard is not necessarily related to a violation of the standard.

Year Coverage indicates the extent to which available monitoring data represent the time of the year when concentrations are expected to be highest. 0 means that data represent none of the high period; 100 means that data represent the entire high period. A high Year Coverage does not mean that there was sufficient data for annual statistics to be considered valid.

* means there was insufficient data available to determine the value.

Available Pollutants:

8-Hour Ozone | Hourly Ozone | PM2.5 | PM10 | Carbon Monoxide | Nitrogen Dioxide | State Sulfur Dioxide | Hydrogen Sulfide

California Environmental Protection Agency
Air Resources Board

Top 4 Summary: Highest 4 Daily 24-Hour PM10 Averages

at San Bernardino-4th Street

iADAM

	2011		2012		2013	
	Date	24-Hr Average	Date	24-Hr Average	Date	24-Hr Average
National:						
First High:	Jul 3	128.4	Jul 12	68.1	Oct 4	177.3
Second High:	Dec 1	100.1	Aug 10	63.9	Apr 27	66.8
Third High:	Sep 2	74.5	Jul 20	62.8	Nov 12	64.5
Fourth High:	Sep 23	63.5	Sep 10	61.0	Jul 18	58.9
California:						
First High:	Sep 24	54.0	May 21	51.0	Oct 25	98.0
Second High:	Oct 18	54.0	Aug 7	49.0	Nov 12	65.0
Third High:	Jul 2	49.0	May 9	47.0	Jul 21	49.0
Fourth High:	Aug 25	49.0	Jul 26	46.0	Jul 9	43.0
National:						
Estimated # Days > 24-Hour Std:		0.0		0.0		1.0
Measured # Days > 24-Hour Std:		0		0		1
3-Yr Avg Est # Days > 24-Hr Std:		0.0		0.0		0.0
Annual Average:		*31.2*		*32.0*		*32.7*
3-Year Average:		*31*		*31*		*32*
California:						
Estimated # Days > 24-Hour Std:		12.3		*		11.5
Measured # Days > 24-Hour Std:		2		1		2
Annual Average:		30.1		*		30.1
3-Year Maximum Annual Average:		31		31		30
Year Coverage:		0		0		0

Notes:

Daily PM10 averages and related statistics are available at San Bernardino-4th Street between 1989 and 2013. Some years in this range may not be represented.
All averages expressed in micrograms per cubic meter.
The national annual average PM10 standard was revoked in December 2006 and is no longer in effect. Statistics related to the revoked standard are shown in *italics* or *italics* .
An exceedance of a standard is not necessarily related to a violation of the standard.
All values listed above represent midnight-to-midnight 24-hour averages and may be related to an exceptional event.
State and national statistics may differ for the following reasons:
State statistics are based on California approved samplers, whereas national statistics are based on samplers using federal reference or equivalent methods. State and

national statistics may therefore be based on different samplers.

State statistics for 1998 and later are based on local conditions (except for sites in the South Coast Air Basin, where State statistics for 2002 and later are based on local conditions). National statistics are based on standard conditions.

State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

Measurements are usually collected every six days. Measured days counts the days that a measurement was greater than the level of the standard; Estimated days mathematically estimates how many days concentrations would have been greater than the level of the standard had each day been monitored.

3-Year statistics represent the listed year and the 2 years before the listed year.

Year Coverage indicates the extent to which available monitoring data represent the time of the year when concentrations are expected to be highest. 0 means that data represent none of the high period; 100 means that data represent the entire high period. A high Year Coverage does not mean that there was sufficient data for annual statistics to be considered valid.

* means there was insufficient data available to determine the value.

Available Pollutants:

8-Hour Ozone | Hourly Ozone | PM2.5 | PM10 | Carbon Monoxide | Nitrogen Dioxide | State Sulfur Dioxide | Hydrogen Sulfide

California Environmental Protection Agency
Air Resources Board

Top 4 Summary: Highest 4 Daily 24-Hour PM2.5 Averages

at San Bernardino-4th Street

iADAM

	2011		2012		2013	
	Date	24-Hr Average	Date	24-Hr Average	Date	24-Hr Average
National:						
First High:	Oct 24	65.0	Jul 5	34.8	Oct 25	55.3
Second High:	Oct 21	45.7	Nov 26	33.5	Mar 20	34.6
Third High:	Dec 11	32.5	Mar 31	27.1	Jan 1	33.4
Fourth High:	Mar 13	27.6	Jan 19	26.5	Mar 17	32.3
California:						
First High:	Oct 24	65.0	Jul 5	34.8	Oct 25	55.3
Second High:	Oct 21	45.7	Nov 26	33.5	Mar 20	34.6
Third High:	Dec 11	32.5	Mar 31	27.1	Jan 1	33.4
Fourth High:	Mar 13	27.6	Jan 19	26.5	Mar 17	32.3
National:						
Estimated # Days > 24-Hour Std:		*		0.0		3.3
Measured # Days > 24-Hour Std:		2		0		1
24-Hour Standard Design Value:		*		*		*
24-Hour Standard 98th Percentile:		*		27.1		33.4
Annual Standard Design Value:		*		*		*
Annual Average:		*		11.7		11.4
California:						
Annual Std Designation Value:		*		*		*
Annual Average:		*		*		*
Year Coverage:		85		86		92

Notes:

Daily PM2.5 averages and related statistics are available at San Bernardino-4th Street between 1999 and 2013. Some years in this range may not be represented.
All averages expressed in micrograms per cubic meter.
An exceedance of a standard is not necessarily related to a violation of the standard.
State statistics are based on California approved samplers, whereas national statistics are based on samplers using federal reference or equivalent methods. State and national statistics may therefore be based on different samplers.
Year Coverage indicates the extent to which available monitoring data represent the time of the year when concentrations are expected to be highest. 0 means that data represent none of the high period; 100 means that data represent the entire high period. A high Year Coverage does not mean that there was sufficient data for annual statistics to be considered valid.

* means there was insufficient data available to determine the value.

Available Pollutants:

8-Hour Ozone | Hourly Ozone | PM2.5 | PM10 | Carbon Monoxide | Nitrogen Dioxide | State Sulfur Dioxide | Hydrogen Sulfide

Monitor Values Report

Geographic Area: San Bernardino County, CA
Pollutant: CO
Year: 2011
Exceptional Events: Included (if any)

Duration Description=1 HOUR

Duration Description	Obs	First Max	Second Max	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
1 HOUR	7926	4.4	4.4	0	None	1	060710001	200 E. Buena Vista, Barstow	Barstow	San Bernardino	CA	09
1 HOUR	7287	1.9	1.8	0	None	1	060710306	14306 Park Ave., Victorville, Ca	Victorville	San Bernardino	CA	09
1 HOUR	8142	1.8	1.7	0	None	1	060711004	1350 San Bernardino Rd., Upland	Upland	San Bernardino	CA	09
1 HOUR	7872	1.6	1.6	0	None	1	060712002	14360 Arrow Blvd., Fontana	Fontana	San Bernardino	CA	09
1 HOUR	8008	1.9	1.9	0	None	1	060719004	24302 4th St., San Bernardino, Ca.	San Bernardino	San Bernardino	CA	09

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

AirData reports are produced from a direct query of the AQS Data Mart. The data represent the best and most recent information available to EPA from state agencies. However, some values may be absent due to incomplete reporting, and some values may change due to quality assurance activities. The AQS database is updated daily by state, local, and tribal organizations who own and submit the data. Please contact the appropriate air quality monitoring agency to report any data problems. <http://www.epa.gov/airquality/airdata/ad_contacts.html>

Readers are cautioned not to rank order geographic areas based on AirData reports. Air pollution levels measured at a particular monitoring site are not necessarily representative of the air quality for an entire county or urban area.

This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: August 18, 2014

Monitor Values Report

Geographic Area: San Bernardino County, CA
Pollutant: CO
Year: 2011
Exceptional Events: Included (if any)

Duration Description=8-HR RUN AVG END HOUR

Duration Description	Obs	First Max	Second Max	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
8-HR RUN AVG END HOUR	8216	1.4	1.3	0	None	1	060710001	200 E. Buena Vista, Barstow	Barstow	San Bernardino	CA	09
8-HR RUN AVG END HOUR	7312	1.5	1.5	0	None	1	060710306	14306 Park Ave., Victorville, Ca	Victorville	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8550	1.3	1.1	0	None	1	060711004	1350 San Bernardino Rd., Upland	Upland	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8444	1.1	1.1	0	None	1	060712002	14360 Arrow Blvd., Fontana	Fontana	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8507	1.7	1.5	0	None	1	060719004	24302 4th St., San Bernardino, Ca.	San Bernardino	San Bernardino	CA	09

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

AirData reports are produced from a direct query of the AQS Data Mart. The data represent the best and most recent information available to EPA from state agencies. However, some values may be absent due to incomplete reporting, and some values may change due to quality assurance activities. The AQS database is updated daily by state, local, and tribal organizations who own and submit the data. Please contact the appropriate air quality monitoring agency to report any data problems. <http://www.epa.gov/airquality/airdata/ad_contacts.html>

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This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: August 18, 2014

Monitor Values Report

Geographic Area: San Bernardino County, CA
Pollutant: CO
Year: 2012
Exceptional Events: Included (if any)

Duration Description=1 HOUR

Duration Description	Obs	First Max	Second Max	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
1 HOUR	8342	0.9	0.9	0	None	1	060710001	200 E. Buena Vista, Barstow	Barstow	San Bernardino	CA	09
1 HOUR	7862	2.1	1.9	0	None	1	060710306	14306 Park Ave., Victorville, Ca	Victorville	San Bernardino	CA	09
1 HOUR	7853	1.9	1.7	0	None	1	060711004	1350 San Bernardino Rd., Upland	Upland	San Bernardino	CA	09
1 HOUR	8132	2	1.5	0	None	1	060712002	14360 Arrow Blvd., Fontana	Fontana	San Bernardino	CA	09
1 HOUR	7810	3.1	2	0	None	1	060719004	24302 4th St., San Bernardino, Ca.	San Bernardino	San Bernardino	CA	09

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Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: August 18, 2014

Monitor Values Report

Geographic Area: San Bernardino County, CA
Pollutant: CO
Year: 2012
Exceptional Events: Included (if any)

Duration Description=8-HR RUN AVG END HOUR

Duration Description	Obs	First Max	Second Max	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
8-HR RUN AVG END HOUR	8685	0.7	0.6	0	None	1	060710001	200 E. Buena Vista, Barstow	Barstow	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8054	1.8	1.5	0	None	1	060710306	14306 Park Ave., Victorville, Ca	Victorville	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8249	1.1	1.1	0	None	1	060711004	1350 San Bernardino Rd., Upland	Upland	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8533	1.1	1	0	None	1	060712002	14360 Arrow Blvd., Fontana	Fontana	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8289	1.7	1.6	0	None	1	060719004	24302 4th St., San Bernardino, Ca.	San Bernardino	San Bernardino	CA	09

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

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This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: August 18, 2014

Monitor Values Report

Geographic Area: San Bernardino County, CA
Pollutant: CO
Year: 2013
Exceptional Events: Included (if any)

Duration Description=1 HOUR

Duration Description	Obs	First Max	Second Max	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
1 HOUR	6432	0.9	0.8	0	None	1	060710001	200 E. Buena Vista, Barstow	Barstow	San Bernardino	CA	09
1 HOUR	7784	1.2	1.1	0	None	1	060710306	14306 Park Ave., Victorville, Ca	Victorville	San Bernardino	CA	09
1 HOUR	7846	3	2.9	0	None	1	060711004	1350 San Bernardino Rd., Upland	Upland	San Bernardino	CA	09
1 HOUR	7957	1.9	1.7	0	None	1	060712002	14360 Arrow Blvd., Fontana	Fontana	San Bernardino	CA	09
1 HOUR	7891	3.8	3.3	0	None	1	060719004	24302 4th St., San Bernardino, Ca.	San Bernardino	San Bernardino	CA	09

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

AirData reports are produced from a direct query of the AQS Data Mart. The data represent the best and most recent information available to EPA from state agencies. However, some values may be absent due to incomplete reporting, and some values may change due to quality assurance activities. The AQS database is updated daily by state, local, and tribal organizations who own and submit the data. Please contact the appropriate air quality monitoring agency to report any data problems. <http://www.epa.gov/airquality/airdata/ad_contacts.html>

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Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: August 18, 2014

Monitor Values Report

Geographic Area: San Bernardino County, CA
Pollutant: CO
Year: 2013
Exceptional Events: Included (if any)

Duration Description=8-HR RUN AVG END HOUR

Duration Description	Obs	First Max	Second Max	Actual Exc	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
8-HR RUN AVG END HOUR	6725	0.6	0.5	0	None	1	060710001	200 E. Buena Vista, Barstow	Barstow	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8350	0.9	0.9	0	None	1	060710306	14306 Park Ave., Victorville, Ca	Victorville	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8268	1.4	1.2	0	None	1	060711004	1350 San Bernardino Rd., Upland	Upland	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8380	1.2	1.2	0	None	1	060712002	14360 Arrow Blvd., Fontana	Fontana	San Bernardino	CA	09
8-HR RUN AVG END HOUR	8369	1.7	1.6	0	None	1	060719004	24302 4th St., San Bernardino, Ca.	San Bernardino	San Bernardino	CA	09

Get detailed information about this report, including column descriptions, at http://www.epa.gov/airquality/airdata/ad_about_reports.html#mon

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Readers are cautioned not to rank order geographic areas based on AirData reports. Air pollution levels measured at a particular monitoring site are not necessarily representative of the air quality for an entire county or urban area.

This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Source: U.S. EPA AirData <http://www.epa.gov/airdata>
Generated: August 18, 2014

California Environmental Protection Agency
Air Resources Board

Quality Assurance Air Monitoring Site Information

This page last reviewed on November 21, 2011

Site Information for San Bernardino

View Larger Map

AIRS Number	ARB Number	Site Start Date	Reporting Agency and Agency Code
060719004	36203	5/1/86	South Coast AQMD (061)

Site Address	County	Air Basin	Latitude (N)	Longitude (W)	Elevation (m)
24302 E. 4th St, San Bernardino CA 92410	San Bernardino	South Coast	34.10669	-117.27408	317

Pollutants Monitored (click on parameter link for real-time data) Note: multiple monitors may be available through the AQMIS query tool.
CO, NO_2, O_3, PM_{10}, $TEOM_{PM10}$, $PM_{2.5}$, TSP, Relative Humidity, Wind Direction, Horizontal Wind Speed

Site Photos	Photo Sequences	Site Surveys
--Select Photos--	--Select Position And Direction--	--Select Survey--

Other ARB Database Information	Real-Time Met Data
--Select Database--	--Select Data Server--

Site Information Menu Top Page Quality Assurance Programs Search QA Site Information Database

For real-time air quality data visit: Air Quality and Meteorological Information System (AQMIS)

Questions regarding data or the AQMIS search tool should be submitted to:
Air Quality and Meteorological Information System (AQMIS)

For Air Monitoring Site related inquiries, please contact:
Mr. Ranjit Bhullar, Manager
Quality Assurance Section

APPENDIX C CO PROTOCOL EXCERPTS

Table 1. Projects Exempt from All Emissions Analyses

<u>Safety</u> Railroad/highway crossing Hazard elimination program Safer non-Federal-aid system roads Shoulder improvements Increasing sight distance Safety improvement program Traffic control devices and operating assistance other than signalization projects Railroad/highway crossing warning devices Guardrails, median barriers, crash cushions Pavement resurfacing and/or rehabilitation Pavement marking demonstration Emergency relief (23 U.S.C. 125) Fencing Skid treatments Safety roadside rest areas Adding medians Truck climbing lanes outside the urbanized area Lighting improvements Widening narrow pavements or reconstructing bridges (no additional travel lanes) Emergency truck pullovers <u>Mass Transit</u> Operating assistance to transit agencies Purchase of support vehicles Rehabilitation of transit vehicles[2] Purchase of office, shop, and operating equipment for existing facilities Purchase of operating equipment for vehicles (e.g. radios, fareboxes, lifts, etc.) Construction of renovation of power, signal, and communications systems Construction of small passenger shelters and information kiosks Reconstruction or renovation of transit buildings and structures (e.g., rail or bus buildings, storage and maintenance facilities, stations, terminals, and ancillary structures). Rehabilitation or reconstruction of track structures, track and track bed in existing right-of-way Purchase of new buses and rail cars to replace exiting vehicles or for minor expansions of the fleet[2] Construction of new bus or rail storage/maintenance facilities categorically excluded in 23 CFR Part 771 <u>Air Quality</u> Continuation of ride-sharing and van-pooling promotion activities at current level Bicycle and pedestrian facilities

Table 1 (continued). Projects Exempt from all Emissions Analyses

<u>Other</u>

[2]PM_{10} nonattainment or maintenance areas, such projects are exempt only if they are in compliance with control measures in the applicable implementation plan.

Specific activities which do not involve or lead directly to construction, such as: Planning and technical studies Grants for training and research programs Planning activities conducted pursuant to titles 23 and 49 U.S.C. Federal-aid systems revisions Engineering to assess social, economic, and environmental effects of the proposed action or alternatives to that action Noise attenuation Emergency or hardship advance land acquisitions [23 CFR 712.204(d)] Acquisition of scenic easements Plantings, landscaping, etc. Sign removal Directional and informational signs Transportation enhancement activities (except rehabilitation and operation of historic transportation buildings, structures, or facilities) Repair of damage caused by natural disasters, civil unrest, or terrorist acts, except projects involving substantial functional, locational or capacity changes

Source: 40 CFR Part 93, Table 2

2.15 Projects Exempt from Regional Emissions Analyses

Certain projects are ordinarily exempt from all regional emissions analyses according to Table 3 of 40 CFR § 93.127, reproduced in Table 2 of the Protocol. However, the exempt status may be revoked if the MPO, in consultation with the local air district, the California Air Resources Board (CARB), Caltrans, EPA, and the FHWA (in the case of a highway project) or the FTA (in the case of a transit project) concur that a project has potential regional emissions impacts for any reason [40 CFR § 93.127].

Table 2. Projects Exempt from Regional Emissions Analysis

Intersection channelization projects Intersection signalization projects at individual intersections Interchange reconfiguration projects Changes in vertical and horizontal alignment Truck size and weight inspection stations Bus terminals and transfer points

Source: 40 CFR Part 93, Table 3

2.16 Traffic signal synchronization projects

Traffic signal synchronization projects may be approved, funded, and implemented without satisfying the requirements of the conformity rule. However, all subsequent regional emissions analyses required by 40 CFR 93.118 and 93.119 for transportation plans, TIPs, or projects not from a conforming plan and TIP must include such regionally significant traffic signal synchronization projects. [FR Doc. 97–20968 Filed 8–14–97; 8:45 am]

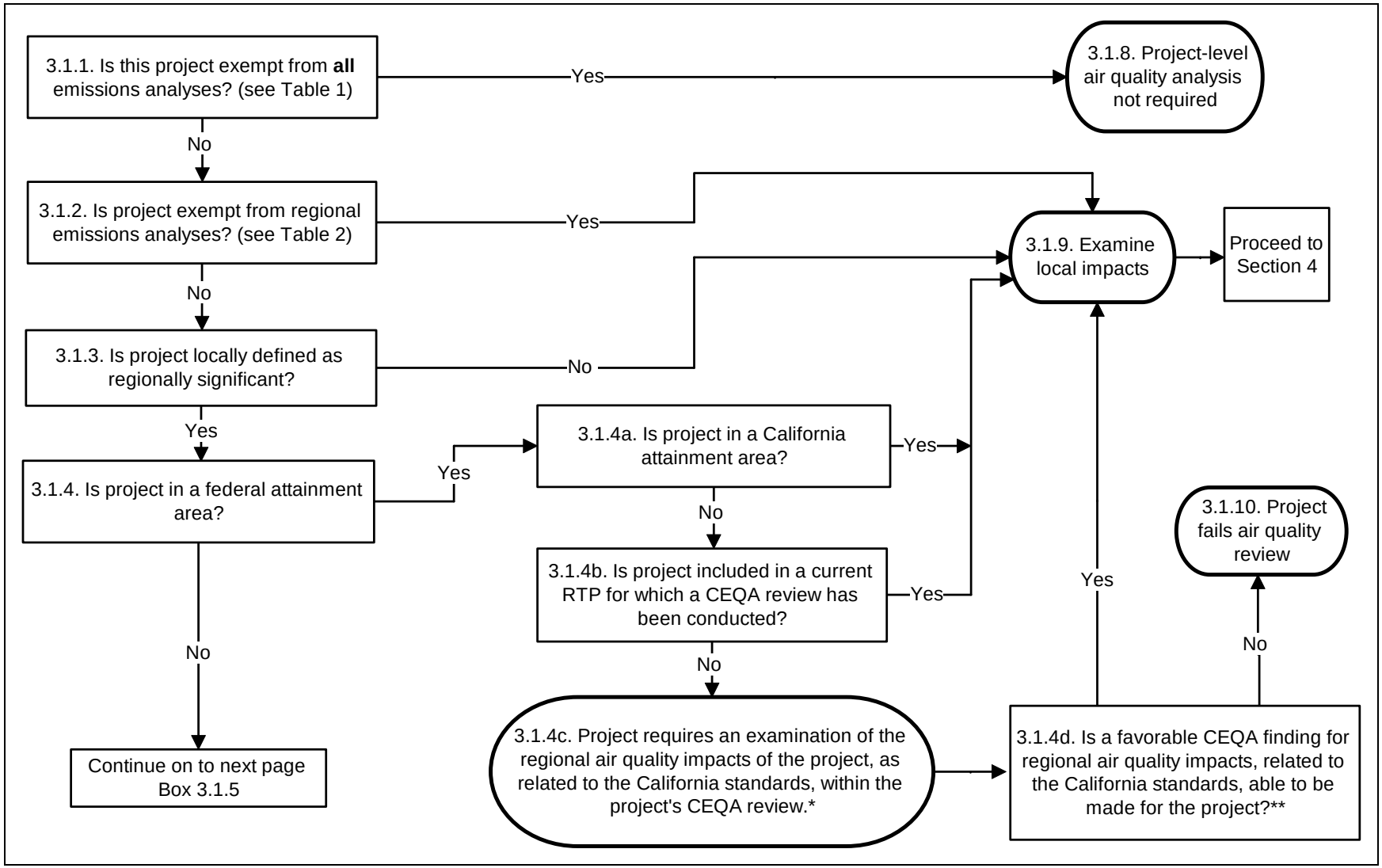


Figure 1. Requirements for New Projects

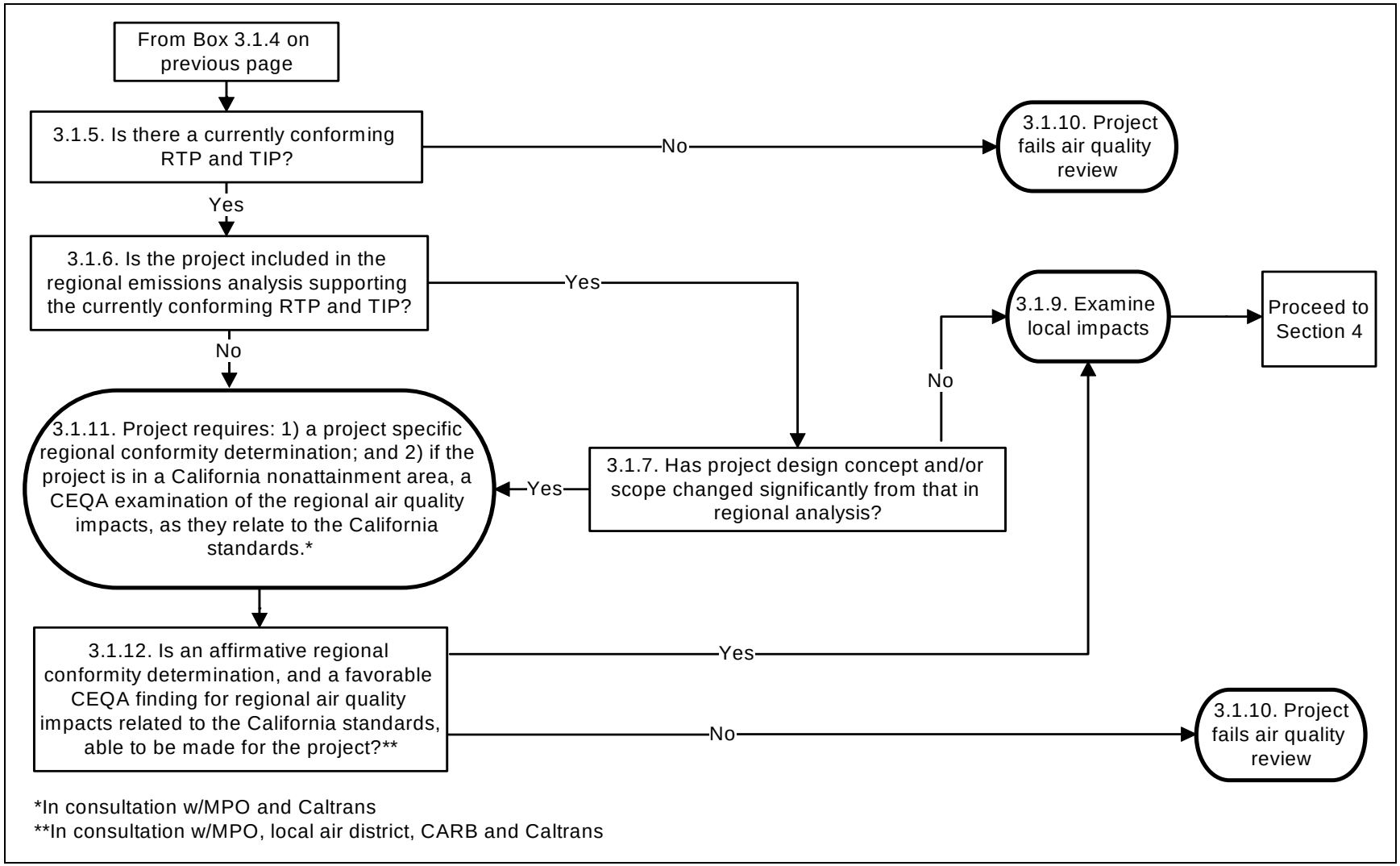


Figure 1 (cont.). Requirements for New Projects

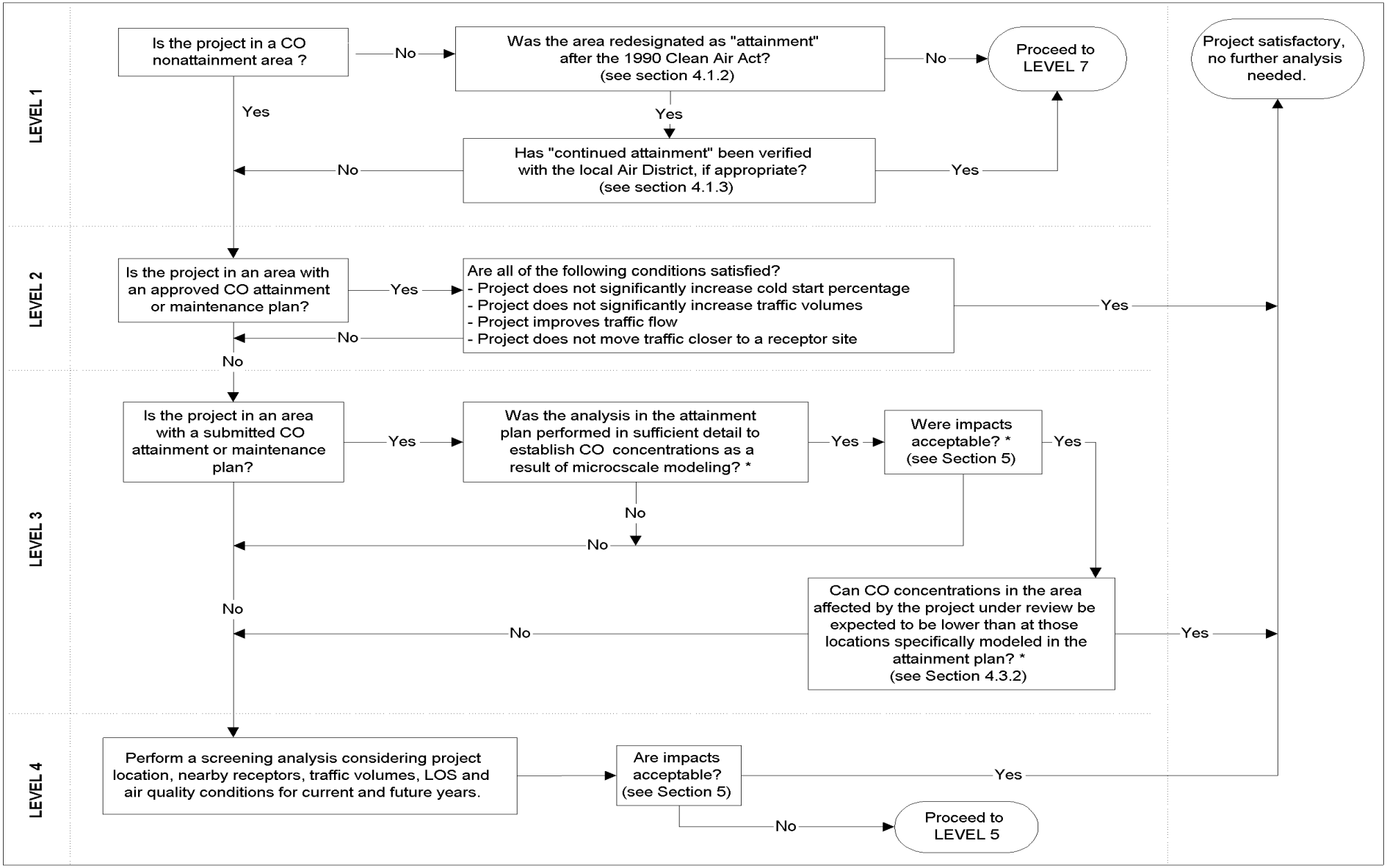


Figure 3. Local CO Analysis

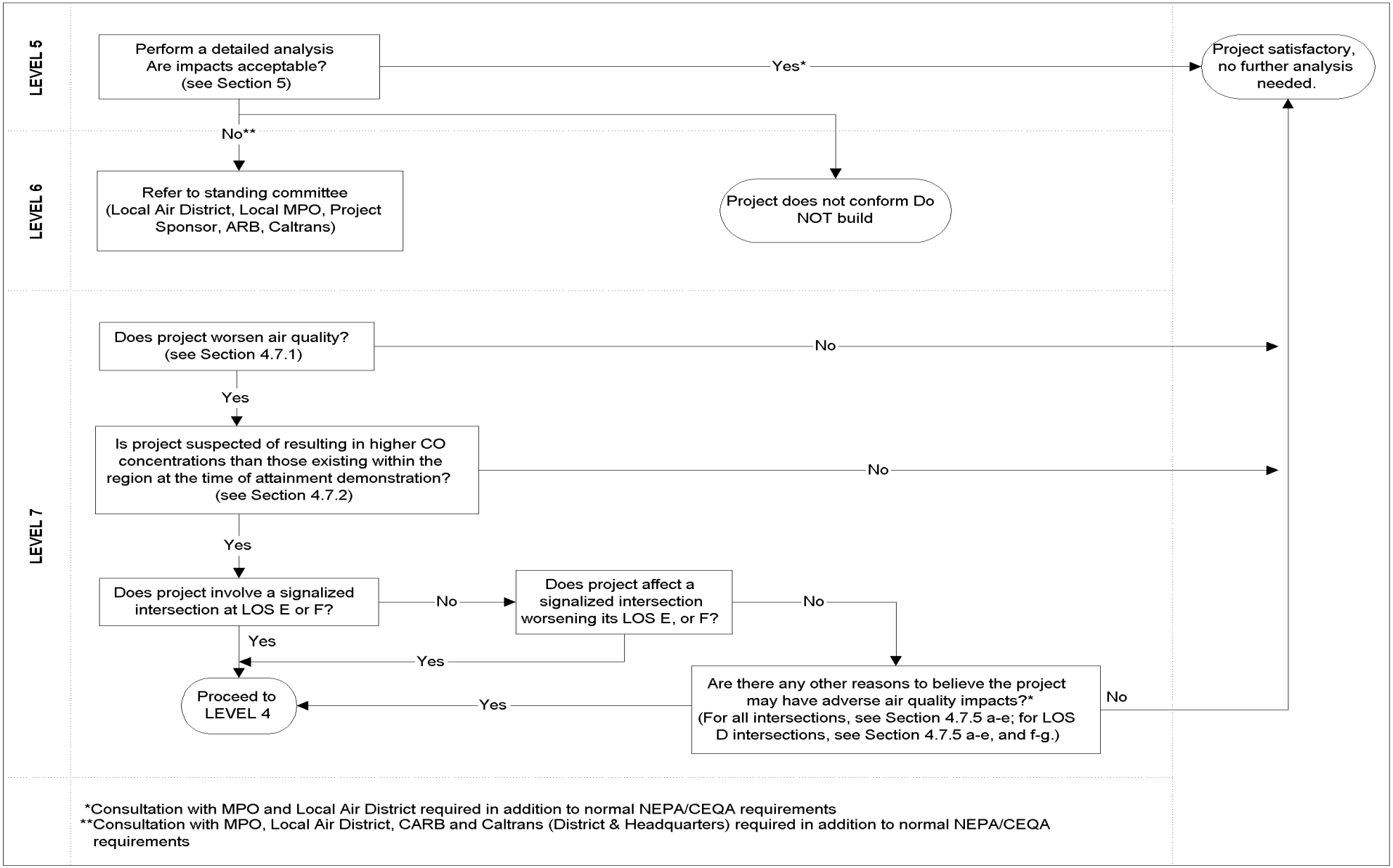


Figure 3 (cont.). Local CO Analysis

APPENDIX D TCWG PM CONFORMITY DOCUMENTATION

PM Hot Spot Analysis Project Lists

Review of PM Hot Spot Interagency Review Forms

August, 2014	Determination
201186 August 2014	Not a POAQC - Hot Spot Analysis Not Required (EPA concurrence received via email after the meeting).
SBD41339 August 2014	Not a POAQC - Hot Spot Analysis Not Required (EPA concurrence received via email after the meeting; ADDT volumes in submitted PM hot spot review form were reaffirmed by project lead via email after the meeting).
I-110offramp August 2014	Not a POAQC - Hot Spot Analysis Not Required (EPA concurrence received via email after the meeting).
20061012 August 2014 Figs_Atts 20061012 August 2014	Not a POAQC - Hot Spot Analysis Not Required (FTA and EPA concurrences received via email after the meeting).

RTIP ID# *(required)* 201186

TCWG Consideration Date: August 26, 2014

Project Description *(clearly describe project)*

The proposed Build Alternative would reconstruct and improve the existing State Route (SR) 210 diamond interchange by widening Base Line Street and the interchange ramps within the limits of the project. Regional vicinity and project location maps are provided in Figure 1 and Figure 2, respectively. The proposed Build Alternative includes the following design features and elements:

- Base Line Street between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes, and storage for vehicle queues.
- Base Line Street from Buckeye Street to Seine Avenue would generally be widened from four through lanes (two in each direction) to six through lanes (three in each direction).
- A two-lane exit would be created at the westbound exit ramp.
- The existing Base Line Street overcrossing would be widened to accommodate the new lanes.
- Retaining walls would be constructed, as needed, in areas of widening.
- The proposed project would require the acquisition of new permanent right of way and temporary construction easements (TCEs) would be needed during the construction period to facilitate access to the construction work areas.
- Drainage system improvements would be constructed to address storm water runoff.
- Storm water treatment best management practice (BMP) features would be included as part of the proposed project at select locations where identified benefits outweigh impacts.
- Ramp metering would be installed on the entrance ramps at the interchange.
- Utilities would be relocated, as needed, to accommodate the improved facility.
- Temporary construction easements (TCEs) along Base Line would be needed during the construction period.

A project layout illustration is provided in Figure 3.

Type of Project *(use Table 1 on instruction sheet)*

Reconfigure existing interchange

County	**Narrative Location/Route & Postmiles:** SR-210 at Base Line St. (PM R28.3/R30.3) **Caltrans Projects – EA#** 1C970
San Bernardino	

Lead Agency: SANBAG

Contact Person	**Phone#**	**Fax#**	**Email**
Keith Cooper	213-312-1752	213-312-1799	Keith.Cooper@icfi.com

Hot Spot Pollutant of Concern *(check one or both)* **PM2.5** ✓ **PM10** ✓

Federal Action for which Project-Level PM Conformity is Needed *(check appropriate box)*

Categorical Exclusion (NEPA)	✓ **EA or Draft EIS**	**FONSI or Final EIS**	**PS&E or Construction**	**Other**

Scheduled Date of Federal Action: 2015

NEPA Assignment – Project Type *(check appropriate box)*

Exempt	**Section 326 –Categorical Exemption**	✓ **Section 327 – Non-Categorical Exemption**

Current Programming Dates *(as appropriate)*

	PE/Environmental	ENG	ROW	CON
Start	2013	2013	2015	2017
End	2015	2015	2016	2018

Project Purpose and Need (Summary): *(attach additional sheets as necessary)*

The purpose of the proposed project is to improve the operations and reduce congestion at the existing interchange.

This area of southwestern San Bernardino County in the City of Highland has grown significantly over the past ten years and is experiencing continued population and employment growth. In particular, commercial and residential development is occurring along Base Line Street near SR-210. For example, new retail centers are planned on vacant land northwest of the interchange and on vacant parcels northeast of the interchange. The SR-210/Base Line Street interchange is an important component of the City of Highland's traffic circulation system. By the future year of 2040, traffic volumes on Base Line and the interchange ramps will increase substantially. The increasing demand for freeway access at Base Line Street is causing, and will continue to cause, congestion at the interchange ramp terminal intersections and along this segment of the Base Line Street arterial corridor. Both of the ramp terminal intersections at Base Line Street will experience increases in delay between existing and future year conditions. In particular, the evening peak hour level of service for the westbound ramp terminal intersection will degrade to level of service (LOS) E by 2040 if no improvements are implemented, which is below Caltrans' and the City of Highland's acceptable operating condition.

In addition to intersection levels of service, historical accident data appears to indicate that existing congestion and poor interchange operations may be factors contributing to higher than average accident rates on some elements at the SR-210/Base Line Street interchange. The expected increase in demand for freeway access will create additional safety concerns if improvements to the interchange are not implemented.

Surrounding Land Use/Traffic Generators *(especially effect on diesel traffic)*

As shown in Figure 3, surrounding land uses primarily include residential uses, with some commercial uses. New retail centers are planned on the vacant parcels located northwest of the interchange, and on the vacant parcels located northeast of the interchange.

Opening Year: Build and No Build LOS, AADT, % and # trucks, truck AADT of proposed facility

Build and No Build Alternative: Base Line Street project limits 2020 AADT highest estimate is 23,990, with 5% truck percentage, or 1,200 Truck AADT.

	No Build (AM/PM)	Build (AM/PM)
SR-210 EB Ramps/Base Line	B/B	B/B
SR-210 WB Ramps/Base Line	B/C	A/A

Source: URS Corporation, July 2014. Traffic Operations Report State Route 210 (SR-210) at Base Line (PM R28.3/R30.3) in the City of Highland. Prepared for SANBAG.

RTP Horizon Year / Design Year: Build and No Build LOS, AADT, % and # trucks, truck AADT of proposed facility

Build and No Build Alternative: Base Line Street project limits 2040 AADT highest estimate is 29,450, with 5% truck percentage, or 1,473 Truck AADT.

	No Build (AM/PM)	Build (AM/PM)
SR-210 EB Ramps/Base Line	C/C	C/B
SR-210 WB Ramps/Base Line	D/D	B/B

Source: URS Corporation, July 2014. Traffic Operations Report State Route 210 (SR-210) at Base Line (PM R28.3/R30.3) in the City of Highland. Prepared for SANBAG.

Opening Year: If facility is an interchange(s) or intersection(s), Build and No Build cross-street AADT, % and # trucks, truck AADT

Base Line Street at SR 210 On/Off Ramps Year 2020 Traffic Volumes (Build and No Build)			
Roadway Segment	AADT	Truck Percentage	Truck AADT
Base Line, west of interchange	17,210	5%	861
Base Line, between ramps	19,800	5%	990
Base Line, east of interchange	23,990	5%	1,200
Eastbound off-ramp	5,830	5%	292
Eastbound on-ramp	6,020	5%	301
Westbound off-ramp	6,200	5%	310
Westbound on-ramp	5,400	5%	270
Source: URS Corporation, July 2014. Traffic Operations Report State Route 210 (SR-210) at Base Line (PM R28.3/R30.3) in the City of Highland. Prepared for SANBAG.			

RTP Horizon Year / Design Year: If facility is an interchange (s) or intersection(s), Build and No Build cross-street AADT, % and # trucks, truck AADT

Base Line Street at SR 210 On/Off Ramps Year 2040 Traffic Volumes (Build and No Build)			
Roadway Segment	AADT	Truck Percentage	Truck AADT
Base Line, west of interchange	21,400	5%	1,070
Base Line, between ramps	24,370	5%	1,219
Base Line, east of interchange	29,450	5%	1,473
Eastbound off-ramp	6,730	5%	337
Eastbound on-ramp	6,920	5%	346
Westbound off-ramp	7,130	5%	357
Westbound on-ramp	7,410	5%	371
Source: URS Corporation, July 2014. Traffic Operations Report State Route 210 (SR-210) at Base Line (PM R28.3/R30.3) in the City of Highland. Prepared for SANBAG.			

Describe potential traffic redistribution effects of congestion relief *(impact on other facilities)*

The project proposes improvements to the local arterial as well as geometric improvements at the ramp termini. The project would not impact SR-210 operations or affect regional traffic demand and distribution.

Although the SR-210/Base Line interchange is predicted to operate at low Levels of Service in future years, it is not anticipated that traffic would divert to other routes. Even without development of the proposed project, the subject interchange would remain the shortest path for local travel. The Build Alternative would simply handle future vehicle volumes at a better Level of Service.

Therefore, no separate regional model runs for the No Build and Build conditions were necessary or performed since the projected No Build and Build volumes would be identical, and only the interchange geometric improvements changes would occur as part of the project.

Comments/Explanation/Details *(attach additional sheets as necessary)*

The proposed project is within a nonattainment area for the federal PM2.5 and PM10 standards. As such, hotspot analyses are required for conformity purposes for any project considered to be a project of air quality concern (POAQC) per 40 CFR 93.123(b)(1). EPA does not require hotspot analyses for projects that are not considered to be a POAQC.

The proposed project does not qualify as a POAQC because of the following reasons:

- The proposed project is not a new or expanded highway project. The project proposes improvements to an existing local arterial, and geometric improvements at existing interchange ramp termini. No traffic volume increases are anticipated to occur under the Build Alternative, when compared to the No Build Alternative.
- The LOS conditions in the project vicinity with and without the proposed project are shown above. The proposed project would result in overall improvements in LOS at opening year 2020 and at horizon year 2040.
- The proposed project does not include the construction of a new bus or rail terminal.
- The proposed project does not expand an existing bus or rail terminal.
- The proposed project is not in or affecting locations, areas, or categories of sites that are identified in the PM2.5 and PM10 applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation.

Therefore, the proposed project meets the CAA requirements and 40 CFR 93.116 without any explicit hot-spot analysis. The proposed project would not create a new, or worsen an existing, PM10 or PM2.5 violation.

Attachments:

Figure 1. Regional Vicinity Map

Figure 2. Project Location Map

Figure 3. Project Layout Map

Traffic Operations Report State Route 210 (SR-210) at Base Line (PM R28.3/R30.3) in the City of Highland (without appendices). July 2014. URS Corporation.

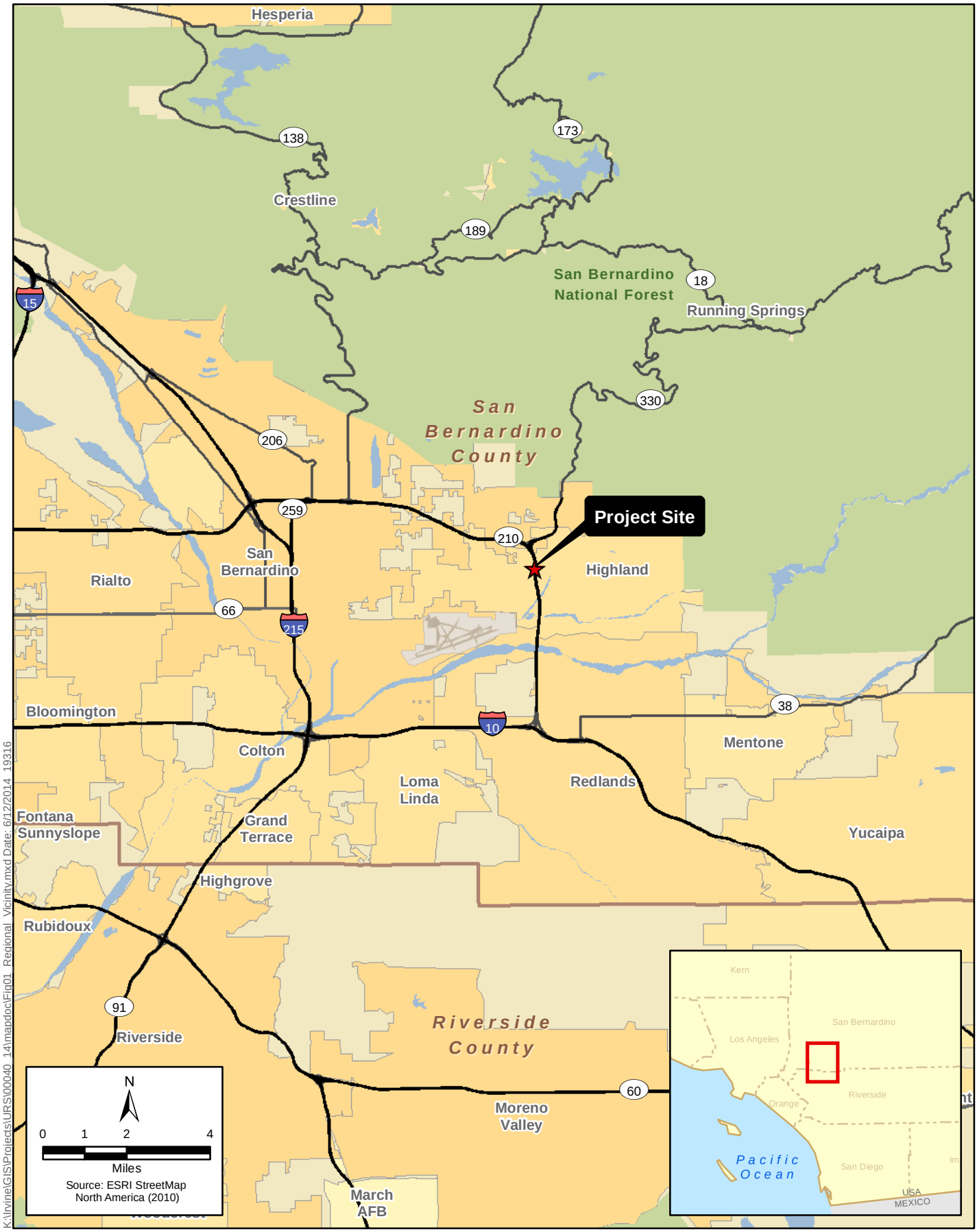


Figure 1
Regional Vicinity Map
SR-210/Base Line Interchange Project

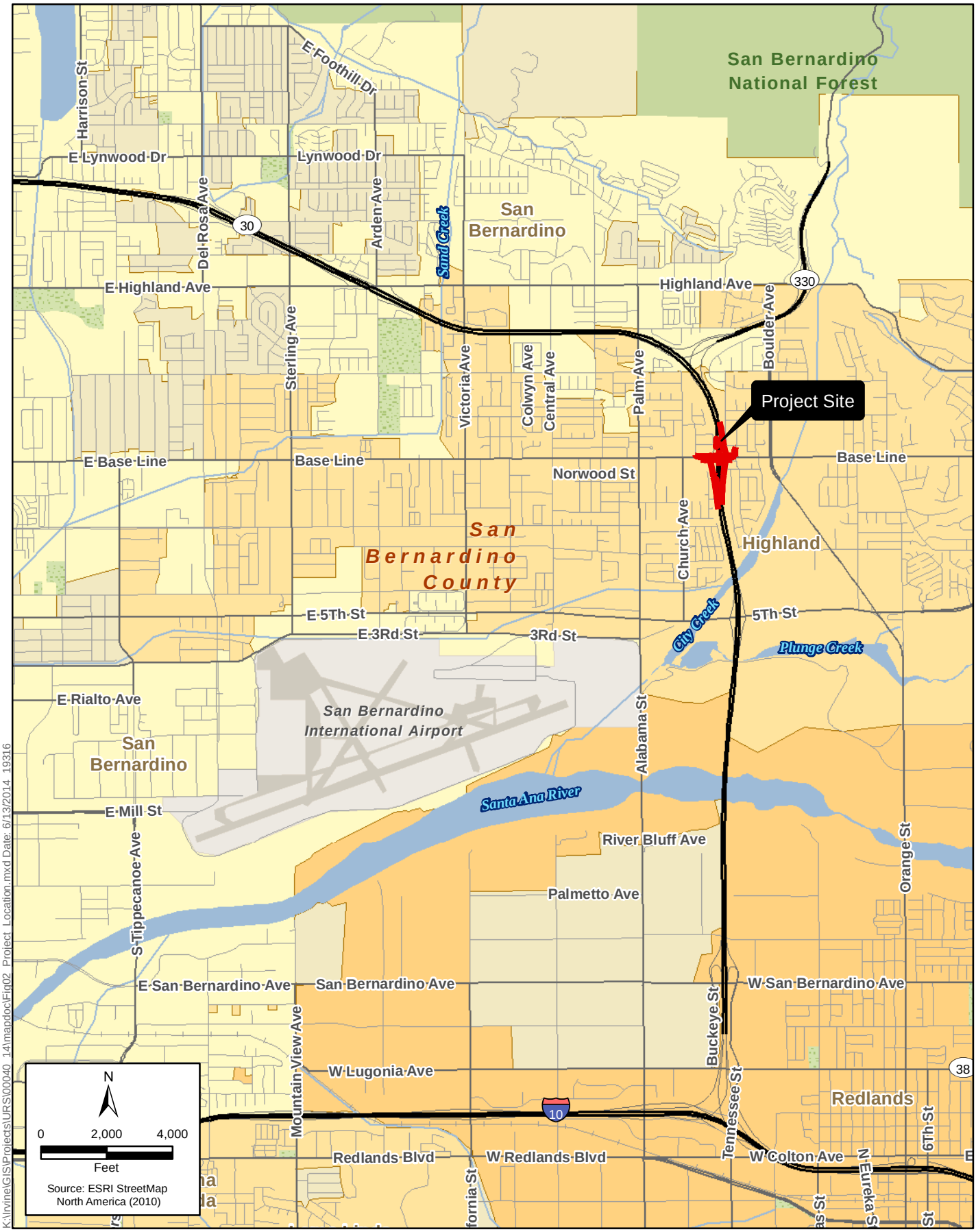
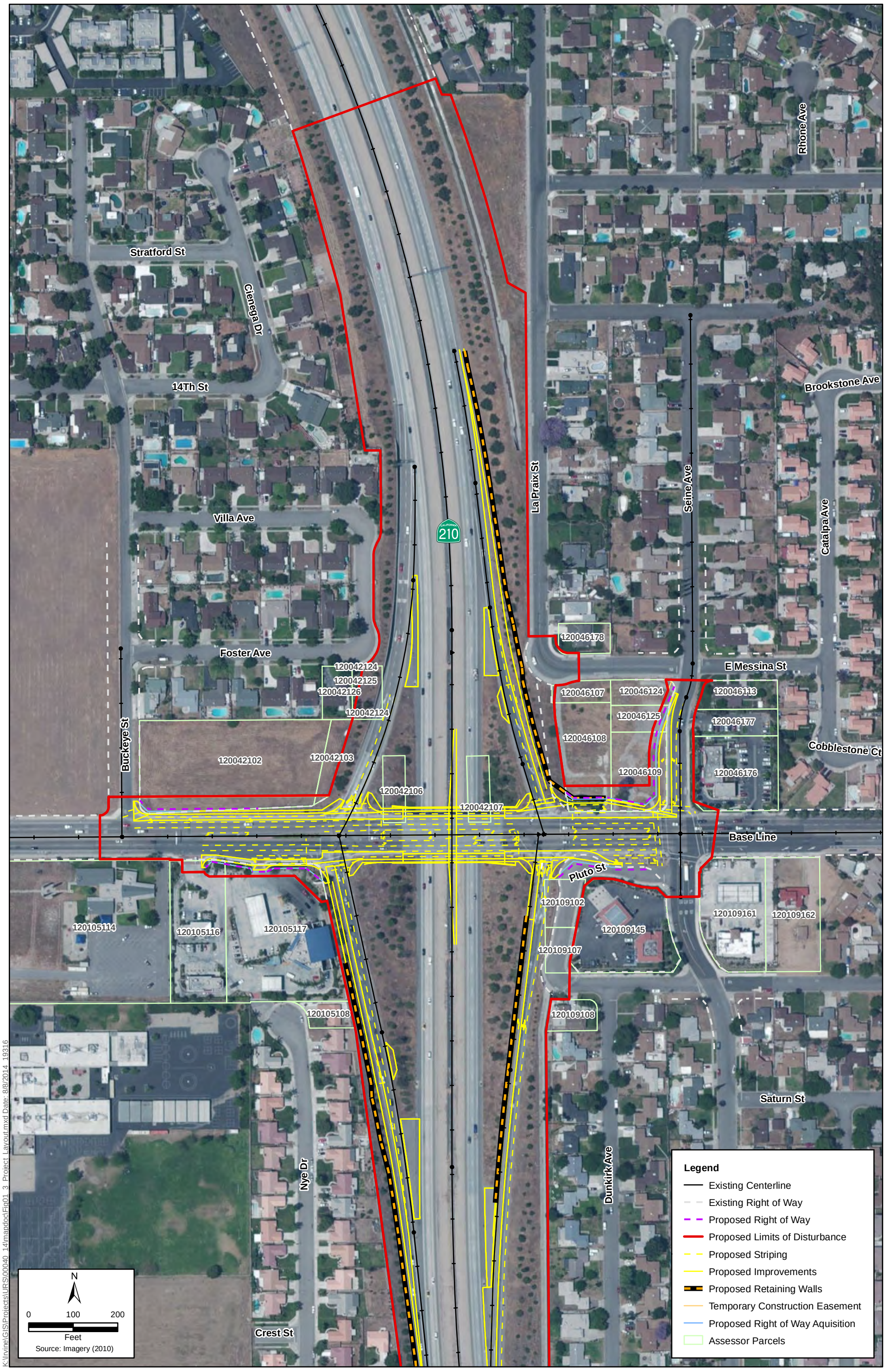


Figure 2
Project Location Map
SR-210/Base Line Interchange Project



K:\Irvine\GIS\Projects\URS\00040_14\mapdoc\Fig01_3_Project_Layout.mxd Date: 8/8/2014 19316

Figure 3 - Sheet 1
Project Layout Map
SR-210/Base Line Interchange Project

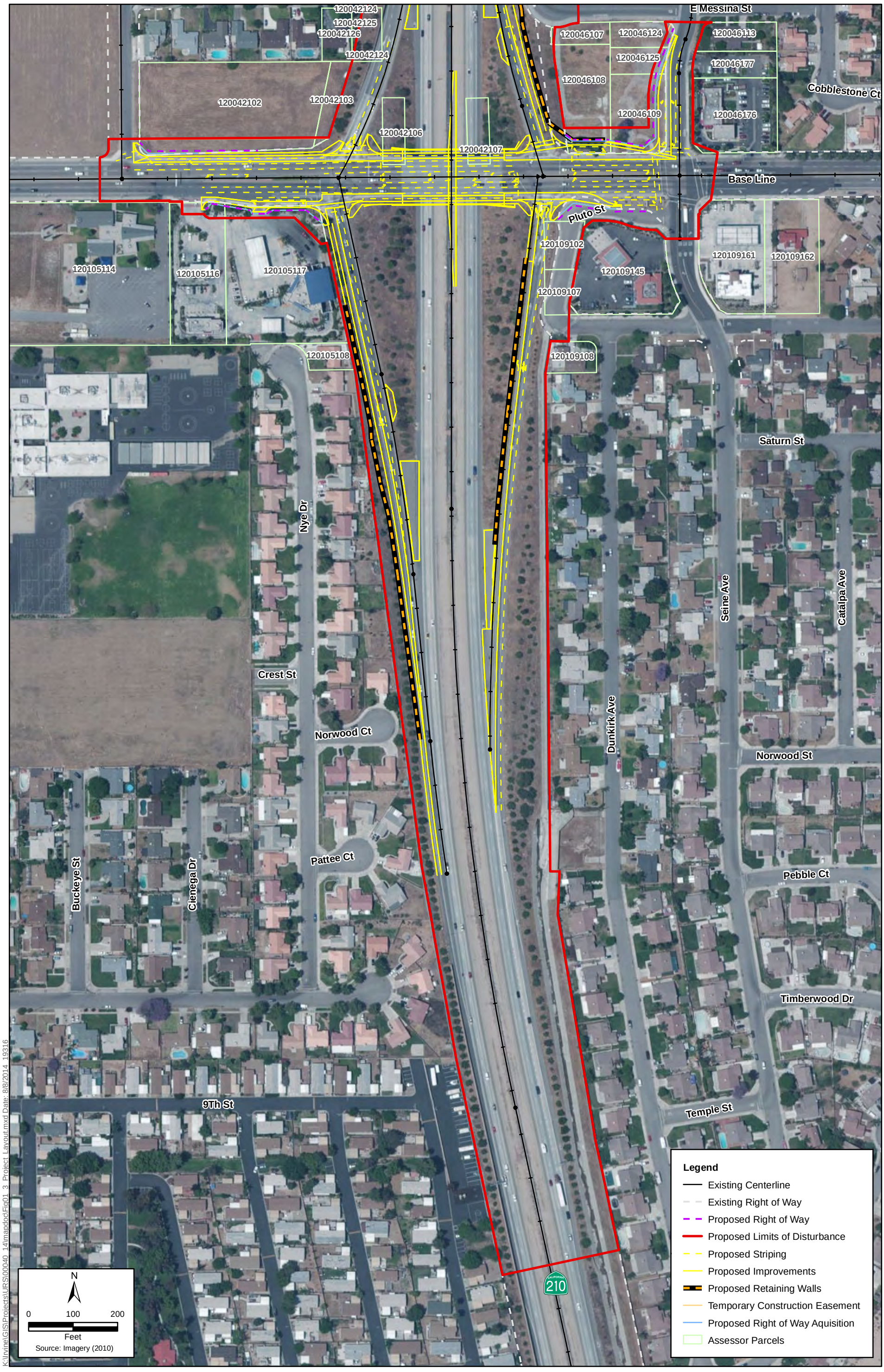


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Figure 3 - Sheet 2
Project Layout Map
SR-210/Base Line Interchange Project

TRAFFIC OPERATIONS ANALYSIS REPORT STATE ROUTE 210 (SR-210) AT BASE LINE (PM R28.3/R30.3) IN THE CITY OF HIGHLAND

EA 1C970, PROJECT NO. 0813000105

Prepared for

San Bernardino Associated Governments

In conjunction with

Caltrans – District 8

July 2014

URS

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Project Number: 29866552

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TRAFFIC OPERATIONS ANALYSIS

1.0 INTRODUCTION

This document presents the traffic operations analysis completed for the proposed improvements to the State Route 210 (SR-210)/Base Line interchange in the City of Highland. The project sponsors and stakeholders include the San Bernardino Associated Governments (SANBAG), City of Highland and the California Department of Transportation (Caltrans). The traffic study area includes an area of influence based on potential operational and/or safety concerns. This area is defined as the existing SR-210/Base Line interchange plus the first adjacent signalized intersections in either direction of the interchange ramp terminal intersections and the first adjacent interchanges on either side of the SR-210/Base Line interchange. The area of influence along the local roadway network (Base Line) encompasses Church Avenue to the west and Seine Avenue to the east. The mainline freeway area of influence extends to State Route 330 (SR-330) to the north and 5th Street-Greenspot Road to the south; however, these adjacent interchanges are not physically affected by the proposed SR-210/Base Line interchange improvements.

Traffic volumes were developed for three scenarios:

- Existing 2013 traffic,
- Opening Year 2020 traffic and
- Horizon Year 2040 traffic.

Traffic operations on Base Line and at the interchange were analyzed for each of these three scenarios for the No Build Alternative, and for the Build Alternative in Opening Year 2020 and Horizon Year 2040. Mainline freeway operations were analyzed under Horizon Year 2040 Build and No Build conditions to demonstrate the relationship of the proposed project with adjacent freeway segments and interchanges.

Under the No Build Alternative, Base Line would not be widened through the interchange and the existing diamond interchange would remain unimproved.

The proposed project would widen Base Line from Buckeye Street to Seine Avenue and widen the existing interchange ramps in the City of Highland. Within the limits of the proposed project, Base Line is generally a four-lane arterial with turn lanes at intersections. The purpose of the proposed project is to reduce congestion and improve operational efficiency at the interchange and throughout the Base Line corridor. The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and the interchange ramps within the limits of the project. The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes and storage for vehicle queues.
- A two-lane exit would be created at the westbound exit ramp.
- The existing Base Line overcrossing would be widened to accommodate the new lanes.
- Ramp metering would be installed on the entrance ramps at the interchange.

1.1 Background

The City of Highland has been developing a master plan for Base Line to establish the ultimate build-out of this critical gateway arterial corridor within the City. The plan extends approximately one mile west and one mile east of the SR-210 interchange, from Palm Avenue on the west to Boulder Avenue on the east. The City identified the existing Base Line interchange to be a critical segment of the arterial corridor. Therefore, in September 2010, the City of Highland completed a detailed study of this segment of the Base Line corridor through the existing SR-210 interchange area and beyond titled, Base Line 2040 Master Plan Configuration Traffic Study (Master Plan Study). The Master Plan Study considered four possible alternatives through the interchange area:

- No Build
- Modified Interchange Configuration
- Proposed Minimal Improvements
- Additional Improvements

The Modified Interchange Configuration contemplated a complete reconstruction of the existing SR-210/Base Line interchange; however that alternative was dropped from further study due to the significant right of way impacts, business and residential relocations, replacement of the existing overcrossing and high costs. The Proposed Minimal Improvements alternative essentially would implement the recommended intersection improvements identified in the City's Preferred General Plan. At the interchange, this includes two eastbound through lanes, three westbound through lanes and one full length left turn pocket and one back-to-back left turn pocket in each direction on the Base Line overcrossing. The Additional Improvements alternative included the same improvements as the Proposed Minimal Improvements alternative, plus additional widening of the Base Line overcrossing to provide two full length left turn pockets in each direction (in lieu of the back-to-back configuration) and three through lanes in the eastbound direction (in lieu of only two).

The Master Plan Study concluded that the Additional Improvements alternative did not provide an appreciable improvement in level of service over the Proposed Minimal Improvements option. The Master Plan Study recommended that the Proposed Minimal Improvements alternative be advanced and that further coordination with Caltrans be initiated to identify interchange ramp and/or mainline improvements that may be necessary elements of the complete circulation system.

In August 2012, SANBAG, working with the City of Highland, performed a cursory analysis of the Master Plan Study, with an emphasis on the interchange ramps and freeway operational aspects of the Proposed Minimal Improvements alternative. In general, SANBAG confirmed the improvements proposed by the City of Highland. In addition, SANBAG's study recommended the following additional improvements:

- Provision of a two-lane exit at the westbound exit ramp connection to the mainline freeway
- Addition of ramp meters on the entrance ramps
- Widening the entrance ramps to provide HOV preferential lanes
- Provision of a third turn lane at the westbound exit ramp terminal intersection at Base Line

It was determined that the City of Highland's Master Plan Study – Proposed Minimal Improvements alternative coupled with the additional features identified by the SANBAG analysis would provide for adequate operations at the interchange through the Horizon Year 2040.

In February 2014, a Traffic Operations Analysis Report (TOAR) for the SR-210 Mixed Flow Lane Addition Project from Highland Avenue (PM R25.0) to San Bernardino Avenue (PM R33.2) in San Bernardino County was approved by Caltrans. The freeway widening project also includes the creation of auxiliary lanes between the Base Line interchange and the 5th Street-Greenspot Road interchange and an eastbound acceleration lane at the 5th Street entrance ramp and an eastbound deceleration lane at the Highland Avenue exit ramp. It is anticipated that the mainline freeway lane addition project will be constructed by 2020. The SR-210/Base Line interchange lies within this segment of the SR-210 proposed widening.

Finally, a traffic forecasting methodology memorandum titled, SR-210/Base Line Interchange Improvement Project – Traffic Forecasting Memorandum (Forecasting Memo), dated October 30, 2013 was prepared to identify the detailed procedures to be used in developing the traffic volumes for use in the traffic operations analysis of the SR-210/Base Line interchange. In addition to the step-by-step methodologies presented in the Forecasting Memo, the Existing, Opening Year and Horizon Year traffic volumes were also documented in the Forecasting Memo. The Forecasting Memo was approved by Caltrans on February 6, 2014.

Base Line

The City of Highland General Plan circulation element designates Base Line within the limits of the project as a Primary Arterial. Within the study area, Base Line is designated as a Truck Route with a Class II Bike Lane (on-street) in the City of Highland General Plan. The existing Base Line overcrossing consists of two lanes in each direction plus westbound and eastbound double left turn lanes.

Beyond the limits of the freeway interchange, the City of Highland is considering widening improvements at certain locations to implement other elements of the City's arterial corridor master plan. Some of those improvements have already been designed and are anticipated to be constructed by the end of 2014. These include a dedicated eastbound right turn pocket on Base Line approaching Seine Avenue and an additional northbound left turn pocket (total of two) on Seine Avenue approaching Base Line.

Other improvements in the City's master plan beyond the interchange are also being considered by the City, but there is no firm funding or scheduling commitment for implementation of these remaining corridor elements. These improvements include expanding the Base Line intersections at Church Avenue and at Buckeye Street, widening Base Line from four through lanes to six through lanes between Church Avenue and Buckeye Street, widening eastbound Base Line to three lanes between Seine Avenue and Stoney Creek Drive, widening Base Line to add a westbound shared through-right turn lane approaching the Seine Avenue intersection and installation of various raised medians throughout the Base Line corridor. Because of the uncertainty of any or all of these future improvements, the traffic operational analyses prepared in this study assume that none of these other improvements will be constructed. The results presented in this study are therefore, conservative and not dependent on other projects that would not be in the direct control of the interchange project sponsors and stakeholders. This assumption also provides stronger independent utility for the interchange project.

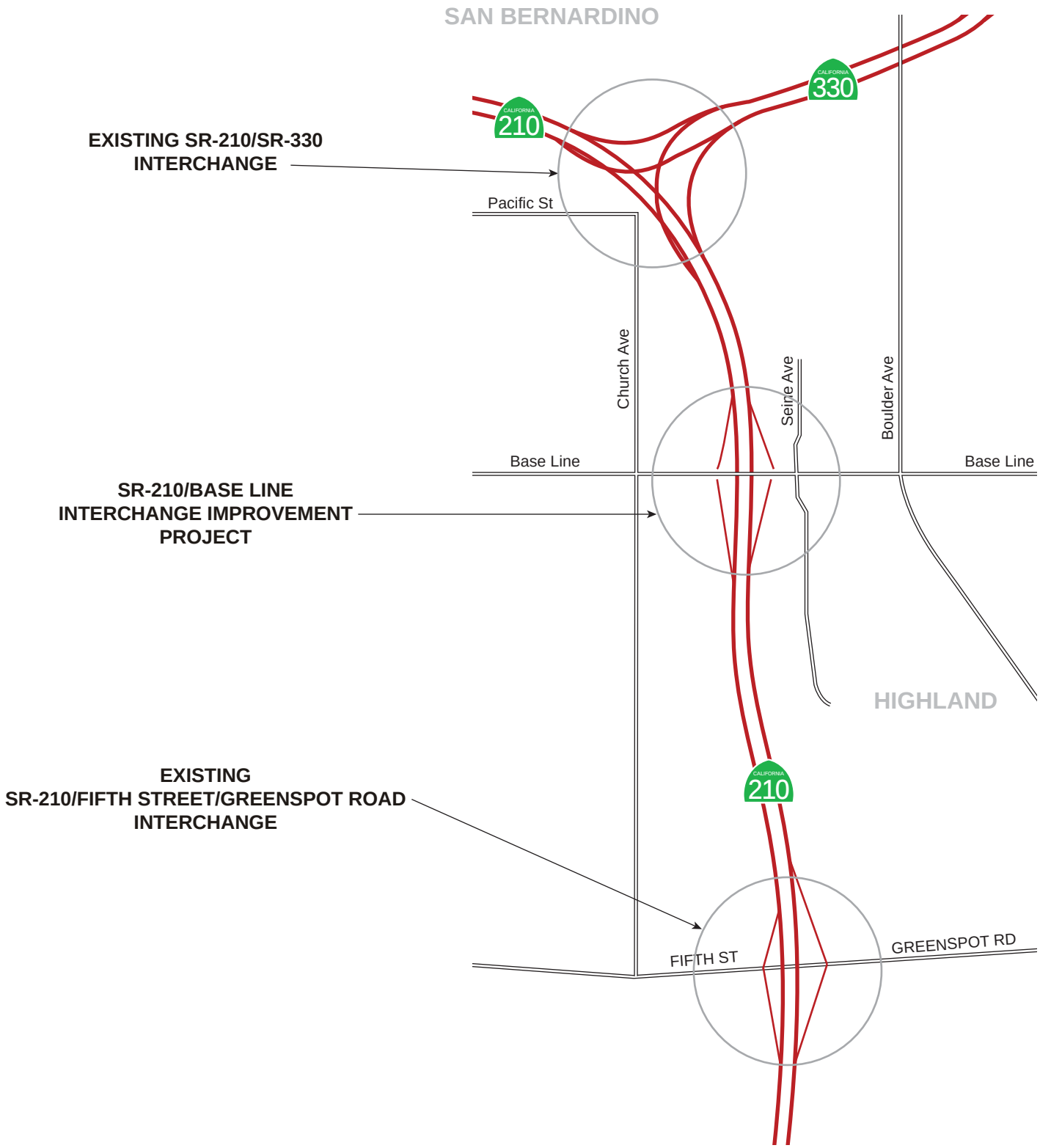
State Route 210 (SR-210)

The SR-210/Base Line interchange is located in the City of Highland and serves growing residential and commercial development in the City. SR-210 is an east/west freeway, and it traverses in a generally northwest/southeast direction, diagonally through the western portion of the City. To the north and west, SR-210 continues through San Bernardino County and is the link to the I-215 and I-15 Freeways and State Routes 18 and 57, and the greater Los Angeles area. To the south, SR-210 continues through San Bernardino County and connects to the I-10 Freeway. Adjacent interchanges exist on SR-210 at SR-330 to the north and at 5th Street–Greenspot Road to the south. The project location map is illustrated in **Figure 1**.

SR-210 in San Bernardino County is included in the National Highway System, the California Freeway and Expressway System and the "12 foot Wide Arterial System". The SR-210, within the project limits, is classified as a Principal Arterial highway.

State Route 330 (SR-330)

State Route 330 (SR-330) is a 15-mile freeway/conventional two-lane highway where the westerly segment begins at the junction of the SR-210 and extends northeasterly to SR-18. SR-330 is generally considered a conventional two-lane highway since only the initial one mile segment from the junction at SR-210 is constructed to freeway standards. SR-330 is located within San Bernardino County and is utilized as one of the main accesses into the cities of Big Bear and Lake Arrowhead. Access from east/westbound SR-210, onto northbound SR-330 is provided via connector ramps and access onto east/westbound SR-210 from southbound SR-330 is provided also via connector ramps. Where SR-330 connects to SR-210, there are existing auxiliary lanes on SR-210 in both the eastbound and westbound directions between SR-330 and the Base Line interchange.



PROJECT LOCATION MAP

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

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	PM: DS	PROJECT NO: 29866552	

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2.0 EXISTING AND FUTURE YEAR TRAFFIC VOLUMES

2.1 Existing Traffic Volumes

Existing traffic counts including AM and PM peak hour turning movement counts at all study area intersections and 24-hour daily traffic counts at locations in the project area were conducted in June 2013 by National Data and Surveying Services (NDS) and attached as Appendix A. To adjust the traffic volumes to a March 2013 count (spring 2013) when school was in session, a seasonal adjustment factor was estimated and applied to the existing traffic counts. Based on traffic data from Caltrans PEMS for March and June in year 2013, the peak hour average traffic volumes in March 2013 are approximately 7% higher than the peak hour average traffic volumes in June 2013. Therefore, a seasonal adjustment factor of 1.07 was estimated and applied to the June 2013 traffic counts to provide 2013 seasonal adjusted traffic counts for use as the existing 2013 traffic volumes in this study. **Table 1** shows the PEMS traffic data used to estimate the seasonal factor.

Table 1: Caltrans PEMS Traffic Data and Seasonal Factor

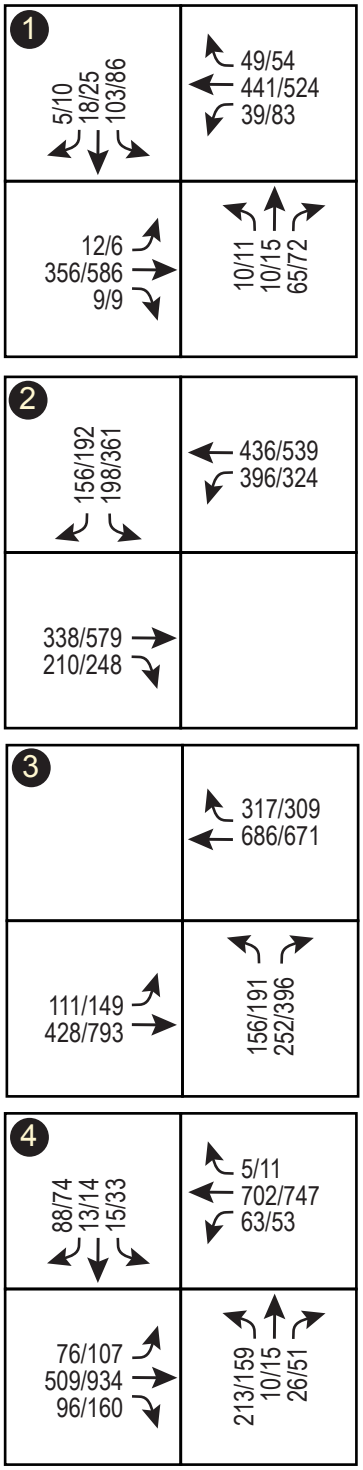
	Average Peak Hour Volumes (vph) [1]							
	EB SR-210				**WB SR-210**			
	March		**June**		**March**		**June**	
	AM	PM	AM	PM	AM	PM	AM	PM
Base Line Off-Ramp	456	843	417	780	772	539	728	541
Base Line On-Ramp	341	568	284	569	688	469	593	472
Sum March								*4,676*
Sum June								*4,383*
Ratio (March / June)								**1.07**

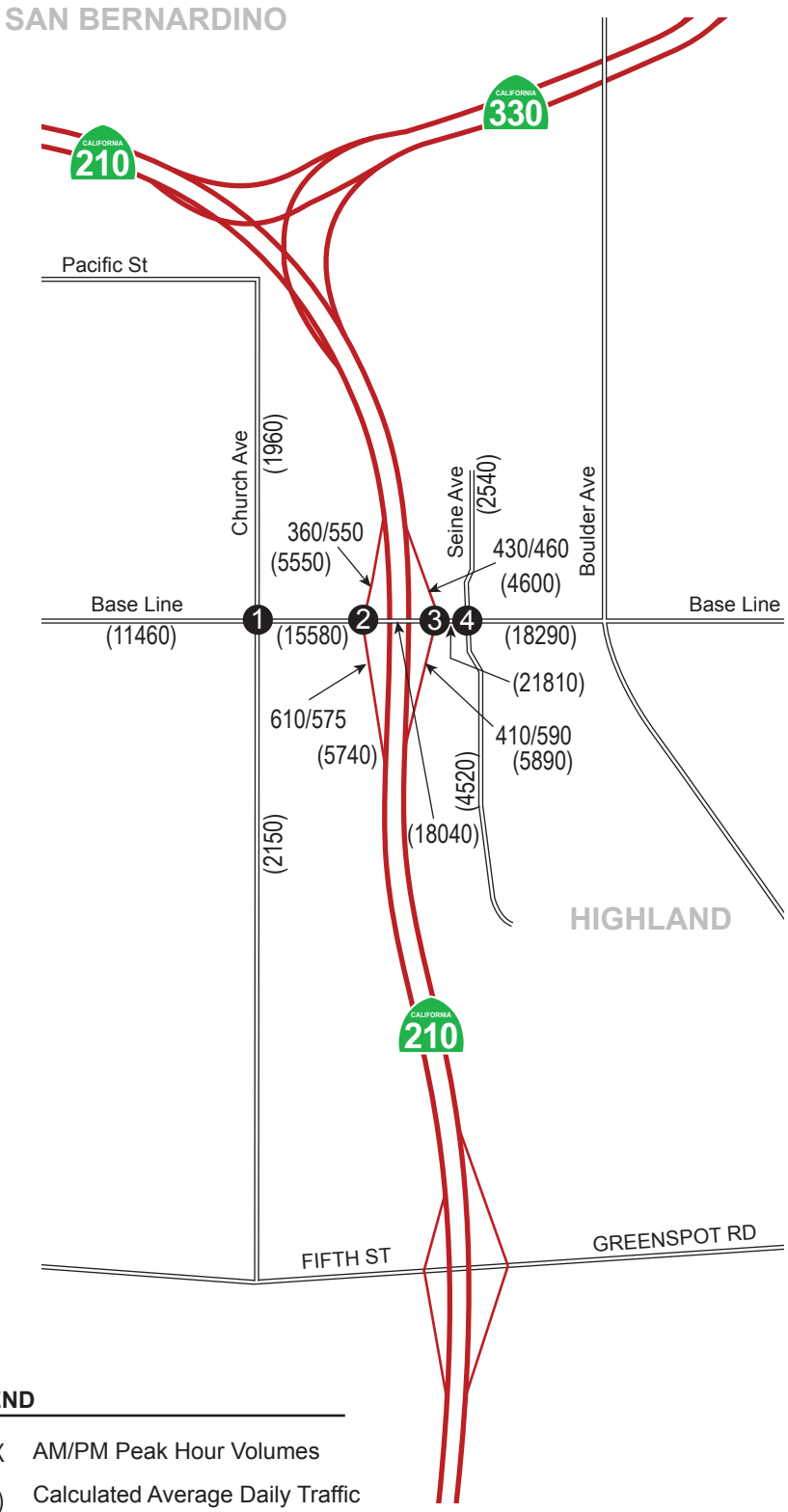
Note 1. Based on Year 2013 monthly peak hour average PEMS data. Vph = vehicles per hour.

The 2013 existing seasonal adjusted 2013 AM and PM peak hour volumes for this study area including turn movements at the study intersections are illustrated in **Figure 2**, and the traffic counts are provided in the Appendix A.

2.2 Future Year Traffic Volume Forecasts

A traffic forecast model was developed by the San Bernardino Associated Governments (SANBAG) specifically for use within San Bernardino County. The current SANBAG model is a sub-regional (subset) of the regional Southern California Associated Governments (SCAG) Model and incorporates more refined local details otherwise not included in larger scale regional models. The SANBAG Model incorporates elements of the most recent Regional Transportation Plan (RTP), 2012-2035.





LEGEND

XX/XX	AM/PM Peak Hour Volumes
(XX)	Calculated Average Daily Traffic (ADT) Volumes.

EXISTING YEAR 2013 TRAFFIC VOLUMES

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

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CREATED BY: SV	DATE: April 2014	FIGURE 2
PM: DS	PROJECT NO: 29866552	

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The development of the San Bernardino County Transportation Analysis Model (SBTAM) was completed in June 2012, in partnership with Southern California Association of Governments (SCAG). SANBAG currently has the 2008 and 2035 SBTAM traffic model networks applicable for the proposed project study area.

The forecasted traffic volume model plots from the 2008 and 2035 SBTAM traffic demand models were utilized for the project study area. Review of the 2008 SBTAM traffic demand model found the 2008 SBTAM model traffic volumes at the SR-210/Base Line interchange to be significantly higher than traffic counts conducted at the interchange in both 2011 and 2013. The high model traffic volumes at the SR-210/Base Line interchange were discussed with SANBAG on October 28, 2013. SANBAG concluded that the travel demand model volumes were not calibrated for this interchange and the model forecasting would need to be adjusted. As a result, growth rates from the 2008 and 2035 SBTAM models were calculated. These growth rates were applied to the seasonal adjusted 2013 traffic counts to develop forecasted traffic volumes. A more detailed discussion of the forecasting methodology is presented in the SR-210/Base Line Interchange Improvement Project – Traffic Forecasting Memorandum, dated October 30, 2013.

The growth rate derived traffic forecasts were post-processed to develop Opening Year 2020 and Horizon Year 2040 traffic volume projections. Both AM and PM peak hour turning movement volumes were post-processed at each study intersection using the design year (2040) peak hour approach and departure volumes in conjunction with the seasonal adjusted existing (2013) turning movement volumes.

The following steps outline the traffic forecasting methodology and post-processing used to estimate the Opening Year 2020 and Horizon Year 2040 traffic volume forecasts:

- The growth between the 2008 and 2035 SBTAM travel demand model volumes was used to determine the overall growth between 2008 and 2035 accounting for 27 years of growth. This growth in traffic volumes was used to determine annualized growth rates, which ranged between 1.5 to 2.5 percent per year, for the interchange and along the Base Line corridor.
- Growth factors were estimated based on the annualized growth rates from the SBTAM models. These growth factors were applied to the Existing 2013 seasonal adjusted traffic volumes to develop Opening Year 2020 and Horizon Year 2040 projected traffic volumes.
- The growth rate derived traffic volume forecasts were post-processed in developing Opening Year 2020 and Horizon Year 2040 traffic volume projections. Both AM and PM peak hour turning movement volumes were post-processed at each study intersection using the future year (Opening Year 2020/Horizon Year 2040, as appropriate) peak hour approach and departure volumes in conjunction with the seasonal adjusted existing (2013) turning movement volumes.
- The AM and PM peak hour traffic volumes were balanced between intersections using the peak hour directional approach and departure volumes at the study area intersections.

The post-processed peak hour volumes for Opening Year 2020 and Horizon Year 2040 are presented later in this report.

The project proposes improvements to the local arterial as well as geometric improvements at the ramp termini. The project would not impact SR-210 operations or affect regional traffic demand or distribution. Therefore, no separate regional model runs for No Build and Build conditions are necessary since the No Build and Build volumes are identical and only the interchange geometric improvement changes occur as part of the project.

3.0 ANALYSIS METHODOLOGIES

This report evaluates traffic operations at the SR-210/Base Line interchange and along the Base Line corridor in the study area under Existing 2013 conditions, Opening Year 2020 and Horizon Year 2040 conditions. The Base Line arterial corridor and intersecting interchange ramps are analyzed for improvements. The freeway ramp junctions and adjacent mainline freeway segments are considered to ensure that proposed improvements at the interchange will not have negative impacts on the mainline freeway or adjacent interchanges.

3.1 Intersection Operations

Intersection levels of service were calculated using the HCM analysis methodologies, using the Synchro 8 software, which accounts for the effects of signal coordination and platoon formation on intersection operations. Traffic signal timing was optimized using Synchro 8. Network cycle lengths between 60 seconds to 120 seconds at 10 second intervals were first analyzed and evaluated. A common network cycle length was selected for optimization based upon several measures of effectiveness such as performance index, total delay, total stops and unserved vehicles. Next, network offsets along with the phase splits at the study intersections were optimized.

The average control delay per vehicle is estimated for each lane group and aggregated for each approach and for the intersection as a whole. Level of service is directly related to the control delay value. The level of service criteria are listed in **Table 2** for signalized intersections.

Table 2: Level of Service (LOS) Criteria for Signalized Intersections

LOS	Control Delay per Vehicle (sec/veh)
A	≤ 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

Source:
Exhibit 18-4 from Highway Capacity Manual 2010.

3.2 Basic Freeway Segment Operations

A basic freeway segment is a freeway mainline segment that is not within a ramp influence area (i.e., within 1,500 feet of a ramp) or within a weaving segment. Adding or dropping a lane results in the termination of a basic freeway segment. Peak hour volumes on basic freeway segments are analyzed using the methodology contained in HCM Chapter 11 ("Basic Freeway Segments"), with calculations performed using the Highway Capacity Software (HCS 2010). Level of service criteria for basic freeway segments are given in **Table 3**.

Table 3: LOS Criteria for Basic Freeway Segments

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	Demand exceeds capacity >45

Source:
Exhibit 11-5 from Highway Capacity Manual 2010.

3.3 Weaving Segments

A weaving segment is a freeway mainline segment in which two streams of traffic must cross, such as in an auxiliary lane connecting an upstream on-ramp to a downstream off-ramp. The segment is evaluated if the weaving length is less than the maximum length as calculated by the equation listed below.

$$L_{MAX} = [5{,}728(1 + VR)^{1.6}] - [1{,}566N_{WL}]$$

Peak hour volumes in freeway weaving sections are analyzed using the methodology contained in HCM Chapter 12 ("Freeway Weaving"). A weaving segment, in which both weaving movements require a single lane change, such as in an auxiliary lane between a single-lane on-ramp and single-lane off-ramp, is a "Type A" weaving segment. A weaving segment in which one weaving movement requires a single lane change and the other weaving movement can be made without any lane change, such as in an auxiliary lane between a single-lane on-ramp and a two-lane off-ramp, is a "Type B" weaving segment. Consistent with Highway Capacity Manual procedures, a segment consisting of a one-lane on-ramp closely followed by a one-lane off-ramp without connecting auxiliary lane is not analyzed as a weaving segment, but as separate merge and diverge areas (Highway Capacity Manual, p. 12-16). Level of service criteria for weaving segments are listed in **Table 4**.

Table 4: LOS Criteria for Weaving Segments

LOS	Density (pc/mi/ln)	
	Freeway Weaving Segment	Multilane and Collector-Distributor Weaving Segments
A	0-10	0-12
B	> 10-20	> 12-24
C	> 20-28	> 24-32
D	> 28-35	> 32-36
E	> 35	> 36
F	Demand Exceeds Capacity	

Source:
Exhibit 12-10 from Highway Capacity Manual 2010.

3.4 Ramp Connection Merge/Diverge Areas

The merge/diverge analysis methodology consists of three primary steps. The first step calculates the flow entering the outer two lanes of the freeway immediately upstream of the merge influence area or at the beginning of the deceleration lane of the diverge influence area. The influence area for ramps and ramp junctions is 1,500 feet, including the acceleration and deceleration lane along with the outer two lanes of the freeway. Chapter 13 ("Ramps and Ramp Junctions") of the HCM indicates that other freeway lanes may be affected by merging or diverging maneuvers, but the defined area within the 1,500 feet generally experiences most of the impacts across all levels of service.

The second step compares capacity values with the demand flows in order to determine potential for congestion. There are several capacity values that are evaluated that include: maximum total flow approaching a diverge area on the freeway, maximum total flow departing from a merge or diverge area on the freeway, maximum total flow entering the ramp influence area, and maximum flow on a ramp. The capacity of a merge or diverge area is controlled by the capacity of the freeway segments upstream and downstream of the ramps or by the capacity of the ramp itself.

The third step calculates the density of flow within the ramp influence area and the level of service based on the density is determined. The level of service is represented by LOS A through LOS E. Although a density value is determined, LOS F occurs when the total demand flows exceed any of the capacity checks. Level of service criteria for merge and diverge areas are listed in **Table 5**. The density values shown for LOS A through LOS E assume stable operation, with no breakdown within the merge influence area.

Table 5: LOS Criteria for Merge and Diverge Areas

LOS	Density (pc/mi/ln)
A	≤ 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	Demand exceeds capacity

Source:
Exhibit 13-2 from Highway Capacity Manual 2010.

3.5 Queuing Analysis

Queuing analyses were conducted for the two ramp terminal intersections on Base Line at SR-210 and for the intersection of Base Line and Seine Avenue using Synchro Analysis software consistent with HCM 2010 analysis methodology. The queuing analyses compare the minimum required storage lengths to the storage lengths provided for the analyzed intersections.

The minimum required storage lengths are based on the 95th percentile queue lengths as calculated in the Synchro queuing worksheets. Synchro reports the 95th percentile queue length for a single lane of a lane group (highest queue length considering all lanes of the lane group) and not the total queue length of all lanes in that lane group.

The provided storage lengths for an intersection are measured from the limit line to the end of the bay taper for turn movements. For off-ramps, the provided storage lengths are measured from the off-ramp exit gore point to the crosswalk if it is a continuous lane. If turn lane (left or right) pockets are provided at the end of the off-ramp, then the provided storage lengths are measured from the limit line to the end of the bay taper for that turn lane.

3.6 Ramp Meter Queuing Analysis

Ramp metering analyses were conducted for ramp metering conditions for the Horizon Year 2040 Build Alternative scenario. The ramp metering analysis spreadsheets are set up for both AM and PM peak period conditions. Additionally, the ramp lanes, an average vehicle length, and the ramp storage length are input for each ramp. A ramp metering discharge rate (vehicles per hour per lane) between 240 and 900 vph/lane is used by Caltrans. For on-ramps, the provided storage lengths are measured from the crosswalk to the ramp meter limit line.

4.0 EXISTING 2013 TRAFFIC CONDITIONS

4.1 Intersection Levels of Service

The existing seasonal adjusted traffic counts for the AM and PM peak hours were input into Synchro along with the existing intersection geometric configurations and parameters such as peak hour factors (PHF), percent heavy vehicles, signal timing, etc. The levels of service at the study intersections under existing conditions are summarized in **Table 6** and the level of service calculation worksheets are contained in Appendix B.

Table 6: Existing 2013 Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	18.8	B	20.2	C
2	SR-210 EB ramps/Base Line	18.5	B	17.1	B
3	SR-210 WB ramps/Base Line	25.6	C	18.4	B
4	Base Line/Seine Avenue	20.1	C	24.3	C

Notes:
1. Used Highway Capacity Manual 2010 methodology.
2. Analysis was performed using existing lane geometry and traffic controls.
3. Existing volumes based on counts conducted in June 2013 with a seasonal factor.

As shown in **Table 6**, all study area intersections are currently operating at LOS C or better during the existing conditions in both the AM and PM peak hours.

5.0 OPENING YEAR 2020 TRAFFIC CONDITIONS

5.1 Opening Year 2020 Projected Traffic Volumes

Opening year traffic volumes were developed for the Year 2020 using the methodology described in the Future Year Traffic Volume Forecasts section of this report. The Opening Year 2020 ramp peak hour volumes at Base Line and turn movements at study intersections along Base Line are illustrated on **Figure 3**. Traffic volumes for both No Build and Build conditions are the same, because the project does not appreciably affect mainline or local traffic demand.

5.2 Opening Year 2020 No Build Alternative Traffic Conditions

The 2020 No Build analysis includes the improvements described previously at the Base Line/Seine Avenue intersection, which are being constructed by the City of Highland and should be complete by the end of 2014.

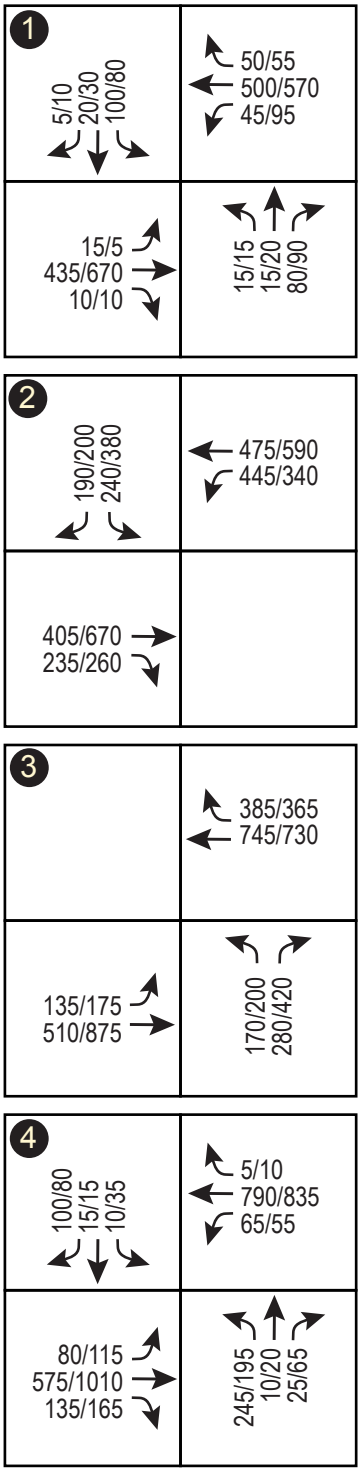
The level of service results at the study intersections under Opening Year 2020 No Build conditions are summarized in **Table 7**. Level of service calculation worksheets are contained in Appendix B.

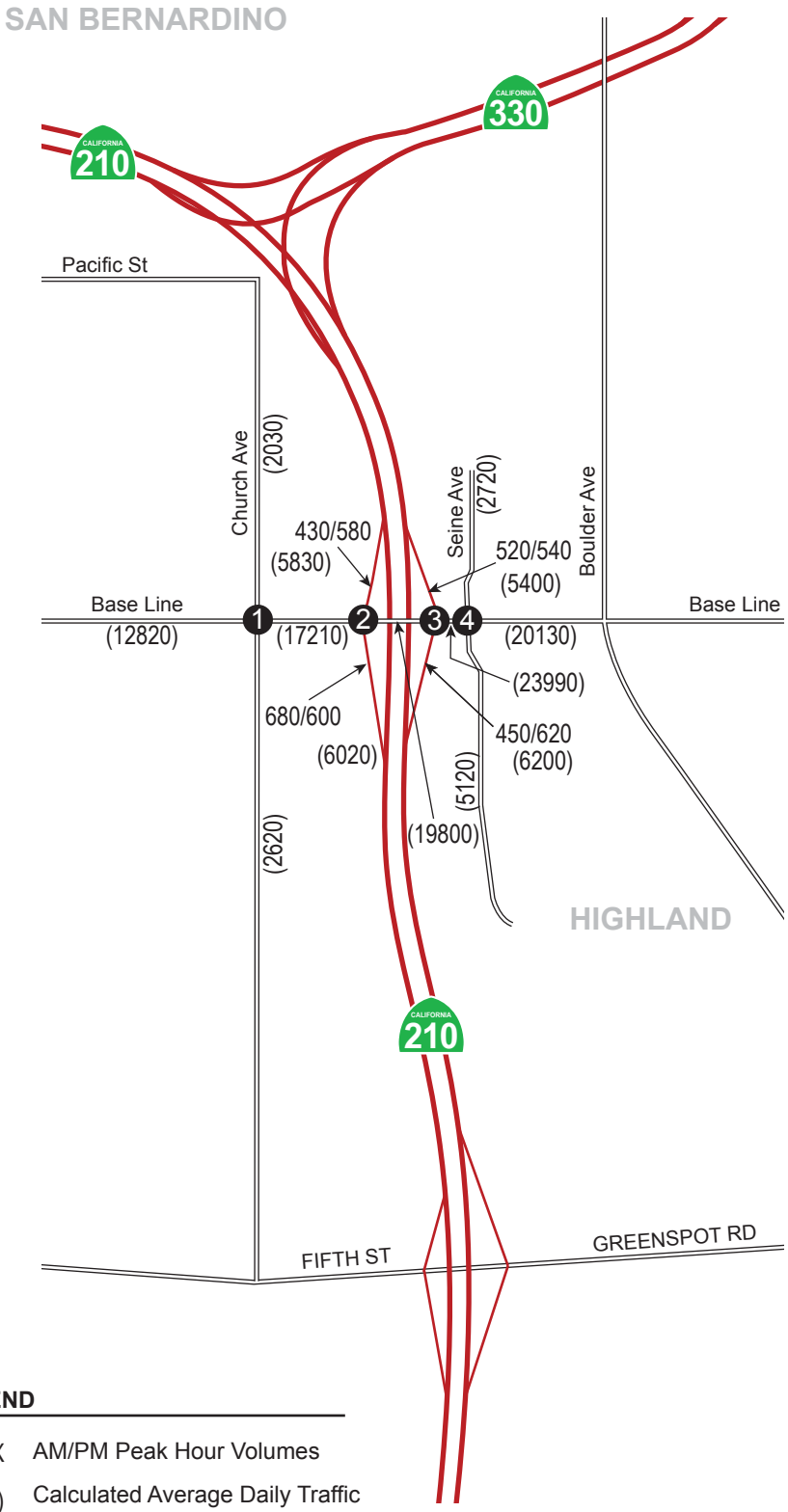
Table 7: Opening Year 2020 No Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	19.0	B	16.9	B
2	SR-210 EB ramps/Base Line	18.5	B	19.0	B
3	SR-210 WB ramps/Base Line	19.6	B	26.9	C
4	Base Line/Seine Avenue	25.2	C	17.9	B

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2020 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 7**, all study area intersections are projected to operate at LOS C or better under Opening Year 2020 No Build conditions in both the AM and PM peak hours.





LEGEND

XX/XX	AM/PM Peak Hour Volumes
(XX)	Calculated Average Daily Traffic (ADT) Volumes.

OPENING YEAR 2020 TRAFFIC VOLUMES

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

URS	CREATED BY: SV	DATE: April 2014	FIGURE 3
	PM: DS	PROJECT NO: 29866552	

K:\2014\SR-210 Base Line Interchange Improvement\Figures.ai

5.3 Opening Year 2020 Build Alternative Traffic Conditions

The 2020 Build Alternative widens Base Line from Buckeye Street to Seine Avenue and widens the existing interchange ramps. The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and the interchange ramps within the limits of the project. The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes and storage for vehicle queues.
- A two-lane exit would be created at the westbound exit ramp.
- For the westbound off-ramp, the right turn movement is analyzed as a restricted right turn with a “no-right-turn-on-red” sign.
- Ramp metering would be installed on the on-ramps at the interchange.
- A new crosswalk is proposed across Base Lane, located on the west leg of the Base Line and SR-210 eastbound ramps intersection.

The level of service results at the study intersections under Opening Year 2020 Build conditions are summarized in **Table 8**. Level of service calculation worksheets are contained in Appendix B.

Table 8: Opening Year 2020 Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	19.0	B	16.9	B
2	SR-210 EB ramps/Base Line	14.0	B	14.3	B
3	SR-210 WB ramps/Base Line	7.9	A	8.7	A
4	Base Line/Seine Avenue	23.2	C	21.0	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2020 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 8**, all study area intersections are projected to operate at LOS C or better under Opening Year 2020 Build conditions in both the AM and PM peak hours.

6.0 HORIZON YEAR 2040 TRAFFIC CONDITIONS

6.1 Horizon Year 2040 Projected Traffic Volumes

Horizon year traffic volumes were developed for the Year 2040 using the methodology described above in the Future Year Traffic Volume Forecasts section of this report. The Horizon Year 2040 ramp peak hour volumes at Base Line and turn movements at study intersections along Base line are illustrated in **Figure 4.** Traffic volumes for both the No Build and Build conditions are the same, because the project does not appreciably affect mainline or local traffic demand.

6.2 Horizon Year 2040 No Build Traffic Conditions

Similar to the Opening Year 2020 No Build Alternative, the Horizon Year 2040 No Build Alternative analysis includes the improvements described previously at the Base Line/Seine Avenue intersection, which are being constructed by the City of Highland and should be complete by the end of 2014. The Horizon Year 2040 No Build Alternative was considered as a baseline to measure and compare the proposed improvement alternative.

6.2.1 Intersection Levels of Service

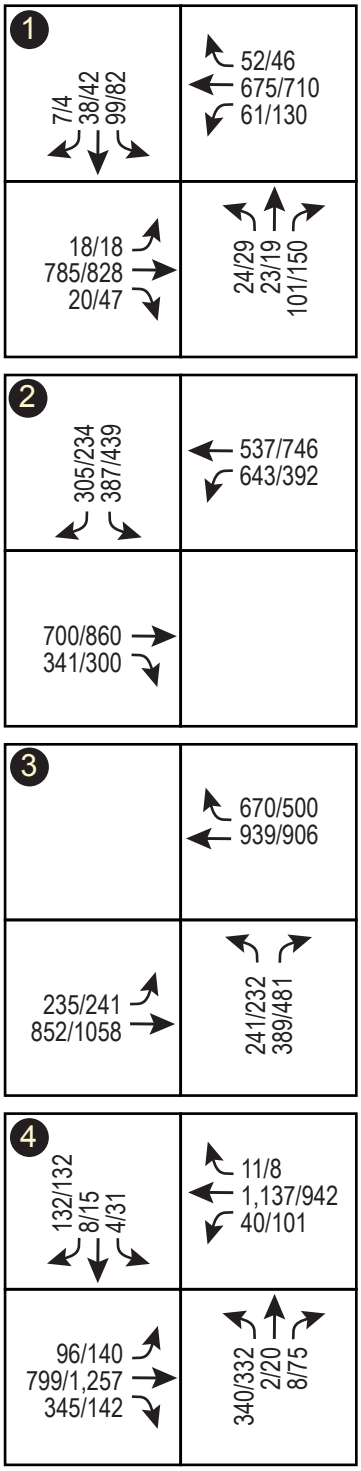
The level of service results at the study intersections under Horizon Year 2040 No Build conditions are summarized in **Table 9**. Level of service calculation worksheets are contained in the Appendix B.

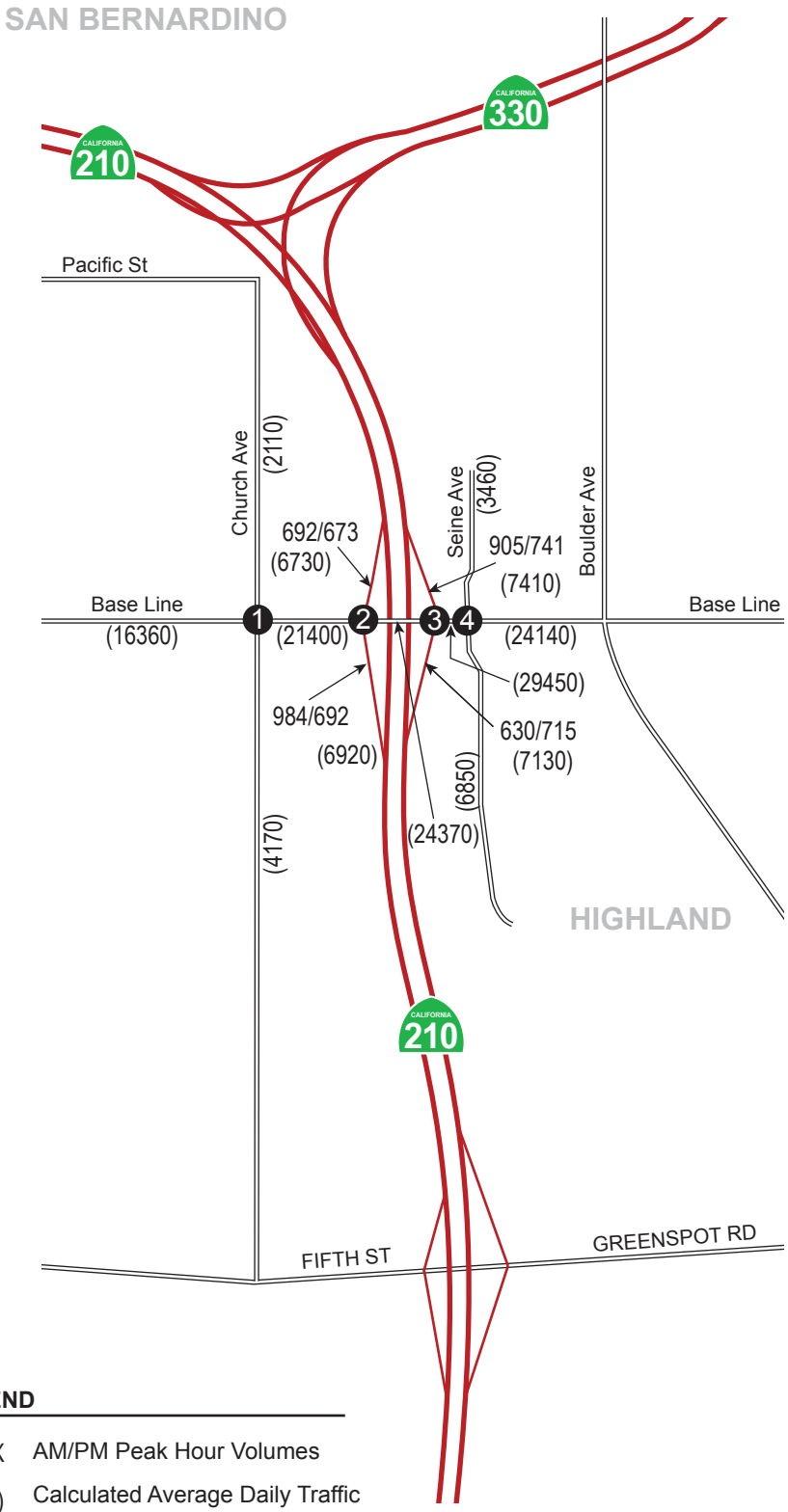
Table 9: Horizon Year (2040) No Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	17.7	B	17.8	B
2	SR-210 EB ramps/Base Line	24.8	C	20.8	C
3	SR-210 WB ramps/Base Line	50.2	D	48.8	D
4	Base Line/Seine Avenue	28.7	C	32.2	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2040 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 9**, the study area intersections are predicted to degrade from existing conditions (which were generally LOS B and LOS C) to LOS C and LOS D if no improvements are implemented at the interchange.





LEGEND

XX/XX	AM/PM Peak Hour Volumes
(XX)	Calculated Average Daily Traffic (ADT) Volumes.

HORIZON YEAR 2040 TRAFFIC VOLUMES

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

URS

CREATED BY: SV	DATE: April 2014	FIGURE 4
PM: DS	PROJECT NO: 29866552	

K:\2014\SR-210 Base Line Interchange Improvement\Figures.ai

6.2.1 Queuing Analysis

This section evaluates projected queuing for the Horizon Year 2040 No Build Alternative condition at closely spaced intersections along Base Line. The queuing analysis was conducted for the two SR-210 freeway ramp terminal intersections and for the intersection of Base Line and Seine Avenue. The intersection of Base Line at Church Avenue was not included since the distance of this intersection from the interchange is too far to have a queuing impact. **Table 10** shows Horizon Year 2040 predicted 95th percentile queue lengths in feet by approach movement compared to the storage provided in the No Build Alternative configuration. Queuing calculation worksheets are contained in the Appendix B.

Table 10: Horizon Year (2040) No Build – 95th Percentile Queue Summary

Intersection/Movement	Storage (feet)	Queue Length per lane (feet)		Adequate Storage
		AM Peak	PM Peak	
SR-210 EB Ramps/Base Line				
Base Line Rd EB Through	850	251	294	Yes
Base Line Rd EB Right-Turn	100	**111**	**102**	**No**
Base Line Rd WB Left-Turn	150	**242**	**162**	**No**
Base Line Rd WB Through	330	77	128	Yes
SR-210 EB Off-Ramp SB Left-Turn	750	189	205	Yes
SR-210 EB Off-Ramp SB Right-Turn	750	190	206	Yes
SR-210 WB Ramps/Base Line				
Base Line Rd EB Left-Turn	100	**148**	**153**	**No**
Base Line Rd EB Through	350	158	258	Yes
Base Line Rd WB Through	225	**628**	**590**	**No**
SR-210 WB Off-Ramp NB Left-Turn	900	205	176	Yes
SR-210 WB Off-Ramp NB Right-Turn	900	430	502	Yes
Seine Avenue/Base Line				
Base Line Rd EB Left-Turn	90	**135**	**176**	**No**
Base Line Rd EB Through	225	**251**	**463**	**No**
Base Line Rd EB Right-Turn	100	90	48	Yes
Base Line Rd WB Left-Turn	150	58	**156**	**No**
Base Line Rd WB Through	1000	470	328	Yes
Seine Ave NB Left-Turn	110	**167**	**195**	**No**
Seine Ave NB Through	800	5	25	Yes
Seine Ave NB Right-Turn	80	0	30	Yes
Seine Ave SB Left-Turn	100	11	43	Yes
Seine Ave SB Through	600	55	60	Yes

Notes:

Shaded cells indicate insufficient storage.

All intersection analyses conducted using Synchro 8.

As shown in **Table 10**, many of the movements at the study area intersections do not have adequate storage capacity for predicted queue lengths in the Horizon Year 2040 No Build conditions in both AM and PM peak hours. Both left turn movements that access the interchange on-ramps show longer queues than can be stored in the existing turn pockets.

Also, the short distance between the westbound freeway ramps and Seine Avenue does not provide sufficient through traffic storage in either of the AM or PM peak periods. Multiple turn movements at the Base Line/Seine Avenue intersection show inadequate storage for the predicted queue lengths in the Horizon Year 2040 No Build conditions.

6.2.3 Mainline Freeway and Adjacent Interchange Analysis

To ensure that the interchange improvements do not have a negative impact on adjacent freeway mainline segments or adjacent interchanges, freeway operations were analyzed beyond the SR-210/Base Line interchange. Mainline freeway weaving segments, as defined by the Highway Capacity Manual, exist between the SR-330 and Base Line interchanges. Additional weaving segments will exist between the Base Line and 5th Street–Greenspot Road interchanges by 2020. Therefore, the analysis of adjacent freeway facilities is a weaving analysis. Ramp junction and mainline freeway segment analyses do not apply. **Table 11** summarizes the density and level of service results for the weave locations along SR-210 in the study area under the Horizon Year 2040 No Build condition.

Table 11: Horizon Year 2040 No Build SR-210/Base Line Mainline Freeway Operations

Direction	Freeway Mainline Segment/Ramp Connection	Merge/Diverge/Weave Analysis					
		Facility	Lanes	AM Peak		PM Peak	
				Density	LOS	Density	LOS
Westbound	SR-210/Greenspot Road On-ramp*	Merge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between 5th Street-Greenspot Road and Base Line*	Weave	3 MF/ 1 Aux	22.7	C	26.8	C
	SR-210/Base Line Off	Diverge	3 MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210/Base Line On	Merge	3 MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between Base Line and SR-330*	Weave	3 MF/ 1 Aux	24.3	C	25.9	C
	SR-210/SR-330 Connector*	Diverge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
Eastbound	SR-210/SR-330 Connector*	Merge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between SR-330 and Base Line*	Weave	3 MF/ 1 Aux	22.3	C	22.0	C
	SR-210/Base Line Off	Diverge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210/Base Line On	Merge	3 MF/ 1 Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between Base Line and 5th Street-Greenspot Road*	Weave	3 MF/ 1 Aux	26.8	C	25.5	C
	SR-210/5th Street Off-ramp*	Diverge	3MF/1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)

Notes:
Density in passenger car equivalents per mile per lane. MF = Mixed Flow. 1L = 1 lane ramp.
*Results from SR-210 Mixed Flow Lane Addition Project from Highland Avenue (PM R25.0) to San Bernardino Avenue (PM R33.2)
(1) Ramp junction analysis is not applicable for ramp connections in weave segments.

All of the weave locations are projected to operate at an acceptable LOS D or better during the AM and PM peak periods. The reported level of service results for the mainline freeway weave locations were obtained from the SR-210 Mixed Flow Lane Addition project TOAR approved on February 18, 2014.

6.3 Horizon Year 2040 Build Alternative Traffic Conditions

The 2040 Build Alternative widens Base Line from Buckeye Street to Seine Avenue and widens the existing interchange ramps. The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and the interchange ramps within the limits of the project. The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes and storage for vehicle queues.
- A two-lane exit would be created at the westbound exit ramp.
- For the westbound off-ramp, the right turn movement is analyzed as a restricted right turn with a “no-right-turn-on-red” sign.
- Ramp metering would be installed on the on-ramps at the interchange.
- A new crosswalk is proposed across Base Lane, located on the west leg of the Base Line and SR-210 eastbound ramps intersection.

6.3.1 Intersection Levels of Service

The level of service results at the study intersections under the Horizon Year 2040 Build Alternative conditions are summarized in **Table 12**. Level of service calculation worksheets are contained in Appendix B.

Table 12: Horizon Year (2040) Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	17.7	B	17.8	B
2	SR-210 EB ramps/Base Line	24.5	C	16.7	B
3	SR-210 WB ramps/Base Line	15.2	B	11.1	B
4	Base Line/Seine Avenue	24.7	C	22.5	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2040 Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 12**, all study area intersections are projected to operate at an acceptable LOS D or better under Horizon Year 2040 Build conditions in both the AM and PM peak hours.

6.3.2 Queuing Analysis

This section evaluates projected queuing for the Horizon Year 2040 Build Alternative condition at intersections along Base Line at the SR-210 interchange. A queuing analysis was conducted for the two ramp terminal intersections on Base Line at SR-210 and for the intersection of Base Line and Seine Avenue. The intersection of Base Line at Church Avenue was not included since the distance of this intersection from the interchange is too far to have a queuing impact. **Table 13** shows Horizon Year 2040 predicted 95th percentile queue lengths in feet by approach movement compared to the storage provided in the Horizon Year 2040 Build Alternative configuration. Queuing calculation worksheets are contained in Appendix B.

Table 13: Horizon Year (2040) Build – 95th Percentile Queue Summary

Intersection/Movement	Storage (feet)	Queue Length per lane (feet)		Adequate Storage
		AM Peak	PM Peak	
SR-210 EB Ramps/Base Line				
Base Line Rd EB Through	850	139	155	Yes
Base Line Rd EB Right-Turn	100	59	49	Yes
Base Line Rd WB Left-Turn	250	228	151	Yes
Base Line Rd WB Through	300	27	36	Yes
SR-210 EB Off-Ramp SB Left-Turn	750	122	136	Yes
SR-210 EB Off-Ramp SB Right-Turn	750	58	73	Yes
SR-210 WB Ramps/Base Line				
Base Line Rd EB Left-Turn	350	100	102	Yes
Base Line Rd EB Through	350	75	115	Yes
Base Line Rd WB Through	225	23	59	Yes
Base Line Rd WB Right-Turn	80	4	29	Yes
SR-210 WB Off-Ramp NB Left-Turn	900	171	153	Yes
SR-210 WB Off-Ramp NB Right-Turn	900	139	164	Yes
Seine Avenue/Base Line				
Base Line Rd EB Left-Turn	180	47	63	Yes
Base Line Rd EB Through	225	87	190	Yes
Base Line Rd EB Right-Turn	100	32	15	Yes
Base Line Rd WB Left-Turn	150	46	126	Yes
Base Line Rd WB Through	1000	418	330	Yes
Seine Ave NB Left-Turn	110	**163**	**147**	**No**
Seine Ave NB Through	800	4	17	Yes
Seine Ave NB Right-Turn	80	0	7	Yes
Seine Ave SB Left-Turn	100	9	33	Yes
Seine Ave SB Through	600	14	20	Yes
Seine Ave SB Right-Turn	100	42	18	Yes

Notes:

Shaded cells indicate insufficient storage.

All intersection analyses conducted using Synchro 8.

As shown in **Table 13**, the many locations of inadequate storage identified in the Horizon Year 2040 No Build scenario (refer to **Table 10**) have been improved to the extent that only one movement is under-provided in the Horizon Year 2040 Build scenario. All of the turn movements and through traffic queues at the interchange ramp terminal intersections can be contained within the storage provided by the Build Alternative.

The two on-ramps were also analyzed for future ramp metering in the Horizon Year 2040 Build Alternative scenario. The ramp lanes, an average vehicle length, and the ramp storage length were input for each ramp. A ramp metering discharge rate [vehicles per hour (vph) per lane] between 240 and 900 vph/lane is used by Caltrans. To be conservative, a ramp metering discharge rate of 240 vph/lane was used in this analysis. **Table 14** presents the ramp metering queuing analysis for each of the on-ramps.

Table 14: Horizon Year 2040 Build Alternative – Ramp Meter Queuing Analysis

On-Ramp	Peak Hour	Lanes	Available Storage per Lane (ft)	Total Arrival (1)	Meter Rate	Max. Queue Ft/Lane	Adequate Storage
WB	AM	2	250	1,244	240	122	Yes
	PM			1,163	240	141	Yes
EB	AM	2	500	1,284	240	236	Yes
	PM			952	240	0	Yes

Notes:
(1) For 3 hour peak period

Table 14 indicates that the storage provided on all on-ramps with proposed ramp metering for the Horizon Year 2040 Build Alternative are adequate using an assumed meter rate of 240 vph/lane. The projected maximum queue identified in **Table 14** can be decreased by increasing the meter rate, as needed.

6.3.3 Mainline Freeway and Adjacent Interchange Analysis

The mainline freeway and adjacent interchange analyses are governed by the traffic volumes entering and exiting the freeway at the SR-210/Base Line interchange and the geometrics of the ramp junctions at connection points between the interchange and the mainline freeway lanes. The Horizon Year 2040 traffic volumes are the same for both the No Build and Build conditions. Also, auxiliary lanes will exist between the SR-210/Base Line interchange and the adjacent SR-330 and adjacent 5th Street-Greenspot Road interchanges. Therefore, the mainline freeway and adjacent interchange analysis for the Horizon Year 2040 Build conditions is the same as the analysis for the Horizon Year 2040 No Build conditions presented in the previous section. Thus, as shown in **Table 11**, all of the weave locations are projected to operate at an acceptable LOS C or better during the AM and PM peak periods.

APPENDIX E EMISSIONS MODELING OUTPUTS

- Roadway Construction Emissions Model Worksheets

Welcome to the Road Construction Emissions Model, Version 7.1.5.1

User Instructions

This spreadsheet system contains the following individual worksheets:

1. This worksheet of User Instructions
2. Emission Estimates
3. Data Entry
4. EMFAC2011
5. OFFROAD Convert
6. OFFROAD HP & LF
7. OFFROAD EF

Changes from previous version of Road Construction Emissions Model

(Version 7.1.4 to 7.1.5) (updated by SMAQMD 12/11/13 with assistance from ENVIRON Corporation)

1) Grubbing and Land Clearing Phase calculation of active months in 2007, 2017, 2019 fixed.
2) Soil Hauling Emissions calculation to select override if it exists for round trips/day.
3) Worker Commute Emissions calculation of starting and hot soak emissions; drainage phase PM_{10} emission rate.
4) Water Truck Emissions calculation to select number of months for Grubbing and Land Clearing Phase; maximum acreage/day after 2025.

(Version 6.3.2 to Version 7.1.0, 7.1.1, 7.1.2, 7.1.3 & 7.1.4) (updated by SMAQMD 8/2/13)

1) EMFAC2011 emission factors added (previous EMFAC versions dropped).
2) OFFROAD2011 emission factors added (and fixed error).
3) OFFROAD2007 for categories not in OFFROAD2011 (and fixed error)
4) Project length changed to include calendar years 2009 through 2025.
5) Average Offroad HP by Equipment Type calculation updated and corrected
6) Load Factor Adjustment deactivated (default load factors already incorporated in ARB's calculation of emission factors)
7) Crawler Tractor equipment added to model
8) Air Compressors ROG & Default Excavators calculation on Data Entry sheet corrected.
9) Default equipment list updated
10) Corrections to Worker Commute Emissions calculations

The Emission Estimates worksheet calculates a project's emissions in pounds per day (and kilograms per day) by project phase and tons (and megagrams) over the entire construction period.
The worksheet can be used to estimate emissions for both vehicle exhaust and fugitive dust. The methodology used to estimate fugitive dust emissions is a simplified methodology involving estimates of the maximum area (acreage) of land disturbed daily. Detailed fugitive dust emission estimates associated with individual materials handling operations and/or activity/vehicle types cannot be conducted with this version of the model.
The Emission Estimates worksheet cannot be modified directly, it is a protected worksheet. It can only be modified indirectly by entering information for the project in selected areas of the Data Entry worksheet.
The last four of these worksheets - EMFAC2011, OFFROAD Convert, OFFROAD HP & LP, and OFFROAD EF - cannot be modified by the user. They are protected worksheets.
Even though all or portions of several worksheets are protected, the individual formulas used in the calculations can be seen by the user.
The Data Entry worksheet includes several areas that can be modified by the user.
User instructions in the Data Entry worksheet are highlighted in red.
On the Data Entry worksheet, the user has two options for entering project data: required data and optional data. Required data is entered in the data input section (yellow cells). That required data is then used by the worksheet to calculate default values for the project.
The user can override the default values (blue cells) calculated for a project and is encouraged to do so if project specific information is available. Due to the difficulty in developing reliable default values for road construction projects, the user is encouraged to enter as much site specific information as is available for the project being analyzed.
The Data Entry Worksheet also includes a button that allows the user to clear previously entered data. This button is found just at the top of and to the right of the data entry portion of the worksheet.
When projects are discontinuous, the user must make adjustments to the spreadsheet manually, since the program cannot be setup to anticpate unexpected project delays.

#VALUE! <- This error message may occur during use of the spreadsheets. This occurs whenever the user enters a non numeric value, including a space character, into a cell that is used to calculate a numeric value. Consequently, to erase values entered into the spreadsheets, use the delete key instead of the space bar!

Note: Information in this worksheet is based on conversations with knowledgeable individuals at the Sacramento Metropolitan Air Quality Management District, the California Department of Transportation, the California Air Resources Board, the U.S. EPA, and private industry involved in road construction.
Also, the 26th edition of Walker's Building Estimator's Reference Book (1999) was used in the development of this spreadsheet.
This spreadsheet was prepared by Jones & Stokes and TIAX LLC with the financial support and direction of the Sacramento Metropolitan Air Quality Management District.

http://www.airquality.org
Karen Huss

http://www.jonesandstokes.com
Shannon Hatcher

http://www.tetratech.com/
Karen Law

Road Construction Emissions Model, Version 7.1.5.1

Emission Estimates for -> SR210/Base Line Project Phases (English Units)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	Total PM10 (lbs/day)	Exhaust PM10 (lbs/day)	Fugitive Dust PM10 (lbs/day)	Total PM2.5 (lbs/day)	Exhaust PM2.5 (lbs/day)	Fugitive Dust PM2.5 (lbs/day)	CO2 (lbs/day)
Grubbing/Land Clearing	2.6	15.2	21.8	11.0	1.0	10.0	3.0	0.9	2.1	2,885.3
Grading/Excavation	10.0	54.3	101.3	15.1	5.1	10.0	6.7	4.6	2.1	11,777.7
Drainage/Utilities/Sub-Grade	5.5	32.6	46.6	12.7	2.7	10.0	4.5	2.4	2.1	6,336.1
Paving	2.6	18.6	20.4	1.3	1.3	-	1.1	1.1	-	3,435.7
Maximum (pounds/day)	10.0	54.3	101.3	15.1	5.1	10.0	6.7	4.6	2.1	11,777.7
Total (tons/construction project)	2.2	12.4	20.5	3.9	1.1	2.8	1.6	1.0	0.6	2,551.8

Notes: Project Start Year -> 2017
Project Length (months) -> 30
Total Project Area (acres) -> 7
Maximum Area Disturbed/Day (acres) -> 1
Total Soil Imported/Exported (yd^3/day)-> 112

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> SR210/Base Line Project Phases (Metric Units)	ROG (kgs/day)	CO (kgs/day)	NOx (kgs/day)	Total PM10 (kgs/day)	Exhaust PM10 (kgs/day)	Fugitive Dust PM10 (kgs/day)	Total PM2.5 (kgs/day)	Exhaust PM2.5 (kgs/day)	Fugitive Dust PM2.5 (kgs/day)	CO2 (kgs/day)
Grubbing/Land Clearing	1.2	6.9	9.9	5.0	0.5	4.5	1.4	0.4	0.9	1,311.5
Grading/Excavation	4.6	24.7	46.1	6.9	2.3	4.5	3.0	2.1	0.9	5,353.5
Drainage/Utilities/Sub-Grade	2.5	14.8	21.2	5.8	1.2	4.5	2.0	1.1	0.9	2,880.0
Paving	1.2	8.5	9.3	0.6	0.6	-	0.5	0.5	-	1,561.7
Maximum (kilograms/day)	4.6	24.7	46.1	6.9	2.3	4.5	3.0	2.1	0.9	5,353.5
Total (megagrams/construction project)	2.0	11.2	18.6	3.5	1.0	2.5	1.4	0.9	0.5	2,314.5

Notes: Project Start Year -> 2017
Project Length (months) -> 30
Total Project Area (hectares) -> 3
Maximum Area Disturbed/Day (hectares) -> 0
Total Soil Imported/Exported ($meters^3$/day)-> 86

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model
Data Entry Worksheet

Version 7.1.5.1

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a
yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

Input Type	*Inputs provided by URS unless otherwise noted.*		
Project Name	SR210/Base Line		
Construction Start Year	2017	Enter a Year between 2009 and 2025 (inclusive)	
Project Type	2	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction	
Project Construction Time	30.00	months	
Predominant Soil/Site Type: Enter 1, 2, or 3	1	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock	
Project Length	1.20	miles	*Project note: Includes length of ramps and affected Base Line Street. Measured by ICF.*
Total Project Area	7.00	acres	
Maximum Area Disturbed/Day	1.00	acres	
Water Trucks Used?	1	1. Yes 2. No	
Soil Imported	0.00	yd^3/day	
Soil Exported	112.31	yd^3/day	*Project note: URS assumes 14600CY of soil imported over 6 months with 5 day work weeks.*
Average Truck Capacity	20	yd^3 (assume 20 if unknown)	

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007	%
Grubbing/Land Clearing		3.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation		12.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		10.50	0.00	0.00	0.00	0.00	0.00	0.00
Paving		4.50	0.00	0.00	0.00	0.00	0.00	0.00
Totals	0.00	30.00						

NOTE: soil hauling emissions are included in the Grading/Excavation Construction Period Phase, therefore the Construction Period for Grading/Excavation cannot be zero if hauling is part of the project.
Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip		30
Round trips/day		6
Vehicle miles traveled/day (calculated)	168.4615385	

Hauling Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate (grams/mile)	0.15	7.24	0.66	0.16	0.09	1645.57
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00

Pounds per day	0.05	2.69	0.24	0.06	0.03	610.61
Tons per contruction period	0.01	0.35	0.03	0.01	0.00	80.60

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip		20
One-way trips/day		2
No. of employees: Grubbing/Land Clearing		8
No. of employees: Grading/Excavation		23
No. of employees: Drainage/Utilities/Sub-Grade		16
No. of employees: Paving		13

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.133	0.172	1.555	0.047	0.020	443.765
Emission rate - Grading/Excavation (grams/mile)	0.129	0.168	1.516	0.047	0.020	443.794
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.119	0.152	1.383	0.047	0.020	443.574
Emission rate - Paving (grams/mile)	0.112	0.140	1.291	0.047	0.020	441.739
Emission rate - Grubbing/Land Clearing (grams/trip)	0.457	0.287	3.779	0.004	0.003	95.644
Emission rate - Grading/Excavation (grams/trip)	0.447	0.279	3.687	0.004	0.003	95.661
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.410	0.251	3.366	0.004	0.003	95.727
Emission rate - Paving (grams/trip)	0.382	0.228	3.101	0.004	0.003	95.822
Pounds per day - Grubbing/Land Clearing	0.103	0.123	1.152	0.031	0.013	296.397
Tons per const. Period - Grub/Land Clear	0.003	0.004	0.038	0.001	0.000	9.781
Pounds per day - Grading/Excavation	0.301	0.360	3.371	0.093	0.039	889.250
Tons per const. Period - Grading/Excavation	0.040	0.048	0.445	0.012	0.005	117.381
Pounds per day - Drainage/Utilities/Sub-Grade	0.200	0.236	2.221	0.067	0.028	641.926
Tons per const. Period - Drain/Util/Sub-Grade	0.023	0.027	0.257	0.008	0.003	74.142
Pounds per day - Paving	0.144	0.167	1.593	0.052	0.022	491.774
Tons per const. Period - Paving	0.007	0.008	0.079	0.003	0.001	24.343
tons per construction period	0.073	0.087	0.818	0.024	0.010	225.647

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust		1		40
Grading/Excavation - Exhaust		1		40
Drainage/Utilities/Subgrade		1		40

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.15	7.43	0.65	0.16	0.09	1652.56
Emission rate - Grading/Excavation (grams/mile)	0.15	7.24	0.66	0.16	0.09	1645.57
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.15	6.55	0.68	0.16	0.09	1620.60
Pounds per day - Grubbing/Land Clearing	0.01	0.65	0.06	0.01	0.01	145.60
Tons per const. Period - Grub/Land Clear	0.00	0.02	0.00	0.00	0.00	4.80
Pound per day - Grading/Excavation	0.01	0.64	0.06	0.01	0.01	144.98
Tons per const. Period - Grading/Excavation	0.00	0.08	0.01	0.00	0.00	19.14
Pound per day - Drainage/Utilities/Subgrade	0.01	0.58	0.06	0.01	0.01	142.78
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.07	0.01	0.00	0.00	16.49

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		1	10.0	0.3	2.1	0.1
Fugitive Dust - Grading/Excavation		1	10.0	1.3	2.1	0.3
Fugitive Dust - Drainage/Utilities/Subgrade		1	10.0	1.2	2.1	0.2

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
	1	Crawler Tractors	0.71	4.47	9.06	0.35	0.32	825.49
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	2	Excavators	0.76	5.58	8.10	0.40	0.37	1145.50
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	3	Signal Boards	0.96	3.98	3.81	0.25	0.23	472.30
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	2.4	14.0	21.0	1.0	0.9	2443.3
	Grubbing/Land Clearing	tons per phase	0.1	0.5	0.7	0.0	0.0	80.6

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00

		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00	0.00
	1	Crawler Tractors	0.69	4.47	8.88	0.34	0.31	825.35
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	3	Excavators	1.09	8.37	11.51	0.56	0.52	1718.27
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
	2	Graders	1.93	6.94	18.62	1.05	0.96	1337.54
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
	2	Rollers	0.62	3.02	5.56	0.40	0.37	558.89
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rubber Tired Loaders	0.48	3.12	5.86	0.20	0.18	662.71
	2	Scrapers	2.64	14.51	31.64	1.26	1.16	3216.20
	3	Signal Boards	0.93	3.95	3.78	0.25	0.23	472.30
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	4	Tractors/Loaders/Backhoes	1.28	6.28	11.81	0.88	0.81	1341.59
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	9.7	50.7	97.7	4.9	4.5	10132.9
	Grading	tons per phase	1.3	6.7	12.9	0.7	0.6	1337.5

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Air Compressors	0.57	3.40	3.82	0.29	0.27	507.95
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Generator Sets	0.42	2.95	3.39	0.22	0.20	487.07
	1	Graders	0.86	3.46	8.20	0.46	0.42	667.32
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00

		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Plate Compactors	0.04	0.21	0.25	0.01	0.01	34.45
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pumps	0.36	2.44	2.80	0.19	0.17	396.14
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rough Terrain Forklifts	0.16	2.03	2.00	0.09	0.09	372.67
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
	1	Scrapers	1.18	7.26	13.86	0.55	0.50	1608.48
	3	Signal Boards	0.83	3.86	3.66	0.22	0.20	472.30
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	3	Tractors/Loaders/Backhoes	0.82	4.71	7.80	0.55	0.50	1004.98
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	5.2	30.3	45.8	2.6	2.4	5551.4
	Drainage	tons per phase	0.6	3.5	5.3	0.3	0.3	641.2

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pavers	0.29	2.84	2.99	0.15	0.13	482.15
	1	Paving Equipment	0.22	2.69	2.20	0.11	0.10	426.26
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
	2	Rollers	0.47	3.02	4.45	0.29	0.27	558.88
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	3	Signal Boards	0.74	3.77	3.55	0.20	0.18	472.30
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	3	Tractors/Loaders/Backhoes	0.73	4.70	7.04	0.47	0.43	1004.37

		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	2.4	17.0	20.2	1.2	1.1	2944.0
	Paving	tons per phase	0.1	0.8	1.0	0.1	0.1	145.7
Total Emissions all Phases (tons per construction period) =>			2.1	11.5	19.9	1.0	1.0	2205.1

Equipment default values for horsepower and hours/day can be overridden in cells C289 through C322 and E289 through E322.

Equipment		Default Values Horsepower		Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		106		8
Bore/Drill Rigs		206		8
Cement and Mortar Mixers		10		8
Concrete/Industrial Saws		64		8
Cranes		226		8
Crawler Tractors		208		8
Crushing/Proc. Equipment		142		8
Excavators		163		8
Forklifts		89		8
Generator Sets		66		8
Graders		175		8
Off-Highway Tractors		123		8
Off-Highway Trucks		400		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		167		8
Pavers		126		8
Paving Equipment		131		8
Plate Compactors		8		8
Pressure Washers		26		8
Pumps		53		8
Rollers		81		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		255		8
Rubber Tired Loaders		200		8
Scrapers		362		8
Signal Boards		20		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98		8
Trenchers		81		8
Welders		45		8

0

END OF DATA ENTRY SHEET

APPENDIX F TRAFFIC DATA

- Traffic Operations Analysis Report State Route 210 (SR-210) at Base Line PM R (28.3/30.3) in the City of Highland

TRAFFIC OPERATIONS ANALYSIS REPORT STATE ROUTE 210 (SR-210) AT BASE LINE (PM R28.3/R30.3) IN THE CITY OF HIGHLAND

EA 1C970, PROJECT NO. 0813000105

Prepared for

San Bernardino Associated Governments

In conjunction with

Caltrans – District 8

July 2014

URS

2020 East First Street, Suite 400
Santa Ana, California 92705

Project Number: 29866552

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TRAFFIC OPERATIONS ANALYSIS

1.0 INTRODUCTION

This document presents the traffic operations analysis completed for the proposed improvements to the State Route 210 (SR-210)/Base Line interchange in the City of Highland. The project sponsors and stakeholders include the San Bernardino Associated Governments (SANBAG), City of Highland and the California Department of Transportation (Caltrans). The traffic study area includes an area of influence based on potential operational and/or safety concerns. This area is defined as the existing SR-210/Base Line interchange plus the first adjacent signalized intersections in either direction of the interchange ramp terminal intersections and the first adjacent interchanges on either side of the SR-210/Base Line interchange. The area of influence along the local roadway network (Base Line) encompasses Church Avenue to the west and Seine Avenue to the east. The mainline freeway area of influence extends to State Route 330 (SR-330) to the north and 5th Street-Greenspot Road to the south; however, these adjacent interchanges are not physically affected by the proposed SR-210/Base Line interchange improvements.

Traffic volumes were developed for three scenarios:

- Existing 2013 traffic,
- Opening Year 2020 traffic and
- Horizon Year 2040 traffic.

Traffic operations on Base Line and at the interchange were analyzed for each of these three scenarios for the No Build Alternative, and for the Build Alternative in Opening Year 2020 and Horizon Year 2040. Mainline freeway operations were analyzed under Horizon Year 2040 Build and No Build conditions to demonstrate the relationship of the proposed project with adjacent freeway segments and interchanges.

Under the No Build Alternative, Base Line would not be widened through the interchange and the existing diamond interchange would remain unimproved.

The proposed project would widen Base Line from Buckeye Street to Seine Avenue and widen the existing interchange ramps in the City of Highland. Within the limits of the proposed project, Base Line is generally a four-lane arterial with turn lanes at intersections. The purpose of the proposed project is to reduce congestion and improve operational efficiency at the interchange and throughout the Base Line corridor. The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and the interchange ramps within the limits of the project. The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes and storage for vehicle queues.
- A two-lane exit would be created at the westbound exit ramp.
- The existing Base Line overcrossing would be widened to accommodate the new lanes.
- Ramp metering would be installed on the entrance ramps at the interchange.

1.1 Background

The City of Highland has been developing a master plan for Base Line to establish the ultimate build-out of this critical gateway arterial corridor within the City. The plan extends approximately one mile west and one mile east of the SR-210 interchange, from Palm Avenue on the west to Boulder Avenue on the east. The City identified the existing Base Line interchange to be a critical segment of the arterial corridor. Therefore, in September 2010, the City of Highland completed a detailed study of this segment of the Base Line corridor through the existing SR-210 interchange area and beyond titled, Base Line 2040 Master Plan Configuration Traffic Study (Master Plan Study). The Master Plan Study considered four possible alternatives through the interchange area:

- No Build
- Modified Interchange Configuration
- Proposed Minimal Improvements
- Additional Improvements

The Modified Interchange Configuration contemplated a complete reconstruction of the existing SR-210/Base Line interchange; however that alternative was dropped from further study due to the significant right of way impacts, business and residential relocations, replacement of the existing overcrossing and high costs. The Proposed Minimal Improvements alternative essentially would implement the recommended intersection improvements identified in the City's Preferred General Plan. At the interchange, this includes two eastbound through lanes, three westbound through lanes and one full length left turn pocket and one back-to-back left turn pocket in each direction on the Base Line overcrossing. The Additional Improvements alternative included the same improvements as the Proposed Minimal Improvements alternative, plus additional widening of the Base Line overcrossing to provide two full length left turn pockets in each direction (in lieu of the back-to-back configuration) and three through lanes in the eastbound direction (in lieu of only two).

The Master Plan Study concluded that the Additional Improvements alternative did not provide an appreciable improvement in level of service over the Proposed Minimal Improvements option. The Master Plan Study recommended that the Proposed Minimal Improvements alternative be advanced and that further coordination with Caltrans be initiated to identify interchange ramp and/or mainline improvements that may be necessary elements of the complete circulation system.

In August 2012, SANBAG, working with the City of Highland, performed a cursory analysis of the Master Plan Study, with an emphasis on the interchange ramps and freeway operational aspects of the Proposed Minimal Improvements alternative. In general, SANBAG confirmed the improvements proposed by the City of Highland. In addition, SANBAG's study recommended the following additional improvements:

- Provision of a two-lane exit at the westbound exit ramp connection to the mainline freeway
- Addition of ramp meters on the entrance ramps
- Widening the entrance ramps to provide HOV preferential lanes
- Provision of a third turn lane at the westbound exit ramp terminal intersection at Base Line

It was determined that the City of Highland's Master Plan Study – Proposed Minimal Improvements alternative coupled with the additional features identified by the SANBAG analysis would provide for adequate operations at the interchange through the Horizon Year 2040.

In February 2014, a Traffic Operations Analysis Report (TOAR) for the SR-210 Mixed Flow Lane Addition Project from Highland Avenue (PM R25.0) to San Bernardino Avenue (PM R33.2) in San Bernardino County was approved by Caltrans. The freeway widening project also includes the creation of auxiliary lanes between the Base Line interchange and the 5th Street-Greenspot Road interchange and an eastbound acceleration lane at the 5th Street entrance ramp and an eastbound deceleration lane at the Highland Avenue exit ramp. It is anticipated that the mainline freeway lane addition project will be constructed by 2020. The SR-210/Base Line interchange lies within this segment of the SR-210 proposed widening.

Finally, a traffic forecasting methodology memorandum titled, SR-210/Base Line Interchange Improvement Project – Traffic Forecasting Memorandum (Forecasting Memo), dated October 30, 2013 was prepared to identify the detailed procedures to be used in developing the traffic volumes for use in the traffic operations analysis of the SR-210/Base Line interchange. In addition to the step-by-step methodologies presented in the Forecasting Memo, the Existing, Opening Year and Horizon Year traffic volumes were also documented in the Forecasting Memo. The Forecasting Memo was approved by Caltrans on February 6, 2014.

Base Line

The City of Highland General Plan circulation element designates Base Line within the limits of the project as a Primary Arterial. Within the study area, Base Line is designated as a Truck Route with a Class II Bike Lane (on-street) in the City of Highland General Plan. The existing Base Line overcrossing consists of two lanes in each direction plus westbound and eastbound double left turn lanes.

Beyond the limits of the freeway interchange, the City of Highland is considering widening improvements at certain locations to implement other elements of the City's arterial corridor master plan. Some of those improvements have already been designed and are anticipated to be constructed by the end of 2014. These include a dedicated eastbound right turn pocket on Base Line approaching Seine Avenue and an additional northbound left turn pocket (total of two) on Seine Avenue approaching Base Line.

Other improvements in the City's master plan beyond the interchange are also being considered by the City, but there is no firm funding or scheduling commitment for implementation of these remaining corridor elements. These improvements include expanding the Base Line intersections at Church Avenue and at Buckeye Street, widening Base Line from four through lanes to six through lanes between Church Avenue and Buckeye Street, widening eastbound Base Line to three lanes between Seine Avenue and Stoney Creek Drive, widening Base Line to add a westbound shared through-right turn lane approaching the Seine Avenue intersection and installation of various raised medians throughout the Base Line corridor. Because of the uncertainty of any or all of these future improvements, the traffic operational analyses prepared in this study assume that none of these other improvements will be constructed. The results presented in this study are therefore, conservative and not dependent on other projects that would not be in the direct control of the interchange project sponsors and stakeholders. This assumption also provides stronger independent utility for the interchange project.

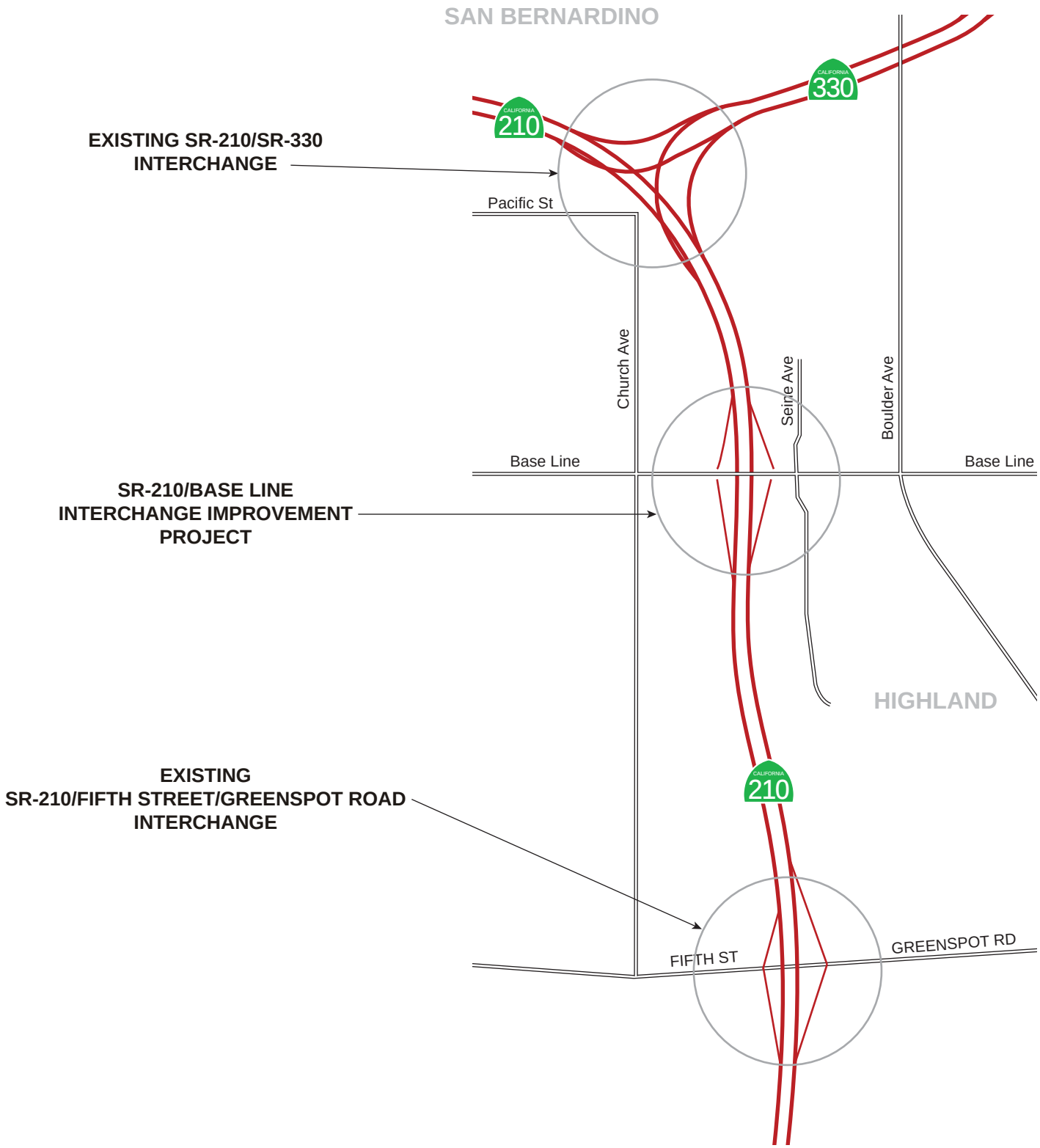
State Route 210 (SR-210)

The SR-210/Base Line interchange is located in the City of Highland and serves growing residential and commercial development in the City. SR-210 is an east/west freeway, and it traverses in a generally northwest/southeast direction, diagonally through the western portion of the City. To the north and west, SR-210 continues through San Bernardino County and is the link to the I-215 and I-15 Freeways and State Routes 18 and 57, and the greater Los Angeles area. To the south, SR-210 continues through San Bernardino County and connects to the I-10 Freeway. Adjacent interchanges exist on SR-210 at SR-330 to the north and at 5th Street–Greenspot Road to the south. The project location map is illustrated in **Figure 1**.

SR-210 in San Bernardino County is included in the National Highway System, the California Freeway and Expressway System and the "12 foot Wide Arterial System". The SR-210, within the project limits, is classified as a Principal Arterial highway.

State Route 330 (SR-330)

State Route 330 (SR-330) is a 15-mile freeway/conventional two-lane highway where the westerly segment begins at the junction of the SR-210 and extends northeasterly to SR-18. SR-330 is generally considered a conventional two-lane highway since only the initial one mile segment from the junction at SR-210 is constructed to freeway standards. SR-330 is located within San Bernardino County and is utilized as one of the main accesses into the cities of Big Bear and Lake Arrowhead. Access from east/westbound SR-210, onto northbound SR-330 is provided via connector ramps and access onto east/westbound SR-210 from southbound SR-330 is provided also via connector ramps. Where SR-330 connects to SR-210, there are existing auxiliary lanes on SR-210 in both the eastbound and westbound directions between SR-330 and the Base Line interchange.



PROJECT LOCATION MAP

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

URS	CREATED BY: SV	DATE: April 2014	FIGURE 1
	PM: DS	PROJECT NO: 29866552	

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2.0 EXISTING AND FUTURE YEAR TRAFFIC VOLUMES

2.1 Existing Traffic Volumes

Existing traffic counts including AM and PM peak hour turning movement counts at all study area intersections and 24-hour daily traffic counts at locations in the project area were conducted in June 2013 by National Data and Surveying Services (NDS) and attached as Appendix A. To adjust the traffic volumes to a March 2013 count (spring 2013) when school was in session, a seasonal adjustment factor was estimated and applied to the existing traffic counts. Based on traffic data from Caltrans PEMS for March and June in year 2013, the peak hour average traffic volumes in March 2013 are approximately 7% higher than the peak hour average traffic volumes in June 2013. Therefore, a seasonal adjustment factor of 1.07 was estimated and applied to the June 2013 traffic counts to provide 2013 seasonal adjusted traffic counts for use as the existing 2013 traffic volumes in this study. **Table 1** shows the PEMS traffic data used to estimate the seasonal factor.

Table 1: Caltrans PEMS Traffic Data and Seasonal Factor

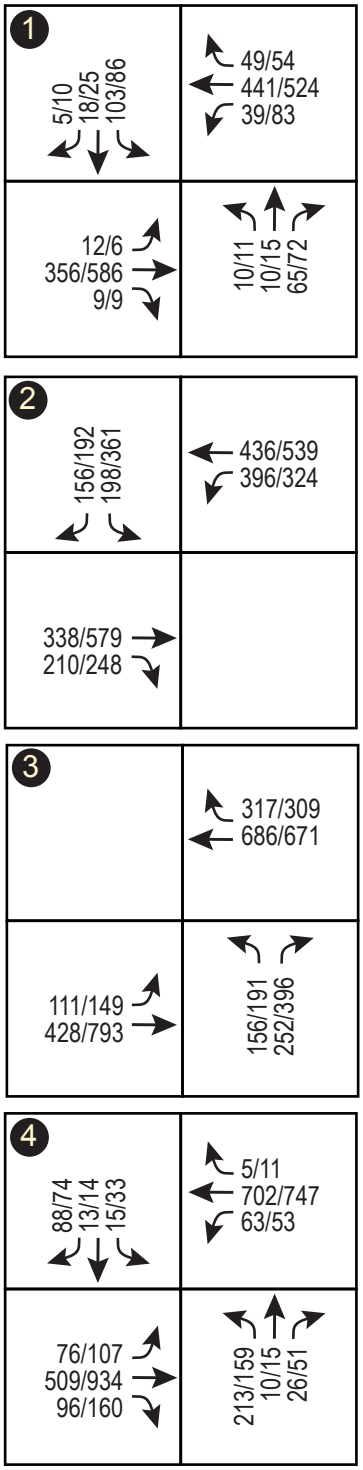
	Average Peak Hour Volumes (vph) [1]							
	EB SR-210				**WB SR-210**			
	March		**June**		**March**		**June**	
	AM	PM	AM	PM	AM	PM	AM	PM
Base Line Off-Ramp	456	843	417	780	772	539	728	541
Base Line On-Ramp	341	568	284	569	688	469	593	472
Sum March								*4,676*
Sum June								*4,383*
Ratio (March / June)								**1.07**

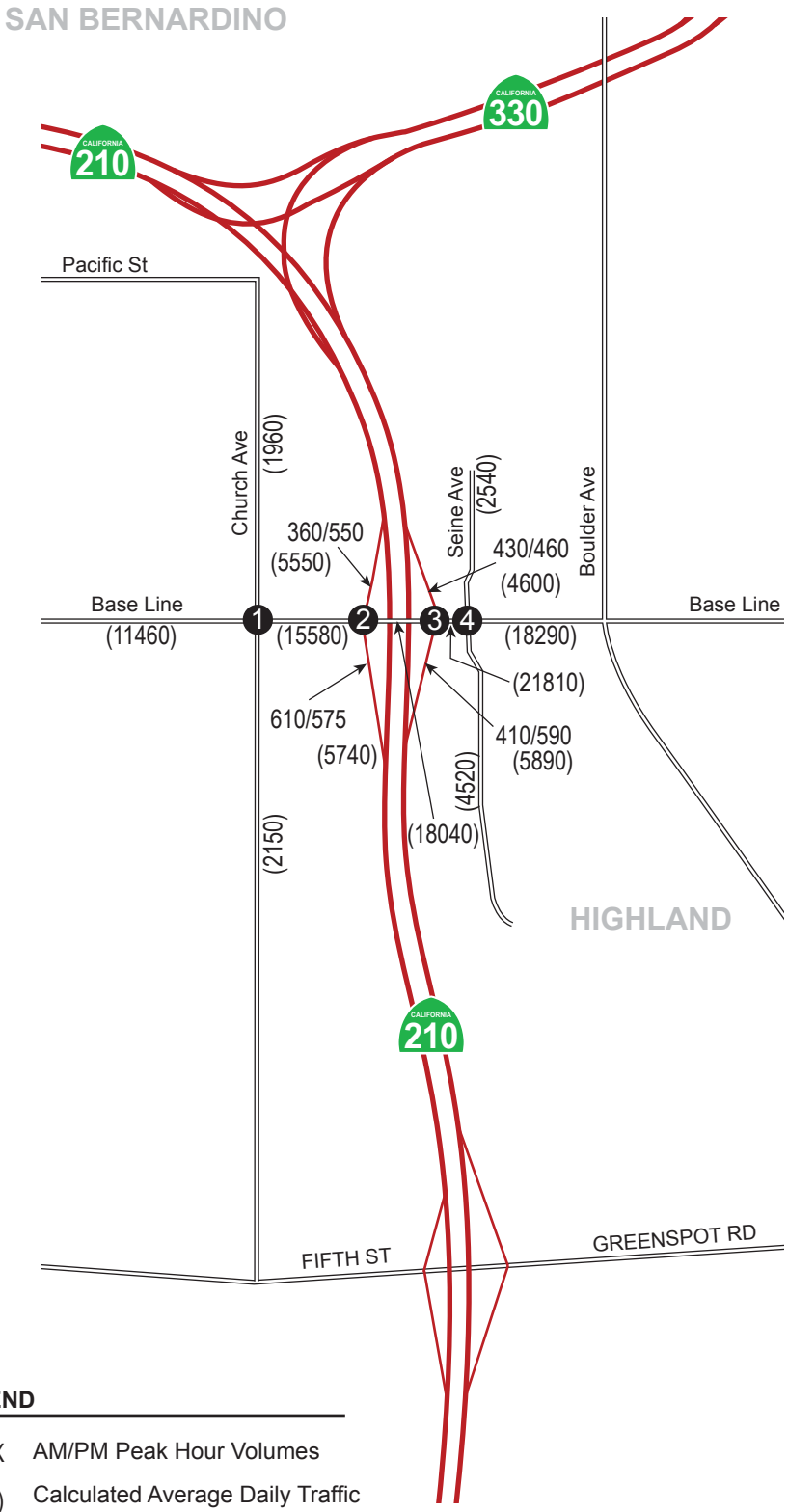
Note 1. Based on Year 2013 monthly peak hour average PEMS data. Vph = vehicles per hour.

The 2013 existing seasonal adjusted 2013 AM and PM peak hour volumes for this study area including turn movements at the study intersections are illustrated in **Figure 2**, and the traffic counts are provided in the Appendix A.

2.2 Future Year Traffic Volume Forecasts

A traffic forecast model was developed by the San Bernardino Associated Governments (SANBAG) specifically for use within San Bernardino County. The current SANBAG model is a sub-regional (subset) of the regional Southern California Associated Governments (SCAG) Model and incorporates more refined local details otherwise not included in larger scale regional models. The SANBAG Model incorporates elements of the most recent Regional Transportation Plan (RTP), 2012-2035.





LEGEND

XX/XX	AM/PM Peak Hour Volumes
(XX)	Calculated Average Daily Traffic (ADT) Volumes.

EXISTING YEAR 2013 TRAFFIC VOLUMES

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

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CREATED BY: SV	DATE: April 2014	FIGURE 2
PM: DS	PROJECT NO: 29866552	

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The development of the San Bernardino County Transportation Analysis Model (SBTAM) was completed in June 2012, in partnership with Southern California Association of Governments (SCAG). SANBAG currently has the 2008 and 2035 SBTAM traffic model networks applicable for the proposed project study area.

The forecasted traffic volume model plots from the 2008 and 2035 SBTAM traffic demand models were utilized for the project study area. Review of the 2008 SBTAM traffic demand model found the 2008 SBTAM model traffic volumes at the SR-210/Base Line interchange to be significantly higher than traffic counts conducted at the interchange in both 2011 and 2013. The high model traffic volumes at the SR-210/Base Line interchange were discussed with SANBAG on October 28, 2013. SANBAG concluded that the travel demand model volumes were not calibrated for this interchange and the model forecasting would need to be adjusted. As a result, growth rates from the 2008 and 2035 SBTAM models were calculated. These growth rates were applied to the seasonal adjusted 2013 traffic counts to develop forecasted traffic volumes. A more detailed discussion of the forecasting methodology is presented in the SR-210/Base Line Interchange Improvement Project – Traffic Forecasting Memorandum, dated October 30, 2013.

The growth rate derived traffic forecasts were post-processed to develop Opening Year 2020 and Horizon Year 2040 traffic volume projections. Both AM and PM peak hour turning movement volumes were post-processed at each study intersection using the design year (2040) peak hour approach and departure volumes in conjunction with the seasonal adjusted existing (2013) turning movement volumes.

The following steps outline the traffic forecasting methodology and post-processing used to estimate the Opening Year 2020 and Horizon Year 2040 traffic volume forecasts:

- The growth between the 2008 and 2035 SBTAM travel demand model volumes was used to determine the overall growth between 2008 and 2035 accounting for 27 years of growth. This growth in traffic volumes was used to determine annualized growth rates, which ranged between 1.5 to 2.5 percent per year, for the interchange and along the Base Line corridor.
- Growth factors were estimated based on the annualized growth rates from the SBTAM models. These growth factors were applied to the Existing 2013 seasonal adjusted traffic volumes to develop Opening Year 2020 and Horizon Year 2040 projected traffic volumes.
- The growth rate derived traffic volume forecasts were post-processed in developing Opening Year 2020 and Horizon Year 2040 traffic volume projections. Both AM and PM peak hour turning movement volumes were post-processed at each study intersection using the future year (Opening Year 2020/Horizon Year 2040, as appropriate) peak hour approach and departure volumes in conjunction with the seasonal adjusted existing (2013) turning movement volumes.
- The AM and PM peak hour traffic volumes were balanced between intersections using the peak hour directional approach and departure volumes at the study area intersections.

The post-processed peak hour volumes for Opening Year 2020 and Horizon Year 2040 are presented later in this report.

The project proposes improvements to the local arterial as well as geometric improvements at the ramp termini. The project would not impact SR-210 operations or affect regional traffic demand or distribution. Therefore, no separate regional model runs for No Build and Build conditions are necessary since the No Build and Build volumes are identical and only the interchange geometric improvement changes occur as part of the project.

3.0 ANALYSIS METHODOLOGIES

This report evaluates traffic operations at the SR-210/Base Line interchange and along the Base Line corridor in the study area under Existing 2013 conditions, Opening Year 2020 and Horizon Year 2040 conditions. The Base Line arterial corridor and intersecting interchange ramps are analyzed for improvements. The freeway ramp junctions and adjacent mainline freeway segments are considered to ensure that proposed improvements at the interchange will not have negative impacts on the mainline freeway or adjacent interchanges.

3.1 Intersection Operations

Intersection levels of service were calculated using the HCM analysis methodologies, using the Synchro 8 software, which accounts for the effects of signal coordination and platoon formation on intersection operations. Traffic signal timing was optimized using Synchro 8. Network cycle lengths between 60 seconds to 120 seconds at 10 second intervals were first analyzed and evaluated. A common network cycle length was selected for optimization based upon several measures of effectiveness such as performance index, total delay, total stops and unserved vehicles. Next, network offsets along with the phase splits at the study intersections were optimized.

The average control delay per vehicle is estimated for each lane group and aggregated for each approach and for the intersection as a whole. Level of service is directly related to the control delay value. The level of service criteria are listed in **Table 2** for signalized intersections.

Table 2: Level of Service (LOS) Criteria for Signalized Intersections

LOS	Control Delay per Vehicle (sec/veh)
A	≤ 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

Source:
Exhibit 18-4 from Highway Capacity Manual 2010.

3.2 Basic Freeway Segment Operations

A basic freeway segment is a freeway mainline segment that is not within a ramp influence area (i.e., within 1,500 feet of a ramp) or within a weaving segment. Adding or dropping a lane results in the termination of a basic freeway segment. Peak hour volumes on basic freeway segments are analyzed using the methodology contained in HCM Chapter 11 ("Basic Freeway Segments"), with calculations performed using the Highway Capacity Software (HCS 2010). Level of service criteria for basic freeway segments are given in **Table 3**.

Table 3: LOS Criteria for Basic Freeway Segments

LOS	Density (pc/mi/ln)
A	≤ 11
B	> 11-18
C	> 18-26
D	> 26-35
E	> 35-45
F	Demand exceeds capacity >45

Source:
Exhibit 11-5 from Highway Capacity Manual 2010.

3.3 Weaving Segments

A weaving segment is a freeway mainline segment in which two streams of traffic must cross, such as in an auxiliary lane connecting an upstream on-ramp to a downstream off-ramp. The segment is evaluated if the weaving length is less than the maximum length as calculated by the equation listed below.

$$L_{MAX} = [5{,}728(1 + VR)^{1.6}] - [1{,}566N_{WL}]$$

Peak hour volumes in freeway weaving sections are analyzed using the methodology contained in HCM Chapter 12 ("Freeway Weaving"). A weaving segment, in which both weaving movements require a single lane change, such as in an auxiliary lane between a single-lane on-ramp and single-lane off-ramp, is a "Type A" weaving segment. A weaving segment in which one weaving movement requires a single lane change and the other weaving movement can be made without any lane change, such as in an auxiliary lane between a single-lane on-ramp and a two-lane off-ramp, is a "Type B" weaving segment. Consistent with Highway Capacity Manual procedures, a segment consisting of a one-lane on-ramp closely followed by a one-lane off-ramp without connecting auxiliary lane is not analyzed as a weaving segment, but as separate merge and diverge areas (Highway Capacity Manual, p. 12-16). Level of service criteria for weaving segments are listed in **Table 4**.

Table 4: LOS Criteria for Weaving Segments

LOS	Density (pc/mi/ln)	
	Freeway Weaving Segment	Multilane and Collector-Distributor Weaving Segments
A	0-10	0-12
B	> 10-20	> 12-24
C	> 20-28	> 24-32
D	> 28-35	> 32-36
E	> 35	> 36
F	Demand Exceeds Capacity	

Source:
Exhibit 12-10 from Highway Capacity Manual 2010.

3.4 Ramp Connection Merge/Diverge Areas

The merge/diverge analysis methodology consists of three primary steps. The first step calculates the flow entering the outer two lanes of the freeway immediately upstream of the merge influence area or at the beginning of the deceleration lane of the diverge influence area. The influence area for ramps and ramp junctions is 1,500 feet, including the acceleration and deceleration lane along with the outer two lanes of the freeway. Chapter 13 ("Ramps and Ramp Junctions") of the HCM indicates that other freeway lanes may be affected by merging or diverging maneuvers, but the defined area within the 1,500 feet generally experiences most of the impacts across all levels of service.

The second step compares capacity values with the demand flows in order to determine potential for congestion. There are several capacity values that are evaluated that include: maximum total flow approaching a diverge area on the freeway, maximum total flow departing from a merge or diverge area on the freeway, maximum total flow entering the ramp influence area, and maximum flow on a ramp. The capacity of a merge or diverge area is controlled by the capacity of the freeway segments upstream and downstream of the ramps or by the capacity of the ramp itself.

The third step calculates the density of flow within the ramp influence area and the level of service based on the density is determined. The level of service is represented by LOS A through LOS E. Although a density value is determined, LOS F occurs when the total demand flows exceed any of the capacity checks. Level of service criteria for merge and diverge areas are listed in **Table 5**. The density values shown for LOS A through LOS E assume stable operation, with no breakdown within the merge influence area.

Table 5: LOS Criteria for Merge and Diverge Areas

LOS	Density (pc/mi/ln)
A	≤ 10
B	> 10-20
C	> 20-28
D	> 28-35
E	> 35
F	Demand exceeds capacity

Source:
Exhibit 13-2 from Highway Capacity Manual 2010.

3.5 Queuing Analysis

Queuing analyses were conducted for the two ramp terminal intersections on Base Line at SR-210 and for the intersection of Base Line and Seine Avenue using Synchro Analysis software consistent with HCM 2010 analysis methodology. The queuing analyses compare the minimum required storage lengths to the storage lengths provided for the analyzed intersections.

The minimum required storage lengths are based on the 95th percentile queue lengths as calculated in the Synchro queuing worksheets. Synchro reports the 95th percentile queue length for a single lane of a lane group (highest queue length considering all lanes of the lane group) and not the total queue length of all lanes in that lane group.

The provided storage lengths for an intersection are measured from the limit line to the end of the bay taper for turn movements. For off-ramps, the provided storage lengths are measured from the off-ramp exit gore point to the crosswalk if it is a continuous lane. If turn lane (left or right) pockets are provided at the end of the off-ramp, then the provided storage lengths are measured from the limit line to the end of the bay taper for that turn lane.

3.6 Ramp Meter Queuing Analysis

Ramp metering analyses were conducted for ramp metering conditions for the Horizon Year 2040 Build Alternative scenario. The ramp metering analysis spreadsheets are set up for both AM and PM peak period conditions. Additionally, the ramp lanes, an average vehicle length, and the ramp storage length are input for each ramp. A ramp metering discharge rate (vehicles per hour per lane) between 240 and 900 vph/lane is used by Caltrans. For on-ramps, the provided storage lengths are measured from the crosswalk to the ramp meter limit line.

4.0 EXISTING 2013 TRAFFIC CONDITIONS

4.1 Intersection Levels of Service

The existing seasonal adjusted traffic counts for the AM and PM peak hours were input into Synchro along with the existing intersection geometric configurations and parameters such as peak hour factors (PHF), percent heavy vehicles, signal timing, etc. The levels of service at the study intersections under existing conditions are summarized in **Table 6** and the level of service calculation worksheets are contained in Appendix B.

Table 6: Existing 2013 Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	18.8	B	20.2	C
2	SR-210 EB ramps/Base Line	18.5	B	17.1	B
3	SR-210 WB ramps/Base Line	25.6	C	18.4	B
4	Base Line/Seine Avenue	20.1	C	24.3	C

Notes:
1. Used Highway Capacity Manual 2010 methodology.
2. Analysis was performed using existing lane geometry and traffic controls.
3. Existing volumes based on counts conducted in June 2013 with a seasonal factor.

As shown in **Table 6**, all study area intersections are currently operating at LOS C or better during the existing conditions in both the AM and PM peak hours.

5.0 OPENING YEAR 2020 TRAFFIC CONDITIONS

5.1 Opening Year 2020 Projected Traffic Volumes

Opening year traffic volumes were developed for the Year 2020 using the methodology described in the Future Year Traffic Volume Forecasts section of this report. The Opening Year 2020 ramp peak hour volumes at Base Line and turn movements at study intersections along Base Line are illustrated on **Figure 3**. Traffic volumes for both No Build and Build conditions are the same, because the project does not appreciably affect mainline or local traffic demand.

5.2 Opening Year 2020 No Build Alternative Traffic Conditions

The 2020 No Build analysis includes the improvements described previously at the Base Line/Seine Avenue intersection, which are being constructed by the City of Highland and should be complete by the end of 2014.

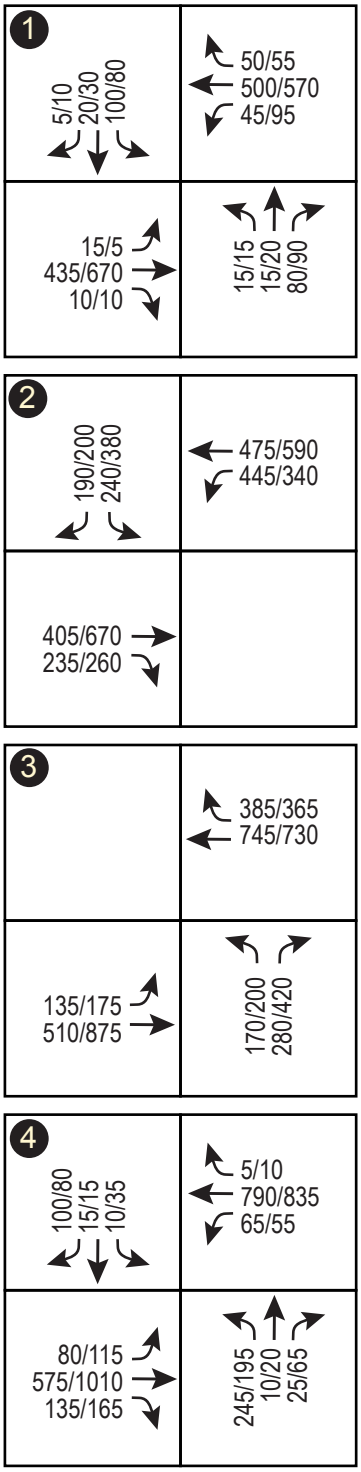
The level of service results at the study intersections under Opening Year 2020 No Build conditions are summarized in **Table 7**. Level of service calculation worksheets are contained in Appendix B.

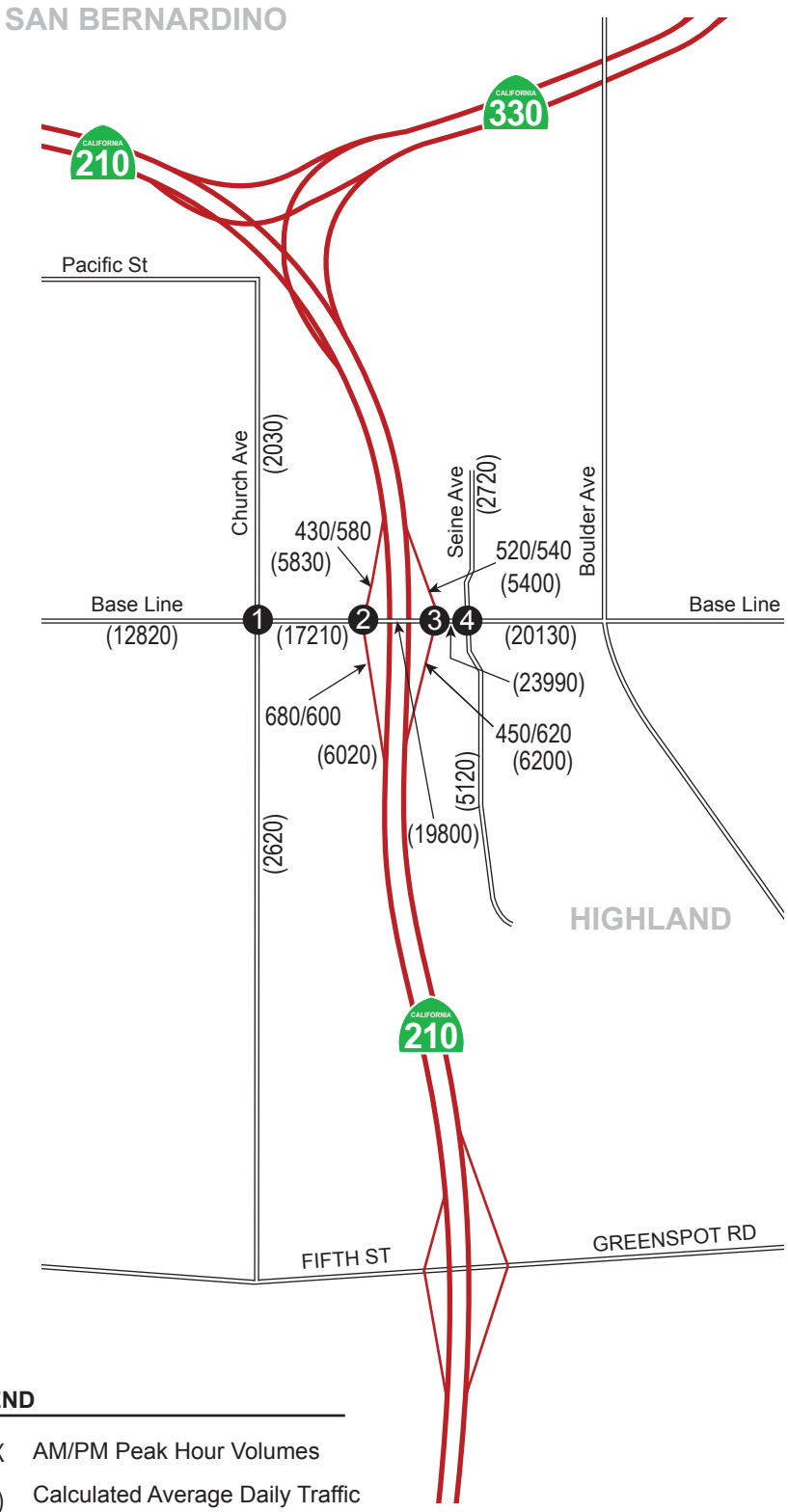
Table 7: Opening Year 2020 No Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	19.0	B	16.9	B
2	SR-210 EB ramps/Base Line	18.5	B	19.0	B
3	SR-210 WB ramps/Base Line	19.6	B	26.9	C
4	Base Line/Seine Avenue	25.2	C	17.9	B

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2020 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 7**, all study area intersections are projected to operate at LOS C or better under Opening Year 2020 No Build conditions in both the AM and PM peak hours.





LEGEND

XX/XX	AM/PM Peak Hour Volumes
(XX)	Calculated Average Daily Traffic (ADT) Volumes.

OPENING YEAR 2020 TRAFFIC VOLUMES

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

URS	CREATED BY: SV	DATE: April 2014	FIGURE 3
	PM: DS	PROJECT NO: 29866552	

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5.3 Opening Year 2020 Build Alternative Traffic Conditions

The 2020 Build Alternative widens Base Line from Buckeye Street to Seine Avenue and widens the existing interchange ramps. The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and the interchange ramps within the limits of the project. The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes and storage for vehicle queues.
- A two-lane exit would be created at the westbound exit ramp.
- For the westbound off-ramp, the right turn movement is analyzed as a restricted right turn with a “no-right-turn-on-red” sign.
- Ramp metering would be installed on the on-ramps at the interchange.
- A new crosswalk is proposed across Base Lane, located on the west leg of the Base Line and SR-210 eastbound ramps intersection.

The level of service results at the study intersections under Opening Year 2020 Build conditions are summarized in **Table 8**. Level of service calculation worksheets are contained in Appendix B.

Table 8: Opening Year 2020 Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	19.0	B	16.9	B
2	SR-210 EB ramps/Base Line	14.0	B	14.3	B
3	SR-210 WB ramps/Base Line	7.9	A	8.7	A
4	Base Line/Seine Avenue	23.2	C	21.0	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2020 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 8**, all study area intersections are projected to operate at LOS C or better under Opening Year 2020 Build conditions in both the AM and PM peak hours.

6.0 HORIZON YEAR 2040 TRAFFIC CONDITIONS

6.1 Horizon Year 2040 Projected Traffic Volumes

Horizon year traffic volumes were developed for the Year 2040 using the methodology described above in the Future Year Traffic Volume Forecasts section of this report. The Horizon Year 2040 ramp peak hour volumes at Base Line and turn movements at study intersections along Base line are illustrated in **Figure 4.** Traffic volumes for both the No Build and Build conditions are the same, because the project does not appreciably affect mainline or local traffic demand.

6.2 Horizon Year 2040 No Build Traffic Conditions

Similar to the Opening Year 2020 No Build Alternative, the Horizon Year 2040 No Build Alternative analysis includes the improvements described previously at the Base Line/Seine Avenue intersection, which are being constructed by the City of Highland and should be complete by the end of 2014. The Horizon Year 2040 No Build Alternative was considered as a baseline to measure and compare the proposed improvement alternative.

6.2.1 Intersection Levels of Service

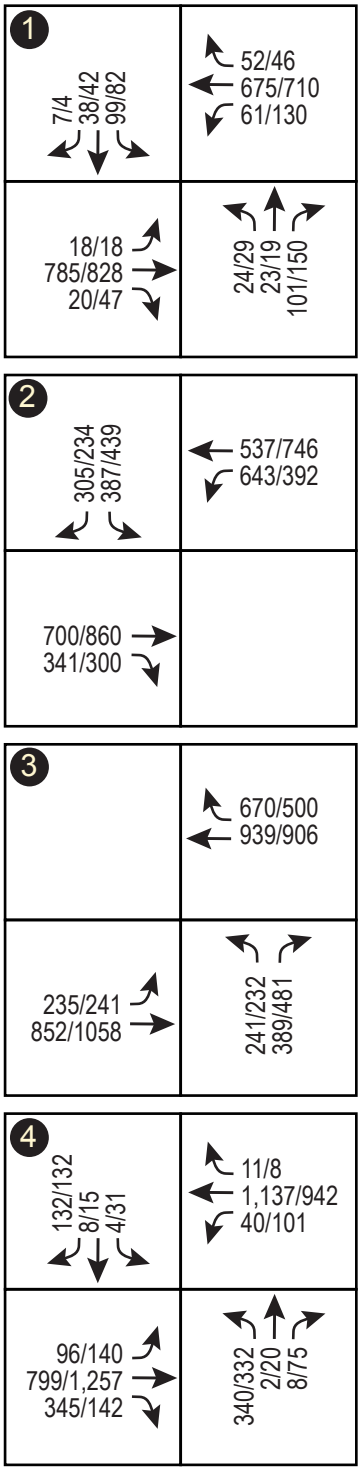
The level of service results at the study intersections under Horizon Year 2040 No Build conditions are summarized in **Table 9**. Level of service calculation worksheets are contained in the Appendix B.

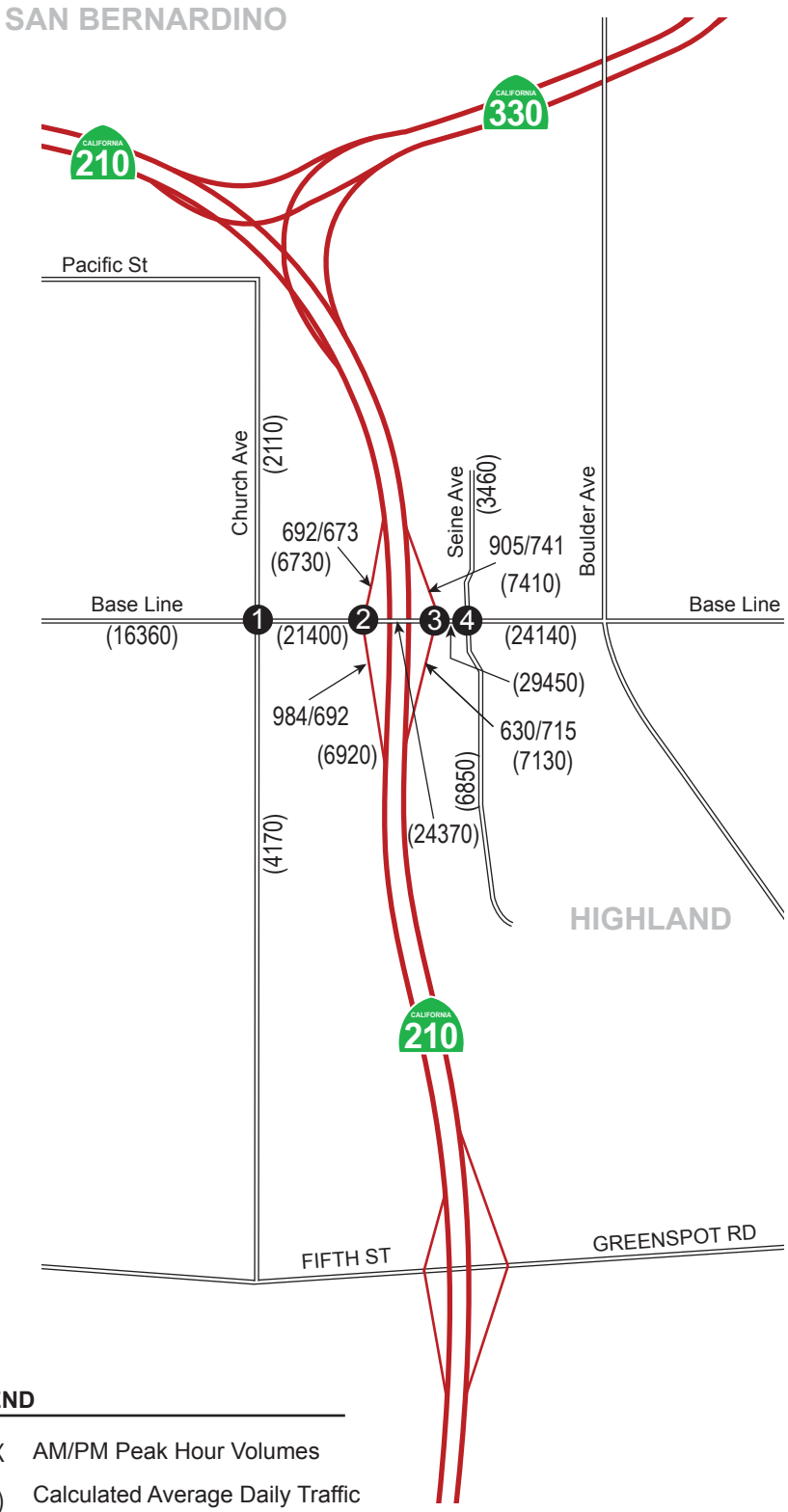
Table 9: Horizon Year (2040) No Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	17.7	B	17.8	B
2	SR-210 EB ramps/Base Line	24.8	C	20.8	C
3	SR-210 WB ramps/Base Line	50.2	D	48.8	D
4	Base Line/Seine Avenue	28.7	C	32.2	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2040 No Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 9**, the study area intersections are predicted to degrade from existing conditions (which were generally LOS B and LOS C) to LOS C and LOS D if no improvements are implemented at the interchange.





LEGEND

XX/XX	AM/PM Peak Hour Volumes
(XX)	Calculated Average Daily Traffic (ADT) Volumes.

HORIZON YEAR 2040 TRAFFIC VOLUMES

SR-210 AT BASE LINE
INTERCHANGE IMPROVEMENT PROJECT

URS

CREATED BY: SV	DATE: April 2014	FIGURE 4
PM: DS	PROJECT NO: 29866552	

K:\2014\SR-210 Base Line Interchange Improvement\Figures.ai

6.2.1 Queuing Analysis

This section evaluates projected queuing for the Horizon Year 2040 No Build Alternative condition at closely spaced intersections along Base Line. The queuing analysis was conducted for the two SR-210 freeway ramp terminal intersections and for the intersection of Base Line and Seine Avenue. The intersection of Base Line at Church Avenue was not included since the distance of this intersection from the interchange is too far to have a queuing impact. **Table 10** shows Horizon Year 2040 predicted 95th percentile queue lengths in feet by approach movement compared to the storage provided in the No Build Alternative configuration. Queuing calculation worksheets are contained in the Appendix B.

Table 10: Horizon Year (2040) No Build – 95th Percentile Queue Summary

Intersection/Movement	Storage (feet)	Queue Length per lane (feet)		Adequate Storage
		AM Peak	PM Peak	
SR-210 EB Ramps/Base Line				
Base Line Rd EB Through	850	251	294	Yes
Base Line Rd EB Right-Turn	100	**111**	**102**	**No**
Base Line Rd WB Left-Turn	150	**242**	**162**	**No**
Base Line Rd WB Through	330	77	128	Yes
SR-210 EB Off-Ramp SB Left-Turn	750	189	205	Yes
SR-210 EB Off-Ramp SB Right-Turn	750	190	206	Yes
SR-210 WB Ramps/Base Line				
Base Line Rd EB Left-Turn	100	**148**	**153**	**No**
Base Line Rd EB Through	350	158	258	Yes
Base Line Rd WB Through	225	**628**	**590**	**No**
SR-210 WB Off-Ramp NB Left-Turn	900	205	176	Yes
SR-210 WB Off-Ramp NB Right-Turn	900	430	502	Yes
Seine Avenue/Base Line				
Base Line Rd EB Left-Turn	90	**135**	**176**	**No**
Base Line Rd EB Through	225	**251**	**463**	**No**
Base Line Rd EB Right-Turn	100	90	48	Yes
Base Line Rd WB Left-Turn	150	58	**156**	**No**
Base Line Rd WB Through	1000	470	328	Yes
Seine Ave NB Left-Turn	110	**167**	**195**	**No**
Seine Ave NB Through	800	5	25	Yes
Seine Ave NB Right-Turn	80	0	30	Yes
Seine Ave SB Left-Turn	100	11	43	Yes
Seine Ave SB Through	600	55	60	Yes

Notes:

Shaded cells indicate insufficient storage.

All intersection analyses conducted using Synchro 8.

As shown in **Table 10**, many of the movements at the study area intersections do not have adequate storage capacity for predicted queue lengths in the Horizon Year 2040 No Build conditions in both AM and PM peak hours. Both left turn movements that access the interchange on-ramps show longer queues than can be stored in the existing turn pockets.

Also, the short distance between the westbound freeway ramps and Seine Avenue does not provide sufficient through traffic storage in either of the AM or PM peak periods. Multiple turn movements at the Base Line/Seine Avenue intersection show inadequate storage for the predicted queue lengths in the Horizon Year 2040 No Build conditions.

6.2.3 Mainline Freeway and Adjacent Interchange Analysis

To ensure that the interchange improvements do not have a negative impact on adjacent freeway mainline segments or adjacent interchanges, freeway operations were analyzed beyond the SR-210/Base Line interchange. Mainline freeway weaving segments, as defined by the Highway Capacity Manual, exist between the SR-330 and Base Line interchanges. Additional weaving segments will exist between the Base Line and 5th Street–Greenspot Road interchanges by 2020. Therefore, the analysis of adjacent freeway facilities is a weaving analysis. Ramp junction and mainline freeway segment analyses do not apply. **Table 11** summarizes the density and level of service results for the weave locations along SR-210 in the study area under the Horizon Year 2040 No Build condition.

Table 11: Horizon Year 2040 No Build SR-210/Base Line Mainline Freeway Operations

Direction	Freeway Mainline Segment/Ramp Connection	Merge/Diverge/Weave Analysis					
		Facility	Lanes	AM Peak		PM Peak	
				Density	LOS	Density	LOS
Westbound	SR-210/Greenspot Road On-ramp*	Merge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between 5th Street-Greenspot Road and Base Line*	Weave	3 MF/ 1 Aux	22.7	C	26.8	C
	SR-210/Base Line Off	Diverge	3 MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210/Base Line On	Merge	3 MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between Base Line and SR-330*	Weave	3 MF/ 1 Aux	24.3	C	25.9	C
	SR-210/SR-330 Connector*	Diverge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
Eastbound	SR-210/SR-330 Connector*	Merge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between SR-330 and Base Line*	Weave	3 MF/ 1 Aux	22.3	C	22.0	C
	SR-210/Base Line Off	Diverge	3MF/ 1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210/Base Line On	Merge	3 MF/ 1 Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)
	SR-210 between Base Line and 5th Street-Greenspot Road*	Weave	3 MF/ 1 Aux	26.8	C	25.5	C
	SR-210/5th Street Off-ramp*	Diverge	3MF/1L Ramp	N/A (1)	N/A (1)	N/A (1)	N/A (1)

Notes:
Density in passenger car equivalents per mile per lane. MF = Mixed Flow. 1L = 1 lane ramp.
*Results from SR-210 Mixed Flow Lane Addition Project from Highland Avenue (PM R25.0) to San Bernardino Avenue (PM R33.2)
(1) Ramp junction analysis is not applicable for ramp connections in weave segments.

All of the weave locations are projected to operate at an acceptable LOS D or better during the AM and PM peak periods. The reported level of service results for the mainline freeway weave locations were obtained from the SR-210 Mixed Flow Lane Addition project TOAR approved on February 18, 2014.

6.3 Horizon Year 2040 Build Alternative Traffic Conditions

The 2040 Build Alternative widens Base Line from Buckeye Street to Seine Avenue and widens the existing interchange ramps. The proposed Build Alternative would reconstruct and improve the existing diamond interchange by widening Base Line and the interchange ramps within the limits of the project. The proposed Build Alternative includes the following design features and elements:

- Base Line between Buckeye Street and Seine Avenue and the interchange ramps would be widened to add through lanes, turn lanes and storage for vehicle queues.
- A two-lane exit would be created at the westbound exit ramp.
- For the westbound off-ramp, the right turn movement is analyzed as a restricted right turn with a “no-right-turn-on-red” sign.
- Ramp metering would be installed on the on-ramps at the interchange.
- A new crosswalk is proposed across Base Lane, located on the west leg of the Base Line and SR-210 eastbound ramps intersection.

6.3.1 Intersection Levels of Service

The level of service results at the study intersections under the Horizon Year 2040 Build Alternative conditions are summarized in **Table 12**. Level of service calculation worksheets are contained in Appendix B.

Table 12: Horizon Year (2040) Build – Peak Hour Intersection Level of Service

ID	Signalized Intersection Name	AM Peak		PM Peak	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
1	Base Line/Church Avenue	17.7	B	17.8	B
2	SR-210 EB ramps/Base Line	24.5	C	16.7	B
3	SR-210 WB ramps/Base Line	15.2	B	11.1	B
4	Base Line/Seine Avenue	24.7	C	22.5	C

Notes:
1. Using Highway Capacity Manual 2010 methodology.
2. 2040 Build volumes were calculated based on the revised forecast volumes prepared using the 2013 counts and SBTAM demand model.

As shown in **Table 12**, all study area intersections are projected to operate at an acceptable LOS D or better under Horizon Year 2040 Build conditions in both the AM and PM peak hours.

6.3.2 Queuing Analysis

This section evaluates projected queuing for the Horizon Year 2040 Build Alternative condition at intersections along Base Line at the SR-210 interchange. A queuing analysis was conducted for the two ramp terminal intersections on Base Line at SR-210 and for the intersection of Base Line and Seine Avenue. The intersection of Base Line at Church Avenue was not included since the distance of this intersection from the interchange is too far to have a queuing impact. **Table 13** shows Horizon Year 2040 predicted 95th percentile queue lengths in feet by approach movement compared to the storage provided in the Horizon Year 2040 Build Alternative configuration. Queuing calculation worksheets are contained in Appendix B.

Table 13: Horizon Year (2040) Build – 95th Percentile Queue Summary

Intersection/Movement	Storage (feet)	Queue Length per lane (feet)		Adequate Storage
		AM Peak	PM Peak	
SR-210 EB Ramps/Base Line				
Base Line Rd EB Through	850	139	155	Yes
Base Line Rd EB Right-Turn	100	59	49	Yes
Base Line Rd WB Left-Turn	250	228	151	Yes
Base Line Rd WB Through	300	27	36	Yes
SR-210 EB Off-Ramp SB Left-Turn	750	122	136	Yes
SR-210 EB Off-Ramp SB Right-Turn	750	58	73	Yes
SR-210 WB Ramps/Base Line				
Base Line Rd EB Left-Turn	350	100	102	Yes
Base Line Rd EB Through	350	75	115	Yes
Base Line Rd WB Through	225	23	59	Yes
Base Line Rd WB Right-Turn	80	4	29	Yes
SR-210 WB Off-Ramp NB Left-Turn	900	171	153	Yes
SR-210 WB Off-Ramp NB Right-Turn	900	139	164	Yes
Seine Avenue/Base Line				
Base Line Rd EB Left-Turn	180	47	63	Yes
Base Line Rd EB Through	225	87	190	Yes
Base Line Rd EB Right-Turn	100	32	15	Yes
Base Line Rd WB Left-Turn	150	46	126	Yes
Base Line Rd WB Through	1000	418	330	Yes
Seine Ave NB Left-Turn	110	**163**	**147**	**No**
Seine Ave NB Through	800	4	17	Yes
Seine Ave NB Right-Turn	80	0	7	Yes
Seine Ave SB Left-Turn	100	9	33	Yes
Seine Ave SB Through	600	14	20	Yes
Seine Ave SB Right-Turn	100	42	18	Yes

Notes:

Shaded cells indicate insufficient storage.

All intersection analyses conducted using Synchro 8.

As shown in **Table 13**, the many locations of inadequate storage identified in the Horizon Year 2040 No Build scenario (refer to **Table 10**) have been improved to the extent that only one movement is under-provided in the Horizon Year 2040 Build scenario. All of the turn movements and through traffic queues at the interchange ramp terminal intersections can be contained within the storage provided by the Build Alternative.

The two on-ramps were also analyzed for future ramp metering in the Horizon Year 2040 Build Alternative scenario. The ramp lanes, an average vehicle length, and the ramp storage length were input for each ramp. A ramp metering discharge rate [vehicles per hour (vph) per lane] between 240 and 900 vph/lane is used by Caltrans. To be conservative, a ramp metering discharge rate of 240 vph/lane was used in this analysis. **Table 14** presents the ramp metering queuing analysis for each of the on-ramps.

Table 14: Horizon Year 2040 Build Alternative – Ramp Meter Queuing Analysis

On-Ramp	Peak Hour	Lanes	Available Storage per Lane (ft)	Total Arrival (1)	Meter Rate	Max. Queue Ft/Lane	Adequate Storage
WB	AM	2	250	1,244	240	122	Yes
	PM			1,163	240	141	Yes
EB	AM	2	500	1,284	240	236	Yes
	PM			952	240	0	Yes

Notes:
(1) For 3 hour peak period

Table 14 indicates that the storage provided on all on-ramps with proposed ramp metering for the Horizon Year 2040 Build Alternative are adequate using an assumed meter rate of 240 vph/lane. The projected maximum queue identified in **Table 14** can be decreased by increasing the meter rate, as needed.

6.3.3 Mainline Freeway and Adjacent Interchange Analysis

The mainline freeway and adjacent interchange analyses are governed by the traffic volumes entering and exiting the freeway at the SR-210/Base Line interchange and the geometrics of the ramp junctions at connection points between the interchange and the mainline freeway lanes. The Horizon Year 2040 traffic volumes are the same for both the No Build and Build conditions. Also, auxiliary lanes will exist between the SR-210/Base Line interchange and the adjacent SR-330 and adjacent 5th Street-Greenspot Road interchanges. Therefore, the mainline freeway and adjacent interchange analysis for the Horizon Year 2040 Build conditions is the same as the analysis for the Horizon Year 2040 No Build conditions presented in the previous section. Thus, as shown in **Table 11**, all of the weave locations are projected to operate at an acceptable LOS C or better during the AM and PM peak periods.

Appendix A
Existing Traffic Counts

ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

Church Ave and Base Line Rd , City of Highland

Date: 6/12/2013

Day: Wednesday

Project #: CA13_6108_001

AM Peak Hour	715 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (Church Ave)

	Lanes 0	1	1		
AM	4	16	96	65	AM
NOON	0	0	0	0	NOON
PM	9	23	80	69	PM

Eastbound Approach (Base Line Rd)

Lanes	AM	NOON	PM
	425	0	508
1	11	0	5
2	332	0	547
0	8	0	8

Westbound Approach

Lanes	AM	NOON	PM
0	45	0	50
2	412	0	489
1	36	0	77
	488	0	694

Northbound Approach

					Lanes
AM	60	9	9	60	AM
NOON	0	0	0	0	NOON
PM	108	10	14	67	PM
		1	1	0	

CONTROL: Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	7:00 PM

Total Ins & Outs

	North Leg		
AM	116	65	AM
NOON	0	0	NOON
PM	112	69	PM

West Leg	AM	NOON	PM
	425	0	508
	351	0	560

East Leg	AM	NOON	PM
	493	0	616
	488	0	694

South Leg		
AM	60	78
NOON	0	0
PM	108	91

Total Volume Per Leg

North Leg	
AM	181
NOON	0
PM	181

West Leg	AM	NOON	PM
	776	0	1068

East Leg	AM	NOON	PM
	981	0	1310

South Leg	
AM	138
NOON	0
PM	199

ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

SR-210 EB Ramps and Base Line Rd , City of Highland

Date: 6/12/2013

Day: Wednesday

Project #: CA13_6108_002

AM Peak Hour	730 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (SR-210 EB Ramps)

Lanes	1	0.5	1.5		
AM	145	3	185	0	AM
NOON	0	0	0	0	NOON
PM	179	1	337	0	PM

Eastbound Approach (Base Line Rd)

Lanes	AM	NOON	PM
	552	0	682
0	0	0	0
2	315	0	541
1	196	0	231

Westbound Approach

Lanes	AM	NOON	PM
0	0	0	0
2	407	0	503
2	370	0	302
	500	0	878

Northbound Approach

AM	569	0	0	0	AM
NOON	0	0	0	0	NOON
PM	534	0	0	0	PM
		0	0	0	Lanes

CONTROL: Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	7:00 PM

Total Ins & Outs

	North Leg		
	333	0	AM
	0	0	NOON
	517	0	PM

West Leg			East Leg		
AM	NOON	PM			
552	0	682	777	0	805
511	0	772	500	0	878
			AM	NOON	PM

South Leg		
AM	569	0
NOON	0	0
PM	534	0

Total Volume Per Leg

North Leg		
333		AM
0		NOON
517		PM

West Leg			East Leg		
AM	NOON	PM			
1063	0	1454	1277	0	1683
			AM	NOON	PM

South Leg	
AM	569
NOON	0
PM	534

ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

SR-210 WB Ramps and Base Line Rd , City of Highland

Date: 6/12/2013

Day: Wednesday

Project #: CA13_6108_003

AM Peak Hour	730 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (SR-210 WB Ramps)

	Lanes	0	0	0		
AM		0	0	0	399	AM
NOON		0	0	0	0	NOON
PM		0	0	0	428	PM

Eastbound Approach (Base Line Rd)

Lanes	AM	NOON	PM
	786	0	805
2	103	0	139
2	400	0	741
2	0	0	0

Westbound Approach

AM	NOON	PM	Lanes
296	0	288	0
641	0	627	2
0	0	0	0
635	0	1111	

Northbound Approach

AM	0	145	0	235	AM
NOON	0	0	0	0	NOON
PM	0	178	1	370	PM
		0.5	0.5	1	Lanes

CONTROL: Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	7:00 PM

Total Ins & Outs

	AM	NOON	PM
North Leg	0	0	0
	399	0	428
West Leg	786	0	805
	503	0	880
East Leg	937	0	915
	635	0	1111
South Leg	0	0	0
	380	0	549

Total Volume Per Leg

	AM	NOON	PM
North Leg	399	0	428
West Leg	1289	0	1685
East Leg	1572	0	2026
South Leg	380	0	549

ITM Peak Hour Summary

Prepared by:

NDS

National Data & Surveying Services

Siene Ave and Base Line Rd , City of Highland

Date: 6/12/2013

Day: Wednesday

Project #: CA13_6108_004

AM Peak Hour	730 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (Siene Ave)

Lanes	0	1	1		
AM	82	12	14	84	AM
NOON	0	0	0	0	NOON
PM	69	13	30	124	PM

Eastbound Approach (Base Line Rd)

	AM	NOON	PM
	937	0	915
1	71	0	100
2	475	0	872
0	89	0	149
Lanes	AM	NOON	PM

Westbound Approach

AM	NOON	PM	Lanes
4	0	10	0
656	0	698	2
58	0	49	1
513	0	949	
AM	NOON	PM	

Northbound Approach

AM	159	199	9	24	AM
NOON	0	0	0	0	NOON
PM	211	148	14	47	PM
		1	1	1	Lanes

CONTROL: Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	7:00 PM

Total Ins & Outs

	North Leg		
AM	108	84	AM
NOON	0	0	NOON
PM	112	124	PM

West Leg			East Leg		
AM	NOON	PM			
937	0	915	718	0	757
635	0	1121	513	0	949
			AM	NOON	PM

	South Leg	
AM	159	232
NOON	0	0
PM	211	209

Total Volume Per Leg

	North Leg
AM	192
NOON	0
PM	236

West Leg			East Leg		
AM	NOON	PM			
1572	0	2036	1231	0	1706
			AM	NOON	PM

	South Leg
AM	391
NOON	0
PM	420

ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

Boulder Ave and Base Line Rd , City of Highland

Date: 6/12/2013

Day: Wednesday

Project #: CA13_6108_005

AM Peak Hour	730 AM
NOON Peak Hour	
PM Peak Hour	445 PM

Peak Hour Summary

Southbound Approach (Boulder Ave)

Lanes	1	2	1		
AM	138	49	42	337	AM
NOON	0	0	0	0	NOON
PM	298	126	77	512	PM

Eastbound Approach (Base Line Rd)

Lanes	AM	NOON	PM
	674	0	750
2	215	0	316
2	231	0	556
1	34	0	79

Westbound Approach

Lanes	AM	NOON	PM
1	49	0	57
2	491	0	365
1	14	0	31
	278	0	647

Northbound Approach

AM	97	45	73	5	AM
NOON	0	0	0	0	NOON
PM	236	87	139	14	PM
Lanes		1	3	0	Lanes

CONTROL: Signalized

Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	7:00 PM

Total Ins & Outs

	AM	NOON	PM
North Leg	229	0	501
	337	0	512
West Leg	674	0	750
	480	0	951
East Leg	554	0	453
	278	0	647
South Leg	97	0	236
	123	0	240

Total Volume Per Leg

	AM	NOON	PM
North Leg	566	0	1013
West Leg	1154	0	1701
East Leg	832	0	1100
South Leg	220	0	476

Prepared by NDS/ATD

VOLUME

EB SR-210 Ramps @ Baseline Ave

Day: Wednesday
Date: 6/12/2013

City: Highland
Project #: CA13_6110_001

DAILY TOTALS	Off	On			Total
	5,403	8,201	0	0	13,604

AM Period	Off		On		TOTAL		PM Period	Off		On		TOTAL	
00:00	11		13		24		12:00	58		130		188	
00:15	18		11		29		12:15	51		99		150	
00:30	15		15		30		12:30	75		115		190	
00:45	9	53	14	53	23	106	12:45	70	254	129	473	199	727
01:00	5		12		17		13:00	70		125		195	
01:15	5		16		21		13:15	65		119		184	
01:30	5		11		16		13:30	100		119		219	
01:45	6	21	4	43	10	64	13:45	77	312	129	492	206	804
02:00	5		10		15		14:00	75		107		182	
02:15	5		7		12		14:15	75		133		208	
02:30	8		9		17		14:30	103		123		226	
02:45	8	26	10	36	18	62	14:45	72	325	96	459	168	784
03:00	3		14		17		15:00	89		115		204	
03:15	6		8		14		15:15	111		122		233	
03:30	9		26		35		15:30	88		129		217	
03:45	7	25	18	66	25	91	15:45	123	411	116	482	239	893
04:00	4		27		31		16:00	93		129		222	
04:15	18		40		58		16:15	95		134		229	
04:30	16		29		45		16:30	100		118		218	
04:45	9	47	43	139	52	186	16:45	133	421	137	518	270	939
05:00	17		60		77		17:00	148		146		294	
05:15	13		55		68		17:15	138		133		271	
05:30	20		79		99		17:30	110		138		248	
05:45	26	76	83	277	109	353	17:45	106	502	114	531	220	1033
06:00	28		93		121		18:00	110		110		220	
06:15	36		98		134		18:15	98		132		230	
06:30	40		131		171		18:30	93		91		184	
06:45	37	141	117	439	154	580	18:45	82	383	109	442	191	825
07:00	60		162		222		19:00	70		125		195	
07:15	64		144		208		19:15	90		69		159	
07:30	76		159		235		19:30	76		86		162	
07:45	96	296	144	609	240	905	19:45	77	313	84	364	161	677
08:00	79		134		213		20:00	47		92		139	
08:15	82		132		214		20:15	69		74		143	
08:30	64		142		206		20:30	56		65		121	
08:45	63	288	128	536	191	824	20:45	53	225	72	303	125	528
09:00	80		105		185		21:00	69		73		142	
09:15	54		107		161		21:15	62		56		118	
09:30	52		111		163		21:30	55		80		135	
09:45	56	242	120	443	176	685	21:45	43	229	47	256	90	485
10:00	68		106		174		22:00	27		45		72	
10:15	69		131		200		22:15	46		47		93	
10:30	65		126		191		22:30	35		45		80	
10:45	75	277	120	483	195	760	22:45	15	123	32	169	47	292
11:00	72		137		209		23:00	20		34		54	
11:15	80		108		188		23:15	20		24		44	
11:30	79		122		201		23:30	23		27		50	
11:45	103	334	118	485	221	819	23:45	16	79	18	103	34	182
TOTALS		1826		3609		5435	TOTALS		3577		4592		8169
SPLIT %		33.6%		66.4%		40.0%	SPLIT %		43.8%		56.2%		60.0%

DAILY TOTALS	Off	On			Total
	5,403	8,201	0	0	13,604

AM Peak Hour	11:00	07:00			07:00	PM Peak Hour	16:45	16:45			16:45
AM Pk Volume	334	609			905	PM Pk Volume	529	554			1083
Pk Hr Factor	0.811	0.940			0.943	Pk Hr Factor	0.894	0.949			0.921
7 - 9 Volume	584	1145	0	0	1729	4 - 6 Volume	923	1049	0	0	1972
7 - 9 Peak Hour	07:30	07:00			07:00	4 - 6 Peak Hour	16:45	16:45			16:45
7 - 9 Pk Volume	333	609	0	0	905	4 - 6 Pk Volume	529	554	0	0	1083
Pk Hr Factor	0.867	0.940	0.000	0.000	0.943	Pk Hr Factor	0.894	0.949	0.000	0.000	0.921

Prepared by NDS/ATD

VOLUME

WB SR-210 Ramps @ Baseline Ave

Day: Wednesday
Date: 6/12/2013

City: Highland
Project #: CA13_6110_002

DAILY TOTALS	Off	On			Total
	7,574	5,537	0	0	13,111

AM Period	Off		On		TOTAL		PM Period	Off		On		TOTAL	
00:00	18		16		34		12:00	113		79		192	
00:15	15		8		23		12:15	122		79		201	
00:30	11		8		19		12:30	132		72		204	
00:45	17	61	4	36	21	97	12:45	124	491	94	324	218	815
01:00	4		8		12		13:00	116		84		200	
01:15	13		5		18		13:15	121		82		203	
01:30	14		0		14		13:30	118		94		212	
01:45	10	41	7	20	17	61	13:45	106	461	82	342	188	803
02:00	12		8		20		14:00	128		84		212	
02:15	7		2		9		14:15	123		80		203	
02:30	7		8		15		14:30	148		92		240	
02:45	29	55	9	27	38	82	14:45	160	559	69	325	229	884
03:00	9		5		14		15:00	162		82		244	
03:15	8		7		15		15:15	126		73		199	
03:30	8		11		19		15:30	142		112		254	
03:45	5	30	7	30	12	60	15:45	137	567	99	366	236	933
04:00	5		9		14		16:00	149		92		241	
04:15	11		17		28		16:15	163		86		249	
04:30	16		26		42		16:30	142		88		230	
04:45	14	46	17	69	31	115	16:45	127	581	88	354	215	935
05:00	17		27		44		17:00	127		120		247	
05:15	15		34		49		17:15	163		112		275	
05:30	27		47		74		17:30	132		108		240	
05:45	30	89	49	157	79	246	17:45	154	576	85	425	239	1001
06:00	31		28		59		18:00	142		94		236	
06:15	54		49		103		18:15	140		90		230	
06:30	59		66		125		18:30	129		88		217	
06:45	67	211	90	233	157	444	18:45	139	550	73	345	212	895
07:00	74		96		170		19:00	111		60		171	
07:15	69		86		155		19:15	116		49		165	
07:30	114		95		209		19:30	96		67		163	
07:45	104	361	101	378	205	739	19:45	98	421	55	231	153	652
08:00	84		106		190		20:00	105		57		162	
08:15	78		97		175		20:15	112		66		178	
08:30	85		91		176		20:30	91		62		153	
08:45	74	321	80	374	154	695	20:45	100	408	69	254	169	662
09:00	83		77		160		21:00	84		58		142	
09:15	75		88		163		21:15	98		50		148	
09:30	81		81		162		21:30	34		11		45	
09:45	101	340	72	318	173	658	21:45	80	296	49	168	129	464
10:00	66		67		133		22:00	61		36		97	
10:15	85		66		151		22:15	58		34		92	
10:30	82		68		150		22:30	46		25		71	
10:45	118	351	65	266	183	617	22:45	49	214	21	116	70	330
11:00	118		74		192		23:00	42		16		58	
11:15	85		76		161		23:15	35		13		48	
11:30	93		84		177		23:30	35		14		49	
11:45	109	405	90	324	199	729	23:45	27	139	12	55	39	194
TOTALS		2311		2232		4543	TOTALS		5263		3305		8568
SPLIT %		50.9%		49.1%		34.7%	SPLIT %		61.4%		38.6%		65.3%

DAILY TOTALS	Off	On			Total
	7,574	5,537	0	0	13,111

AM Peak Hour	11:45	07:30			11:45	PM Peak Hour	14:30	16:45			17:00
AM Pk Volume	476	399			796	PM Pk Volume	596	428			1001
Pk Hr Factor	0.902	0.941			0.975	Pk Hr Factor	0.920	0.892			0.910
7 - 9 Volume	682	752	0	0	1434	4 - 6 Volume	1157	779	0	0	1936
7 - 9 Peak Hour	07:30	07:30			07:30	4 - 6 Peak Hour	16:00	16:45			17:00
7 - 9 Pk Volume	380	399	0	0	779	4 - 6 Pk Volume	581	428	0	0	1001
Pk Hr Factor	0.833	0.941	0.000	0.000	0.932	Pk Hr Factor	0.891	0.892	0.000	0.000	0.910

Prepared by NDS/ATD

VOLUME

Base Line Rd btwn Church Ave & SR-210 EB Ramps

Day: Wednesday
Date: 6/12/2013

City: Highland
Project #: CA13_6109_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	8,671	8,864	17,535

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			17		15		32		12:00			132		135		267	
00:15			17		18		35		12:15			148		165		313	
00:30			14		30		44		12:30			122		139		261	
00:45			13	61	33	96	46	157	12:45			114	516	164	603	278	1119
01:00			9		22		31		13:00			160		149		309	
01:15			12		16		28		13:15			151		124		275	
01:30			4		14		18		13:30			123		131		254	
01:45			11	36	16	68	27	104	13:45			121	555	144	548	265	1103
02:00			6		12		18		14:00			127		170		297	
02:15			5		3		8		14:15			141		127		268	
02:30			7		8		15		14:30			137		130		267	
02:45			6	24	6	29	12	53	14:45			151	556	114	541	265	1097
03:00			7		6		13		15:00			145		108		253	
03:15			6		7		13		15:15			127		137		264	
03:30			10		7		17		15:30			160		138		298	
03:45			15	38	8	28	23	66	15:45			154	586	177	560	331	1146
04:00			9		10		19		16:00			122		152		274	
04:15			23		13		36		16:15			147		172		319	
04:30			35		14		49		16:30			186		149		335	
04:45			26	93	14	51	40	144	16:45			178	633	143	616	321	1249
05:00			36		10		46		17:00			175		165		340	
05:15			32		22		54		17:15			174		121		295	
05:30			50		21		71		17:30			200		144		344	
05:45			48	166	31	84	79	250	17:45			159	708	153	583	312	1291
06:00			54		60		114		18:00			136		150		286	
06:15			58		55		113		18:15			158		162		320	
06:30			71		65		136		18:30			129		126		255	
06:45			78	261	75	255	153	516	18:45			123	546	129	567	252	1113
07:00			81		98		179		19:00			105		131		236	
07:15			94		121		215		19:15			131		126		257	
07:30			137		127		264		19:30			102		142		244	
07:45			148	460	138	484	286	944	19:45			81	419	125	524	206	943
08:00			134		113		247		20:00			89		108		197	
08:15			120		92		212		20:15			114		133		247	
08:30			106		118		224		20:30			103		106		209	
08:45			110	470	118	441	228	911	20:45			86	392	95	442	181	834
09:00			98		119		217		21:00			100		102		202	
09:15			127		97		224		21:15			72		146		218	
09:30			131		98		229		21:30			89		101		190	
09:45			131	487	126	440	257	927	21:45			74	335	124	473	198	808
10:00			99		140		239		22:00			76		91		167	
10:15			125		101		226		22:15			61		85		146	
10:30			125		122		247		22:30			49		57		106	
10:45			116	465	114	477	230	942	22:45			36	222	65	298	101	520
11:00			102		122		224		23:00			45		50		95	
11:15			123		128		251		23:15			36		53		89	
11:30			145		110		255		23:30			26		33		59	
11:45			140	510	108	468	248	978	23:45			25	132	52	188	77	320
TOTALS				3071		2921		5992	TOTALS				5600		5943		11543
SPLIT %				51.3%		48.7%		34.2%	SPLIT %				48.5%		51.5%		65.8%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	8,671	8,864	17,535

AM Peak Hour			11:30	11:45	11:45	PM Peak Hour			16:45	15:45	16:15
AM Pk Volume			565	547	1089	PM Pk Volume			727	650	1315
Pk Hr Factor			0.954	0.829	0.870	Pk Hr Factor			0.909	0.918	0.967
7 - 9 Volume	0	0	930	925	1855	4 - 6 Volume	0	0	1341	1199	2540
7 - 9 Peak Hour			07:30	07:15	07:15	4 - 6 Peak Hour			16:45	16:15	16:15
7 - 9 Pk Volume	0	0	539	499	1012	4 - 6 Pk Volume	0	0	727	629	1315
Pk Hr Factor	0.000	0.000	0.910	0.904	0.885	Pk Hr Factor	0.000	0.000	0.909	0.914	0.967

Prepared by NDS/ATD

VOLUME

Base Line Rd btwn Seine Ave & Stoney Creek Dr

Day: Wednesday
Date: 6/12/2013

City: Highland
Project #: CA13_6109_002

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	9,763	10,579	20,342

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			17		20		37		12:00			148		150		298	
00:15			13		8		21		12:15			145		167		312	
00:30			13		8		21		12:30			149		192		341	
00:45			12	55	4	40	16	95	12:45			157	599	222	731	379	1330
01:00			10		5		15		13:00			173		170		343	
01:15			7		4		11		13:15			152		170		322	
01:30			7		4		11		13:30			176		183		359	
01:45			7	31	3	16	10	47	13:45			150	651	185	708	335	1359
02:00			7		5		12		14:00			143		162		305	
02:15			1		1		2		14:15			145		140		285	
02:30			6		1		7		14:30			145		168		313	
02:45			5	19	1	8	6	27	14:45			172	605	165	635	337	1240
03:00			5		8		13		15:00			148		174		322	
03:15			4		11		15		15:15			156		146		302	
03:30			6		20		26		15:30			164		144		308	
03:45			4	19	11	50	15	69	15:45			167	635	166	630	333	1265
04:00			2		17		19		16:00			186		167		353	
04:15			12		15		27		16:15			226		163		389	
04:30			11		33		44		16:30			193		164		357	
04:45			18	43	20	85	38	128	16:45			249	854	154	648	403	1502
05:00			16		17		33		17:00			237		204		441	
05:15			10		33		43		17:15			249		167		416	
05:30			20		48		68		17:30			237		192		429	
05:45			29	75	60	158	89	233	17:45			241	964	142	705	383	1669
06:00			35		83		118		18:00			210		180		390	
06:15			59		101		160		18:15			221		183		404	
06:30			68		108		176		18:30			178		164		342	
06:45			92	254	150	442	242	696	18:45			148	757	123	650	271	1407
07:00			77		164		241		19:00			139		129		268	
07:15			71		189		260		19:15			155		144		299	
07:30			109		213		322		19:30			133		98		231	
07:45			121	378	180	746	301	1124	19:45			139	566	96	467	235	1033
08:00			119		180		299		20:00			120		129		249	
08:15			116		156		272		20:15			142		125		267	
08:30			106		165		271		20:30			143		122		265	
08:45			122	463	153	654	275	1117	20:45			140	545	99	475	239	1020
09:00			113		164		277		21:00			97		113		210	
09:15			144		146		290		21:15			88		110		198	
09:30			126		188		314		21:30			91		80		171	
09:45			150	533	146	644	296	1177	21:45			72	348	62	365	134	713
10:00			124		167		291		22:00			64		71		135	
10:15			118		168		286		22:15			55		48		103	
10:30			126		159		285		22:30			62		68		130	
10:45			125	493	162	656	287	1149	22:45			29	210	39	226	68	436
11:00			131		185		316		23:00			44		35		79	
11:15			140		162		302		23:15			25		48		73	
11:30			120		177		297		23:30			24		24		48	
11:45			150	541	186	710	336	1251	23:45			32	125	23	130	55	255
TOTALS				2904		4209		7113	TOTALS				6859		6370		13229
SPLIT %				40.8%		59.2%		35.0%	SPLIT %				51.8%		48.2%		65.0%

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	9,763	10,579	20,342

AM Peak Hour			11:45	07:15	11:45	PM Peak Hour			16:45	12:30	16:45
AM Pk Volume			592	762	1287	PM Pk Volume			972	754	1689
Pk Hr Factor			0.987	0.894	0.944	Pk Hr Factor			0.976	0.849	0.957
7 - 9 Volume	0	0	841	1400	2241	4 - 6 Volume	0	0	1818	1353	3171
7 - 9 Peak Hour			07:30	07:15	07:30	4 - 6 Peak Hour			16:45	16:45	16:45
7 - 9 Pk Volume	0	0	465	762	1194	4 - 6 Pk Volume	0	0	972	717	1689
Pk Hr Factor	0.000	0.000	0.961	0.894	0.927	Pk Hr Factor	0.000	0.000	0.976	0.879	0.957

Appendix B
Traffic Analysis Worksheets

Intersections
Level of Service Worksheets

Existing

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	12	356	9	39	441	49	10	10	65	103	18	5
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	15	451	11	46	525	58	13	13	87	132	23	6
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.79	0.79	0.79	0.84	0.84	0.84	0.75	0.75	0.75	0.78	0.78	0.78
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	26	680	17	108	770	85	825	109	727	751	737	192
Arrive On Green	0.01	0.20	0.20	0.06	0.25	0.25	0.53	0.53	0.53	0.53	0.53	0.53
Sat Flow, veh/h	1723	3430	84	1723	3124	344	1336	204	1365	1253	1385	361
Grp Volume(v), veh/h	15	226	236	46	288	295	13	0	100	132	0	29
Grp Sat Flow(s),veh/h/ln	1723	1719	1795	1723	1719	1749	1336	0	1569	1253	0	1746
Q Serve(g_s), s	0.5	7.1	7.1	1.5	8.8	8.9	0.3	0.0	1.9	3.4	0.0	0.5
Cycle Q Clear(g_c), s	0.5	7.1	7.1	1.5	8.8	8.9	0.7	0.0	1.9	5.3	0.0	0.5
Prop In Lane	1.00		0.05	1.00		0.20	1.00		0.87	1.00		0.21
Lane Grp Cap(c), veh/h	26	341	356	108	424	431	825	0	836	751	0	930
V/C Ratio(X)	0.59	0.66	0.66	0.42	0.68	0.68	0.02	0.00	0.12	0.18	0.00	0.03
Avail Cap(c_a), veh/h	237	1034	1079	355	1152	1172	825	0	836	751	0	930
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.5	21.5	21.5	26.3	19.9	19.9	6.6	0.0	6.8	8.1	0.0	6.5
Incr Delay (d2), s/veh	19.7	2.2	2.1	2.6	1.9	1.9	0.0	0.0	0.3	0.5	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	3.5	3.7	0.8	4.4	4.5	0.1	0.0	0.9	1.3	0.0	0.2
LnGrp Delay(d),s/veh	48.2	23.7	23.7	28.9	21.8	21.8	6.7	0.0	7.1	8.6	0.0	6.5
LnGrp LOS	D	C	C	C	C	C	A		A	A		A
Approach Vol, veh/h		477			629			113			161	
Approach Delay, s/veh		24.5			22.3			7.0			8.2	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		35.0	7.7	15.5		35.0	4.9	18.3
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		31.0	12.0	35.0		31.0	8.0	39.0
Max Q Clear Time (g_c+I1), s		3.9	3.5	9.1		7.3	2.5	10.9
Green Ext Time (p_c), s		1.2	2.2	2.5		1.2	0.0	3.4

Intersection Summary	
HCM 2010 Ctrl Delay	20.2
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	338	210	396	436	0	0	0	0	198	4	156
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	1810	1810
Adj Flow Rate, veh/h	0	356	221	455	501	0				234	0	181
Adj No. of Lanes	0	2	1	2	2	0				2	0	1
Peak Hour Factor	0.95	0.95	0.95	0.87	0.87	0.87				0.86	0.86	0.86
Percent Heavy Veh, %	0	5	5	5	5	0				5	5	5
Cap, veh/h	0	722	323	762	1733	0				1254	0	559
Arrive On Green	0.00	0.21	0.21	0.23	0.50	0.00				0.36	0.00	0.36
Sat Flow, veh/h	0	3529	1538	3343	3529	0				3447	0	1538
Grp Volume(v), veh/h	0	356	221	455	501	0				234	0	181
Grp Sat Flow(s),veh/h/ln	0	1719	1538	1672	1719	0				1723	0	1538
Q Serve(g_s), s	0.0	5.5	8.0	7.4	5.1	0.0				2.8	0.0	5.1
Cycle Q Clear(g_c), s	0.0	5.5	8.0	7.4	5.1	0.0				2.8	0.0	5.1
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	722	323	762	1733	0				1254	0	559
V/C Ratio(X)	0.00	0.49	0.68	0.60	0.29	0.00				0.19	0.00	0.32
Avail Cap(c_a), veh/h	0	1648	737	1492	3410	0				1254	0	559
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	21.1	22.0	20.9	8.7	0.0				13.1	0.0	13.9
Incr Delay (d2), s/veh	0.0	0.5	2.6	0.8	0.1	0.0				0.3	0.0	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	2.7	3.6	3.4	2.4	0.0				1.4	0.0	2.4
LnGrp Delay(d),s/veh	0.0	21.6	24.6	21.6	8.8	0.0				13.5	0.0	15.4
LnGrp LOS		C	C	C	A					B		B
Approach Vol, veh/h		577			956						415	
Approach Delay, s/veh		22.7			14.9						14.3	
Approach LOS		C			B						B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	17.8	16.7		26.0		34.5		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	27.0	29.0		22.0		60.0		
Max Q Clear Time (g_c+I1), s	9.4	10.0		7.1		7.1		
Green Ext Time (p_c), s	4.4	2.7		1.3		5.3		

Intersection Summary	
HCM 2010 Ctrl Delay	17.1
HCM 2010 LOS	B

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	111	428	0	0	686	317	156	0	252	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1810	1810	0	0	1810	1900	1900	1810	1810			
Adj Flow Rate, veh/h	121	465	0	0	738	341	188	0	304			
Adj No. of Lanes	2	2	0	0	2	0	0	1	1			
Peak Hour Factor	0.92	0.92	0.92	0.93	0.93	0.93	0.83	0.83	0.83			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	240	1862	0	0	943	435	593	0	529			
Arrive On Green	0.07	0.54	0.00	0.00	0.41	0.41	0.34	0.00	0.34			
Sat Flow, veh/h	3343	3529	0	0	2377	1056	1723	0	1538			
Grp Volume(v), veh/h	121	465	0	0	555	524	188	0	304			
Grp Sat Flow(s),veh/h/ln	1672	1719	0	0	1719	1623	1723	0	1538			
Q Serve(g_s), s	2.4	5.0	0.0	0.0	19.5	19.6	5.6	0.0	11.3			
Cycle Q Clear(g_c), s	2.4	5.0	0.0	0.0	19.5	19.6	5.6	0.0	11.3			
Prop In Lane	1.00		0.00	0.00		0.65	1.00		1.00			
Lane Grp Cap(c), veh/h	240	1862	0	0	709	670	593	0	529			
V/C Ratio(X)	0.50	0.25	0.00	0.00	0.78	0.78	0.32	0.00	0.57			
Avail Cap(c_a), veh/h	383	2857	0	0	1133	1070	593	0	529			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00			
Uniform Delay (d), s/veh	31.2	8.5	0.0	0.0	17.8	17.8	16.9	0.0	18.7			
Incr Delay (d2), s/veh	1.6	0.1	0.0	0.0	1.9	2.1	1.4	0.0	4.5			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.2	2.3	0.0	0.0	9.6	9.1	2.9	0.0	5.4			
LnGrp Delay(d),s/veh	32.8	8.6	0.0	0.0	19.7	19.8	18.3	0.0	23.2			
LnGrp LOS	C	A			B	B	B		C			
Approach Vol, veh/h		586			1079			492				
Approach Delay, s/veh		13.6			19.8			21.3				
Approach LOS		B			B			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		28.0		41.8			9.0	32.8
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		24.0		58.0			8.0	46.0
Max Q Clear Time (g_c+I1), s		13.3		7.0			4.4	21.6
Green Ext Time (p_c), s		0.5		3.5			1.1	7.2

Intersection Summary	
HCM 2010 Ctrl Delay	18.4
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	76	509	96	63	702	5	213	10	26	15	13	88
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1810	1810	1810	1900
Adj Flow Rate, veh/h	80	536	101	70	780	6	260	12	32	19	17	114
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	0
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.82	0.82	0.82	0.77	0.77	0.77
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	104	720	135	175	1016	8	628	868	738	730	98	655
Arrive On Green	0.06	0.25	0.25	0.10	0.29	0.29	0.48	0.48	0.48	0.48	0.48	0.48
Sat Flow, veh/h	1723	2890	543	1723	3497	27	1218	1810	1538	1318	204	1365
Grp Volume(v), veh/h	80	318	319	70	383	403	260	12	32	19	0	131
Grp Sat Flow(s),veh/h/ln	1723	1719	1714	1723	1719	1805	1218	1810	1538	1318	0	1569
Q Serve(g_s), s	3.2	12.1	12.2	2.7	14.4	14.4	10.9	0.2	0.8	0.5	0.0	3.4
Cycle Q Clear(g_c), s	3.2	12.1	12.2	2.7	14.4	14.4	14.3	0.2	0.8	0.8	0.0	3.4
Prop In Lane	1.00		0.32	1.00		0.01	1.00		1.00	1.00		0.87
Lane Grp Cap(c), veh/h	104	428	427	175	499	524	628	868	738	730	0	753
V/C Ratio(X)	0.77	0.74	0.75	0.40	0.77	0.77	0.41	0.01	0.04	0.03	0.00	0.17
Avail Cap(c_a), veh/h	243	849	847	219	825	866	628	868	738	730	0	753
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	32.8	24.5	24.5	29.8	23.0	23.0	14.5	9.6	9.8	9.9	0.0	10.5
Incr Delay (d2), s/veh	11.4	2.6	2.6	1.5	2.5	2.4	2.0	0.0	0.1	0.1	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	6.0	6.1	1.4	7.2	7.5	4.0	0.1	0.4	0.2	0.0	1.6
LnGrp Delay(d),s/veh	44.2	27.1	27.2	31.3	25.5	25.3	16.5	9.7	9.9	9.9	0.0	11.0
LnGrp LOS	D	C	C	C	C	C	B	A	A	A		B
Approach Vol, veh/h		717			856			304			150	
Approach Delay, s/veh		29.0			25.9			15.5			10.8	
Approach LOS		C			C			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		38.0	11.2	21.7		38.0	8.3	24.6
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		34.0	9.0	35.0		34.0	10.0	34.0
Max Q Clear Time (g_c+I1), s		16.3	4.7	14.2		5.4	5.2	16.4
Green Ext Time (p_c), s		1.9	0.1	3.5		2.1	0.1	4.2

Intersection Summary	
HCM 2010 Ctrl Delay	24.3
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	6	586	9	83	524	54	11	15	72	86	25	10
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	6	623	10	91	576	59	13	18	86	96	28	11
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.94	0.94	0.94	0.91	0.91	0.91	0.84	0.84	0.84	0.90	0.90	0.90
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	107	919	15	117	854	87	705	121	580	639	550	216
Arrive On Green	0.06	0.27	0.27	0.07	0.27	0.27	0.44	0.44	0.44	0.44	0.44	0.44
Sat Flow, veh/h	1723	3463	56	1723	3150	322	1324	273	1306	1248	1238	486
Grp Volume(v), veh/h	6	309	324	91	314	321	13	0	104	96	0	39
Grp Sat Flow(s),veh/h/ln	1723	1719	1800	1723	1719	1753	1324	0	1579	1248	0	1724
Q Serve(g_s), s	0.2	8.7	8.7	2.8	8.8	8.8	0.3	0.0	2.1	2.7	0.0	0.7
Cycle Q Clear(g_c), s	0.2	8.7	8.7	2.8	8.8	8.8	1.0	0.0	2.1	4.8	0.0	0.7
Prop In Lane	1.00		0.03	1.00		0.18	1.00		0.83	1.00		0.28
Lane Grp Cap(c), veh/h	107	456	477	117	466	475	705	0	702	639	0	766
V/C Ratio(X)	0.06	0.68	0.68	0.78	0.67	0.68	0.02	0.00	0.15	0.15	0.00	0.05
Avail Cap(c_a), veh/h	191	1210	1267	511	1528	1558	705	0	702	639	0	766
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	23.8	17.8	17.8	24.8	17.6	17.6	8.8	0.0	8.9	10.3	0.0	8.5
Incr Delay (d2), s/veh	0.2	1.8	1.7	10.4	1.7	1.7	0.0	0.0	0.4	0.5	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	4.3	4.5	1.7	4.3	4.5	0.1	0.0	1.0	1.0	0.0	0.4
LnGrp Delay(d),s/veh	24.0	19.5	19.5	35.2	19.3	19.3	8.9	0.0	9.4	10.8	0.0	8.7
LnGrp LOS	C	B	B	D	B	B	A		A	B		A
Approach Vol, veh/h		639			726			117			135	
Approach Delay, s/veh		19.6			21.3			9.3			10.2	
Approach LOS		B			C			A			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		28.0	7.7	18.3		28.0	7.4	18.6
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		24.0	16.0	38.0		24.0	6.0	48.0
Max Q Clear Time (g_c+I1), s		4.1	4.8	10.7		6.8	2.2	10.8
Green Ext Time (p_c), s		1.1	0.1	3.6		1.0	1.3	3.8

Intersection Summary	
HCM 2010 Ctrl Delay	18.8
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	579	248	324	539	0	0	0	0	361	2	192
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	1810	1810
Adj Flow Rate, veh/h	0	629	270	338	561	0				411	0	218
Adj No. of Lanes	0	2	1	2	2	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.96	0.96	0.96				0.88	0.88	0.88
Percent Heavy Veh, %	0	5	5	5	5	0				5	5	5
Cap, veh/h	0	1061	475	462	1736	0				1305	0	582
Arrive On Green	0.00	0.31	0.31	0.14	0.50	0.00				0.38	0.00	0.38
Sat Flow, veh/h	0	3529	1538	3343	3529	0				3447	0	1538
Grp Volume(v), veh/h	0	629	270	338	561	0				411	0	218
Grp Sat Flow(s),veh/h/ln	0	1719	1538	1672	1719	0				1723	0	1538
Q Serve(g_s), s	0.0	10.6	10.1	6.7	6.6	0.0				5.8	0.0	7.0
Cycle Q Clear(g_c), s	0.0	10.6	10.1	6.7	6.6	0.0				5.8	0.0	7.0
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1061	475	462	1736	0				1305	0	582
V/C Ratio(X)	0.00	0.59	0.57	0.73	0.32	0.00				0.32	0.00	0.37
Avail Cap(c_a), veh/h	0	1652	739	925	2803	0				1305	0	582
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	20.1	19.9	28.4	10.1	0.0				15.1	0.0	15.5
Incr Delay (d2), s/veh	0.0	0.5	1.1	2.3	0.1	0.0				0.6	0.0	1.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	5.1	4.4	3.2	3.1	0.0				2.9	0.0	3.3
LnGrp Delay(d),s/veh	0.0	20.6	21.0	30.6	10.2	0.0				15.7	0.0	17.3
LnGrp LOS		C	C	C	B					B		B
Approach Vol, veh/h		899			899						629	
Approach Delay, s/veh		20.7			17.9						16.2	
Approach LOS		C			B						B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	13.5	25.2		30.0		38.7		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	19.0	33.0		26.0		56.0		
Max Q Clear Time (g_c+I1), s	8.7	12.6		9.0		8.6		
Green Ext Time (p_c), s	0.8	8.6		2.1		11.0		

Intersection Summary	
HCM 2010 Ctrl Delay	18.5
HCM 2010 LOS	B

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	149	793	0	0	671	309	191	2	396	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1810	1810	0	0	1810	1900	1900	1810	1810			
Adj Flow Rate, veh/h	162	862	0	0	746	343	227	2	471			
Adj No. of Lanes	2	2	0	0	2	0	0	1	1			
Peak Hour Factor	0.92	0.92	0.92	0.90	0.90	0.90	0.84	0.84	0.84			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	230	1780	0	0	923	424	667	6	601			
Arrive On Green	0.07	0.52	0.00	0.00	0.40	0.40	0.39	0.39	0.39			
Sat Flow, veh/h	3343	3529	0	0	2381	1052	1709	15	1538			
Grp Volume(v), veh/h	162	862	0	0	560	529	229	0	471			
Grp Sat Flow(s),veh/h/ln	1672	1719	0	0	1719	1624	1724	0	1538			
Q Serve(g_s), s	4.1	14.1	0.0	0.0	25.1	25.2	8.1	0.0	23.4			
Cycle Q Clear(g_c), s	4.1	14.1	0.0	0.0	25.1	25.2	8.1	0.0	23.4			
Prop In Lane	1.00		0.00	0.00		0.65	0.99		1.00			
Lane Grp Cap(c), veh/h	230	1780	0	0	693	654	673	0	601			
V/C Ratio(X)	0.70	0.48	0.00	0.00	0.81	0.81	0.34	0.00	0.78			
Avail Cap(c_a), veh/h	230	1895	0	0	750	709	673	0	601			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00			
Uniform Delay (d), s/veh	39.7	13.5	0.0	0.0	23.0	23.0	18.7	0.0	23.3			
Incr Delay (d2), s/veh	9.3	0.2	0.0	0.0	6.1	6.5	1.4	0.0	9.9			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	2.2	6.6	0.0	0.0	13.0	12.4	4.1	0.0	11.6			
LnGrp Delay(d),s/veh	48.9	13.7	0.0	0.0	29.2	29.6	20.0	0.0	33.2			
LnGrp LOS	D	B			C	C	C		C			
Approach Vol, veh/h		1024			1089			700				
Approach Delay, s/veh		19.3			29.4			28.9				
Approach LOS		B			C			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		38.0		49.1			10.0	39.1
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		34.0		48.0			6.0	38.0
Max Q Clear Time (g_c+I1), s		25.4		16.1			6.1	27.2
Green Ext Time (p_c), s		0.9		16.4			0.0	7.9

Intersection Summary	
HCM 2010 Ctrl Delay	25.6
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	107	934	160	53	747	11	159	15	51	33	14	74
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1810	1810	1810	1900
Adj Flow Rate, veh/h	118	1026	176	58	821	12	167	16	54	40	17	90
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.95	0.95	0.95	0.82	0.82	0.82
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	151	1297	222	93	1416	21	459	608	517	526	84	446
Arrive On Green	0.09	0.44	0.44	0.05	0.41	0.41	0.34	0.34	0.34	0.34	0.34	0.34
Sat Flow, veh/h	1723	2937	503	1723	3469	51	1245	1810	1538	1287	250	1325
Grp Volume(v), veh/h	118	600	602	58	407	426	167	16	54	40	0	107
Grp Sat Flow(s),veh/h/ln	1723	1719	1721	1723	1719	1801	1245	1810	1538	1287	0	1576
Q Serve(g_s), s	4.8	21.4	21.4	2.4	13.1	13.1	7.9	0.4	1.7	1.5	0.0	3.5
Cycle Q Clear(g_c), s	4.8	21.4	21.4	2.4	13.1	13.1	11.3	0.4	1.7	2.0	0.0	3.5
Prop In Lane	1.00		0.29	1.00		0.03	1.00		1.00	1.00		0.84
Lane Grp Cap(c), veh/h	151	759	760	93	702	735	459	608	517	526	0	530
V/C Ratio(X)	0.78	0.79	0.79	0.62	0.58	0.58	0.36	0.03	0.10	0.08	0.00	0.20
Avail Cap(c_a), veh/h	314	1132	1133	169	987	1034	459	608	517	526	0	530
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.9	17.1	17.1	33.1	16.4	16.4	20.9	15.9	16.3	16.5	0.0	16.9
Incr Delay (d2), s/veh	8.5	2.3	2.3	6.7	0.8	0.7	2.2	0.1	0.4	0.3	0.0	0.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	10.5	10.5	1.3	6.4	6.7	3.0	0.2	0.8	0.6	0.0	1.6
LnGrp Delay(d),s/veh	40.4	19.4	19.4	39.7	17.1	17.1	23.1	15.9	16.7	16.8	0.0	17.7
LnGrp LOS	D	B	B	D	B	B	C	B	B	B		B
Approach Vol, veh/h		1320			891			237			147	
Approach Delay, s/veh		21.3			18.6			21.2			17.5	
Approach LOS		C			B			C			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		28.0	7.9	35.5		28.0	10.2	33.1
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		24.0	7.0	47.0		24.0	13.0	41.0
Max Q Clear Time (g_c+I1), s		13.3	4.4	23.4		5.5	6.8	15.1
Green Ext Time (p_c), s		1.2	1.3	8.1		1.5	0.1	5.2

Intersection Summary	
HCM 2010 Ctrl Delay	20.1
HCM 2010 LOS	C

Opening Year 2020 – No Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	14	435	11	45	501	51	14	14	81	101	22	5
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	15	473	12	49	545	55	15	15	88	110	24	5
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	26	723	18	106	813	82	800	117	684	724	740	154
Arrive On Green	0.01	0.21	0.21	0.06	0.26	0.26	0.51	0.51	0.51	0.51	0.51	0.51
Sat Flow, veh/h	1723	3426	87	1723	3155	318	1336	229	1343	1249	1453	303
Grp Volume(v), veh/h	15	237	248	49	296	304	15	0	103	110	0	29
Grp Sat Flow(s),veh/h/ln	1723	1719	1794	1723	1719	1753	1336	0	1572	1249	0	1756
Q Serve(g_s), s	0.5	6.9	7.0	1.5	8.5	8.5	0.3	0.0	1.9	2.8	0.0	0.5
Cycle Q Clear(g_c), s	0.5	6.9	7.0	1.5	8.5	8.5	0.8	0.0	1.9	4.7	0.0	0.5
Prop In Lane	1.00		0.05	1.00		0.18	1.00		0.85	1.00		0.17
Lane Grp Cap(c), veh/h	26	363	379	106	443	452	800	0	801	724	0	894
V/C Ratio(X)	0.58	0.65	0.65	0.46	0.67	0.67	0.02	0.00	0.13	0.15	0.00	0.03
Avail Cap(c_a), veh/h	251	1157	1207	407	1313	1339	800	0	801	724	0	894
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.9	19.9	19.9	24.9	18.3	18.3	6.9	0.0	7.1	8.3	0.0	6.7
Incr Delay (d2), s/veh	19.3	2.0	1.9	3.1	1.8	1.7	0.0	0.0	0.3	0.4	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	3.5	3.6	0.8	4.2	4.4	0.1	0.0	0.9	1.0	0.0	0.2
LnGrp Delay(d),s/veh	46.2	21.8	21.8	28.0	20.1	20.1	7.0	0.0	7.4	8.8	0.0	6.8
LnGrp LOS	D	C	C	C	C	C	A		A	A		A
Approach Vol, veh/h		500			649			118			139	
Approach Delay, s/veh		22.5			20.7			7.4			8.4	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		32.0	7.4	15.6		32.0	4.8	18.2
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		28.0	13.0	37.0		28.0	8.0	42.0
Max Q Clear Time (g_c+I1), s		3.9	3.5	9.0		6.7	2.5	10.5
Green Ext Time (p_c), s		1.1	2.4	2.6		1.1	0.0	3.6

Intersection Summary	
HCM 2010 Ctrl Delay	19.0
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	406	236	445	473	0	0	0	0	241	5	190
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	1810	1810
Adj Flow Rate, veh/h	0	441	257	484	514	0				266	0	207
Adj No. of Lanes	0	2	1	2	2	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	5	5
Cap, veh/h	0	801	359	770	1804	0				1215	0	542
Arrive On Green	0.00	0.23	0.23	0.23	0.52	0.00				0.35	0.00	0.35
Sat Flow, veh/h	0	3529	1538	3343	3529	0				3447	0	1538
Grp Volume(v), veh/h	0	441	257	484	514	0				266	0	207
Grp Sat Flow(s),veh/h/ln	0	1719	1538	1672	1719	0				1723	0	1538
Q Serve(g_s), s	0.0	7.4	10.0	8.5	5.4	0.0				3.5	0.0	6.6
Cycle Q Clear(g_c), s	0.0	7.4	10.0	8.5	5.4	0.0				3.5	0.0	6.6
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	801	359	770	1804	0				1215	0	542
V/C Ratio(X)	0.00	0.55	0.72	0.63	0.28	0.00				0.22	0.00	0.38
Avail Cap(c_a), veh/h	0	1476	660	1384	3110	0				1215	0	542
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	22.0	23.0	22.6	8.7	0.0				14.8	0.0	15.8
Incr Delay (d2), s/veh	0.0	0.6	2.7	0.9	0.1	0.0				0.4	0.0	2.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	3.6	4.5	4.0	2.6	0.0				1.7	0.0	3.1
LnGrp Delay(d),s/veh	0.0	22.6	25.7	23.4	8.7	0.0				15.2	0.0	17.8
LnGrp LOS		C	C	C	A					B		B
Approach Vol, veh/h		698			998						473	
Approach Delay, s/veh		23.7			15.9						16.4	
Approach LOS		C			B						B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	19.0	19.2		27.0		38.2		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	27.0	28.0		23.0		59.0		
Max Q Clear Time (g_c+I1), s	10.5	12.0		8.6		7.4		
Green Ext Time (p_c), s	4.5	3.2		1.5		5.5		

Intersection Summary	
HCM 2010 Ctrl Delay	18.5
HCM 2010 LOS	B

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	135	512	0	0	746	385	172	0	278	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1810	1810	0	0	1810	1900	1900	1810	1810			
Adj Flow Rate, veh/h	147	557	0	0	811	418	187	0	302			
Adj No. of Lanes	2	2	0	0	2	0	0	1	1			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	224	2069	0	0	1064	545	509	0	454			
Arrive On Green	0.07	0.60	0.00	0.00	0.48	0.48	0.30	0.00	0.30			
Sat Flow, veh/h	3343	3529	0	0	2292	1128	1723	0	1538			
Grp Volume(v), veh/h	147	557	0	0	632	597	187	0	302			
Grp Sat Flow(s),veh/h/ln	1672	1719	0	0	1719	1610	1723	0	1538			
Q Serve(g_s), s	3.3	6.0	0.0	0.0	23.4	23.7	6.7	0.0	13.4			
Cycle Q Clear(g_c), s	3.3	6.0	0.0	0.0	23.4	23.7	6.7	0.0	13.4			
Prop In Lane	1.00		0.00	0.00		0.70	1.00		1.00			
Lane Grp Cap(c), veh/h	224	2069	0	0	831	779	509	0	454			
V/C Ratio(X)	0.66	0.27	0.00	0.00	0.76	0.77	0.37	0.00	0.66			
Avail Cap(c_a), veh/h	344	2606	0	0	1038	972	509	0	454			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00			
Uniform Delay (d), s/veh	35.4	7.4	0.0	0.0	16.4	16.5	21.7	0.0	24.0			
Incr Delay (d2), s/veh	3.3	0.1	0.0	0.0	2.6	2.9	2.0	0.0	7.5			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.6	2.8	0.0	0.0	11.7	11.1	3.5	0.0	6.6			
LnGrp Delay(d),s/veh	38.7	7.4	0.0	0.0	19.0	19.4	23.7	0.0	31.5			
LnGrp LOS	D	A			B	B	C		C			
Approach Vol, veh/h		704			1229			489				
Approach Delay, s/veh		14.0			19.2			28.5				
Approach LOS		B			B			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		27.0		50.9			9.2	41.6
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		23.0		59.0			8.0	47.0
Max Q Clear Time (g_c+I1), s		15.4		8.0			5.3	25.7
Green Ext Time (p_c), s		0.4		17.4			0.1	12.0

Intersection Summary	
HCM 2010 Ctrl Delay	19.6
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	82	573	135	66	789	4	244	8	23	12	13	98
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1900
Adj Flow Rate, veh/h	89	623	147	72	858	4	265	9	25	13	14	107
Adj No. of Lanes	1	2	1	1	2	0	2	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	115	1444	646	95	1433	7	794	697	592	214	18	140
Arrive On Green	0.07	0.42	0.42	0.05	0.41	0.41	0.24	0.39	0.39	0.10	0.10	0.10
Sat Flow, veh/h	1723	3438	1538	1723	3509	16	3343	1810	1538	1330	181	1384
Grp Volume(v), veh/h	89	623	147	72	420	442	265	9	25	13	0	121
Grp Sat Flow(s),veh/h/ln	1723	1719	1538	1723	1719	1807	1672	1810	1538	1330	0	1565
Q Serve(g_s), s	4.4	11.0	5.3	3.5	16.4	16.4	5.6	0.3	0.9	0.8	0.0	6.5
Cycle Q Clear(g_c), s	4.4	11.0	5.3	3.5	16.4	16.4	5.6	0.3	0.9	1.0	0.0	6.5
Prop In Lane	1.00		1.00	1.00		0.01	1.00		1.00	1.00		0.88
Lane Grp Cap(c), veh/h	115	1444	646	95	702	738	794	697	592	214	0	158
V/C Ratio(X)	0.78	0.43	0.23	0.76	0.60	0.60	0.33	0.01	0.04	0.06	0.00	0.77
Avail Cap(c_a), veh/h	201	1444	646	181	702	738	794	697	592	328	0	292
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	39.4	17.6	15.9	39.9	19.9	19.9	27.1	16.3	16.5	35.2	0.0	37.5
Incr Delay (d2), s/veh	10.6	0.9	0.8	11.8	3.7	3.6	0.2	0.0	0.1	0.1	0.0	7.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	5.4	2.4	2.0	8.4	8.8	2.6	0.1	0.4	0.3	0.0	3.1
LnGrp Delay(d),s/veh	50.0	18.5	16.8	51.8	23.6	23.4	27.3	16.3	16.6	35.3	0.0	45.1
LnGrp LOS	D	B	B	D	C	C	C	B	B	D		D
Approach Vol, veh/h		859			934			299			134	
Approach Delay, s/veh		21.5			25.7			26.1			44.1	
Approach LOS		C			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	8.7	40.0	24.4	12.6	9.7	39.0		37.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	9.0	36.0	13.0	16.0	10.0	35.0		33.0
Max Q Clear Time (g_c+I1), s	5.5	13.0	7.6	8.5	6.4	18.4		2.9
Green Ext Time (p_c), s	0.1	4.4	0.5	0.4	0.1	4.5		1.1

Intersection Summary	
HCM 2010 Ctrl Delay	25.2
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	6	670	12	96	568	53	15	20	88	82	31	11
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	7	728	13	104	617	58	16	22	96	89	34	12
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	13	1027	18	201	1292	121	601	112	488	530	485	171
Arrive On Green	0.01	0.30	0.30	0.12	0.41	0.41	0.38	0.38	0.38	0.38	0.38	0.38
Sat Flow, veh/h	1723	3456	62	1723	3178	298	1316	295	1287	1233	1279	451
Grp Volume(v), veh/h	7	362	379	104	333	342	16	0	118	89	0	46
Grp Sat Flow(s),veh/h/ln	1723	1719	1799	1723	1719	1757	1316	0	1582	1233	0	1730
Q Serve(g_s), s	0.2	10.9	10.9	3.3	8.3	8.3	0.5	0.0	2.9	3.0	0.0	1.0
Cycle Q Clear(g_c), s	0.2	10.9	10.9	3.3	8.3	8.3	1.4	0.0	2.9	5.9	0.0	1.0
Prop In Lane	1.00		0.03	1.00		0.17	1.00		0.81	1.00		0.26
Lane Grp Cap(c), veh/h	13	511	535	201	699	714	601	0	600	530	0	656
V/C Ratio(X)	0.55	0.71	0.71	0.52	0.48	0.48	0.03	0.00	0.20	0.17	0.00	0.07
Avail Cap(c_a), veh/h	178	1185	1240	475	1481	1514	601	0	600	530	0	656
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.7	18.2	18.2	24.1	12.7	12.7	11.9	0.0	12.1	14.1	0.0	11.5
Incr Delay (d2), s/veh	32.6	1.8	1.7	2.0	0.5	0.5	0.1	0.0	0.7	0.7	0.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	5.4	5.6	1.7	4.0	4.1	0.2	0.0	1.4	1.1	0.0	0.5
LnGrp Delay(d),s/veh	61.3	20.0	19.9	26.1	13.2	13.2	12.0	0.0	12.8	14.8	0.0	11.7
LnGrp LOS	E	B	B	C	B	B	B		B	B		B
Approach Vol, veh/h		748			779			134			135	
Approach Delay, s/veh		20.3			14.9			12.7			13.7	
Approach LOS		C			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		26.0	10.8	21.2		26.0	4.4	27.6
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		22.0	16.0	40.0		22.0	6.0	50.0
Max Q Clear Time (g_c+I1), s		4.9	5.3	12.9		7.9	2.2	10.3
Green Ext Time (p_c), s		1.1	3.0	4.4		1.0	0.0	4.4

Intersection Summary	
HCM 2010 Ctrl Delay	16.9
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	669	261	341	589	0	0	0	0	381	2	202
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	1810	1810
Adj Flow Rate, veh/h	0	727	284	371	640	0				415	0	220
Adj No. of Lanes	0	2	1	2	2	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	5	5
Cap, veh/h	0	1015	454	627	1858	0				1188	0	530
Arrive On Green	0.00	0.30	0.30	0.19	0.54	0.00				0.34	0.00	0.34
Sat Flow, veh/h	0	3529	1538	3343	3529	0				3447	0	1538
Grp Volume(v), veh/h	0	727	284	371	640	0				415	0	220
Grp Sat Flow(s),veh/h/ln	0	1719	1538	1672	1719	0				1723	0	1538
Q Serve(g_s), s	0.0	13.2	11.1	7.1	7.3	0.0				6.2	0.0	7.6
Cycle Q Clear(g_c), s	0.0	13.2	11.1	7.1	7.3	0.0				6.2	0.0	7.6
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1015	454	627	1858	0				1188	0	530
V/C Ratio(X)	0.00	0.72	0.63	0.59	0.34	0.00				0.35	0.00	0.41
Avail Cap(c_a), veh/h	0	1679	751	961	2865	0				1188	0	530
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	21.9	21.2	25.8	9.0	0.0				17.0	0.0	17.4
Incr Delay (d2), s/veh	0.0	1.0	1.4	0.9	0.1	0.0				0.8	0.0	2.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.3	4.8	3.3	3.5	0.0				3.1	0.0	3.6
LnGrp Delay(d),s/veh	0.0	22.9	22.6	26.7	9.1	0.0				17.8	0.0	19.8
LnGrp LOS		C	C	C	A					B		B
Approach Vol, veh/h		1011			1011						635	
Approach Delay, s/veh		22.8			15.6						18.5	
Approach LOS		C			B						B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	17.1	24.6		28.0		41.6		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	20.0	34.0		24.0		58.0		
Max Q Clear Time (g_c+I1), s	9.1	15.2		9.6		9.3		
Green Ext Time (p_c), s	4.0	5.4		2.1		6.1		

Intersection Summary	
HCM 2010 Ctrl Delay	19.0
HCM 2010 LOS	B

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	175	875	0	0	729	363	201	2	417	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1810	1810	0	0	1810	1900	1900	1810	1810			
Adj Flow Rate, veh/h	190	951	0	0	792	395	218	2	453			
Adj No. of Lanes	2	2	0	0	2	0	0	1	1			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	293	1865	0	0	909	451	621	6	559			
Arrive On Green	0.09	0.54	0.00	0.00	0.41	0.41	0.36	0.36	0.36			
Sat Flow, veh/h	3343	3529	0	0	2318	1106	1708	16	1538			
Grp Volume(v), veh/h	190	951	0	0	611	576	220	0	453			
Grp Sat Flow(s),veh/h/ln	1672	1719	0	0	1719	1614	1724	0	1538			
Q Serve(g_s), s	4.7	14.9	0.0	0.0	27.8	28.0	7.9	0.0	22.6			
Cycle Q Clear(g_c), s	4.7	14.9	0.0	0.0	27.8	28.0	7.9	0.0	22.6			
Prop In Lane	1.00		0.00	0.00		0.69	0.99		1.00			
Lane Grp Cap(c), veh/h	293	1865	0	0	701	659	627	0	559			
V/C Ratio(X)	0.65	0.51	0.00	0.00	0.87	0.88	0.35	0.00	0.81			
Avail Cap(c_a), veh/h	314	2057	0	0	787	739	627	0	559			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00			
Uniform Delay (d), s/veh	37.6	12.3	0.0	0.0	23.2	23.2	19.8	0.0	24.5			
Incr Delay (d2), s/veh	4.2	0.2	0.0	0.0	9.6	10.6	1.5	0.0	12.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	2.3	7.1	0.0	0.0	14.9	14.3	4.1	0.0	11.4			
LnGrp Delay(d),s/veh	41.9	12.6	0.0	0.0	32.8	33.8	21.3	0.0	36.5			
LnGrp LOS	D	B			C	C	C		D			
Approach Vol, veh/h		1141			1187			673				
Approach Delay, s/veh		17.4			33.3			31.5				
Approach LOS		B			C			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		35.0		50.2			11.5	38.8
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		31.0		51.0			8.0	39.0
Max Q Clear Time (g_c+I1), s		24.6		16.9			6.7	30.0
Green Ext Time (p_c), s		0.7		8.1			0.9	4.8

Intersection Summary	
HCM 2010 Ctrl Delay	26.9
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	114	1011	167	57	835	12	193	18	63	35	14	79
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1900
Adj Flow Rate, veh/h	124	1099	182	62	908	13	210	20	68	38	15	86
Adj No. of Lanes	1	2	1	1	2	0	2	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	177	1868	836	81	1692	24	309	439	373	209	22	127
Arrive On Green	0.10	0.54	0.54	0.05	0.49	0.49	0.09	0.24	0.24	0.09	0.09	0.09
Sat Flow, veh/h	1723	3438	1538	1723	3470	50	3343	1810	1538	1266	234	1340
Grp Volume(v), veh/h	124	1099	182	62	450	471	210	20	68	38	0	101
Grp Sat Flow(s),veh/h/ln	1723	1719	1538	1723	1719	1801	1672	1810	1538	1266	0	1573
Q Serve(g_s), s	5.0	15.4	4.4	2.6	13.0	13.0	4.4	0.6	2.5	2.0	0.0	4.5
Cycle Q Clear(g_c), s	5.0	15.4	4.4	2.6	13.0	13.0	4.4	0.6	2.5	2.6	0.0	4.5
Prop In Lane	1.00		1.00	1.00		0.03	1.00		1.00	1.00		0.85
Lane Grp Cap(c), veh/h	177	1868	836	81	838	878	309	439	373	209	0	149
V/C Ratio(X)	0.70	0.59	0.22	0.77	0.54	0.54	0.68	0.05	0.18	0.18	0.00	0.68
Avail Cap(c_a), veh/h	312	1868	836	216	838	878	466	756	643	372	0	351
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.1	11.0	8.5	33.8	12.8	12.8	31.5	20.8	21.5	30.9	0.0	31.4
Incr Delay (d2), s/veh	5.0	1.4	0.6	14.1	2.5	2.3	2.6	0.0	0.2	0.4	0.0	5.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	7.5	2.0	1.5	6.7	7.0	2.1	0.3	1.1	0.7	0.0	2.2
LnGrp Delay(d),s/veh	36.1	12.4	9.1	47.9	15.2	15.1	34.2	20.9	21.8	31.3	0.0	36.8
LnGrp LOS	D	B	A	D	B	B	C	C	C	C		D
Approach Vol, veh/h		1405			983			298			139	
Approach Delay, s/veh		14.0			17.2			30.4			35.3	
Approach LOS		B			B			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	7.4	43.0	10.6	10.8	11.4	39.0		21.4
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	9.0	39.0	10.0	16.0	13.0	35.0		30.0
Max Q Clear Time (g_c+I1), s	4.6	17.4	6.4	6.5	7.0	15.0		4.5
Green Ext Time (p_c), s	0.2	8.3	0.4	0.4	0.2	5.3		1.1

Intersection Summary	
HCM 2010 Ctrl Delay	17.9
HCM 2010 LOS	B

Opening Year 2020 – Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	14	435	11	45	501	51	14	14	81	101	22	5
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	15	473	12	49	545	55	15	15	88	110	24	5
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	26	723	18	106	813	82	800	117	684	724	740	154
Arrive On Green	0.01	0.21	0.21	0.06	0.26	0.26	0.51	0.51	0.51	0.51	0.51	0.51
Sat Flow, veh/h	1723	3426	87	1723	3155	318	1336	229	1343	1249	1453	303
Grp Volume(v), veh/h	15	237	248	49	296	304	15	0	103	110	0	29
Grp Sat Flow(s),veh/h/ln	1723	1719	1794	1723	1719	1753	1336	0	1572	1249	0	1756
Q Serve(g_s), s	0.5	6.9	7.0	1.5	8.5	8.5	0.3	0.0	1.9	2.8	0.0	0.5
Cycle Q Clear(g_c), s	0.5	6.9	7.0	1.5	8.5	8.5	0.8	0.0	1.9	4.7	0.0	0.5
Prop In Lane	1.00		0.05	1.00		0.18	1.00		0.85	1.00		0.17
Lane Grp Cap(c), veh/h	26	363	379	106	443	452	800	0	801	724	0	894
V/C Ratio(X)	0.58	0.65	0.65	0.46	0.67	0.67	0.02	0.00	0.13	0.15	0.00	0.03
Avail Cap(c_a), veh/h	251	1157	1207	407	1313	1339	800	0	801	724	0	894
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.9	19.9	19.9	24.9	18.3	18.3	6.9	0.0	7.1	8.3	0.0	6.7
Incr Delay (d2), s/veh	19.3	2.0	1.9	3.1	1.8	1.7	0.0	0.0	0.3	0.4	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	3.5	3.6	0.8	4.2	4.4	0.1	0.0	0.9	1.0	0.0	0.2
LnGrp Delay(d),s/veh	46.2	21.8	21.8	28.0	20.1	20.1	7.0	0.0	7.4	8.8	0.0	6.8
LnGrp LOS	D	C	C	C	C	C	A		A	A		A
Approach Vol, veh/h		500			649			118			139	
Approach Delay, s/veh		22.5			20.7			7.4			8.4	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		32.0	7.4	15.6		32.0	4.8	18.2
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		28.0	13.0	37.0		28.0	8.0	42.0
Max Q Clear Time (g_c+I1), s		3.9	3.5	9.0		6.7	2.5	10.5
Green Ext Time (p_c), s		1.1	2.4	2.6		1.1	0.0	3.6

Intersection Summary	
HCM 2010 Ctrl Delay	19.0
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	406	236	445	473	0	0	0	0	241	0	190
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	0	1810
Adj Flow Rate, veh/h	0	441	257	484	514	0				262	0	207
Adj No. of Lanes	0	3	1	2	3	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	0	5
Cap, veh/h	0	1482	461	780	2964	0				892	0	410
Arrive On Green	0.00	0.30	0.30	0.47	1.00	0.00				0.27	0.00	0.27
Sat Flow, veh/h	0	5103	1538	3343	5103	0				3343	0	1538
Grp Volume(v), veh/h	0	441	257	484	514	0				262	0	207
Grp Sat Flow(s),veh/h/ln	0	1647	1538	1672	1647	0				1672	0	1538
Q Serve(g_s), s	0.0	4.1	8.4	6.5	0.0	0.0				3.7	0.0	6.8
Cycle Q Clear(g_c), s	0.0	4.1	8.4	6.5	0.0	0.0				3.7	0.0	6.8
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1482	461	780	2964	0				892	0	410
V/C Ratio(X)	0.00	0.30	0.56	0.62	0.17	0.00				0.29	0.00	0.50
Avail Cap(c_a), veh/h	0	1482	461	780	2964	0				892	0	410
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.94	0.94	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	16.1	17.6	14.0	0.0	0.0				17.5	0.0	18.6
Incr Delay (d2), s/veh	0.0	0.5	4.8	1.4	0.1	0.0				0.8	0.0	4.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	1.9	4.2	3.1	0.0	0.0				1.8	0.0	3.4
LnGrp Delay(d),s/veh	0.0	16.7	22.4	15.4	0.1	0.0				18.3	0.0	23.0
LnGrp LOS		B	C	B	A					B		C
Approach Vol, veh/h		698			998						469	
Approach Delay, s/veh		18.8			7.5						20.4	
Approach LOS		B			A						C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	18.0	22.0		20.0		40.0		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	14.0	18.0		16.0		36.0		
Max Q Clear Time (g_c+I1), s	8.5	10.4		8.8		2.0		
Green Ext Time (p_c), s	2.4	2.2		1.0		5.4		

Intersection Summary	
HCM 2010 Ctrl Delay	14.0
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	135	512	0	0	746	385	172	0	278	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1882	1882	0	0	1810	1810	1810	0	1810			
Adj Flow Rate, veh/h	147	557	0	0	811	418	187	0	302			
Adj No. of Lanes	2	2	0	0	3	1	1	0	2			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	0	5			
Cap, veh/h	237	2086	0	0	2216	690	488	0	767			
Arrive On Green	0.09	0.78	0.00	0.00	0.90	0.90	0.28	0.00	0.28			
Sat Flow, veh/h	3477	3670	0	0	5103	1538	1723	0	2707			
Grp Volume(v), veh/h	147	557	0	0	811	418	187	0	302			
Grp Sat Flow(s),veh/h/ln	1739	1788	0	0	1647	1538	1723	0	1354			
Q Serve(g_s), s	2.4	2.6	0.0	0.0	1.5	3.7	5.2	0.0	5.4			
Cycle Q Clear(g_c), s	2.4	2.6	0.0	0.0	1.5	3.7	5.2	0.0	5.4			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	237	2086	0	0	2216	690	488	0	767			
V/C Ratio(X)	0.62	0.27	0.00	0.00	0.37	0.61	0.38	0.00	0.39			
Avail Cap(c_a), veh/h	290	2086	0	0	2216	690	488	0	767			
HCM Platoon Ratio	1.33	1.33	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	0.96	0.96	0.00	0.00	0.65	0.65	1.00	0.00	1.00			
Uniform Delay (d), s/veh	26.5	3.1	0.0	0.0	1.8	1.9	17.3	0.0	17.3			
Incr Delay (d2), s/veh	2.7	0.3	0.0	0.0	0.3	2.6	2.3	0.0	1.5			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.3	1.3	0.0	0.0	0.7	1.6	2.8	0.0	2.2			
LnGrp Delay(d),s/veh	29.2	3.4	0.0	0.0	2.1	4.5	19.6	0.0	18.9			
LnGrp LOS	C	A			A	A	B		B			
Approach Vol, veh/h		704			1229			489				
Approach Delay, s/veh		8.8			2.9			19.1				
Approach LOS		A			A			B				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		21.0		39.0			8.1	30.9
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		17.0		35.0			5.0	26.0
Max Q Clear Time (g_c+I1), s		7.4		4.6			4.4	5.7
Green Ext Time (p_c), s		1.3		12.7			0.0	10.5

Intersection Summary	
HCM 2010 Ctrl Delay	7.9
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	82	573	135	66	789	4	244	8	23	12	13	98
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1810
Adj Flow Rate, veh/h	89	623	147	72	858	4	265	9	25	13	14	107
Adj No. of Lanes	2	3	1	1	2	0	2	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	174	1421	443	90	1010	5	971	827	703	250	179	152
Arrive On Green	0.10	0.58	0.58	0.05	0.29	0.29	0.29	0.46	0.46	0.10	0.10	0.10
Sat Flow, veh/h	3343	4940	1538	1723	3509	16	3343	1810	1538	1330	1810	1538
Grp Volume(v), veh/h	89	623	147	72	420	442	265	9	25	13	14	107
Grp Sat Flow(s),veh/h/ln	1672	1647	1538	1723	1719	1807	1672	1810	1538	1330	1810	1538
Q Serve(g_s), s	1.5	4.2	3.0	2.4	13.6	13.6	3.6	0.2	0.5	0.5	0.4	4.0
Cycle Q Clear(g_c), s	1.5	4.2	3.0	2.4	13.6	13.6	3.6	0.2	0.5	0.7	0.4	4.0
Prop In Lane	1.00		1.00	1.00		0.01	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	174	1421	443	90	495	520	971	827	703	250	179	152
V/C Ratio(X)	0.51	0.44	0.33	0.80	0.85	0.85	0.27	0.01	0.04	0.05	0.08	0.70
Avail Cap(c_a), veh/h	226	1421	443	117	495	520	971	827	703	478	490	417
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.96	0.96	0.96	0.79	0.79	0.79	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.7	9.8	9.6	27.7	19.8	19.8	16.2	8.8	8.9	24.4	24.2	25.8
Incr Delay (d2), s/veh	2.2	0.9	1.9	20.8	13.6	13.0	0.2	0.0	0.1	0.1	0.2	5.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	1.9	1.4	1.7	8.3	8.6	1.7	0.1	0.2	0.2	0.2	1.9
LnGrp Delay(d),s/veh	28.0	10.8	11.5	48.5	33.4	32.9	16.3	8.8	8.9	24.5	24.4	31.6
LnGrp LOS	C	B	B	D	C	C	B	A	A	C	C	C
Approach Vol, veh/h		859			934			299			134	
Approach Delay, s/veh		12.7			34.3			15.5			30.1	
Approach LOS		B			C			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	8.0	21.0	21.2	9.8	8.0	21.0		31.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	4.0	17.0	7.0	16.0	4.0	17.0		27.0
Max Q Clear Time (g_c+I1), s	4.4	6.2	5.6	6.0	3.5	15.6		2.5
Green Ext Time (p_c), s	0.0	3.3	0.2	0.3	0.0	0.7		1.0

Intersection Summary	
HCM 2010 Ctrl Delay	23.2
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	6	670	12	96	568	53	15	20	88	82	31	11
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	7	728	13	104	617	58	16	22	96	89	34	12
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	13	1027	18	201	1292	121	601	112	488	530	485	171
Arrive On Green	0.01	0.30	0.30	0.12	0.41	0.41	0.38	0.38	0.38	0.38	0.38	0.38
Sat Flow, veh/h	1723	3456	62	1723	3178	298	1316	295	1287	1233	1279	451
Grp Volume(v), veh/h	7	362	379	104	333	342	16	0	118	89	0	46
Grp Sat Flow(s),veh/h/ln	1723	1719	1799	1723	1719	1757	1316	0	1582	1233	0	1730
Q Serve(g_s), s	0.2	10.9	10.9	3.3	8.3	8.3	0.5	0.0	2.9	3.0	0.0	1.0
Cycle Q Clear(g_c), s	0.2	10.9	10.9	3.3	8.3	8.3	1.4	0.0	2.9	5.9	0.0	1.0
Prop In Lane	1.00		0.03	1.00		0.17	1.00		0.81	1.00		0.26
Lane Grp Cap(c), veh/h	13	511	535	201	699	714	601	0	600	530	0	656
V/C Ratio(X)	0.55	0.71	0.71	0.52	0.48	0.48	0.03	0.00	0.20	0.17	0.00	0.07
Avail Cap(c_a), veh/h	178	1185	1240	475	1481	1514	601	0	600	530	0	656
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	28.7	18.2	18.2	24.1	12.7	12.7	11.9	0.0	12.1	14.1	0.0	11.5
Incr Delay (d2), s/veh	32.6	1.8	1.7	2.0	0.5	0.5	0.1	0.0	0.7	0.7	0.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	5.4	5.6	1.7	4.0	4.1	0.2	0.0	1.4	1.1	0.0	0.5
LnGrp Delay(d),s/veh	61.3	20.0	19.9	26.1	13.2	13.2	12.0	0.0	12.8	14.8	0.0	11.7
LnGrp LOS	E	B	B	C	B	B	B		B	B		B
Approach Vol, veh/h		748			779			134			135	
Approach Delay, s/veh		20.3			14.9			12.7			13.7	
Approach LOS		C			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		26.0	10.8	21.2		26.0	4.4	27.6
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		22.0	16.0	40.0		22.0	6.0	50.0
Max Q Clear Time (g_c+I1), s		4.9	5.3	12.9		7.9	2.2	10.3
Green Ext Time (p_c), s		1.1	3.0	4.4		1.0	0.0	4.4

Intersection Summary	
HCM 2010 Ctrl Delay	16.9
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	669	261	341	589	0	0	0	0	381	0	202
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	0	1810
Adj Flow Rate, veh/h	0	727	284	371	640	0				414	0	220
Adj No. of Lanes	0	3	1	2	3	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	0	5
Cap, veh/h	0	1564	487	669	2882	0				947	0	436
Arrive On Green	0.00	0.32	0.32	0.40	1.00	0.00				0.28	0.00	0.28
Sat Flow, veh/h	0	5103	1538	3343	5103	0				3343	0	1538
Grp Volume(v), veh/h	0	727	284	371	640	0				414	0	220
Grp Sat Flow(s),veh/h/ln	0	1647	1538	1672	1647	0				1672	0	1538
Q Serve(g_s), s	0.0	7.1	9.3	5.1	0.0	0.0				6.1	0.0	7.2
Cycle Q Clear(g_c), s	0.0	7.1	9.3	5.1	0.0	0.0				6.1	0.0	7.2
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1564	487	669	2882	0				947	0	436
V/C Ratio(X)	0.00	0.46	0.58	0.55	0.22	0.00				0.44	0.00	0.50
Avail Cap(c_a), veh/h	0	1564	487	669	2882	0				947	0	436
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.91	0.91	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	16.4	17.2	15.9	0.0	0.0				17.6	0.0	18.0
Incr Delay (d2), s/veh	0.0	1.0	5.0	0.9	0.2	0.0				1.5	0.0	4.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	3.3	4.6	2.4	0.0	0.0				3.0	0.0	3.6
LnGrp Delay(d),s/veh	0.0	17.4	22.2	16.9	0.2	0.0				19.1	0.0	22.1
LnGrp LOS		B	C	B	A					B		C
Approach Vol, veh/h		1011			1011						634	
Approach Delay, s/veh		18.8			6.3						20.1	
Approach LOS		B			A						C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	16.0	23.0		21.0		39.0		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	12.0	19.0		17.0		35.0		
Max Q Clear Time (g_c+I1), s	7.1	11.3		9.2		2.0		
Green Ext Time (p_c), s	2.3	3.3		1.6		5.9		

Intersection Summary	
HCM 2010 Ctrl Delay	14.3
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	175	875	0	0	729	363	201	2	417	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1882	1882	0	0	1810	1810	1810	1900	1810			
Adj Flow Rate, veh/h	190	951	0	0	792	395	218	2	453			
Adj No. of Lanes	2	2	0	0	3	1	1	0	2			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	406	2026	0	0	1894	590	517	0	812			
Arrive On Green	0.23	1.00	0.00	0.00	0.77	0.77	0.30	0.30	0.30			
Sat Flow, veh/h	3477	3670	0	0	5103	1538	1723	0	2707			
Grp Volume(v), veh/h	190	951	0	0	792	395	218	0	453			
Grp Sat Flow(s),veh/h/ln	1739	1788	0	0	1647	1538	1723	0	1354			
Q Serve(g_s), s	2.8	0.0	0.0	0.0	3.3	7.4	6.1	0.0	8.4			
Cycle Q Clear(g_c), s	2.8	0.0	0.0	0.0	3.3	7.4	6.1	0.0	8.4			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	406	2026	0	0	1894	590	517	0	812			
V/C Ratio(X)	0.47	0.47	0.00	0.00	0.42	0.67	0.42	0.00	0.56			
Avail Cap(c_a), veh/h	406	2026	0	0	1894	590	517	0	812			
HCM Platoon Ratio	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	0.89	0.89	0.00	0.00	0.68	0.68	1.00	0.00	1.00			
Uniform Delay (d), s/veh	21.4	0.0	0.0	0.0	4.7	5.2	16.8	0.0	17.7			
Incr Delay (d2), s/veh	0.7	0.7	0.0	0.0	0.5	4.1	2.5	0.0	2.8			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.4	0.2	0.0	0.0	1.4	3.5	3.2	0.0	3.5			
LnGrp Delay(d),s/veh	22.1	0.7	0.0	0.0	5.2	9.3	19.3	0.0	20.4			
LnGrp LOS	C	A			A	A	B		C			
Approach Vol, veh/h		1141			1187			671				
Approach Delay, s/veh		4.3			6.5			20.1				
Approach LOS		A			A			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		22.0		38.0			11.0	27.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		18.0		34.0			7.0	23.0
Max Q Clear Time (g_c+I1), s		10.4		2.0			4.8	9.4
Green Ext Time (p_c), s		1.7		8.0			1.4	5.4

Intersection Summary	
HCM 2010 Ctrl Delay	8.7
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	114	1011	167	57	835	12	193	18	63	35	14	79
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1810
Adj Flow Rate, veh/h	124	1099	182	62	908	13	210	20	68	38	15	86
Adj No. of Lanes	2	3	1	1	2	0	2	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	201	1570	489	77	1048	15	933	790	671	227	163	139
Arrive On Green	0.12	0.64	0.64	0.04	0.30	0.30	0.28	0.44	0.44	0.09	0.09	0.09
Sat Flow, veh/h	3343	4940	1538	1723	3470	50	3343	1810	1538	1266	1810	1538
Grp Volume(v), veh/h	124	1099	182	62	450	471	210	20	68	38	15	86
Grp Sat Flow(s),veh/h/ln	1672	1647	1538	1723	1719	1801	1672	1810	1538	1266	1810	1538
Q Serve(g_s), s	2.1	8.7	1.3	2.1	14.7	14.7	2.9	0.4	1.6	1.7	0.5	3.2
Cycle Q Clear(g_c), s	2.1	8.7	1.3	2.1	14.7	14.7	2.9	0.4	1.6	2.1	0.5	3.2
Prop In Lane	1.00		1.00	1.00		0.03	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	201	1570	489	77	519	544	933	790	671	227	163	139
V/C Ratio(X)	0.62	0.70	0.37	0.81	0.87	0.87	0.23	0.03	0.10	0.17	0.09	0.62
Avail Cap(c_a), veh/h	224	1570	489	116	519	544	933	790	671	453	486	413
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.87	0.87	0.87	0.82	0.82	0.82	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.6	9.0	1.2	28.2	19.6	19.6	16.5	9.6	9.9	25.8	24.9	26.1
Incr Delay (d2), s/veh	3.7	2.3	1.9	18.3	14.7	14.1	0.1	0.1	0.3	0.3	0.2	4.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	4.0	1.3	1.4	9.0	9.3	1.3	0.2	0.7	0.6	0.2	1.5
LnGrp Delay(d),s/veh	29.2	11.3	3.1	46.5	34.3	33.8	16.6	9.6	10.2	26.1	25.1	30.6
LnGrp LOS	C	B	A	D	C	C	B	A	B	C	C	C
Approach Vol, veh/h		1405			983			298			139	
Approach Delay, s/veh		11.8			34.8			14.7			28.8	
Approach LOS		B			C			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	6.6	23.4	20.6	9.4	8.0	22.0		30.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	4.0	18.0	6.0	16.0	4.0	18.0		26.0
Max Q Clear Time (g_c+I1), s	4.1	10.7	4.9	5.2	4.1	16.7		3.6
Green Ext Time (p_c), s	0.0	4.4	0.1	0.3	0.0	0.7		1.0

Intersection Summary	
HCM 2010 Ctrl Delay	21.0
HCM 2010 LOS	C

Horizon Year 2040 – No Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	785	20	61	675	52	24	23	101	99	38	7
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	20	853	22	66	734	57	26	25	110	108	41	8
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	32	1163	30	130	1281	99	606	114	503	521	574	112
Arrive On Green	0.02	0.34	0.34	0.08	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39
Sat Flow, veh/h	1723	3425	88	1723	3233	251	1312	293	1289	1214	1472	287
Grp Volume(v), veh/h	20	428	447	66	390	401	26	0	135	108	0	49
Grp Sat Flow(s),veh/h/ln	1723	1719	1794	1723	1719	1765	1312	0	1582	1214	0	1759
Q Serve(g_s), s	0.7	13.5	13.5	2.3	10.9	10.9	0.8	0.0	3.5	4.0	0.0	1.1
Cycle Q Clear(g_c), s	0.7	13.5	13.5	2.3	10.9	10.9	1.9	0.0	3.5	7.5	0.0	1.1
Prop In Lane	1.00		0.05	1.00		0.14	1.00		0.81	1.00		0.16
Lane Grp Cap(c), veh/h	32	584	609	130	681	699	606	0	617	521	0	686
V/C Ratio(X)	0.62	0.73	0.73	0.51	0.57	0.57	0.04	0.00	0.22	0.21	0.00	0.07
Avail Cap(c_a), veh/h	196	1201	1254	308	1313	1348	606	0	617	521	0	686
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.0	17.9	17.9	27.3	14.5	14.5	12.4	0.0	12.5	15.0	0.0	11.8
Incr Delay (d2), s/veh	17.5	1.8	1.7	3.0	0.8	0.7	0.1	0.0	0.8	0.9	0.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	6.6	6.9	1.2	5.2	5.4	0.3	0.0	1.7	1.5	0.0	0.6
LnGrp Delay(d),s/veh	47.5	19.7	19.6	30.4	15.3	15.3	12.5	0.0	13.3	15.9	0.0	12.0
LnGrp LOS	D	B	B	C	B	B	B		B	B		B
Approach Vol, veh/h		895			857			161			157	
Approach Delay, s/veh		20.3			16.4			13.2			14.7	
Approach LOS		C			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		28.0	8.6	24.9		28.0	5.2	28.4
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		24.0	11.0	43.0		24.0	7.0	47.0
Max Q Clear Time (g_c+I1), s		5.5	4.3	15.5		9.5	2.7	12.9
Green Ext Time (p_c), s		1.4	2.6	5.4		1.3	0.0	5.2

Intersection Summary	
HCM 2010 Ctrl Delay	17.7
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	700	341	643	537	0	0	0	0	387	0	305
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	1810	1810
Adj Flow Rate, veh/h	0	761	371	699	584	0				421	0	332
Adj No. of Lanes	0	2	1	2	2	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	5	5
Cap, veh/h	0	1061	475	924	2189	0				894	0	399
Arrive On Green	0.00	0.31	0.31	0.28	0.64	0.00				0.26	0.00	0.26
Sat Flow, veh/h	0	3529	1538	3343	3529	0				3447	0	1538
Grp Volume(v), veh/h	0	761	371	699	584	0				421	0	332
Grp Sat Flow(s),veh/h/ln	0	1719	1538	1672	1719	0				1723	0	1538
Q Serve(g_s), s	0.0	15.2	16.9	14.7	5.7	0.0				7.9	0.0	15.7
Cycle Q Clear(g_c), s	0.0	15.2	16.9	14.7	5.7	0.0				7.9	0.0	15.7
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1061	475	924	2189	0				894	0	399
V/C Ratio(X)	0.00	0.72	0.78	0.76	0.27	0.00				0.47	0.00	0.83
Avail Cap(c_a), veh/h	0	1382	618	1171	2765	0				894	0	399
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	23.7	24.3	25.5	6.1	0.0				24.1	0.0	27.0
Incr Delay (d2), s/veh	0.0	1.3	4.8	2.2	0.1	0.0				1.8	0.0	18.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	7.4	7.8	7.1	2.7	0.0				4.0	0.0	8.6
LnGrp Delay(d),s/veh	0.0	24.9	29.1	27.7	6.2	0.0				25.9	0.0	45.0
LnGrp LOS		C	C	C	A					C		D
Approach Vol, veh/h		1132			1283						753	
Approach Delay, s/veh		26.3			17.9						34.3	
Approach LOS		C			B						C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	25.3	27.8		24.0		53.1		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	27.0	31.0		20.0		62.0		
Max Q Clear Time (g_c+I1), s	16.7	18.9		17.7		7.7		
Green Ext Time (p_c), s	4.6	4.9		0.8		7.5		

Intersection Summary	
HCM 2010 Ctrl Delay	24.8
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	235	852	0	0	939	670	241	0	389	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1882	1882	0	0	1810	1900	1900	1810	1810			
Adj Flow Rate, veh/h	255	926	0	0	1021	728	262	0	423			
Adj No. of Lanes	2	2	0	0	2	0	0	1	1			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	270	2265	0	0	1013	672	479	0	427			
Arrive On Green	0.08	0.63	0.00	0.00	0.51	0.51	0.28	0.00	0.28			
Sat Flow, veh/h	3477	3670	0	0	2073	1314	1723	0	1538			
Grp Volume(v), veh/h	255	926	0	0	875	874	262	0	423			
Grp Sat Flow(s),veh/h/ln	1739	1788	0	0	1719	1578	1723	0	1538			
Q Serve(g_s), s	6.6	11.5	0.0	0.0	45.6	46.0	11.7	0.0	24.7			
Cycle Q Clear(g_c), s	6.6	11.5	0.0	0.0	45.6	46.0	11.7	0.0	24.7			
Prop In Lane	1.00		0.00	0.00		0.83	1.00		1.00			
Lane Grp Cap(c), veh/h	270	2265	0	0	879	806	479	0	427			
V/C Ratio(X)	0.94	0.41	0.00	0.00	1.00	1.08	0.55	0.00	0.99			
Avail Cap(c_a), veh/h	270	2265	0	0	879	806	479	0	427			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00			
Uniform Delay (d), s/veh	41.3	8.2	0.0	0.0	21.9	22.0	27.7	0.0	32.4			
Incr Delay (d2), s/veh	39.5	0.1	0.0	0.0	29.2	57.0	4.4	0.0	41.1			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	4.6	5.7	0.0	0.0	28.5	32.5	6.1	0.0	15.3			
LnGrp Delay(d),s/veh	80.8	8.3	0.0	0.0	51.1	79.0	32.1	0.0	73.5			
LnGrp LOS	F	A			D	F	C		E			
Approach Vol, veh/h		1181			1749			685				
Approach Delay, s/veh		23.9			65.0			57.7				
Approach LOS		C			E			E				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		29.0		61.0			11.0	50.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		25.0		57.0			7.0	46.0
Max Q Clear Time (g_c+I1), s		26.7		13.5			8.6	48.0
Green Ext Time (p_c), s		0.0		8.4			0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	50.2
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	96	799	345	40	1137	11	340	2	8	4	8	132
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1900
Adj Flow Rate, veh/h	104	868	375	43	1236	12	370	2	9	4	9	143
Adj No. of Lanes	1	2	1	1	2	0	2	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	130	1587	710	53	1455	14	691	673	572	243	11	175
Arrive On Green	0.08	0.46	0.46	0.03	0.42	0.42	0.21	0.37	0.37	0.12	0.12	0.12
Sat Flow, veh/h	1723	3438	1538	1723	3489	34	3343	1810	1538	1358	92	1460
Grp Volume(v), veh/h	104	868	375	43	609	639	370	2	9	4	0	152
Grp Sat Flow(s),veh/h/ln	1723	1719	1538	1723	1719	1804	1672	1810	1538	1358	0	1552
Q Serve(g_s), s	5.3	16.1	6.9	2.2	28.4	28.4	8.8	0.1	0.3	0.2	0.0	8.5
Cycle Q Clear(g_c), s	5.3	16.1	6.9	2.2	28.4	28.4	8.8	0.1	0.3	0.3	0.0	8.5
Prop In Lane	1.00		1.00	1.00		0.02	1.00		1.00	1.00		0.94
Lane Grp Cap(c), veh/h	130	1587	710	53	717	752	691	673	572	243	0	186
V/C Ratio(X)	0.80	0.55	0.53	0.81	0.85	0.85	0.54	0.00	0.02	0.02	0.00	0.82
Avail Cap(c_a), veh/h	155	1587	710	117	717	752	691	673	572	325	0	280
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	40.3	17.2	3.4	42.7	23.3	23.3	31.4	17.5	17.6	34.5	0.0	38.1
Incr Delay (d2), s/veh	21.3	1.4	2.8	23.7	12.0	11.5	0.8	0.0	0.1	0.0	0.0	10.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	7.9	5.4	1.4	15.8	16.4	4.1	0.0	0.1	0.1	0.0	4.2
LnGrp Delay(d),s/veh	61.7	18.6	6.2	66.4	35.3	34.9	32.2	17.5	17.6	34.5	0.0	48.8
LnGrp LOS	E	B	A	E	D	C	C	B	B	C		D
Approach Vol, veh/h		1347			1291			381			156	
Approach Delay, s/veh		18.4			36.1			31.8			48.4	
Approach LOS		B			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	6.7	45.0	22.3	14.7	10.7	41.0		37.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	6.0	39.0	13.0	16.0	8.0	37.0		33.0
Max Q Clear Time (g_c+I1), s	4.2	18.1	10.8	10.5	7.3	30.4		2.3
Green Ext Time (p_c), s	0.0	7.4	0.3	0.4	0.0	3.9		1.4

Intersection Summary	
HCM 2010 Ctrl Delay	28.7
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	828	47	130	710	46	29	19	150	82	42	4
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	20	900	51	141	772	50	32	21	163	89	46	4
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	32	1189	67	259	1609	104	486	55	425	359	503	44
Arrive On Green	0.02	0.36	0.36	0.15	0.49	0.49	0.31	0.31	0.31	0.31	0.31	0.31
Sat Flow, veh/h	1723	3308	187	1723	3279	212	1311	179	1386	1161	1642	143
Grp Volume(v), veh/h	20	468	483	141	405	417	32	0	184	89	0	50
Grp Sat Flow(s),veh/h/ln	1723	1719	1776	1723	1719	1772	1311	0	1565	1161	0	1784
Q Serve(g_s), s	0.8	15.6	15.6	4.9	10.2	10.2	1.2	0.0	6.0	4.3	0.0	1.3
Cycle Q Clear(g_c), s	0.8	15.6	15.6	4.9	10.2	10.2	2.5	0.0	6.0	10.3	0.0	1.3
Prop In Lane	1.00		0.11	1.00		0.12	1.00		0.89	1.00		0.08
Lane Grp Cap(c), veh/h	32	618	638	259	844	870	486	0	480	359	0	547
V/C Ratio(X)	0.62	0.76	0.76	0.55	0.48	0.48	0.07	0.00	0.38	0.25	0.00	0.09
Avail Cap(c_a), veh/h	132	1081	1117	449	1397	1440	486	0	480	359	0	547
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.8	18.4	18.4	25.7	11.1	11.1	17.0	0.0	17.8	21.8	0.0	16.1
Incr Delay (d2), s/veh	18.0	1.9	1.9	1.8	0.4	0.4	0.3	0.0	2.3	1.6	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	7.7	8.0	2.5	4.9	5.1	0.5	0.0	2.9	1.5	0.0	0.7
LnGrp Delay(d),s/veh	49.8	20.3	20.3	27.4	11.5	11.5	17.3	0.0	20.1	23.5	0.0	16.5
LnGrp LOS	D	C	C	C	B	B	B		C	C		B
Approach Vol, veh/h		971			963			216			139	
Approach Delay, s/veh		20.9			13.8			19.7			20.9	
Approach LOS		C			B			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		24.0	13.8	27.4		24.0	5.2	36.0
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		20.0	17.0	41.0		20.0	5.0	53.0
Max Q Clear Time (g_c+I1), s		8.0	6.9	17.6		12.3	2.8	12.2
Green Ext Time (p_c), s		1.4	3.7	5.8		1.1	0.0	5.8

Intersection Summary	
HCM 2010 Ctrl Delay	17.8
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	860	300	392	746	0	0	0	0	439	0	234
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	1810	1810
Adj Flow Rate, veh/h	0	935	326	426	811	0				477	0	254
Adj No. of Lanes	0	2	1	2	2	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	5	5
Cap, veh/h	0	1208	540	654	2058	0				1027	0	458
Arrive On Green	0.00	0.35	0.35	0.20	0.60	0.00				0.30	0.00	0.30
Sat Flow, veh/h	0	3529	1538	3343	3529	0				3447	0	1538
Grp Volume(v), veh/h	0	935	326	426	811	0				477	0	254
Grp Sat Flow(s),veh/h/ln	0	1719	1538	1672	1719	0				1723	0	1538
Q Serve(g_s), s	0.0	18.7	13.5	9.1	9.6	0.0				8.7	0.0	10.7
Cycle Q Clear(g_c), s	0.0	18.7	13.5	9.1	9.6	0.0				8.7	0.0	10.7
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1208	540	654	2058	0				1027	0	458
V/C Ratio(X)	0.00	0.77	0.60	0.65	0.39	0.00				0.46	0.00	0.55
Avail Cap(c_a), veh/h	0	1603	717	823	2627	0				1027	0	458
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	22.3	20.6	28.6	8.1	0.0				22.1	0.0	22.8
Incr Delay (d2), s/veh	0.0	1.7	1.1	1.2	0.1	0.0				1.5	0.0	4.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	9.1	5.9	4.3	4.5	0.0				4.3	0.0	5.1
LnGrp Delay(d),s/veh	0.0	24.1	21.7	29.9	8.3	0.0				23.6	0.0	27.6
LnGrp LOS		C	C	C	A					C		C
Approach Vol, veh/h		1261			1237						731	
Approach Delay, s/veh		23.5			15.7						25.0	
Approach LOS		C			B						C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	19.1	31.1		27.0		50.2		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	19.0	36.0		23.0		59.0		
Max Q Clear Time (g_c+I1), s	11.1	20.7		12.7		11.6		
Green Ext Time (p_c), s	4.0	6.4		2.1		8.2		

Intersection Summary	
HCM 2010 Ctrl Delay	20.8
HCM 2010 LOS	C

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	241	1058	0	0	906	500	232	0	481	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1882	1882	0	0	1810	1900	1900	1810	1810			
Adj Flow Rate, veh/h	262	1150	0	0	985	543	252	0	523			
Adj No. of Lanes	2	2	0	0	2	0	0	1	1			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	5	5			
Cap, veh/h	270	2026	0	0	962	515	594	0	530			
Arrive On Green	0.08	0.57	0.00	0.00	0.44	0.44	0.34	0.00	0.34			
Sat Flow, veh/h	3477	3670	0	0	2256	1159	1723	0	1538			
Grp Volume(v), veh/h	262	1150	0	0	776	752	252	0	523			
Grp Sat Flow(s),veh/h/ln	1739	1788	0	0	1719	1605	1723	0	1538			
Q Serve(g_s), s	6.8	18.5	0.0	0.0	40.0	40.0	10.1	0.0	30.4			
Cycle Q Clear(g_c), s	6.8	18.5	0.0	0.0	40.0	40.0	10.1	0.0	30.4			
Prop In Lane	1.00		0.00	0.00		0.72	1.00		1.00			
Lane Grp Cap(c), veh/h	270	2026	0	0	764	713	594	0	530			
V/C Ratio(X)	0.97	0.57	0.00	0.00	1.02	1.05	0.42	0.00	0.99			
Avail Cap(c_a), veh/h	270	2026	0	0	764	713	594	0	530			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00			
Uniform Delay (d), s/veh	41.4	12.5	0.0	0.0	25.0	25.0	22.7	0.0	29.3			
Incr Delay (d2), s/veh	46.0	0.4	0.0	0.0	36.5	48.9	2.2	0.0	36.1			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	5.0	9.2	0.0	0.0	26.6	27.3	5.1	0.0	18.1			
LnGrp Delay(d),s/veh	87.4	12.8	0.0	0.0	61.5	73.9	24.9	0.0	65.4			
LnGrp LOS	F	B			F	F	C		E			
Approach Vol, veh/h		1412			1528			775				
Approach Delay, s/veh		26.7			67.6			52.2				
Approach LOS		C			E			D				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		35.0		55.0			11.0	44.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		31.0		51.0			7.0	40.0
Max Q Clear Time (g_c+I1), s		32.4		20.5			8.8	42.0
Green Ext Time (p_c), s		0.0		23.2			0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	48.8
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	140	1257	142	101	942	8	332	20	75	31	15	132
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1900
Adj Flow Rate, veh/h	152	1366	154	110	1024	9	361	22	82	34	16	143
Adj No. of Lanes	1	2	1	1	2	0	2	1	1	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	211	1566	701	134	1436	13	545	603	513	227	20	177
Arrive On Green	0.12	0.46	0.46	0.08	0.41	0.41	0.16	0.33	0.33	0.13	0.13	0.13
Sat Flow, veh/h	1723	3438	1538	1723	3492	31	3343	1810	1538	1248	157	1405
Grp Volume(v), veh/h	152	1366	154	110	504	529	361	22	82	34	0	159
Grp Sat Flow(s),veh/h/ln	1723	1719	1538	1723	1719	1804	1672	1810	1538	1248	0	1562
Q Serve(g_s), s	7.6	32.3	5.5	5.7	22.0	22.0	9.1	0.7	3.4	2.2	0.0	8.9
Cycle Q Clear(g_c), s	7.6	32.3	5.5	5.7	22.0	22.0	9.1	0.7	3.4	3.0	0.0	8.9
Prop In Lane	1.00		1.00	1.00		0.02	1.00		1.00	1.00		0.90
Lane Grp Cap(c), veh/h	211	1566	701	134	707	742	545	603	513	227	0	196
V/C Ratio(X)	0.72	0.87	0.22	0.82	0.71	0.71	0.66	0.04	0.16	0.15	0.00	0.81
Avail Cap(c_a), veh/h	211	1566	701	134	707	742	545	603	513	292	0	278
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	38.0	22.1	14.8	40.9	22.1	22.1	35.3	20.2	21.1	36.0	0.0	38.3
Incr Delay (d2), s/veh	11.4	7.0	0.7	31.7	6.0	5.8	3.0	0.1	0.7	0.3	0.0	11.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.3	16.7	2.5	3.9	11.5	12.1	4.4	0.4	1.5	0.8	0.0	4.5
LnGrp Delay(d),s/veh	49.5	29.1	15.5	72.6	28.1	27.9	38.3	20.4	21.8	36.3	0.0	49.6
LnGrp LOS	D	C	B	E	C	C	D	C	C	D		D
Approach Vol, veh/h		1672			1143			465			193	
Approach Delay, s/veh		29.7			32.3			34.6			47.3	
Approach LOS		C			C			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	11.0	45.0	18.7	15.3	15.0	41.0		34.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	7.0	41.0	10.0	16.0	11.0	37.0		30.0
Max Q Clear Time (g_c+I1), s	7.7	34.3	11.1	10.9	9.6	24.0		5.4
Green Ext Time (p_c), s	0.0	4.6	0.0	0.4	0.1	5.0		1.7

Intersection Summary	
HCM 2010 Ctrl Delay	32.2
HCM 2010 LOS	C

Horizon Year 2040 – Build

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	785	20	61	675	52	24	23	101	99	38	7
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	20	853	22	66	734	57	26	25	110	108	41	8
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	32	1163	30	130	1281	99	606	114	503	521	574	112
Arrive On Green	0.02	0.34	0.34	0.08	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39
Sat Flow, veh/h	1723	3425	88	1723	3233	251	1312	293	1289	1214	1472	287
Grp Volume(v), veh/h	20	428	447	66	390	401	26	0	135	108	0	49
Grp Sat Flow(s),veh/h/ln	1723	1719	1794	1723	1719	1765	1312	0	1582	1214	0	1759
Q Serve(g_s), s	0.7	13.5	13.5	2.3	10.9	10.9	0.8	0.0	3.5	4.0	0.0	1.1
Cycle Q Clear(g_c), s	0.7	13.5	13.5	2.3	10.9	10.9	1.9	0.0	3.5	7.5	0.0	1.1
Prop In Lane	1.00		0.05	1.00		0.14	1.00		0.81	1.00		0.16
Lane Grp Cap(c), veh/h	32	584	609	130	681	699	606	0	617	521	0	686
V/C Ratio(X)	0.62	0.73	0.73	0.51	0.57	0.57	0.04	0.00	0.22	0.21	0.00	0.07
Avail Cap(c_a), veh/h	196	1201	1254	308	1313	1348	606	0	617	521	0	686
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	30.0	17.9	17.9	27.3	14.5	14.5	12.4	0.0	12.5	15.0	0.0	11.8
Incr Delay (d2), s/veh	17.5	1.8	1.7	3.0	0.8	0.7	0.1	0.0	0.8	0.9	0.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	6.6	6.9	1.2	5.2	5.4	0.3	0.0	1.7	1.5	0.0	0.6
LnGrp Delay(d),s/veh	47.5	19.7	19.6	30.4	15.3	15.3	12.5	0.0	13.3	15.9	0.0	12.0
LnGrp LOS	D	B	B	C	B	B	B		B	B		B
Approach Vol, veh/h		895			857			161			157	
Approach Delay, s/veh		20.3			16.4			13.2			14.7	
Approach LOS		C			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		28.0	8.6	24.9		28.0	5.2	28.4
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		24.0	11.0	43.0		24.0	7.0	47.0
Max Q Clear Time (g_c+I1), s		5.5	4.3	15.5		9.5	2.7	12.9
Green Ext Time (p_c), s		1.4	2.6	5.4		1.3	0.0	5.2

Intersection Summary	
HCM 2010 Ctrl Delay	17.7
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	700	341	643	537	0	0	0	0	387	0	305
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	0	1810
Adj Flow Rate, veh/h	0	761	371	699	584	0				421	0	332
Adj No. of Lanes	0	3	1	2	3	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	0	5
Cap, veh/h	0	1341	417	1051	3176	0				812	0	374
Arrive On Green	0.00	0.27	0.27	0.42	0.86	0.00				0.24	0.00	0.24
Sat Flow, veh/h	0	5103	1538	3343	5103	0				3343	0	1538
Grp Volume(v), veh/h	0	761	371	699	584	0				421	0	332
Grp Sat Flow(s),veh/h/ln	0	1647	1538	1672	1647	0				1672	0	1538
Q Serve(g_s), s	0.0	9.3	16.2	11.8	1.4	0.0				7.6	0.0	14.6
Cycle Q Clear(g_c), s	0.0	9.3	16.2	11.8	1.4	0.0				7.6	0.0	14.6
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1341	417	1051	3176	0				812	0	374
V/C Ratio(X)	0.00	0.57	0.89	0.67	0.18	0.00				0.52	0.00	0.89
Avail Cap(c_a), veh/h	0	1341	417	1051	3176	0				812	0	374
HCM Platoon Ratio	1.00	1.00	1.00	1.33	1.33	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.87	0.87	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	22.0	24.5	17.4	1.9	0.0				23.0	0.0	25.6
Incr Delay (d2), s/veh	0.0	1.7	23.4	1.4	0.1	0.0				2.4	0.0	25.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	4.4	9.5	5.6	0.7	0.0				3.8	0.0	8.8
LnGrp Delay(d),s/veh	0.0	23.7	47.9	18.8	2.0	0.0				25.3	0.0	51.1
LnGrp LOS		C	D	B	A					C		D
Approach Vol, veh/h		1132			1283						753	
Approach Delay, s/veh		31.6			11.2						36.7	
Approach LOS		C			B						D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	26.0	23.0		21.0		49.0		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	22.0	19.0		17.0		45.0		
Max Q Clear Time (g_c+I1), s	13.8	18.2		16.6		3.4		
Green Ext Time (p_c), s	4.0	0.5		0.2		7.4		

Intersection Summary	
HCM 2010 Ctrl Delay	24.5
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	235	852	0	0	939	670	241	0	389	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1882	1882	0	0	1810	1810	1810	0	1810			
Adj Flow Rate, veh/h	255	926	0	0	1021	728	262	0	423			
Adj No. of Lanes	2	2	0	0	3	1	1	0	2			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	0	5			
Cap, veh/h	397	2248	0	0	2258	703	443	0	696			
Arrive On Green	0.23	1.00	0.00	0.00	0.91	0.91	0.26	0.00	0.26			
Sat Flow, veh/h	3477	3670	0	0	5103	1538	1723	0	2707			
Grp Volume(v), veh/h	255	926	0	0	1021	728	262	0	423			
Grp Sat Flow(s),veh/h/ln	1739	1788	0	0	1647	1538	1723	0	1354			
Q Serve(g_s), s	4.6	0.0	0.0	0.0	2.1	32.0	9.3	0.0	9.6			
Cycle Q Clear(g_c), s	4.6	0.0	0.0	0.0	2.1	32.0	9.3	0.0	9.6			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	397	2248	0	0	2258	703	443	0	696			
V/C Ratio(X)	0.64	0.41	0.00	0.00	0.45	1.04	0.59	0.00	0.61			
Avail Cap(c_a), veh/h	397	2248	0	0	2258	703	443	0	696			
HCM Platoon Ratio	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	0.82	0.82	0.00	0.00	0.47	0.47	1.00	0.00	1.00			
Uniform Delay (d), s/veh	25.7	0.0	0.0	0.0	1.7	3.0	22.8	0.0	22.9			
Incr Delay (d2), s/veh	2.9	0.5	0.0	0.0	0.3	33.0	5.7	0.0	3.9			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	2.4	0.1	0.0	0.0	0.8	15.8	5.1	0.0	4.0			
LnGrp Delay(d),s/veh	28.6	0.5	0.0	0.0	2.0	36.0	28.5	0.0	26.8			
LnGrp LOS	C	A			A	F	C		C			
Approach Vol, veh/h		1181			1749			685				
Approach Delay, s/veh		6.5			16.2			27.4				
Approach LOS		A			B			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		22.0		48.0			12.0	36.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		18.0		44.0			8.0	32.0
Max Q Clear Time (g_c+I1), s		11.6		2.0			6.6	34.0
Green Ext Time (p_c), s		1.5		8.4			0.9	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	15.2
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	96	799	345	40	1137	11	340	2	8	4	8	132
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1810
Adj Flow Rate, veh/h	104	868	375	43	1236	12	370	2	9	4	9	143
Adj No. of Lanes	2	3	1	1	2	0	2	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	170	1705	531	137	1305	13	759	729	619	263	214	182
Arrive On Green	0.10	0.69	0.69	0.08	0.37	0.37	0.23	0.40	0.40	0.12	0.12	0.12
Sat Flow, veh/h	3343	4940	1538	1723	3489	34	3343	1810	1538	1358	1810	1538
Grp Volume(v), veh/h	104	868	375	43	609	639	370	2	9	4	9	143
Grp Sat Flow(s),veh/h/ln	1672	1647	1538	1723	1719	1804	1672	1810	1538	1358	1810	1538
Q Serve(g_s), s	2.1	5.8	10.2	1.6	23.9	23.9	6.7	0.0	0.2	0.2	0.3	6.3
Cycle Q Clear(g_c), s	2.1	5.8	10.2	1.6	23.9	23.9	6.7	0.0	0.2	0.2	0.3	6.3
Prop In Lane	1.00		1.00	1.00		0.02	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	170	1705	531	137	643	674	759	729	619	263	214	182
V/C Ratio(X)	0.61	0.51	0.71	0.31	0.95	0.95	0.49	0.00	0.01	0.02	0.04	0.79
Avail Cap(c_a), veh/h	192	1705	531	149	643	674	759	729	619	415	416	354
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.88	0.88	0.88	0.51	0.51	0.51	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.6	8.0	8.6	30.2	21.1	21.1	23.4	12.4	12.5	27.2	27.2	29.8
Incr Delay (d2), s/veh	4.1	1.0	6.8	0.7	15.5	15.1	0.5	0.0	0.0	0.0	0.1	7.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	2.6	5.1	0.8	13.9	14.5	3.1	0.0	0.1	0.1	0.2	3.0
LnGrp Delay(d),s/veh	34.6	8.9	15.5	30.9	36.6	36.2	23.8	12.4	12.5	27.2	27.3	37.2
LnGrp LOS	C	A	B	C	D	D	C	B	B	C	C	D
Approach Vol, veh/h		1347			1291			381			156	
Approach Delay, s/veh		12.7			36.2			23.5			36.3	
Approach LOS		B			D			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	10.0	28.0	19.8	12.2	8.0	30.0		32.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	6.0	24.0	8.0	16.0	4.0	26.0		28.0
Max Q Clear Time (g_c+I1), s	3.6	12.2	8.7	8.3	4.1	25.9		2.2
Green Ext Time (p_c), s	0.1	5.3	0.0	0.3	0.0	0.1		1.4

Intersection Summary	
HCM 2010 Ctrl Delay	24.7
HCM 2010 LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	828	47	130	710	46	29	19	150	82	42	4
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1900	1810	1810	1900	1810	1810	1900	1810	1810	1900
Adj Flow Rate, veh/h	20	900	51	141	772	50	32	21	163	89	46	4
Adj No. of Lanes	1	2	0	1	2	0	1	1	0	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	32	1189	67	259	1609	104	486	55	425	359	503	44
Arrive On Green	0.02	0.36	0.36	0.15	0.49	0.49	0.31	0.31	0.31	0.31	0.31	0.31
Sat Flow, veh/h	1723	3308	187	1723	3279	212	1311	179	1386	1161	1642	143
Grp Volume(v), veh/h	20	468	483	141	405	417	32	0	184	89	0	50
Grp Sat Flow(s),veh/h/ln	1723	1719	1776	1723	1719	1772	1311	0	1565	1161	0	1784
Q Serve(g_s), s	0.8	15.6	15.6	4.9	10.2	10.2	1.2	0.0	6.0	4.3	0.0	1.3
Cycle Q Clear(g_c), s	0.8	15.6	15.6	4.9	10.2	10.2	2.5	0.0	6.0	10.3	0.0	1.3
Prop In Lane	1.00		0.11	1.00		0.12	1.00		0.89	1.00		0.08
Lane Grp Cap(c), veh/h	32	618	638	259	844	870	486	0	480	359	0	547
V/C Ratio(X)	0.62	0.76	0.76	0.55	0.48	0.48	0.07	0.00	0.38	0.25	0.00	0.09
Avail Cap(c_a), veh/h	132	1081	1117	449	1397	1440	486	0	480	359	0	547
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.8	18.4	18.4	25.7	11.1	11.1	17.0	0.0	17.8	21.8	0.0	16.1
Incr Delay (d2), s/veh	18.0	1.9	1.9	1.8	0.4	0.4	0.3	0.0	2.3	1.6	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	7.7	8.0	2.5	4.9	5.1	0.5	0.0	2.9	1.5	0.0	0.7
LnGrp Delay(d),s/veh	49.8	20.3	20.3	27.4	11.5	11.5	17.3	0.0	20.1	23.5	0.0	16.5
LnGrp LOS	D	C	C	C	B	B	B		C	C		B
Approach Vol, veh/h		971			963			216			139	
Approach Delay, s/veh		20.9			13.8			19.7			20.9	
Approach LOS		C			B			B			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		24.0	13.8	27.4		24.0	5.2	36.0
Change Period (Y+Rc), s		4.0	4.0	4.0		4.0	4.0	4.0
Max Green Setting (Gmax), s		20.0	17.0	41.0		20.0	5.0	53.0
Max Q Clear Time (g_c+I1), s		8.0	6.9	17.6		12.3	2.8	12.2
Green Ext Time (p_c), s		1.4	3.7	5.8		1.1	0.0	5.8

Intersection Summary	
HCM 2010 Ctrl Delay	17.8
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	860	300	392	746	0	0	0	0	439	0	234
Number	5	2	12	1	6	16				7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0				0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00				1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	0	1810	1810	1810	1810	0				1810	0	1810
Adj Flow Rate, veh/h	0	935	326	426	811	0				477	0	254
Adj No. of Lanes	0	3	1	2	3	0				2	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				0.92	0.92	0.92
Percent Heavy Veh, %	0	5	5	5	5	0				5	0	5
Cap, veh/h	0	1694	527	764	3105	0				860	0	396
Arrive On Green	0.00	0.34	0.34	0.46	1.00	0.00				0.26	0.00	0.26
Sat Flow, veh/h	0	5103	1538	3343	5103	0				3343	0	1538
Grp Volume(v), veh/h	0	935	326	426	811	0				477	0	254
Grp Sat Flow(s),veh/h/ln	0	1647	1538	1672	1647	0				1672	0	1538
Q Serve(g_s), s	0.0	10.7	12.4	6.5	0.0	0.0				8.7	0.0	10.3
Cycle Q Clear(g_c), s	0.0	10.7	12.4	6.5	0.0	0.0				8.7	0.0	10.3
Prop In Lane	0.00		1.00	1.00		0.00				1.00		1.00
Lane Grp Cap(c), veh/h	0	1694	527	764	3105	0				860	0	396
V/C Ratio(X)	0.00	0.55	0.62	0.56	0.26	0.00				0.55	0.00	0.64
Avail Cap(c_a), veh/h	0	1694	527	764	3105	0				860	0	396
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	0.86	0.86	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	18.6	19.2	16.4	0.0	0.0				22.5	0.0	23.1
Incr Delay (d2), s/veh	0.0	1.3	5.4	0.8	0.2	0.0				2.6	0.0	7.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	5.1	6.0	3.0	0.1	0.0				4.3	0.0	5.2
LnGrp Delay(d),s/veh	0.0	19.9	24.5	17.2	0.2	0.0				25.1	0.0	30.9
LnGrp LOS		B	C	B	A					C		C
Approach Vol, veh/h		1261			1237						731	
Approach Delay, s/veh		21.1			6.0						27.1	
Approach LOS		C			A						C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4		6		
Phs Duration (G+Y+Rc), s	20.0	28.0		22.0		48.0		
Change Period (Y+Rc), s	4.0	4.0		4.0		4.0		
Max Green Setting (Gmax), s	16.0	24.0		18.0		44.0		
Max Q Clear Time (g_c+I1), s	8.5	14.4		12.3		2.0		
Green Ext Time (p_c), s	3.9	4.8		1.5		8.1		

Intersection Summary	
HCM 2010 Ctrl Delay	16.7
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	241	1058	0	0	906	500	232	0	481	0	0	0
Number	7	4	14	3	8	18	5	2	12			
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Adj Sat Flow, veh/h/ln	1882	1882	0	0	1810	1810	1810	0	1810			
Adj Flow Rate, veh/h	262	1150	0	0	985	543	252	0	523			
Adj No. of Lanes	2	2	0	0	3	1	1	0	2			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
Percent Heavy Veh, %	5	5	0	0	5	5	5	0	5			
Cap, veh/h	447	2094	0	0	1976	615	517	0	812			
Arrive On Green	0.26	1.00	0.00	0.00	0.80	0.80	0.30	0.00	0.30			
Sat Flow, veh/h	3477	3670	0	0	5103	1538	1723	0	2707			
Grp Volume(v), veh/h	262	1150	0	0	985	543	252	0	523			
Grp Sat Flow(s),veh/h/ln	1739	1788	0	0	1647	1538	1723	0	1354			
Q Serve(g_s), s	4.6	0.0	0.0	0.0	4.6	16.8	8.4	0.0	11.7			
Cycle Q Clear(g_c), s	4.6	0.0	0.0	0.0	4.6	16.8	8.4	0.0	11.7			
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00			
Lane Grp Cap(c), veh/h	447	2094	0	0	1976	615	517	0	812			
V/C Ratio(X)	0.59	0.55	0.00	0.00	0.50	0.88	0.49	0.00	0.64			
Avail Cap(c_a), veh/h	447	2094	0	0	1976	615	517	0	812			
HCM Platoon Ratio	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00			
Upstream Filter(I)	0.81	0.81	0.00	0.00	0.62	0.62	1.00	0.00	1.00			
Uniform Delay (d), s/veh	24.4	0.0	0.0	0.0	4.7	5.9	20.1	0.0	21.3			
Incr Delay (d2), s/veh	1.6	0.8	0.0	0.0	0.6	11.2	3.3	0.0	3.9			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	2.3	0.2	0.0	0.0	1.9	8.3	4.5	0.0	4.8			
LnGrp Delay(d),s/veh	26.0	0.8	0.0	0.0	5.2	17.1	23.4	0.0	25.2			
LnGrp LOS	C	A			A	B	C		C			
Approach Vol, veh/h		1412			1528			775				
Approach Delay, s/veh		5.5			9.4			24.6				
Approach LOS		A			A			C				

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4			7	8
Phs Duration (G+Y+Rc), s		25.0		45.0			13.0	32.0
Change Period (Y+Rc), s		4.0		4.0			4.0	4.0
Max Green Setting (Gmax), s		21.0		41.0			9.0	28.0
Max Q Clear Time (g_c+I1), s		13.7		2.0			6.6	18.8
Green Ext Time (p_c), s		1.9		11.1			1.7	5.4

Intersection Summary	
HCM 2010 Ctrl Delay	11.1
HCM 2010 LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	140	1257	142	101	942	8	332	20	75	31	15	132
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1810	1810	1810	1810	1810	1900	1810	1810	1810	1810	1810	1810
Adj Flow Rate, veh/h	152	1366	154	110	1024	9	361	22	82	34	16	143
Adj No. of Lanes	2	3	1	1	2	0	2	1	1	1	1	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	5	5	5	5	5	5	5	5	5	5	5	5
Cap, veh/h	228	1638	510	139	1202	11	786	752	639	248	223	190
Arrive On Green	0.14	0.66	0.66	0.08	0.34	0.34	0.24	0.42	0.42	0.12	0.12	0.12
Sat Flow, veh/h	3343	4940	1538	1723	3492	31	3343	1810	1538	1248	1810	1538
Grp Volume(v), veh/h	152	1366	154	110	504	529	361	22	82	34	16	143
Grp Sat Flow(s),veh/h/ln	1672	1647	1538	1723	1719	1804	1672	1810	1538	1248	1810	1538
Q Serve(g_s), s	3.0	14.5	1.4	4.4	19.0	19.0	6.5	0.5	2.3	1.7	0.5	6.3
Cycle Q Clear(g_c), s	3.0	14.5	1.4	4.4	19.0	19.0	6.5	0.5	2.3	2.2	0.5	6.3
Prop In Lane	1.00		1.00	1.00		0.02	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	228	1638	510	139	592	621	786	752	639	248	223	190
V/C Ratio(X)	0.67	0.83	0.30	0.79	0.85	0.85	0.46	0.03	0.13	0.14	0.07	0.75
Avail Cap(c_a), veh/h	240	1638	510	148	592	621	786	752	639	381	415	353
HCM Platoon Ratio	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.80	0.80	0.80	0.59	0.59	0.59	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.4	10.3	1.9	31.5	21.2	21.2	22.9	12.0	12.6	28.0	27.0	29.6
Incr Delay (d2), s/veh	5.2	4.2	1.2	15.1	9.2	8.8	0.4	0.1	0.4	0.2	0.1	6.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	7.0	1.1	2.7	10.5	10.9	3.0	0.3	1.0	0.6	0.3	3.0
LnGrp Delay(d),s/veh	34.6	14.5	3.1	46.6	30.4	30.0	23.3	12.1	13.0	28.3	27.2	35.5
LnGrp LOS	C	B	A	D	C	C	C	B	B	C	C	D
Approach Vol, veh/h		1672			1143			465			193	
Approach Delay, s/veh		15.2			31.8			20.9			33.5	
Approach LOS		B			C			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6		8
Phs Duration (G+Y+Rc), s	9.6	27.4	20.4	12.6	9.0	28.0		33.0
Change Period (Y+Rc), s	4.0	4.0	4.0	4.0	4.0	4.0		4.0
Max Green Setting (Gmax), s	6.0	23.0	9.0	16.0	5.0	24.0		29.0
Max Q Clear Time (g_c+I1), s	6.4	16.5	8.5	8.3	5.0	21.0		4.3
Green Ext Time (p_c), s	0.0	4.6	0.1	0.4	0.0	1.7		1.7

Intersection Summary	
HCM 2010 Ctrl Delay	22.5
HCM 2010 LOS	C

Intersections
Queuing Worksheets

Horizon Year 2040 – No Build

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Group Flow (vph)	761	371	699	584	210	211	332
v/c Ratio	0.70	0.55	0.77	0.27	0.50	0.50	0.52
Control Delay	27.9	9.4	33.4	6.2	32.6	32.6	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.9	9.4	33.4	6.2	32.6	32.6	6.8
Queue Length 50th (ft)	170	31	163	56	93	94	0
Queue Length 95th (ft)	251	111	242	77	189	190	69
Internal Link Dist (ft)	812			349		760	
Turn Bay Length (ft)		100	150		250		
Base Capacity (vph)	1376	784	1163	2753	421	421	643
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.47	0.60	0.21	0.50	0.50	0.52

Intersection Summary

Lane Group	EBL	EBT	WBT	NBT	NBR
Lane Group Flow (vph)	255	926	1749	262	423
v/c Ratio	0.92	0.40	0.98	0.55	0.99
Control Delay	80.8	8.7	35.4	32.9	75.8
Queue Delay	0.0	0.6	41.4	0.0	0.0
Total Delay	80.8	9.3	76.8	32.9	75.8
Queue Length 50th (ft)	75	122	428	127	239
Queue Length 95th (ft)	#148	158	#628	205	#430
Internal Link Dist (ft)		349	260	773	
Turn Bay Length (ft)	100				280
Base Capacity (vph)	276	2322	1791	477	427
Starvation Cap Reductn	0	930	359	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.92	0.67	1.22	0.55	0.99

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	104	868	375	43	1248	370	2	9	4	152
v/c Ratio	0.70	0.53	0.42	0.38	0.88	0.48	0.00	0.01	0.03	0.56
Control Delay	65.5	18.8	5.9	50.5	33.4	33.9	18.0	0.0	34.2	15.7
Queue Delay	0.0	1.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.5	19.9	6.4	50.5	33.4	33.9	18.0	0.0	34.2	15.7
Queue Length 50th (ft)	58	191	28	24	336	90	1	0	2	5
Queue Length 95th (ft)	#135	251	90	58	#470	#167	5	0	11	55
Internal Link Dist (ft)		260			976		769			568
Turn Bay Length (ft)	100		100	150		110		80	100	
Base Capacity (vph)	152	1638	884	114	1415	768	665	633	244	394
Starvation Cap Reductn	0	501	192	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.68	0.76	0.54	0.38	0.88	0.48	0.00	0.01	0.02	0.39

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Group Flow (vph)	935	326	426	811	238	239	254
v/c Ratio	0.74	0.46	0.68	0.39	0.50	0.50	0.42
Control Delay	26.2	8.7	36.7	8.4	30.4	30.4	8.6
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Total Delay	26.2	8.7	36.7	8.5	30.4	30.4	8.6
Queue Length 50th (ft)	209	35	104	96	106	106	14
Queue Length 95th (ft)	294	102	162	128	205	206	79
Internal Link Dist (ft)	812			349		760	
Turn Bay Length (ft)		100	150		250		
Base Capacity (vph)	1571	822	804	2575	476	476	601
Starvation Cap Reductn	0	0	0	776	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.40	0.53	0.45	0.50	0.50	0.42

Intersection Summary

Lane Group	EBL	EBT	WBT	NBT	NBR
Lane Group Flow (vph)	262	1150	1528	252	523
v/c Ratio	0.95	0.55	1.00	0.43	0.99
Control Delay	85.9	13.6	46.4	25.5	67.8
Queue Delay	0.0	1.5	37.2	0.0	0.0
Total Delay	85.9	15.1	83.6	25.5	67.8
Queue Length 50th (ft)	77	202	412	109	292
Queue Length 95th (ft)	#153	258	#590	176	#502
Internal Link Dist (ft)		349	260	773	
Turn Bay Length (ft)	100				280
Base Capacity (vph)	276	2077	1530	592	529
Starvation Cap Reductn	0	687	322	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.95	0.83	1.26	0.43	0.99

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	152	1366	154	110	1033	361	22	82	34	159
v/c Ratio	0.72	0.87	0.20	0.83	0.73	0.57	0.04	0.14	0.26	0.56
Control Delay	59.0	29.9	5.9	85.5	26.1	39.4	20.6	5.8	40.3	16.3
Queue Delay	0.0	47.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.0	77.4	5.9	85.5	26.1	39.4	20.6	5.8	40.3	16.3
Queue Length 50th (ft)	85	356	14	63	253	95	8	0	19	9
Queue Length 95th (ft)	#176	#463	48	#156	328	#195	25	30	43	60
Internal Link Dist (ft)		260			976		769			568
Turn Bay Length (ft)	100		100	150		110		80	100	
Base Capacity (vph)	210	1566	759	133	1412	632	603	567	238	395
Starvation Cap Reductn	0	439	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	1.21	0.20	0.83	0.73	0.57	0.04	0.14	0.14	0.40

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Horizon Year 2040 – Build

Lane Group	EBT	EBR	WBL	WBT	SBL	SBR
Lane Group Flow (vph)	761	371	699	584	421	332
v/c Ratio	0.57	0.54	0.67	0.18	0.52	0.53
Control Delay	23.9	5.9	24.1	3.2	25.7	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.9	5.9	24.1	3.2	25.7	6.5
Queue Length 50th (ft)	102	0	163	20	80	0
Queue Length 95th (ft)	139	59	228	27	122	58
Internal Link Dist (ft)	376			349		
Turn Bay Length (ft)		100	120		250	
Base Capacity (vph)	1340	687	1048	3175	809	624
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.54	0.67	0.18	0.52	0.53

Intersection Summary

Lane Group	EBL	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	255	926	1021	728	262	423
v/c Ratio	0.63	0.40	0.45	0.66	0.59	0.61
Control Delay	35.0	3.3	5.5	3.5	29.3	27.3
Queue Delay	0.0	0.0	0.0	1.5	0.0	0.0
Total Delay	35.0	3.3	5.5	5.0	29.3	27.3
Queue Length 50th (ft)	63	74	50	4	99	90
Queue Length 95th (ft)	100	75	m23	m4	171	139
Internal Link Dist (ft)		349	260			
Turn Bay Length (ft)	100			80		100
Base Capacity (vph)	406	2304	2258	1098	442	696
Starvation Cap Reductn	0	0	0	198	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.40	0.45	0.81	0.59	0.61

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	104	868	375	43	1248	370	2	9	4	9	143
v/c Ratio	0.55	0.47	0.46	0.30	0.98	0.40	0.00	0.01	0.03	0.04	0.48
Control Delay	35.6	9.4	3.5	35.8	43.9	27.3	12.5	0.0	24.5	24.8	10.9
Queue Delay	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	9.4	3.6	35.8	43.9	27.3	12.5	0.0	24.5	24.8	10.9
Queue Length 50th (ft)	24	57	13	18	271	68	1	0	2	4	1
Queue Length 95th (ft)	m#47	87	32	46	#418	#163	4	0	9	14	42
Internal Link Dist (ft)		260			976		769			568	
Turn Bay Length (ft)			100	150		110		80	100		100
Base Capacity (vph)	190	1862	813	147	1277	923	765	695	313	413	459
Starvation Cap Reductn	0	0	36	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.47	0.48	0.29	0.98	0.40	0.00	0.01	0.01	0.02	0.31

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBT	EBR	WBL	WBT	SBL	SBR
Lane Group Flow (vph)	935	326	426	811	477	254
v/c Ratio	0.55	0.44	0.56	0.26	0.56	0.47
Control Delay	20.2	4.3	27.3	3.5	25.5	9.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	4.3	27.3	3.5	25.5	9.1
Queue Length 50th (ft)	117	0	106	28	91	17
Queue Length 95th (ft)	155	49	151	36	136	73
Internal Link Dist (ft)	381			349		
Turn Bay Length (ft)		100	120		250	
Base Capacity (vph)	1693	741	762	3105	857	545
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.44	0.56	0.26	0.56	0.47

Intersection Summary

Lane Group	EBL	EBT	WBT	WBR	NBL	NBR
Lane Group Flow (vph)	262	1150	985	543	252	523
v/c Ratio	0.57	0.54	0.50	0.58	0.49	0.64
Control Delay	29.9	4.7	5.6	3.2	24.0	25.6
Queue Delay	0.0	0.3	0.0	0.9	0.0	0.0
Total Delay	29.9	5.0	5.6	4.2	24.0	25.6
Queue Length 50th (ft)	64	93	50	3	88	110
Queue Length 95th (ft)	102	115	m59	m29	153	164
Internal Link Dist (ft)		349	260			
Turn Bay Length (ft)	100			80		100
Base Capacity (vph)	457	2147	1976	939	515	812
Starvation Cap Reductn	0	392	0	177	0	0
Spillback Cap Reductn	0	29	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.66	0.50	0.71	0.49	0.64

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	152	1366	154	110	1033	361	22	82	34	16	143
v/c Ratio	0.64	0.77	0.24	0.75	0.88	0.41	0.03	0.11	0.21	0.07	0.39
Control Delay	34.2	15.3	2.9	63.7	32.1	26.8	12.4	1.1	28.5	25.1	4.6
Queue Delay	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.2	15.4	2.9	63.7	32.2	26.8	12.4	1.1	28.5	25.1	4.6
Queue Length 50th (ft)	32	145	5	47	215	67	5	0	14	6	0
Queue Length 95th (ft)	m#63	190	m15	#126	#330	#147	17	7	33	20	18
Internal Link Dist (ft)		260			976		769			568	
Turn Bay Length (ft)			100	150		110		80	100		100
Base Capacity (vph)	238	1764	639	147	1178	871	749	719	307	413	508
Starvation Cap Reductn	0	30	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	8	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.79	0.24	0.75	0.88	0.41	0.03	0.11	0.11	0.04	0.28

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.