Air Quality Technical Study

United States Highway 50 High Occupancy Vehicle Lanes Project
(Interstate 5 to Watt Avenue, City of Sacramento)

EA: 03-3F 3600

E-FIS: 0312000216

September 2016

Caltrans

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STATE OF CALIFORNIA

Department of Transportation

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Approved By: ________________ Date: 9/21/2016

The environmental review, consultation, and any other action required in accordance with applicable Federal laws for this project is being, or has been, carried-out by Caltrans under its assumption of responsibility pursuant to 23 USC 327.

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EXECUTIVE SUMMARY

This Air Quality Technical Study provides assessment of the potential effects to local and regional air quality that are expected to result from implementation of the Build alternatives to accomplish the objectives of the proposed US Highway 50 (US 50) High Occupancy Vehicle (HOV) Lanes Project. All analyses were conducted to comply with the requirements of the National Environmental Policy Act (NEPA); California Environmental Quality Act (CEQA); the Clean Air Act (CAA), as amended, of 1990; and the California Clean Air Act (CCAA) of 1988. The methodology also utilizes guidelines and procedures provided in applicable air quality analysis protocols, such as the *Transportation Project-Level Carbon Monoxide Protocol*[1], and Federal Highway Administration (FHWA) and United States Environmental Protection Agency (EPA), *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (PM Guidelines)[2], *Greenhouse Gas Analysis Protocol for Transportation Projects* (Caltrans, 2013)[3].

Project Purpose and Description

The project is located in the Sacramento County. The US 50 HOV Lanes (also referred to as Bus/Carpool Lanes) project would widen an existing segment of the US 50 in order to extend the existing HOV lanes in both directions of travel on US 50 westward from their current eastern terminus at Watt Avenue, to downtown Sacramento. The total length of the project is approximately 7.8 miles. The project limits extend from Watt Avenue Interchange in the east to the US 50/Interstate 5 (I-5) Interchange in downtown Sacramento (PM L0.2/R6.1). The primary purpose of the US 50 HOV Lane Project is to improve traffic operations on US 50 by increasing total capacity so that it can better meet growing travel demands in the Sacramento Region.

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1 Caltrans, 1998. California Department of Transportation. *Transportation Project-Level Carbon Monoxide Protocol* (UCD-ITS-RR-97-21, 1997).

2 EPA, 2006a. United States Environmental Protection Agency. Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas. Accessed via Web site at www.epa.gov/air/oaqps/greenbk/. and

EPA, 2013. United States Environmental Protection Agency. *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas.* Accessed via Web site at http://www3.epa.gov/otaq/stateresources/transconf/policy/420b13053-sec.pdf. November.

3 Caltrans, 2013. *Greenhouse Gas Analysis Protocol for Transportation Projects* (CTAQ-RT-13-270.02.4), May.

Project Alternatives and Options

Three design Options are considered for the proposed project:

- ***Option 0*** – this option assumes construction of US 50 HOV lanes between Watt Avenue and 26th Street.

- ***Option 1*** – this option assumes construction of US 50 HOV lanes between Watt Avenue and just west of the I-5 interchange.

- ***Option 2*** – this option assumes construction of an eastbound US 50 HOV lane between Watt Avenue and 26th Street, and construction of a westbound US 50 HOV lane between Watt Avenue and the W-X section of US 50. The westbound US 50 HOV lane would terminate via a westbound HOV drop-ramp (on the leftmost/inside lane) within the W-X section of US 50.

In addition to a No Action (No Build) alternative, three or two Build alternatives were considered with each of the options described above.

- **No Build Alternative** – This alternative assumes that the US 50 corridor within the project limits retains existing (base year 2013) lane configurations.

- **Add HOV Lane Alternative** – This alternative assumes an incremental HOV lane is constructed along each direction of travel on US 50 through the project limits. This alternative has been considered under *all options*.

- **Add Mixed-Flow Lane Alternative** – This alternative assumes an incremental mixed-flow lane is constructed along each direction of travel on US 50 through the project limits. This alternative would be applicable under *Option 0 and Option 1 only*.

- **Take-a-Lane Alternative** – This alternative assumes re-designation of an existing mixed-flow lane to HOV lane, within the project limits. This alternative could be considered under *all three options* described above.

Key Findings

The key findings of the analysis are as follows:

Project Operations:

Project operations under Options, 0, 1 and 2 conform to regional and project-level conformity requirements of CAA and its Transportation Conformity Rule. The project-specific traffic-related operational emissions would be also below the standard levels recommended by the Sacramento Metropolitan Air Quality Management District (SMAQMD) for project compliance with CEQA requirements.

- The project area, Sacramento Valley Air Basin (SVAB), is currently designated (based on national and/or state standards) as a nonattainment area for ozone (O_3) and particulate matter (PM_{10} and $PM_{2.5}$, with aerodynamic diameter of equal or less than 10 microns and diameter of equal or less than 2.5 microns, respectively) and as an attainment/maintenance area for carbon monoxide (CO). Areas designated as nonattainment are required to develop attainment/ maintenance plans and a State Implementation Plan (SIP) to meet state and federal goals for air quality. The Metropolitan Transportation Plan/Sustainable Communities Strategy 2035 (2035 MTP/SCS) [adopted April 19, 2012] and Metropolitan Transportation Improvement Program (MTIP), are prepared by the Sacramento Area Council of Governments (SACOG) to be consistent with the emission budgets established by the SIP or attainment plans that are initially developed and adopted by the Sacramento Metropolitan Air Quality Management District (SMAQMD), and subsequently by the California Air Resources Board (CARB). Therefore, projects that are listed in the current transportation plans (i.e., MTIP and MTP) are considered consistent with the SIP and its emissions budget, which is the basis of demonstrating attainment of ambient air quality standards. Therefore, these projects would meet CAA conformity requirements. The proposed project is fully funded and it is referenced in the Appendix A (Project Listing) of the 2012 regional plan, 2035 MTP/SCS, Appendix A: Project List, page 43 with following description:

  Title: *U.S. HOV;*

  Project Description: *In Sacramento County, on U.S. 50, from Watt Avenue to Downtown Sacramento: Construct high occupancy vehicle (HOV) lanes.*

  The project is also listed in the 2015/18 MTIP including Amendment #4, (adopted and federally approved September 18, 2014). The following project information is excerpted from the MTIP Appendix 3 - List of Individually Listed Projects and Grouped Project Listings:

  SACOG ID: *CAL18838;*

  Lead Agency*: Caltrans D3*

Project Description: *In Sacramento County, on US 50, from 0.3 mile west of SR 99 to 0.8 mile east of Watt Avenue – Construct high occupancy vehicle (HOV) lanes [PM L2.2/R6.1]*

The design concept and scope of the proposed project is consistent with the project description in the MTIP document and the assumptions in SACOG's regional emission analysis; therefore, the project is considered to meet the CAA requirements and is in conformity with the SIP. In addition to the project's design being consistent with the regional emission budget of MTIP and SIP, local-level analyses were performed to evaluate the proposed project's potential CO, MSAT, and PM impacts.

- The proposed project would not exceed federal or state ambient air quality standards for project level (localized) emissions of carbon monoxide (CO) and would not generate particulate matter (PM_{10} and $PM_{2.5}$) hot spots.

- The project would not expose receptors to substantial levels of mobile source air toxics (MSATs) and would not have an adverse health effect to sensitive receptors.

- A quantitative analysis of the greenhouse gas (GHG) emissions from operation of proposed project is also included, per guidelines from Governor's Office of Planning and Research, Caltrans Climate Action Plan and SMAQMD CEQA guidelines.

Construction Emissions

- Temporary construction-related dust and vehicle emissions would occur during site preparation and project construction. During construction, the proposed project would be subject to Caltrans and Sacramento Metropolitan Air Quality Management District (SMAQMD) rules that require best available fugitive dust control measures to be incorporated into construction practices. Construction of the project would take approximately 15 months to complete. The unmitigated emissions from Project construction would not have any adverse effect. Furthermore, with incorporation of best management practices and the applicable rules requirements the emissions would be reduced even further.

- Project construction would not expose sensitive receptors to substantial levels of toxic air contaminants (TAC), or objectionable odors.

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Chapter 1. Proposed Project

1.1. Introduction

The California Department of Transportation, District 3 (Caltrans), proposes to improve Highway 50 (US 50) from Watt Avenue Interchange to Interstate 5 (I-5) Interchange. The proposed US 50 High Occupancy Vehicle Lanes (also referred to as Bus/Carpool Lanes) project would widen an existing segment of the Highway 50 (US 50) in order to extend the existing High Occupancy Vehicle (HOV) lanes in both directions of travel on US 50 westward from their current eastern terminus at Watt Avenue, to downtown Sacramento. The total length of the project is approximately 7.8 miles. The project limits extend from Watt Avenue in the east to the US 50/Interstate 5 (I-5) interchange in the west. The primary purpose of the US 50 HOV Lane Project is to improve traffic operations on US 50 by increasing total capacity so that it can better meet growing travel demands in the Sacramento Region.

Caltrans is both, the lead agency for the project's CEQA document, and as assigned by the FHWA, is the lead agency for the project's NEPA document. This air quality report addresses the potential short-term and long-term air quality impacts of the proposed improvements.

1.2. Project Location and Background

The primary purpose of the proposed project is to improve traffic operations and reduce congestion on US 50 along the proposed project corridor. This would improve the safety and efficiency of local and regional movement of people and goods while minimizing environmental and community impacts.

The proposed segments of US 50 are adjacent to a variety of land uses and receptors, including multi-family and single-family residential areas, parks, schools, medical centers and commercial land uses. Land uses within the 1000-foot zone along each side of the US 50 project segment include the following:

- Residential uses including single-family and multi-family residences;
- Nine local parks;
- Five schools (preschools, elementary and high schools);
- Two hospitals/ medical centers

1.2.1. Project Alternatives

Three design options are being considered for the proposed project:

- *Design Option 0:* includes adding lanes to US 50 between Watt Avenue and 26th Street, one lane on each direction.
- *Design Option 1*: includes addition of traffic lanes to US 50 (one on each direction), between Watt Avenue and just west of the I-5 interchange.
- *Design Option 2:* includes construction of an additional eastbound US 50 lane between Watt Avenue and 26th Street, and construction of an additional westbound US 50 lane between Watt Avenue and the W-X section of US 50. The westbound US 50 HOV lane would terminate via a westbound US 50 HOV drop-ramp (on the leftmost/inside lane) within the W-X section of US 50.

One No-Build and three or two Build alternatives are being considered within each of the Options described above:

- **No Build Alternative** – This alternative assumes that the US 50 corridor within the project limits retains existing (base year 2013) lane configurations.
- **Add HOV Lane Alternative** – This alternative assumes an incremental HOV lane is constructed along each direction of travel on US 50 through the project limits. This alternative has been considered under all options.
- **Add Mixed-Flow Lane Alternative** – This alternative assumes an incremental mixed-flow lane is constructed along each direction of travel on US 50 through the project limits. This alternative would be applicable only under Option 0 and Option 1.
- **Take-a-Lane Alternative** – This alternative assumes re-designation (conversion) of an existing mixed-flow lane to HOV lane, within the project limits. This alternative could be considered under all three options described above.

1.2.2. Project Construction

The proposed project would be constructed within the existing Highway 50 (US 50) right-of-way. Staging areas for equipment and machinery would be located within the existing freeway right-of-way. No off-site construction staging areas would be necessary. However, Temporary Construction Easements (TCEs) on community services and facilities properties along the proposed project corridor may be required in some locations in order to construct the new HOV or Mixed Flow lanes. In order to minimize community and traffic disruptions, construction activities would generally be performed during off-peak periods including nights and weekends. Construction activities are planned to commence in mid-2017 and finish in the last quarter of 2018 a total duration of approximately 15 months.

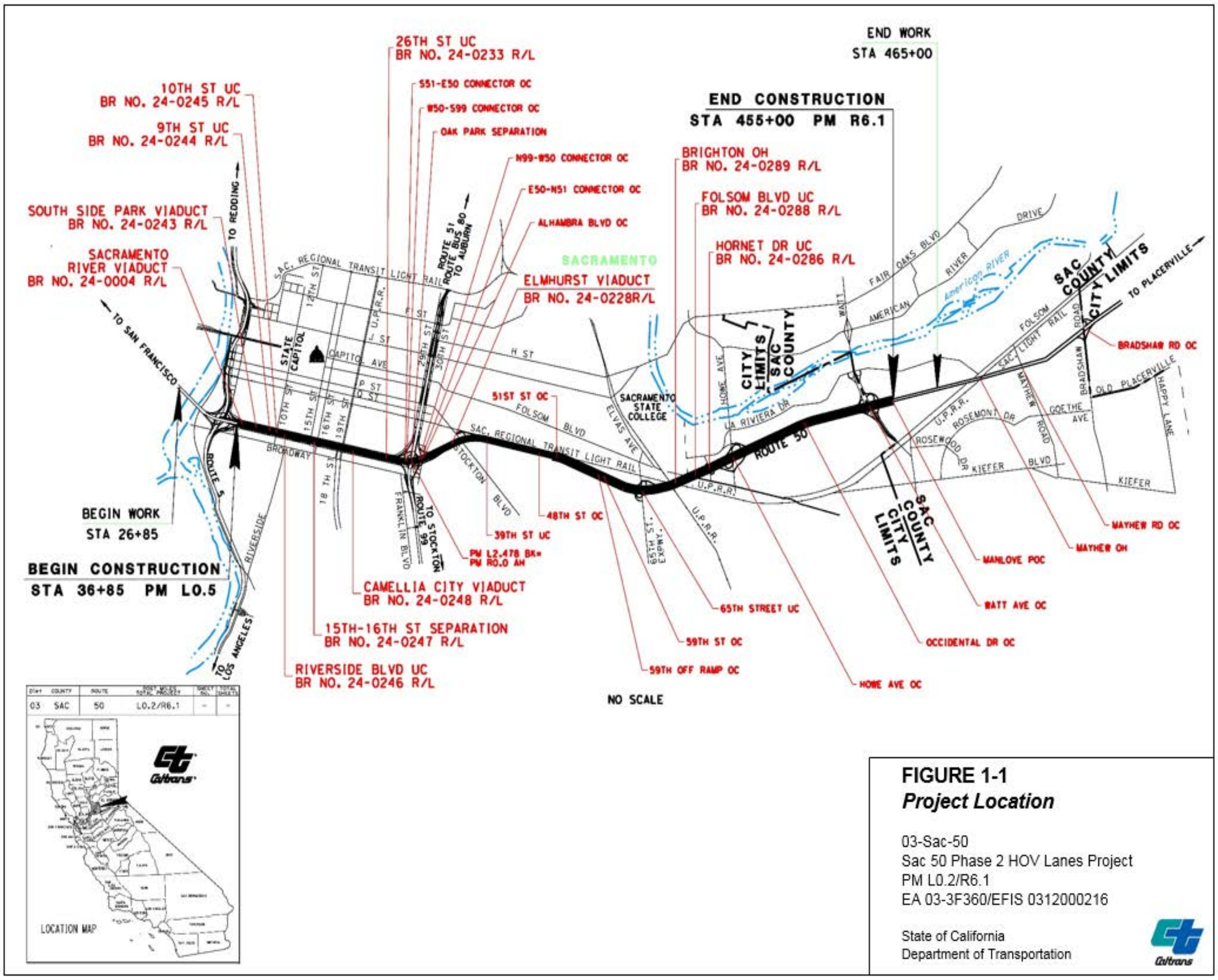

FIGURE 1-1
Project Location

03-Sac-50
Sac 50 Phase 2 HOV Lanes Project
PM L0.2/R6.1
EA 03-3F360/EFIS 0312000216

State of California
Department of Transportation

Chapter 2. Affected Environment

2.1. Regional Setting

The proposed project is located in Sacramento County, within the Sacramento Valley Air Basin (SVAB). The Sacramento Valley Air Basin is comprised of nine air districts: the Shasta County AQMD; the Tehama County APCD; the Glenn County APCD; the Butte County APCD; the Colusa County APCD; the Feather River AQMD that includes Sutter and Yuba Counties; the western portion of the Placer County APCD; the Yolo-Solano AQMD, that includes Yolo County and the eastern portion of Solano County; and the Sacramento Metro AQMD (SMAQMD) that consists of Sacramento County in which the project is located.

2.1.1. Climate and Meteorology

Air quality is affected by the rate, amount, and location of pollutant emissions and the associated meteorological conditions that influence pollutant movement and dispersal. Atmospheric conditions such as temperature, wind speed and direction, in combination with local topography determines how air pollutant emissions affect the local air quality.

The proposed project corridor extends in the Metropolitan Sacramento County within the Sacramento Valley Air Basin (SVAB). The Sacramento Valley is a basin bounded by the Sierra Nevada Mountain Range to the east and the Coastal Mountain Ranges to the west. Topography in the Sacramento Valley is generally flat, with elevations anywhere from slightly below sea level near the Sacramento/San Joaquin Delta to over 2,150 feet above sea level at the Sutter Buttes. Hot dry summers and mild rainy winters characterize the Mediterranean climate of the SVAB. The climate of the SVAB is Mediterranean in character, with mild, rainy winter weather from November through March and warm to hot, dry weather from May through September.

During the year the temperature may range from 20 to 115 degrees Fahrenheit with summer highs usually in the 90s and winter lows occasionally below freezing. Average annual rainfall is about 20 inches with about 75% occurring during the rainy season generally from November through March. The prevailing winds are moderate in strength and vary from moist clean breezes from the south to dry land flows from the north.

Topography is a major factor influencing wind direction over the project area. The mountains surrounding the SVAB create a barrier to airflow, which can trap air pollutants when certain meteorological conditions exist. The highest frequency of air stagnation occurs in the autumn and early winter when large high-pressure cells lie over the Sacramento Valley. The lack of surface wind during these periods and the reduced vertical flow caused by less surface heating reduces the influx of outside air and allows air pollutants to become concentrated in a stable layer of air. The surface concentrations of particulate matter pollutants are highest when these conditions are combined with smoke or when temperature inversions trap cool air, fog and pollutants near the ground.

The ozone season (May through October) in the Sacramento Valley is characterized by stagnant morning air or light winds, with the delta sea breeze arriving in the afternoon out of the southwest.

In addition, longer daylight hours provide a plentiful amount of sunlight to fuel photochemical reactions between reactive organic gases (ROG) and oxides of nitrogen (NOx), which result in ozone formation. Likewise, $PM_{2.5}$, peak concentrations typically occur during the winter season (November – February) when temperature inversion and low wind speeds trap and concentrate $PM_{2.5}$ emissions, cooler temperature and high humidity increase the secondary formation of particulates.

As an air basin, air quality in the Sacramento region is impacted not only by pollutants generated within the region, but also by pollutants generated in the San Francisco Bay Area and the San Joaquin Valley, which are carried into the Sacramento region by Delta breezes. The effect of pollutants transported from the San Francisco Bay Area or from the San Joaquin Valley on air quality in the Sacramento region can vary from substantial to inconsequential on any given day, largely determined by accompanying meteorological conditions. Thus, the success of the Sacramento region in attaining better air quality is partially contingent on the achievement of better air quality in nearby areas that affect Sacramento’s air quality.

2.1.2. Air Quality Pollutants

2.1.2.1. CRITERIA AIR POLLUTANTS

The federal Clean Air Act (CAA), which was passed in 1970 and last amended in 1990, forms the basis for the national air pollution control effort. The CAA identified six criteria air pollutants that are pervasive in urban environments and for which state and national health-based ambient air quality standards have been established. The U.S. Environmental Protection Agency (EPA) calls these pollutants “criteria air pollutants” because the agency has regulated them by developing specific public health- and welfare-based criteria as the basis for setting permissible levels. Ozone, carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter, and lead are the six criteria air pollutants. Notably, particulate matter is measured in two size ranges: PM_{10} for particles less than 10 microns in diameter, and $PM_{2.5}$ for particles less than 2.5 microns in diameter.

The sources of these pollutants, their effects on human health and the nation's welfare, and their final deposition in the atmosphere vary considerably. The criteria pollutants that are most important for this air quality analysis are those that can be traced principally to motor vehicles and construction activities. Of these pollutants, ozone, CO, PM2.5, and PM10 are evaluated on a regional basis. CO and PM are also often analyzed on a localized or "microscale" basis in cases of congested traffic conditions. In addition to the criteria pollutants, toxic air contaminants (TACs), asbestos, and greenhouse gases (GHGs) are air pollutants of concern.

Carbon Monoxide (CO)

CO is a colorless and odorless gas that, in the urban environment, is associated primarily with the incomplete combustion of fossil fuels in motor vehicles. CO emissions are highest during engine cold starts, hard acceleration, stop-and-go driving, and when a vehicle is moving at low speeds. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen-carrying capacity of the blood, and consequently results in reduced oxygen reaching the brain, heart and other body tissues. This condition is critical for people with cardiovascular diseases, chronic lung disease or anemia, as well as fetuses. Even healthy people exposed to high CO concentrations can experience headache, dizziness, fatigue, unconsciousness, and even death.

CO is a public health concern because it combines readily with hemoglobin in human blood, reducing the amount of oxygen transported in the bloodstream. Effects on humans range from slight headaches to nausea to death. CO is a colorless and odorless gas that, in the urban environment, is associated primarily with the incomplete combustion of fossil fuels in motor vehicles exhaust. Relatively high concentrations are typically found near congested intersections and along heavily used roadways carrying slow-moving traffic. CO is dispersed and diluted quickly; even under most severe meteorological and traffic conditions, high concentrations of CO are limited to locations within a relatively short distance (300 to 600 feet) of heavily traveled roadways. Vehicle traffic emissions can cause localized CO impacts, and severe vehicle congestion at major signalized intersections can generate elevated CO levels, called "hot-spots," that can be hazardous to human receptors adjacent to the intersections.

Ozone (O_3): Ozone is a secondary pollutant, which is not directly emitted into the air but is formed in the atmosphere through a series of reactions involving reactive organic gases

(ROG) and nitrogen oxides (NO_X) in the presence of sunlight. ROG and NO_X are called precursors of ozone. NO_X includes various combinations of nitrogen and oxygen, including nitrogen oxide (NO), nitrogen dioxide (NO_2), and others. Ozone is a principal cause of lung and eye irritation in the urban environment. Significant ozone concentrations are usually produced only in the summer, when atmospheric inversions are greatest and temperatures are high. ROG and NO_X emissions are both considered critical in ozone formation.

Nitrogen Dioxide (NO_2): Nitrogen dioxide belongs to a family of highly reactive gases called nitrogen oxides (NOx). NO_2 is a reddish brown gas that is a byproduct of combustion processes. Automobiles and industrial operations are the main sources of NO_2. Aside from its contribution to ozone formation, NO_2 can increase the risk of acute and chronic respiratory disease and reduce visibility. NO_2 may be visible as a coloring component on high pollution days, especially in conjunction with high ozone levels. These gases form when fuel is burned at high temperatures, and come principally from motor vehicle exhaust and stationary sources such as electric utilities and industrial boilers. A suffocating, brownish gas, NO_2 is a strong oxidizing agent that can react in air to form corrosive nitric acid, as well as toxic organic nitrates. It also plays a major role in the atmospheric reactions that produce ground-level ozone (or smog).

Particulate Matter. Particulate matter refers to a wide range of solid or liquid particles in the atmosphere, including smoke, dust, aerosols, and metallic oxides. Particulate matter emissions are generated by a wide variety of sources, including agricultural activities, industrial emissions, dust suspended by vehicle traffic and construction equipment, and secondary aerosols formed by reactions in the atmosphere. Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. Fine particulate matter, $PM_{2.5}$ includes a subgroup of particles that have an aerodynamic diameter of 2.5 micrometers or less. Some particulate matter, such as pollen, is naturally occurring. Extended exposure to particulate matter can increase the risk of chronic respiratory disease. PM_{10} is of concern because it bypasses the body's natural filtration system and can lodge in the lungs. The USEPA and the State of California revised their PM standards several years ago to apply only to these fine particles. $PM_{2.5}$ poses an increased health risk because the particles can deposit deep in the lungs and contain substances that are particularly harmful to human health. Motor vehicles are currently responsible for about half of particulates in Northern California. Wood burning in fireplaces and stoves is another large source of fine particulates.

Sulfur Dioxide (SO_2). SO_2 is a combustion product of sulfur or sulfur-containing fuels such as coal and diesel. SO_2 is also a precursor to the formation of particulate matter, atmospheric sulfate, and atmospheric sulfuric acid formation that could precipitate downwind as acid rain. The maximum SO_2 concentrations recorded in the project area are well below federal and state standards. Accordingly, the region is in attainment status with both federal and state SO_2 standards.

Lead. Leaded gasoline (phased out in the United States beginning in 1973), lead based paint (on older houses and cars), smelters (metal refineries), and manufacture of lead storage batteries have been the primary sources of lead released into the atmosphere. Lead has a range of adverse neurotoxic health effects, which puts children at special risk. Some lead-containing chemicals cause cancer in animals. Lead levels in the air have decreased substantially since leaded gasoline was eliminated. Ambient lead concentrations are only monitored on an as-warranted, site-specific basis in California.

Air Toxics - Mobile Source Air Toxics (MSATs): These toxic pollutants are a subset of the 188 air toxics defined in the Clean Air Act. They are now federally regulated under 40 Code of Federal Regulations 1502.22 by the EPA. Mobile source air toxics are 21 compounds emitted from highway vehicles and non-road equipment. The seven main toxics are acrolein, benzene, 1-3 butadiene, diesel particulate matter (DPM), formaldehyde, naphthalene and polycyclic organic matter. The Federal Highway Administration issued interim guidance on September 30, 2009, for analysis in NEPA documents. There are no existing ambient air standards for the seven main toxics. At the state level, CARB identified DPM as a toxic air contaminant in 1998, primarily based on evidence demonstrating carcinogenic effects in humans. The exhaust from diesel engines includes hundreds of different gaseous and particulate components, many of which are toxic. Mobile sources such as trucks and buses are among the primary sources of diesel emissions, and concentrations of DPM are higher near heavily traveled highways and rail lines with diesel locomotive operations. The risk from DPM as determined by the CARB declined from 750 in one million in 1990 to 570 in one million in 1995; by 2000, the CARB estimated the average statewide cancer risk from DPM at 540 in one million.

Airborne Asbestos (Naturally Occurring Asbestos and Asbestos in building structures): Asbestos occurs naturally in ultramafic rock (which includes serpentine). When this material is disturbed in connection with construction, grading, quarrying, or surface mining operations, asbestos-containing dust can be generated. Asbestos was used as a processed component of building material in older structures and buildings. Asbestos is a known carcinogen. Exposure to asbestos can result in adverse health effects such as lung cancer, mesothelioma (cancer of the linings of the lungs and abdomen), and asbestosis (scarring of lung tissues that results in constricted breathing).

Climate Change and Greenhouse Gases (GHGs): Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other elements of the earth's climate system. 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 related to human activity that include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), tetrafluoromethane, hexafluoroethane, sulfur hexafluoride, and hydrofluorocarbons (HFCs).

2.2. Regulatory setting

2.2.1. Federal Regulations

2.2.1.1. Clean Air Act

The primary legislation that governs federal air quality regulations is the Clean Air Act (CAA) and its Amendments of 1990 (CAAA-1990). The act delegates primary responsibility for clean air to the U.S. Environmental Protection Agency (EPA). The EPA develops rules and regulations to preserve and improve air quality and delegates specific responsibilities to state and local agencies. Under the act, the EPA has established the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants, hazardous air pollutants (HAPs) emission standards, state attainment plans, motor vehicle emissions standards, stationary source emission standards and permits, acid rain control measures, stratospheric O_3 protection, and enforcement provisions.

The NAAQS have two tiers: primary standards to protect public health and secondary standards to prevent environmental degradation (e.g., damage to vegetation and property, visibility impairment). The CAA mandates that the state submit and implement a State Implementation Plan (SIP) for areas not meeting the NAAQS. These plans must include pollution control measures that demonstrate how the standards will be met.

The CAAA-1990 identifies specific emission-reduction goals for areas not meeting the NAAQS. These amendments require a demonstration of reasonable progress toward attainment and incorporation of additional sanctions for failure to attain or to meet interim milestones. The sections of the CAA that are most applicable to the project include Title I (Nonattainment Provisions) and Title II (Mobile Source Provisions).

Title I of the CAA identifies attainment, nonattainment, and unclassifiable areas with regard to the criteria pollutants, and it sets deadlines for all areas to reach attainment for the six criteria pollutants: O_3; nitrogen dioxide (NO_2); sulfur dioxide (SO_2); particulates less than 10 microns in diameter (PM_{10}); carbon monoxide (CO); and lead (Pb). The NAAQS were amended in July 1997 to include the 8-hour O_3 standard and an NAAQS for fine particulates less than 2.5 microns in diameter ($PM_{2.5}$).

Title II of the CAA contains a number of provisions with regard to mobile sources, including motor vehicle emission standards (e.g., new tailpipe emissions standards for cars and trucks, nitrogen oxides [NO_x] standards for heavy-duty vehicles), fuel standards (e.g., requirements for reformulated gasoline), and a program for cleaner fleet vehicles.

EPA reviews the most up-to-date scientific information and the existing ambient standard for each pollutant every 5 years and obtains advice from the Clean Air Scientific Advisory Committee on each review. Based on these, EPA applies consideration to revise NAAQS accordingly. The NAAQS for particulate matters were amended in September 2006 to strengthen the 24-hour $PM_{2.5}$ standard from 65 micrograms per cubic meter ($\mu g/m^3$) to 35 $\mu g/m^3$. The area designation for the new standard became effective in October 2009. In December 2012, EPA strengthened the annual $PM_{2.5}$ primary NAAQS from 15.0 to12.0 $\mu g/m^3$; the area designation for the new standard was issued in December 2014. EPA had revised the O_3 standard in 1997, setting the 8-hour standard at 0.08 parts per million (ppm). This standard was revised twice since then, based on new scientific evidence about the effects of ground-level O_3 on public health and the environment. On March 12, 2008, EPA strengthened the 8-hour O_3 NAAQS to 0.075 ppm and on October 1, 2015, the standard was reduced to 0.070 ppm. The Furthermore, based on new scientific studies and several health risk assessment results, EPA revised the lead NAAQS to provide increased protection for children and other at-risk populations against adverse health effects, most notably including neurological effects in children. The revised standard level is 0.15 $\mu g/m^3$ over 3 months. The final rule was signed on October 15, 2008. The standards for all criteria pollutants are presented in Table 2-1.

2.2.1.2. CONFORMITY OF FEDERAL ACTIONS

The EPA promulgated the General Conformity Regulations to implement Section 176(c) of the CAA. Under the General Conformity Regulations, federal agencies must work with state, tribal, and local governments in a nonattainment or maintenance area to ensure that federal actions conform to the air quality plans established in the applicable state or tribal implementation plan. Conformity is defined under section 176(c) of the CAA as conforming to the purpose of the SIP to ensure that federally supported or approved

Table 2-1. Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [a,c]	Federal Standards [b,c]	
			Primary	Secondary
Ozone (O_3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	—	—
	8 Hour	0.07 ppm (137 $\mu g/m^3$)	0.070 ppm (137 $\mu g/m^3$) [d]	—
Respirable Particulate Matter (PM_{10})	24 Hour	50 $\mu g/m^3$	150 $\mu g/m^3$	Same as Primary
	Annual (AAM)	20 $\mu g/m^3$	— [e]	
Fine Particulate Matter ($PM_{2.5}$)	24 Hour	No Separate State Standard	35 $\mu g/m^3$	Same as Primary
	Annual (AAM)	12 $\mu g/m^3$	12 [f] $\mu g/m^3$	15 $\mu g/m^3$
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	—
	1 Hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	
Nitrogen Dioxide (NO_2)	Annual (AAM)	0.030 ppm (57 $\mu g/m^3$)	0.053 ppm (100 $\mu g/m^3$)	Same as Primary
	1 Hour	0.18 ppm (339 $\mu g/m^3$)	—	
Sulfur Dioxide (SO_2)	Annual (AAM)	—	0.030 ppm (80 $\mu g/m^3$) [i]	—
	24 Hour	0.04 ppm (105 $\mu g/m^3$)	0.14 ppm (365 $\mu g/m^3$) [i]	—
	3 Hour	—	—	0.5 ppm (1,300 $\mu g/m^3$)
	1 Hour	0.25 ppm (655 $\mu g/m^3$)	0.05 ppm (196 $\mu g/m^3$) [i]	—
Lead (Pb) [g]	30-Day Average	1.5 $\mu g/m^3$	—	—
	Calendar Quarter	—	1.5 $\mu g/m^3$	Same as Primary
	Rolling 3-Month [h]	—	0.15 $\mu g/m^3$	Same as Primary
Visibility-Reducing Particles	8 Hour	In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 %	No Federal Standards	
Sulfates	24 Hour	25 $\mu g/m^3$		
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)		
Vinyl Chloride [g]	24 Hour	0.01 ppm (26 $\mu g/m^3$)		

Notes:

a California standards for O_3, CO (except Lake Tahoe), SO_2 (1 and 24 hour), NO_2, suspended particulate matter (PM_{10}, $PM_{2.5}$), and visibility-reducing particles are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

b National standards (other than O_3, PM, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The O_3 standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98% of the daily concentrations, averaged over 3 years, are equal to or less than the standard.

c Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to these reference conditions; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

d On October 1, 2015, the national 8-hour ozone primary and secondary standards were lowered from 0.075 to 0.070 ppm.

e The annual standard of 50 $\mu g/m^3$ was revoked by EPA in December 2006 due to lack of evidence linking health problems to long-term exposure to coarse particulate pollution.

f In December 2012, EPA strengthened the annual $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) from 15.0 to 12.0 micrograms per cubic meter ($\mu g/m^3$). In December 2014, EPA issued final area designations for the 2012 primary annual $PM_{2.5}$ NAAQS. Areas designated “unclassifiable/attainment” must continue to take steps to prevent their air quality from deteriorating to unhealthy levels. The effective date of this standard is April 15, 2015.

g The California Air Resources Board (CARB) has identified Pb and vinyl chloride as 'toxic air contaminants' with no standard level of exposure for adverse health effects determined. These actions allow for implementation of control measures at levels below the ambient concentrations specified for these pollutants.

h Final rule for the new federal standard was signed October 15, 2008.

I On June 2, 2010, a new 1-hour SO_2 standard was established and the existing 24-hour and annual primary standards were revoked. The 1971 standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard. 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.

AAM – annual arithmetic mean; mg/m^3 – milligrams per cubic meter; $\mu g/m^3$ – micrograms per cubic meter; ppm – parts per million

Source: CARB, 2015

plans, programs, and projects do not (1) produce new air quality violations, (2) worsen existing violations, or (3) delay timely attainment of NAAQS. According to the CAA, federally supported activities must conform to the implementation plan's purpose of attaining and maintaining these standards.

The determination of conformity is based on the most recent estimates of emissions, and such estimates are determined from the most recent population, employment, travel, and congestion estimates typically made by the metropolitan planning organization (MPO)

Transportation Conformity Rule

EPA, in conjunction with the United States Department of Transportation (DOT), established the Transportation Conformity Rule, as defined in 40 CFR Parts 51 and 93, on November 30, 1993. The rule implements the Federal CAA conformity provisions. The CAAAs of 1990 require transportation plans, programs, and projects that are funded by or approved under Title 23 United States Code (U.S.C.) or the Federal Transit Act to conform to state or federal air quality plans for achieving NAAQS.

In determining whether a project conforms with an approved air quality plan, agencies must use current emission estimates based on the most recent population, employment, travel, and congestion estimates determined by an area's MPO. The MPOs are required to develop and maintain long-term and short-term plans and programs that set out transportation policies and programs for the region. A conforming transportation plan includes provisions to ensure that the impact of regulated pollutants from approved projects will be reduced to acceptable levels within time frames that meet the NAAQS.

In March 2006, the Transportation Conformity Rule was updated to include regulations for performing project-level analysis of PM_{10} and $PM_{2.5}$ hot-spot impacts. Only projects that are considered "Projects of Local Air Quality Concern" are required to perform an analysis. Projects of air quality concern are defined, generally, as (1) new or expanded highway projects that have a significant number of or significant increase in diesel vehicles, (2) projects affecting intersections that are Level of Service (LOS) D, E, or F with a significant number of diesel vehicles, (3) new or expanded bus and rail terminals and transfer points with a significant number of diesel vehicles congregating in a single location, and (4) projects in or affecting locations, areas, or categories of sites that are identified in the PM_{10} or $PM_{2.5}$ applicable implementation plan as sites of possible violation.

2.2.1.3. EPA Rule on Control of Mobile Source Air Toxics

Controlling air toxic emissions became a national priority with the passage of the CAAA, whereby Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants (HAPs). Mobile Source Air Toxics (MSATs) are a subset of the 188 air toxics. MSATs are compounds emitted from roadway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Airborne toxic metals can also result from engine wear or from impurities in oil or gasoline (see document No. EPA420-R-00-023, December 2000). EPA has assessed the expansive list of HAPs in their latest rule on the *Control of Hazardous Air Pollutants from Mobile Sources* (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their *Integrated Risk Information System* (IRIS) (http://www.epa.gov/ncea/iris/index.html). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999/). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM or DPM), formaldehyde, naphthalene, and polycyclic organic matter (POM). While FHWA considers these the priority MSATs, the list is subject to change and may be adjusted in consideration of future EPA rules. Of these pollutants, DPM, 1,3-butadiene, and benzene account for approximately 89% of the total toxic air pollutants for potential excess cancer risk. DPM accounts for 71.2% of the total toxic air pollutants for potential excess cancer risk[4,5].

FHWA released an interim guidance on February 3, 2006, determining when and how to address MSAT impacts in the National Environmental Policy Act (NEPA) process for transportation projects. The guidance document was updated on September 30, 2009 (FHWA, 2009) and on December 6, 2012 (FHWA, 2012). FHWA has developed a tiered approach for analyzing MSAT, depending on specific project circumstances. FHWA has identified three levels of analysis for three categories of projects:

- No analysis for exempt projects or projects with no potential for meaningful MSAT effects;

4 FHWA, 2006. Federal Highway Administration. Interim Guidance on Air Toxic Analysis in NEPA Documents. February 3.

5 CARB, 2000. California Air Resources Board. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. October.

- Qualitative analysis for projects with low potential MSAT effects; and
- Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

For projects warranting MSAT analysis, the seven priority MSAT should be analyzed.

Category 1: Under Category 1, three types of projects are included: 1) projects qualifying as a categorical exclusion under 23 CFR 771.117(c); 2) projects exempt under the CAA conformity rule under 40 CFR 93.126; and 3) other projects with no meaningful impacts on traffic volumes or vehicle mix.

Category 2: The types of projects included in Category 2 are those that serve to improve operations of highway, transit, or freight movement without adding substantial new capacity or without creating a facility that is likely to meaningfully increase emissions. This category covers a broad range of projects. Any projects not meeting the standard level criteria for higher potential effects set forth in Category 3 below and not meeting the criteria in Category 1 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 traffic is not projected to meet the 140,000 to 150,000 annual average daily traffic (AADT) criterion.

Category 3: includes projects that have the potential for meaningful differences among project alternatives. Only a limited number of projects meet this two-pronged test. To fall into this category, projects would:

- 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 with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000, or greater, by the design year; and
- Projects proposed to be located in proximity to populated areas or in rural areas, in proximity to concentrations of vulnerable populations (i.e., schools, nursing homes, hospitals).

If the analysis for a project indicates meaningful differences in levels of MSAT emissions among alternatives, mitigation options should be identified and considered.

2.2.2. State Regulations and Standards

The State of California began to set its ambient air quality standards (i.e., CAAQS) in 1969 under the mandate of the Mulford-Carrell Act. The California Clean Air Act (CCAA) was enacted September 30, 1988, and it became effective January 1, 1989. The CCAA requires all areas of the state to achieve and maintain the CAAQS by the earliest practicable date. The California Air Resources Board (CARB), which is part of the California EPA regulatory agency, develops air quality regulations at the state level. The state regulations mirror federal regulations by establishing industry-specific pollution controls for criteria, toxic, and nuisance pollutants. California also requires that plans and strategies for attaining state ambient air quality standards as set forth in the CCAA, be developed throughout the state. The ARB is also responsible for developing motor emissions standards for California vehicles.

The federal and state standards for all criteria pollutants are presented in Table 2-1. Table 2-1 shows the CAAQS currently in effect for each of the criteria pollutants, as well as the other pollutants recognized by the state. As shown in Table 2-1, the CAAQS are more stringent than the NAAQS for most of the criteria air pollutants. In addition, the CAAQS include standards for other pollutants recognized by the state. These include sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles.

The state regulations that are applicable to the project include the following:

California Diesel Fuel Regulations. This rule sets sulfur limitations for diesel fuel sold in the state for use in on-road and off-road motor vehicles (CARB 2004). Harbor craft and intrastate locomotives were originally excluded from the rule, but they were later included by a 2004 rule amendment (CARB 2005). Under this rule, diesel fuel used in motor vehicles, except harbor craft and intrastate locomotives, has been limited to 500-ppm sulfur since 1993. The sulfur limit was reduced to 15 ppm beginning September 1, 2006 (a federal diesel rule similarly limited sulfur content nationwide for on-road vehicles to 15 ppm beginning October 15, 2006). Diesel fuel used in harbor craft in the SCAQMD also was limited to 500-ppm sulfur starting January 1, 2006 and 15-ppm sulfur by September 1, 2006. Diesel fuel used in intrastate locomotives (i.e., switch locomotives) was limited to 15-ppm sulfur starting January 1, 2007.

Heavy-Duty Diesel Truck Idling Regulation. This CARB rule became effective in February 1, 2005, and it prohibits heavy-duty diesel trucks from idling for longer than 5 minutes at a time. Truck idling for longer than 5 minutes while queuing is allowed, however, provided the queue is located beyond 100 feet from any homes or schools (CARB 2006).

2.2.3. Local Plans and Regulations

The Sacramento Area Council of Governments (SACOG) is the regional MPO for the project area which prepares air quality conformity determinations for its transportation plans and programs. The purpose of the conformity determination is to ensure that SACOG's plans and programs "conform" to all applicable federal air quality requirements. Based on guidance found in the Federal Clean Air Act, Section 176(c) (42 U.S.C. 7506(c)), and Title 40, Code of Federal Regulations, Part 93, Subpart A, conformity determinations must be based upon the most recent estimates of on-road vehicle-based emissions. The emissions estimates must also be based upon the most recent population, employment, travel and congestion forecasts from SACOG, acting as the federally designated MPO for the Sacramento region. SACOG has an emissions conformity procedure based on the modeling requirements contained in the Federal Clean Air Act, Section 176(c) (42 U.S.C. 7506(c)), and Title 40, CFR, Part 93, Subpart A. As part of this procedure, SACOG prepares a series of forecasting model runs for the Sacramento air quality planning areas using the Sacramento Activity-Based Travel Simulation Model (SACSIM) travel demand model. This model uses estimates of population, employment and travel patterns for 2008, as the "base year," and future estimates of these same parameters for a series of future years. The future years are designated as "milestone" or "horizon" years for certain types of pollutant emissions, under EPA regulations. The SACSIM travel demand model is used to estimate daily vehicle miles traveled (VMT) in five-mile-per-hour increments for each model run. The total number of trips for each model run is also generated. The daily VMT from each generated model run are then used as inputs to the vehicle-emissions forecasting model, EMFAC 2011; SACOG includes VMT data as provided by the Metropolitan Transportation Commission to account for projects in the eastern portion of Solano County. The EMFAC 2011 model forecasts emissions based on the travel-related forecasts from both models.

2.2.4. SMAQMD Rules and Regulations

All projects are subject to SMAQMD rules and regulations in effect at the time of construction. Specific rules applicable to the construction of the proposed project may include the following:

Rule 402 (Nuisance). A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property (California Health & Safety Code, § 41700).

Rule 403 (Fugitive Dust). This rule prohibits emissions of fugitive dust from any active operation, open storage pile, or disturbed surface area that remains visible beyond the emission source property line. During proposed project construction, best available control measures identified in the rule would be required to minimize fugitive dust emissions from proposed demolition, grading, and earth-moving activities. These measures would include use of water or chemicals for control of dust in the demolition of existing structures, construction operations, the construction of roadways or the clearing of land; application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stockpiles, and other surfaces which can give rise to airborne dusts; other means approved by the Air Pollution Control Officer.

Rule 453 (Cutback and Emulsified Asphalt Paving Materials). This rule includes conditions and standards to limit emissions of VOCs from cutback and emulsified asphalt in paving materials, paving and maintenance operations.

District Rule 902 (Asbestos). This rule is intended to limit asbestos emissions from demolition or renovation of structures and the associated disturbance of asbestos-containing waste material generated or handled during these activities. The rule requires lead agencies and their contractors to notify the District of any regulated renovation or demolition activity. This notification includes a description of structures and methods utilized to determine whether asbestos-containing materials are potentially present. All asbestos-containing material found on the site must be removed prior to demolition or renovation activity in accordance with District Rule 902, including specific requirements for surveying, notification, removal, and disposal of material containing asbestos. Therefore, projects that comply with Rule 902 would ensure that asbestos-containing materials would be disposed of appropriately and safely. By complying with District Rule 902, thereby minimizing the release of airborne asbestos emissions, demolition activity would not result in a substantial impact to air quality.

2.2.5. Climate Change Regulations/Policies

2.2.5.1. Federal

Although climate change and GHG reduction is a concern at the federal level, currently no regulations or legislation have been enacted to specifically address project-level reductions of GHG emissions or climate change. Neither the EPA nor the Federal Highway Administration (FHWA) has issued explicit guidance or methods to conduct project-level GHG analysis.[6] 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 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 direct 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 CAA and must be regulated if these gases could be reasonably anticipated to endanger public health or welfare. Responding to the Court's ruling, 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. EPA in conjunction with National Highway Traffic Safety Administration (NHTSA)

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[6] 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.

issued the first of a series of GHG emission standards for new cars and light-duty vehicles in April 2010.[7]

The EPA and the 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.

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, 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 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, fire trucks, cement mixers and refuse haulers or delivery trucks). Together, these standards will cut greenhouse gas emissions and domestic oil use considerably. This program responds to President 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.

Council of Environmental Quality

The Council on Environmental Quality (CEQ) issued a draft guidance memorandum in February 2010 for analyzing the environmental effects of GHG emissions and climate change in NEPA documents. On December 18, 2014, the CEQ released revised draft

7 EPA Web site at: http://www.c2es.org/federal/executive/epa/greenhouse-gas-regulation-faq

guidance that supersedes the draft GHG and climate change guidance released by CEQ in February 2010. The revised draft guidance applies to all proposed Federal agency actions, including land and resource management actions. This guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated GHG emissions, and the implications of climate change for the environmental effects of a proposed action (CEQ 2014). The guidance encourages agencies to draw from their experience and expertise to determine the appropriate level (broad, programmatic or project- or site-specific) and type (quantitative or qualitative) of analysis required to comply with NEPA. The guidance recommends that agencies consider 25,000 MT CO2e on an annual basis as a reference point below which a quantitative analysis of GHG emissions is not recommended unless it is easily accomplished based on available tools and data (CEQ 2014).

2.2.5.2. STATE

With the passage of several pieces of legislation including State Senate and Assembly bills and Executive Orders, California launched an innovative and pro-active 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 S-3-05 (EO) (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 the 2020, and 3) 80% 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 ten percent by the year 2020.

Senate Bill 97 (SB 97) Chapter 185, 2007, Greenhouse Gas Emissions: 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.

California Department of Transportation

Caltrans and its parent agency, the Business, Transportation, and Housing Agency, have taken an active role in addressing GHG emissions and climate change. Recognizing that 98% of California's GHG emissions are from the burning of fossil fuels and 40% of all human-made GHG emissions are from transportation (Caltrans 2006), Caltrans created and is implementing the *Climate Action Program (CAP) at Caltrans*, published in December 2006. It is an interdisciplinary effort intended to promote, facilitate, and coordinate implementation of climate change strategies and related activities within the Department and with partner agencies. The program focuses on both GHG emission reduction and adaptation measures. The overall objective is to encourage innovative ways to balance progressive program delivery within the context of responsible environmental stewardship in a way that:

1) allows transportation strategies, plans, and projects as a whole to contribute to the state's GHG emission reduction plan;

2) provides guidelines, procedures, performance measures, and a quantifiable set of reporting protocol to monitor GHG footprints;

3) considers potential impact of climate variability on transportation system and development of risk assessment for long lasting transportation investments; and
4) advances applied research to support climate change knowledge base in transportation.

The CAP serves as a resource for technical assistance, training, information exchange, and partnership-building opportunities.

Caltrans has taken tangible steps to explore feasible, cost-effective measures for further reduction of greenhouse gas emissions from transportation. The Department works closely with the Climate Action Team (established per AB 32), CalEPA, CARB, California Energy Commission and other stakeholders to ensure an effective cross-agency policy framework to maintain California as a leader in protecting the environment and in the fight against climate change.

In April 2013, Caltrans released a report titled *Caltrans Activities to Address Climate Change – Reducing Greenhouse Gas Emissions and Adapting to Impacts*. The report details the efforts of Caltrans to both adapt to the growing threat of climate change and mitigate its effects by reducing GHG emissions.

Chapter 3. Existing Conditions

3.1. Existing Ambient Air Quality

3.1.1. Criteria Air Pollutants

The CARB and SMAQMD maintain a network of monitoring stations throughout the air basin (SVAB) to effectively monitor source-receptor areas in the region. The nearest air monitoring station to the project site is the Sacramento T Street Station, which is located at 1309 T Street, approximately 0.26 miles (414 meters) north of the project corridor. The criteria pollutants monitored at this station include O_3, NO_2, PM_{10} and $PM_{2.5}$. The nearest station where CO monitored data are available from, is the El Camino & Watt Station, located at 3535 El Camino Street, approximately 3.4 miles north of the project's eastern terminus. Table 3-1 presents ambient air quality data, which was recorded at these stations, for the past five years. As Table 3-1 shows, the recorded data show exceedances of the national standards for 8-hour ozone and 24-hour $PM_{2.5}$ and from the California standards for ozone and PM_{10} on one or more occasions from 2010 through 2014. No exceedances of either the state or national standards were recorded for SO_2, Pb, NO_2, or CO.

3.1.1.1. Attainment Status

Pursuant to the 1990 CAA Amendments (CAAA), EPA classifies air basins (or portions thereof) as attainment or nonattainment for each criteria air pollutant, based on whether or not the National Ambient Air Quality Standards (NAAQS) had been achieved. A "maintenance" area is one that has met the ambient air quality standards, thus removing it from nonattainment status. "Unclassified" is defined by the CAAA as any area that cannot be classified, on the basis of available information, as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

The proposed project is within the Sacramento County, which is currently nonattainment for the 8-hour ozone (Severe 15) and for $PM_{2.5}$[8], maintenance for PM_{10}[9] NAAQS and is either attainment or unclassified for the remaining criteria pollutants national standards.

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8 Effective August 14, 2013 the EPA took the final action to determine that the Sacramento nonattainment area in California has attained the 2006 24-hour fine particle ($PM_{2.5}$) NAAQS. This determination was based upon complete, validated, and certified ambient air monitoring data recorded during the 2010–2012 monitoring period. However, this final action does not constitute a redesignation of the Sacramento nonattainment area to attainment for the 2006 24-hour $PM_{2.5}$ NAAQS under CAA section 107(d)(3) because EPA has not yet approved a maintenance plan for the Sacramento nonattainment area as meeting the requirements of section 175A of the CAA or determined that the area has met the other CAA requirements for redesignation. The classification and designation status in 40 CFR part 81 remain nonattainment for this area until such time as EPA determines that California has met the CAA requirements for redesignating the Sacramento nonattainment area to attainment. http://www.gpo.gov/fdsys/pkg/FR-2013-07-15/pdf/2013-16785.pdf

9 Effective October 28, 2013 EPA approved the State of California's request to redesignate the Sacramento nonattainment area to attainment for the 24-hour particulate matter of ten microns or less

Table 3-1. Criteria Air Pollutants Data Summary (Sacramento T Street Monitoring Station)

Pollutant	Averaging Time	Applicable Standard	2010	2011	2012	2013	2014
Ozone (O_3)	1-Hour	Maximum Concentration (ppm)	0.092	0.100	0.104	0.091	0.085
		Days > CAAQS (0.09 ppm)	0	1	1	0	0
	8-Hour	4th Maximum Concentration (ppm)[a]	0.068	0.072	0.077	0.064	0.071
		Days > NAAQS (0.075 ppm)	0	**1**	**4**	0	0
		Days > CAAQS (0.07 ppm)	1	5	9	0	4
Particulate Matter (PM_{10})	24-Hour	Maximum Concentration (μg/m³)	53.9	42.2	36.7	92.3	106.4
		Days > CAAQS (50 μg/m³)	0	6	0	21	24
		Days > NAAQS (150 μg/m³)	0	0	0	0	0
	Annual	State Annual Average (20 μg/m³)	17.6	19.2	17.8	n/a	21.6
	3-Year Max Annual Avg	State Annual Average (20 μg/m³)	25	20	19	19	20
Particulate Matter ($PM_{2.5}$)	24-Hour	Maximum Concentration (μg/m³)	30.6	50.5	27.1	40	33.2
		Days > NAAQS (35 μg/m³)	0	**18.4**	0	**6**	0
		National Std. 98th Percentile [b]	27.3	**45.1**	20.5	33.4	24.1
	Annual	National Annual (12.0 μg/m³)[c]	8	10.1	8.3	10	8
Carbon Monoxide [d] (CO)	1-Hour	Maximum Concentration (ppm)	2.3	3.0	2.7	3.0	2.5
		Days > CAAQS (20 ppm)	0	0	0	0	0
		Days > NAAQS (35 ppm)	0	0	0	0	0
	8-Hour	Maximum Concentration (ppm)	1.89	2.83	2.14	2.4	2.1
		Days > CAAQS (9.0 ppm)	0	0	0	0	0
Nitrogen Dioxide (NO_2)	1-hour	Maximum Concentration (ppm)	0.066	0.057	0.062	0.059	0.065
		Days > CAAQS (0.18 ppm)	0	0	0	0	0
	Annual	Arithmetic Average (0.053 ppm)	0.013	0.013	0.012	0.012	0.011

AAM – Annual Arithmetic Mean; CAAQS – California ambient air quality standards; μg/m³ – micrograms per cubic meter; NAAQS – National ambient air quality standards; ppm – parts per million; n/a – sufficient data not available to determine the value

The estimated / measured numbers of recorded concentrations above national standards are shown in **bold**.

Note: Ambient data for SO_2 and airborne lead are not included in this table since the Basin is currently in compliance with state and federal standards for these pollutants.

[a] The 8-hour ozone standard is attained when the fourth highest concentration in a year, averaged over 3 years, is equal to or less than the new national standard of 0.075 ppm (effective May 27, 2008).

[b] Attainment condition for $PM_{2.5}$ is that the 3-year average of the 98th percentile of 24-hour concentrations at each monitor within an area must not exceed the standard (35 μg/m³).

[c] On December 14, 2012, the national annual $PM_{2.5}$ primary standard was lowered from 15 μg/m³ to 12.0 μg/m³. The existing national 24-hour $PM_{2.5}$ standards (primary and secondary) were retained at 35 μg/m³, as was the annual secondary standard of 15 μg/m³.

[d] Carbon monoxide concentrations have not been measured at the T Street station since 2006; the listed data are from the El Camino & Watt Monitoring Station located at 3535 El Camino Street, about 3.4 miles north of the project's eastern terminus. The one-hour CO monitored data were obtained from the EPA AirData web site. http://www.epa.gov/airdata/ad_rep_mon.html

Source: CARB, 2015 and EPA, 2015

(PM_{10}) NAAQS. EPA is also approving the PM_{10} maintenance plan and the associated motor vehicle emissions budgets for use in transportation conformity determinations necessary for the Sacramento area, and the attainment year emissions inventory submitted with the plan. http://www.gpo.gov/fdsys/pkg/FR-2013-09-26/pdf/2013-23245.pdf

Based on the state ambient air quality standards (CAAQS), the project area is classified as nonattainment area for 1-hour and 8-hour O_3 and for PM_{10} CAAQS. The area complies with the state standards for sulfates, hydrogen sulfide, and vinyl chloride, and is unclassified for the California standard for visibility-reducing particles. The project area's attainment status with respect to state and federal AAQS is provided in Table 3-2.

Table 3-2. Sacramento County Attainment Status

Pollutant	National Standards[b]	California Standards[c]
Ozone (O_3) – 1-hour	Nonattainment – (Severe)	Nonattainment – (Severe)
Ozone (O_3) – 8-hour	Nonattainment – (Severe 15)	Nonattainment
PM_{10}	Attainment/Maintenance	Nonattainment
$PM_{2.5}$	Nonattainment (Moderate) [a]	Attainment
Carbon Monoxide (CO)	Attainment/Maintenance	Attainment
Nitrogen Dioxide (NO_2)	Attainment /Unclassified	Attainment
Sulfur Dioxide (SO_2)	Attainment	Attainment
Lead (Pb)	Attainment	Attainment

Notes:

[a] Effective August 14, 2013 the EPA took the final action to determine that the Sacramento nonattainment area in California has attained the 2006 24-hour fine particle ($PM_{2.5}$) NAAQS. However, the area re-designation is pending until approval of a maintenance plan by EPA.

[b] EPA Current Nonattainment Counties for Criteria Pollutants http://www.epa.gov/airquality/greenbk/ancl.html page updated January 30, 2015.

[c] State Area Designations, as of June, 2013: http://www.arb.ca.gov/desig/adm/adm.htm

Source: CARB, 2015; EPA, 2015

3.1.2. Toxic Air Contaminants (TACs)

TACs are airborne substances that can cause long-term health effects (e.g., cancer, birth defect, or neurological damage), or short-term acute effects (e.g., headache, eye and respiratory irritation, nausea). TACs include both organic and inorganic chemical substances. They may be emitted from a variety of common sources including gasoline stations, automobiles, diesel engines, dry cleaners, industrial operations, and painting operations. TACs are regulated differently than criteria air pollutants at both federal and state levels. At the federal level these airborne substances are referred to as Hazardous Air Pollutants (HAPs).

In 1998, CARB identified diesel particulate matter (DPM) as a TAC, based on the evidence demonstrating cancer effects in humans. The exhaust from diesel engines includes hundreds of different gaseous and particulate components, many of which are toxic. Mobile sources such as trucks and buses are among the primary sources these emissions, and concentrations of DPM are higher near heavily traveled highways and rail lines with diesel locomotive operations.

According to CARB, DPM emissions decreased 37% from 2000 to 2010 primarily as a result of more stringent emissions standards and the introduction of cleaner burning diesel fuel. Emissions from diesel mobile sources are projected to continue to decrease after 2010. Overall, statewide emissions of DPM are forecasted to decline by 71% in 2035, compared to 2000 emissions.[10] Similarly, the average statewide cancer risk from DPM has declined from 750 in one million in 1990 to 540 in one million in 2000.

Asbestos

According to the California Department of Conservation's California Geological Survey (CGS), Special Report 192, on the relative likelihood for the presence of naturally occurring asbestos (NOA) in eastern Sacramento County, the proposed project location is not an area of naturally- occurring asbestos. Naturally occurring asbestos areas are identified based on the type of rock found in the area. Asbestos-containing rocks found in California are ultramafic rocks, including serpentine rocks and several naturally occurring fibrous minerals that may be present in certain geologic settings. These type of materials are found only in the northeastern portion of Sacramento County, and are not present in the project area[11].

3.1.3. Greenhouse Gases (GHGs)

Prominent GHGs contributing to the greenhouse effect are CO_2, CH_4, N_2O, HFCs, water vapor, perfluorocarbons, and sulfur hexafluoride (SF_6). Human-caused emissions of these GHGs in excess of natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of Earth's climate, known as global climate change or global warming. It is unlikely that global climate change of the past 50 years can be explained without contribution from human activities (IPCC 2007).

Emissions of GHGs contributing to global climate change are attributable, in large part, to human activities associated with the transportation, industrial/manufacturing, utility, residential, commercial, and agricultural sectors (CARB 2008). In California, the transportation sector is the largest emitter of GHGs, followed by electricity generation. Emissions of CO_2 are byproducts of fossil fuel combustion. CH_4, a highly potent GHG,

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[10] CARB, 2013. California Almanac of Emissions and Air Quality - 2013 Edition. Table 3-7 and Figure 3-6

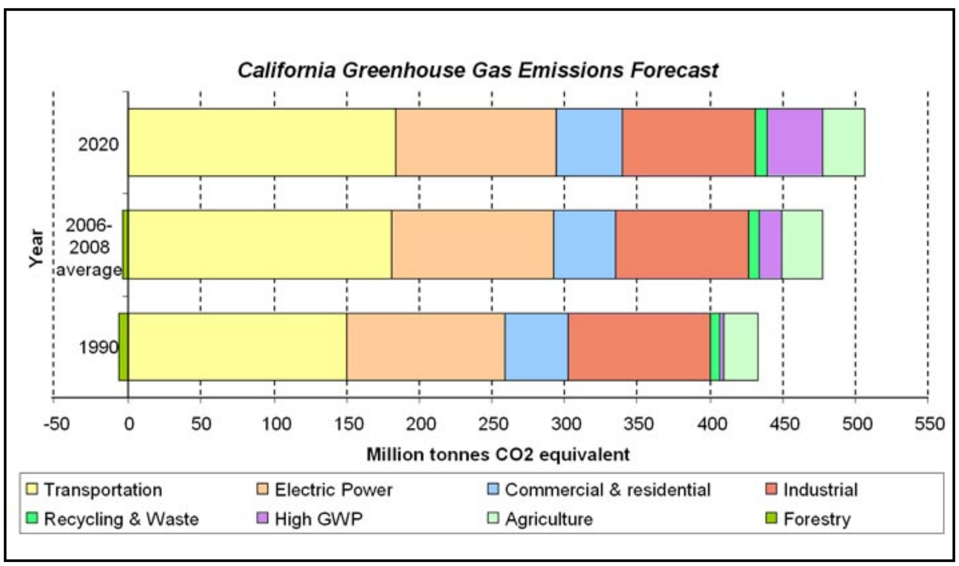
[11] California Department of Conservation. 2006. California Geological Survey, Special Report 192: *Relative Likelihood for the Presence of Naturally Occurring Asbestos in Eastern Sacramento County*. July 7 --- prepared for the Sacramento Metropolitan Air Quality Management District under Interagency Agreement No. 1004-019R. Available online at: www.conservation.ca.gov/cgs/minerals/hazardous_minerals/asbestos/Pages/east_sacramento.aspx .

results from off-gassing (the release of chemicals from nonmetallic substances under ambient or greater pressure conditions) and is largely associated with agricultural practices and landfills. N_2O is also largely attributable to agricultural practices and soil management. CO_2 sinks, or reservoirs, include vegetation and the ocean, which absorb CO_2 through sequestration and dissolution, respectively.

In December 2008, ARB approved the AB 32 Scoping Plan, which contains the main strategies California will use to reduce GHGs. As part of its supporting documentation for the Scoping Plan, ARB released the GHG inventory for California. The forecast is an estimate of the emissions expected to occur in the year 2020 if none of the foreseeable measures included in the Scoping Plan were implemented (see Figure 3-1). The base year used for forecasting emissions is the average of statewide emissions in the GHG inventory for 2006, 2007, and 2008.

3.2. Sensitive Receptors

Some population groups, such as children, the elderly, acutely and chronically ill persons, especially those with cardio-respiratory problems, are considered more sensitive to air pollution than others. Sensitive receptor locations include schools, residential areas, hospitals, elder-care facilities, rehabilitation centers, daycare centers and parks. Residential areas are considered sensitive to air pollution because residents, including children and the elderly, tend to be at home for extended periods of time, resulting in sustained exposure to air pollutants.



Source: CARB Greenhouse Gas Inventory – 2020 Emissions Forecast
http://www.arb.ca.gov/cc/inventory/data/forecast.htm

Figure 3-1. California Greenhouse Gas Forecast

The sensitive receptors that would be potentially affected by the proposed project are located within the project study area along the project segments of US 50. Therefore, during construction of the proposed project, a number of different receptors would be exposed to construction emissions. Sensitive receptors along the affected segments of US 50 include single- and multi-family residences, which are located approximately 500 feet from the boundary of proposed construction activities for the project. In addition to these, there are other land uses such as schools, daycares, parks, medical centers and hospitals within quarter of a mile distance from project corridor. Some examples of sensitive receptors near the proposed project include:

- William Land Elementary School - Preschool (2120 12th Street)
- Sacramento Area YMCA – Preschool and Kindergarten (2021 W Street)
- California Montessori Project (2635 Chestnut Hill Drive)
- UC Davis Medical Center, Ticon-I Building (2000 Stockton Boulevard)
- Sutter Medical Center (7700 Folsom Boulevard)
- Glenbrook Park
- Oki Park
- Salmon Falls Park
- Southside Park
- O'Neil Park
- Sunset Park
- Coloma Park
- Sierra Vista Park

Chapter 4. Impact Analyses

This air quality analysis was conducted using methodology and assumptions that are consistent with the requirements of NEPA, CEQA, the CAA Amendments of 1990, and the CCAA of 1988. The analysis also utilizes guidelines and procedures provided in applicable air quality analysis protocols such as the *Transportation Project-Level Carbon Monoxide Protocol (CO Protocol)*[12]; FHWA and EPA, *Transportation Conformity Guidance for Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas (Guidelines)*[13,14], *Greenhouse Gas Analysis Protocol for Transportation Projects* (Caltrans, 2013), and the latest FHWA *Interim Guidance Update on Air Toxics Analysis in NEPA Document(2012 Guidance)*[15].

4.1. Long-Term Operational Emissions

Vehicular emissions constitute the primary source of air pollutants associated with operation of the proposed project. The analysis is carried out for the preferred build design option (Option 1) applicable alternatives and the No Build alternative. The No Build alternative would not implement the proposed project capacity improvements thereby it would not result in any operational air quality impacts, however, the No Build alternative is not consistent with the projected regional economic growth and population increase within the project area.

4.1.1. Criteria Pollutants

4.1.1.1. Regional Air Quality Conformity

As described in Section 2.2.1, regional conformity is demonstrated by showing that the project is included in conforming transportation plans/programs and with the same design concept and scope that was used for the regional conformity analysis.

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12 Caltrans, 1998. California Department of Transportation. *Transportation Project-Level Carbon Monoxide Protocol* (UCD-ITS-RR-97-21, 1997).

13 EPA, 2006a. United States Environmental Protection Agency. Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas.

14 EPA, 2013. Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas, EPA, 2010 and updates for EMFAC2011 and December 2012 annual PM2.5 NAAQS final rule. November. Available online at: http://www.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm

15 FHWA, 2012. Federal Highway Administration. *Interim Guidance Update on Air Toxic Analysis in NEPA.* December 6. http://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/aqintguidmem.cfm

In determining whether a project conforms to an approved air quality plan, agencies must use current emission estimates based on the most recent population, employment, travel, and congestion estimates determined by SACOG. As the region's MPO, the SACOG is required to develop and maintain long-range and short-range plans and programs. Conforming regional transportation plans/programs model outcome projects that the regulated pollutants will be reduced to acceptable levels within time frames that meet the NAAQS.

The 2035 MTP/SCS (adopted April 19, 2012) and the 2015/2018 MTIP, prepared by the SACOG, rely on the emission budgets established by the SIP or attainment plans that are initially developed and adopted by the SMAQMD, and subsequently by the CARB. Therefore, projects that are listed in the current transportation plans (i.e., MTIP and MTP) are considered consistent with the SIP; hence meet CAA conformity requirements. The proposed project is fully funded and it is referenced in the Appendix A (Project Listing) of the currently adopted plan, 2035 MTP/SCS, Appendix A: Project List, page 43 with following description:

Title: *U.S. HOV;*

Project Description: *In Sacramento County, on U.S. 50, from Watt Avenue to Downtown Sacramento: Construct high occupancy vehicle (HOV) lanes.*

The project is also listed in the 2015/18 MTIP including Amendment #4, (adopted and federally approved September 18, 2014). The following project information is excerpted from the MTIP Appendix 3 - List of Individually Listed Projects and Grouped Project Listings:

SACOG ID: *CAL18838;*

Lead Agency*: Caltrans D3*

Project Description: *In Sacramento County, on US 50, from 0.3 mile west of SR 99 to 0.8 mile east of Watt Avenue – Construct high occupancy vehicle (HOV) lanes [PM L2.2/R6.1]*

The design concept and scope of the proposed project is consistent with the project description in the 2015/2018 MTIP document and the assumptions in SACOG's regional emission analysis; therefore, the project is considered to meet the CAA requirements and is in conformity with the SIP. As such, project development would not conflict with or obstruct implementation of the Air Quality Management Plan (AQMP) or Transportation Control Measures (TCMs) identified in the currently approved SIP.

REGIONAL EMISSIONS ANALYSIS

As discussed above, the project inclusion in conforming regional transportation plan/program (MTP/MTIP) indicates that it has been incorporated into the region's air quality attainment plan. Therefore, the regional emissions analysis was conducted to demonstrate the project impact for disclosure and informational purposes. The project's operational criteria air pollutant emissions, which include emissions from vehicles traveling along the project corridor were estimated for the preferred Build alternatives and compared with the No Build alternative for project opening year 2020 and horizon year 2040. Emissions were also estimated for the base year 2013, representing existing conditions.

For each alternative, daily emissions were estimated using the daily VMT distributed by speed bins of 5 miles per hour (mph). The projected VMT and speed bin distributions were provided by the project traffic study group (Wood Rodgers, 2015). Vehicle emission factors were obtained using CARB's latest mobile source emission inventory model, EMFAC2014 (CARB, 2014)[16]. The results of emission calculations for existing conditions (2013), opening year (2020) and horizon year (2040) are summarized in Table 4-1. The emission impacts of project are presented as the net change and percent change in emissions from the No Build alternative in Table 4-1. As shown, emissions of NOx decreases compared to No Build alternative in opening year (2020) and also for the Option 1 - Add HOV lanes alternative in horizon year (2040).

The data in Table 4-1 also indicate that for the build alternatives, daily emissions of all criteria pollutants, except PM_{10}, show considerable reduction in future analyzed years (2020 and 2040) compared with 2013. This is due to improved vehicle engine efficiency, use of cleaner fuels in the future fleet, and vehicle turnover, all of which would yield reduction in pollutant emissions, even with an increase in traffic volumes and vehicle miles traveled (VMT).

The reason for the difference in the PM_{10} emissions trend (change from base year emissions) can be explained by examining the components of PM_{10} emissions from roadway traffic. The data for total PM_{10} emissions include PM_{10} from vehicle exhaust, tire wear, and brake wear, as well as the re-entrained road dust. Vehicles generate particulate emissions from tire wear and brake wear as well as dust from paved and unpaved roads to be re-entrained or re-suspended into the atmosphere. To show the

[16] EMFAC2014 (v1.0.1) was released in December 2014. On May 15, 2015, CARB released an updated version (v1.0.7) of EMFAC2014 and has submitted it to EPA for approval. EMFAC2014 is currently being reviewed by EPA staff and approval is expected by the end of 2015.

contribution of these non-exhaust PM_{10} emissions, the exhaust PM emission data are presented separately in Table 4-1. As shown, the non-exhaust emissions from road dust and tire and brake wear constitute the majority of total PM_{10} emissions as they increase proportionally with the increase in traffic volume and VMT. The parameters used in calculation of road dust, as well as tire and brake wear emissions of particulates are independent of cleaner fuel or improved vehicle engines; therefore, the estimated emissions will increase with an increase in VMT.

Table 4-1 Summary of Project Daily Operational Emissions
(Total Emissions from Traffic Along the Project Corridor)

Year	Alternative Option 1 Alternatives	Criteria Pollutants Emission (lbs/day)						
		VOC (ROG)	CO	NO_x	PM_{10} Total	PM_{10} exhaust	$PM_{2.5}$ Total	$PM_{2.5}$ exhaust
2013	Base Year	365	8,898	3,089	580	63	194	60
Opening Year 2020	No Project	157	4,438	1,362	591	18	164	17
	Add HOV Lanes	167	4,496	1,265	608	18	168	17
	Add Mixed Flow Lanes	166	4,523	1,314	609	18	169	17
	Take-a-Lane	158	4,366	1,347	587	18	163	17
	Project Increment - Change from No Project (% change)							
	Add HOV Lanes	10 (6%)	58 (1%)	-97 (-7%)	17 (3%)		5 (3%)	
	Add Mixed Flow Lanes	9 (5%)	85 (2%)	-47 (-3%)	18 (3%)		5 (3%)	
	Take-a-Lane	1 (0.6%)	-72 (-2%)	-15 (-1%)	-4 (-0.6%)		-1 (-0.6%)	
Horizon Year 2040	No Project	94	2,394	349	676	5	176	5
	Add HOV Lanes	99	2,362	348	705	5	184	5
	Add Mixed Flow Lanes	99	2,395	360	706	6	184	5
	Take-a-Lane	93	2,302	344	678	5	178	5
	Project Increment - Change from No Project (% change)							
	Add HOV Lanes	5 (5%)	-31 (-1%)	-1 (-0.3%)	29 (4%)		8 (4%)	
	Add Mixed Flow Lanes	5 (5%)	1 (0.1%)	12 (3%)	30 (4%)		8 (4%)	
	Take-a-Lane	-1 (-1%)	-92 (-4%)	-5 (-1%)	2 (0.3%)		2 (1%)	
SMAQMD Standard Levels		*65*	-[3]	*65*	*80*		*82*	
Exceeds Standard Levels?		No	-[3]	No	No		No	

VOC = Volatile organic compounds; ROG = Reactive organic gases; CO = Carbon monoxide; NO_x = Nitrogen oxides; PM_{10} = Particulate matter 10 microns in diameter; $PM_{2.5}$ = Particulate matter 2.5 microns in diameter.
Values may not add up precisely, due to rounding.

1. *Emissions are calculated using projected vehicle miles traveled (VMT) at different speed bins (5, 10, …70 mph), and emission factors calculated from EMFAC2014, at the speed intervals.*
2. *Estimates of directly emitted PM_{10} include emissions from tailpipe, tire wear, brake wear, the contribution from road dust emissions. The Paved Road Dust emission factor was calculated using EPA's methodology (AP-42, Chapter 13. January 2011).*
3. *SMAQMD has not recommended a standard level for regional CO emissions. The area has been in attainment for CO since 1990s.*
4. *Calculations worksheets are provided in Appendix A-1.*

Source: Analysis performed by AECOM, 2015

As Table 4-1 shows, comparison of the total estimated emissions from different project alternatives (including the No-Build alternative) indicate the following projected results.

- The results of emission calculations for the opening year 2020 show that compared with the No-Build alternative, the emissions of NOx under the build alternatives would decrease by 3% to 7%; all other criteria pollutants emissions would increase under the build alternatives, ranging from about 1% to 6%. However, the Take-a-Lane alternative would result in a slight decrease in CO, PM_{10}, and $PM_{2.5}$ emissions.
- In the opening year 2020, the Take-a-Lane alternative would result in operational emissions of VOC, CO, PM_{10}, and $PM_{2.5}$ that are 3% to 5% less than the Add HOV Lanes alternative as a result of reduced VMT under the Take-a-Lane alternative. However, NO_X emissions under the Take-a-Lane alternative would be approximately 7% greater than the Add HOV Lanes alternative because vehicles would operate at lower and less efficient speeds with one less general-use lane.
- The estimated emissions of criteria pollutants in the horizon year 2040 show that the emissions of NOx and CO from Add HOV Lanes and Take-a-Lane alternatives would slightly decrease while for other criteria pollutants and other alternatives emissions increase, ranging from about 1% to 5%, compared to the No-Build alternative.
- In the horizon year 2040, the Take-a-Lane alternative would result in a 1% to 6% decrease in all criteria air pollutants compared to the Add HOV Lane alternative as a result of reduced VMT under the Take-a-Lane alternative.
- Table 4-1 presents comparison of operational emissions from project Build alternatives with the No Build alternative. As shown, the daily emissions of criteria pollutants, for all Build alternatives are either lower than the No Build alternative, or slightly higher. In addition, as Table 4-1 shows, the net change in daily emissions of criteria pollutants for all Build alternatives would be below the standard levels of significance set by the SMAQMD. Therefore, with respect to CEQA, the project's Build alternatives' operational impacts would be less than significant.

Based on the above analysis, the proposed project alternatives would conform to the requirements of CAA and SIP, and would be considered less than significant based on CEQA impact assessment.

4.1.2. Local Operation Impacts

4.1.2.1. PROJECT-LEVEL CONFORMITY

The local analysis is commonly referred to as project-level air quality or hot-spot analysis. Project-level conformity is demonstrated by showing that it will not cause a localized exceedance of carbon monoxide and/or PM (PM_{10} and $PM_{2.5}$) standards, and that it will not interfere with "timely implementation" of transportation control measures called out in the SIP. The primary focus of the analysis is the operational impact on air quality created by the proposed improvements. The analysis is provided for CO, PM_{10}, and $PM_{2.5}$. The analysis years consist of the proposed project's opening year (2020) and the design or horizon year (2040) referenced in the approved plan, which represent the years when the project would impact the traffic conditions. The localized impact analysis (hot-spot analyses) can be qualitative or quantitative.

CO Hot-Spot Analysis

Localized CO impacts from the project alternatives were evaluated following the 1997 CO Protocol. The CO Protocol has a screening exercise that would determine whether the project requires a qualitative or quantitative analysis, or whether no further analysis would be necessary. Below are the steps taken, following Figure 1 of the CO Protocol (flow charts provided as Figures 1 and 3 in CO protocol are included in Appendix A1).

3.1.1 Is the project exempt from all emissions analyses?

No – The project category is not listed in Table 1 of the CO Protocol (derived from 40 CFR Part 93, Table 2) and thus, the proposed project is not exempt from all emission analyses; *continue to step 3.1.2.*

3.1.2 Is project exempt from regional emissions analyses?

No – The proposed project includes components that are not among the projects listed in Table 2 of the Protocol; *continue to step 3.1.3.*

3.1.3 Is project defined as regionally significant?

The project is defined as non-exempt. The proposed project has been included and modeled in the regional emissions analysis of the currently conforming transportation plans/programs, (i.e., 2035 MTP/SCS and 2015/18 MTIP - see Appendix C); *continue to step 3.1.4.*

3.1.4. Is project in a federal attainment area?

No – The project is in the SVAB, which is currently designated nonattainment for O_3, and $PM_{2.5}$ and maintenance for PM_{10} and CO NAAQS; *continue to step 3.1.5.*

3.1.5 Is there a currently conforming RTP and TIP?

Yes – The SACOG's 2035 MTP/SCS and 2015/2018 MTIP are the currently conforming plans for the project area; *continue to step 3.1.6.*

3.1.6 Is the project included in the regional emissions analysis supporting the currently conforming RTP and TIP?

Yes – The project is included in both documents (see Appendix C); *continue to step 3.1.7.*

3.1.7 Has project design concept and/or scope changed significantly from that in regional analysis?

The project scope has not been changed significantly from the proposed project as modeled in the 2035 MTP and 2015/2018 MTIP; *continue to step 3.1.9.*

3.1.9 Examine local impacts – Proceed to Section 4 (Figure 3) [see Appendix A]

Section 4, *local analysis*: procedures delineated in the flow chart of Figure 3 of the CO Protocol were followed as described below.

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

No – The project is located in the SVAB, which was classified attainment/ maintenance area for CO by EPA since 1996 (Maintenance Plans dated 1996, 1998 and 2004). *Proceed to Level 1a.*

Level 1a. Was the area designation "attainment" after the 1990 Clean Air Act?

Yes – See response to previous question. *Proceed to Level 1b.*

Level 1b. Has "continuous attainment" been verified with the local Air District, if appropriate?

Yes – As shown in Table 3-1 the air quality monitoring data show no exceedance, and continued attainment has been verified by SMAQMD. *Proceed to Level 7.*

Level 7. Does project worsen air quality?

The CO Protocol Section 4.7.1 recommends the following criteria to be used to determine whether the project is likely to worsen air quality for the areas affected by the project.

<u>Screening Analysis</u> *(Reference Section 4.7.1 of CO Protocol)*

a. Does the project significantly increase (more than 2%) the percentage of vehicles operating in cold start mode?

An increase in percentage of vehicles in cold start is not anticipated. The existing land use within the project area will remain unchanged with the implementation of any of the proposed alternatives. Furthermore, the project does not include components such as parking lots, where engine cold starts are expected to occur.

b. Does the project significantly increase traffic volumes? According to the Protocol, increases in traffic volume in excess of 5% are generally considered potentially significant. Increases less than 5% would be potentially significant, if a reduction in average speeds is anticipated.

As determined in the project's traffic study, the proposed project is expected to increase traffic volumes along some segments of US 50 in excess of 5% in horizon year (2040), as can be seen from the intersection traffic data presented below in Table 4-2.

Table 4-2. Comparison of Intersections (with LOS E or F) Peak Hour Traffic Volumes for Project Design Option 1 and No-Project Alternatives – Horizon Year 2040

Intersection / Interchange	Peak Hour	No Project Traffic Volume	Add HOV Lanes		Add Mixed Flow Lane	
			Traffic Volume	% Change from No Project	Traffic Volume	% Change from No Project
Jefferson Blvd & Park Blvd / I-80/US Ramps	AM	4429	4470	0.9	4569	3.2
	PM	4756	4899	3.0	4993	5.0
Jefferson Blvd & SR 275 EB On-ramp	AM	2357	2380	1.0	2394	1.6
	PM	2755	2839	3.0	2868	4.1
Jefferson Blvd & SR 275 WB On/Off-ramps	AM	2248	2267	0.8	2313	2.9
	PM	3006	3073	2.2	3128	4.1
5th St & X St & US 50 Off-ramp	AM	1631	1727	5.9	1775	8.8
	PM	1703	1747	2.6	1804	5.9
5th St & W St & I-5/US 50 On-ramps	AM	1412	1422	0.7	1445	2.3
	PM	2949	3002	1.8	3054	3.6
Riverside Blvd & X St	AM	2345	2469	5.3	2537	8.2
	PM	2610	2838	8.7	2895	10.9
15th St & X St & I-80/Us 50 Off-ramp	AM	2205	2346	6.4	2327	5.5
	PM	3525	3898	10.6	3950	12.1
15th St & W St & WB On-ramp	AM	2241	2282	1.8	2319	3.5
	PM	3852	4021	4.4	4103	6.5
16th St & W St/I-80/US 50 WB off	AM	3580	3674	2.6	3741	4.5
	PM	3274	3240	-1.0	3312	1.2
30th St/SR 99 SB off & 12th Ave	AM	2816	2884	2.4	2923	3.8
	PM	3090	3131	1.3	3161	2.3

SR 99 NB Ramps & 12th Ave	AM	2590	2656	2.5	2680	3.5
	PM	2903	2917	0.5	2979	2.6
29th St & N St	AM	2044	2052	0.4	2107	3.1
	PM	3075	3276	6.5	3303	7.4
Stockton Blvd & US 50 WB Ramps/ 35th St	AM	2764	2995	8.4	3050	10.3
	PM	3361	3549	5.6	3610	7.4
59th St & US 50 Ramps/S St	AM	2598	2713	4.4	2711	4.3
	PM	2624	2770	5.6	2817	7.4
65th St & US 50 WB Ramps/S St	AM	4029	4366	8.4	4446	10.3
	PM	4454	4749	6.6	4812	8.0
Howe Ave & US 50 EB Ramps	AM	6301	6610	4.9	6637	5.3
	PM	7034	7849	11.6	7990	13.6
Howe Ave & US 50 WB Ramps	AM	6727	7378	9.7	7512	11.7
	PM	8117	8655	6.6	8771	8.1
Source: US 50 HOV Lanes Project Traffic Report, Wood Rodgers, 2015						

c. *Does the project worsen 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 as worsening traffic flow.*

Based on the project traffic study, some of the studied ramp intersections would have level of service (LOS) of E or F and increased delay. Table 4-3 shows the comparison of intersections LOS and delay for horizon year (2040), as the worst case for No Project and Option 1 alternatives Add HOV Lanes, and Add Mixed Flow Lanes.

Table 4-3. Comparison of Intersections Traffic Conditions for Opening Year (2020), and Horizon Year (2040) for No-Project and Design Option 1 Alternatives

Intersection	2020 - Opening Year				2040 - Horizon Year					
	No Project		Add HOV Lane		No Project		Add HOV Lane		Add Mixed Lane	
	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
Jefferson Blvd & Park Blvd / I-80/US Ramps	56.1	**E**	57.2	**E**	>80	**F**	>80	**F**	>80	**F**
Jefferson Blvd & I-80 EB Off-Ramp	12.7	B	14.7	B	33.4	C	42.0	D	54.4	D
Jefferson Blvd & SR 275 EB On-Ramp	>80	**F**	>80	**F**	52.6	**F**	69.5	**F**	>80	**F**
Jefferson Blvd & SR 275 WB Off/On-Ramps	23.0	C	25.3	D	>80	**F**	>80	**F**	>80	**F**
5th St & I-80 EB On-Ramp	2.0	A	2.0	A	2.1	A	7.4	A	27.5	D
5th St & I-80 WB Off-Ramp/Bridge St	33.7	C	35.0	C	38.6	D	39.6	D	39.9	D
I-5 SB Ramps & Sutterville Rd	16.0	B	15.9	B	14.0	B	3.6	A	7.8	A
I-5 NB Ramps & Sutterville Rd	13.5	B	10.6	B	>80	**F**	>80	**F**	>80	**F**
I-5 NB Off-Ramp & Broadway	2.3	A	2.3	A	2.5	A	2.6	A	2.6	A
US 50/I-5 NB Off-Ramp & I-5 SB Off-Ramp/Q St	0	A	0	A	0	A	0	A	0	A

Table 4-3. Comparison of Intersections Traffic Conditions for Opening Year (2020), and Horizon Year (2040) for No-Project and Design Option 1 Alternatives

Intersection	2020 - Opening Year				2040 - Horizon Year					
	No Project		Add HOV Lane		No Project		Add HOV Lane		Add Mixed Lane	
	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
3rd St & SR 275 On-Ramp & I-5 NB On-Ramp	54.9	D	56.2	**E**	>80	**F**	>80	**F**	>80	**F**
3rd St & I-5 Off-Ramps /J St	72.7	**E**	72.2	**E**	80.0	**E**	79.2	**E**	79.4	**E**
3rd St & I-5 SB Off-Ramp/X St	2.1	A	2.6	A	2.1	A	2.1	A	2.1	A
5th St & X St & US 50 EB Off-Ramp	>80	**F**	>80	**F**	>80	**F**	>80	**F**	>80	**F**
5th St & W St & I-5/US 50 On-ramps	70.4	**E**	>80	**F**	79.3	**E**	>80	**F**	>80	**F**
Riverside Blvd & X St & US 50 EB On-Ramp	32.9	C	73.2	**E**	>80	**F**	>80	**F**	>80	**F**
Riverside Blvd/11th St & W St/US 50 Off-Ramp	40.6	D	51.3	D	48.1	D	46.6	D	48.0	D
15th St & X St & US 50 EB Off-Ramp	68.6	**E**	71.6	**E**	>80	**F**	>80	**F**	>80	**F**
15th St & W St & WB On-ramp	62.0	**E**	70.0	**E**	>80	**F**	>80	**F**	>80	**F**
16th St & X St & US 50 EB On-Ramp	37.4	D	37.7	D	47.5	D	56.9	**E**	68.0	**E**
16th St & US 50 WB Off-Ramp & W St	60.2	**E**	58.5	**E**	>80	**F**	>80	**F**	>80	**F**
26th St & W St & US 50 WB Off-Ramp	29.8	C	29.3	C	37.3	D	38.7	D	39.5	D
27th St & X St & US 50 EB On-Ramp	30.1	D	33.4	D	16.9	C	18.7	C	24.1	C
30th St/SR 99 SB Off-Ramp & 12th Ave	>80	**F**	>80	**F**	>80	**F**	>80	**F**	>80	**F**
SR 99 NB Ramps & 12th Ave	49.0	D	>80	**F**	>80	**F**	>80	**F**	>80	**F**
SR 99 SB On-Ramp & Broadway	3.4	A	13.7	B	47.4	**E**	12.6	B	74.1	**F**
SR 99 NB Off-Ramp & Broadway	26.8	C	27.7	C	26.1	C	27.6	C	28.1	C
29th St & SR 99 SB On-Ramp & T St	40.8	D	40.5	D	34.7	C	35.1	D	35.1	D
SR 99 NB Off-Ramp & 30th St & T St	49.8	D	49.1	D	50.8	D	51.5	D	50.8	D
29th St & P St & SR 51 SB Off-Ramp	69.2	**E**	68.6	**E**	66.8	**E**	67.2	**E**	67.8	**E**
30th St & P St & SR 51 NB On-Ramp	41.7	D	41.1	D	43.0	D	42.7	D	43.4	D
29th St & SR 51 NB On-Ramp & N St	>80	**F**	>80	**F**	>80	**F**	>80	**F**	>80	**F**
SR 51 SB Off-Ramp & 30th St & N St	72.4	**E**	74.1	**E**	76.5	**E**	77.3	**E**	78.8	**E**
34th St & US 50 EB/SR 51 SB Off-Ramp	45.5	D	45.5	D	43.3	D	43.4	D	44.4	D
Stockton Blvd & US 50 EB On-Ramp	3.9	A	4.7	A	>80	**F**	>80	**F**	>80	**F**
Stockton Blvd & US 50 WB Ramps & 35th St	41.5	D	43.8	D	>80	**F**	>80	**F**	>80	**F**
59th St & US 50 EB Off-Ramp/WB On-Ramp/S St	>80	**F**	>80	**F**	>80	**F**	>80	**F**	>80	**F**
65th St & US 50 EB Ramps	29.4	C	29.4	C	15.7	B	18.1	B	20.0	B
65th St & S St/US 50 WB Ramps	70.4	**E**	72.5	**E**	>80	**F**	>80	**F**	>80	**F**
Hornet Dr & US 50 EB Off-Ramp	0.4	A	0.5	A	0.1	A	0.1	A	1.2	A
Hornet Dr & US 50 WB On-Ramp	2.1	A	2.1	A	6.5	A	>80	**F**	>80	**F**
Howe Ave & US 50 EB Ramps	30.4	C	29.3	C	>80	**F**	>80	**F**	>80	**F**
Howe Ave & College Town Dr/US 50 Off-Ramp	70.6	**E**	69.7	**E**	>80	**F**	>80	**F**	>80	**F**
Watt Ave & US 50 EB Direct On/Off-Ramps	51.8	D	53.1	D	17.1	B	>80	**F**	16.7	B

Table 4-3. Comparison of Intersections Traffic Conditions for Opening Year (2020), and Horizon Year (2040) for No-Project and Design Option 1 Alternatives

Intersection	2020 - Opening Year				2040 - Horizon Year					
	No Project		Add HOV Lane		No Project		Add HOV Lane		Add Mixed Lane	
	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
Watt Ave & US 50 WB Direct On/Off-Ramps	16.2	B	17.0	B	>80	**F**	>80	**F**	>80	**F**
Source: Wood Rodgers, 2015										

The above discussion indicates that the proposed project would not meet the criteria in Section 4.7.1 to determine whether the project is likely to worsen air quality for the area. *Go to 4.7.2*.

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

Yes – The guidance for this question states: "Projects potentially creating CO concentrations higher than those existing within the region at the time of attainment demonstration should proceed to Section 4.7.3; other projects should be deemed satisfactory and no further analysis is needed." The information required to determine if current concentrations would be higher than those at the time of attainment is not readily available. Therefore, as a conservative estimate, and because of the addition of US 50 travel lanes and increased ramp intersection volumes, it is assumed that current and proposed future CO concentrations associated with the project implementation could be higher than those at the time of attainment demonstration. *Go to Question 4.7.3.*

- Does the project involve a signalized intersection at LOS E or F?

  Yes – See Table 4-3. *Proceed to Level 4.*

Level 4. Perform a screening analysis considering project location, nearby receptors, traffic volumes, LOS, and air quality conditions for current and future years. Are impacts acceptable?

Based on the above screening analysis, the Project would have the potential of worsening air quality during peak hours of traffic. Therefore, a CO quantitative hot-spot analysis was conducted at 4 ramp intersections, which according to the project traffic study, would have the highest traffic volume and worst peak hour level of service and delay. The analyzed intersections were also selected based on their proximity to residential sites.

Localized CO concentrations were estimated for the opening year (2020) and horizon year (2040) for Option 1 as preferred alternative and the No Build alternative using the CALINE4 dispersion model, developed by Caltrans. The modeling was performed in conjunction with emission factors from the CARB emission factor model EMFAC2011. It should be noted that the results would not change if EMFAC2014 are used, as the CO emission factors do not vary significantly between the two versions of EMFAC.

Background CO concentrations were taken from the nearest monitoring station to the project site, the Sacramento T Street Station, which is located at 1309 T Street, approximately 0.26 miles (414 meters) north of the project corridor. Because the Basin is in maintenance for CO standards, using the average ambient concentrations during the past 5 years at this monitoring station (i.e., 1-hour and 8-hour background concentrations of 2.8 ppm and 2.28 ppm, respectively) is appropriate for background concentrations for future years as well as the existing conditions. Receptor locations were placed 3 meters from each intersection corner, based on CO Protocol guidelines. Other modeling parameters used in CALINE4 based on CO Protocol guidelines include the following:

- Mixing height: 1,000 meters
- Stability class: 7 "G" (very stable atmosphere)
- Wind speed: 0.5 meter/second (minimum speed)
- Wind direction: Worst case (all wind directions in 10-degree increments)
- Surface roughness: 100 (default / suburban)
- 8-hour persistence factor: 0.7

The results of the analysis are provided in Tables 4-4 and 4-5 for opening year and horizon year, respectively.

Table 4-4. Localized CO Concentrations at the Affected Intersection with LOS F and Highest Traffic Volume – Preferred Design Opening Option 1, Opening Year 2020

Intersection	Peak Hour	1-hour Concentration (ppm)			8-hour Concentration (ppm)		
		No Build	Add HOV Lane	Add Mixed Lane	No Build	Add HOV Lane	Add Mixed Lane
15th Street and W Street / WB On-ramp	am	4.3	4.4	4.4	3.3	3.4	3.4
	pm	4.0	4.1	4.0	3.1	3.2	3.1
65th St and S St/US 50 WB Ramps	am	3.6	3.6	3.6	2.8	2.8	2.8
	pm	3.5	3.5	3.5	2.8	2.8	2.8
Howe Ave and US 50 WB Ramps	am	3.9	4.0	4.0	3.1	3.1	3.1
	pm	3.9	4.0	4.0	3.1	3.1	3.1
Jefferson Blvd and Park Blvd / I-80 Ramps	am	4.3	4.4	4.4	3.3	3.4	3.4
	pm	3.8	3.8	3.8	3.0	3.0	3.0

California Standard (ppm)	20	9.0

ppm – parts per million; AM – morning peak hour; PM – afternoon peak hour; WB – westbound; EB – eastbound; NB - northbound

- Total CO concentrations include background 1-hour and 8-hour concentrations of 2.8 and 2.28 ppm, respectively, based on the maximum values recorded during the past 5 years at the Sacramento T Street monitoring station.
- Emission factors were obtained using EMFAC2011 model for Sacramento County and for winter (worst case for CO exhaust emissions).

Source: Analysis/modeling performed by AECOM, 2015

Table 4-5. Localized CO Concentrations at the Affected Intersection with LOS F and Highest Traffic Volume – Preferred Design Opening Option 1, Horizon Year 2040

Intersection	Peak Hour	1-hour Concentration (ppm)			8-hour Concentration (ppm)		
		No Build	Add HOV Lane	Add Mixed Lane	No Build	Add HOV Lane	Add Mixed Lane
15th Street and W Street / WB On-ramp	am	3.5	3.6	3.5	2.8	2.8	2.8
	pm	3.5	3.6	3.6	2.8	2.8	2.8
65th St and S St/US 50 WB Ramps	am	3.3	3.3	3.3	2.6	2.6	2.6
	pm	3.3	3.3	3.3	2.6	2.6	2.6
Howe Ave and US 50 WB Ramps	am	3.4	3.5	3.5	2.7	2.8	2.8
	pm	3.6	3.6	3.6	2.8	2.8	2.8
Jefferson Blvd and Park Blvd / I-80 Ramps	am	3.6	3.6	3.6	2.8	2.8	2.8
	pm	3.4	3.5	3.5	2.7	2.8	2.8
California Standard (ppm)		20			9.0		

ppm – parts per million; AM – morning peak hour; PM – afternoon peak hour; WB – westbound; EB – eastbound; NB - northbound

- Total CO concentrations include background 1-hour and 8-hour concentrations of 2.8 and 2.28 ppm, respectively, based on the maximum values recorded during the past 5 years at the Sacramento T Street monitoring station.
- Emission factors were obtained using EMFAC2011 model for Sacramento County and for winter (worst case for CO exhaust emissions).

Source: Analysis/modeling performed by AECOM, 2015

The results of localized CO analysis, shown in Tables 4-4 and 4-5 indicate that for all analyzed intersections, future predicted CO concentrations for horizon year (2040) are less than the opening year (2020) estimates. These reductions, even with projected regional growth and increased traffic, are due to compliance with adopted regulations and control measures for mobile source emissions, such as improved vehicle engine efficiency, use of cleaner fuel in future fleet and vehicle turnover.

Under CEQA, a project is considered to have significant impacts if it results in CO concentrations that exceed the 1-hour average State standard of 20 ppm (the 1-hour average Federal standard is 35 ppm), and/or the 8-hour average standard of 9.0 ppm. As shown in Tables 4-4 and 4-5, the estimated CO concentrations for the Design Option 1 build alternatives (add HOV lanes, add Mixed Flow lanes) would be less than 50% of the applicable standards in both 2020 and 2040. The modeled data show very little difference (a maximum of 0.28 ppm) between CO concentrations for the No Build alternative and Option 1 applicable alternatives. The project would not have a considerable impact on

1- hour or 8-hour local CO concentrations at the intersections with the highest traffic volumes; subsequently under CEQA, no significant effect is anticipated to occur at any other locations in the study area.

Based on the above analysis, the maximally impacted intersections under the preferred design Option 1 would satisfy the project-level conformity for CO emissions. Therefore, it is not anticipated that implementation of the proposed project would generate CO concentrations at intersections that would exceed the 1- or 8-hour ambient air quality standards. Furthermore, the option 3 was not considered and included for CO analysis because total emission would be slightly less than no-build scenario based on the result of EMFAC 2014 (Table 4-1) and it would be infeasible and out of scope regarding construction scenario to release traffic congestion and improve traffic efficiency.

Particulate Matter (PM) Hot Spot Analysis

The proposed project is within a federal nonattainment area for fine particulate matter ($PM_{2.5}$) and attainment/maintenance area for respirable particulate matter (PM_{10}). As described above in Section 2.2, in March 2006, EPA issued the final Transportation Conformity Rule (40CFR 51.390 and Part 93) that addresses local air quality impacts in PM_{10} and $PM_{2.5}$ nonattainment and maintenance areas. The final rule requires a hot spot analysis to be performed for a project of local air quality concern (POAQC) or any other project identified by the $PM_{2.5}$ and PM_{10} SIP as a POAQC. Further, in November 2013, EPA released its updated guidance document: *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas.* The rule and the guidance documents provide criteria and procedures to ensure that such projects will not cause or contribute to new violations, increase the frequency or severity of any existing violations, or delay timely attainment of the relevant NAAQS as described in 40 CFR 93.101.

Section 40 CFR 93.123(b)(1) of the Transportation Conformity Rule defines types of projects that are considered a POAQC including the following:

- New or expanded highway projects that have a significant number of or significant increase in diesel vehicles;
- Projects affecting intersections that are at 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;
- Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location; and

- Projects in or affecting locations, areas, or categories of sites which are identified in the $PM_{2.5}$ or PM_{10} applicable implementation plan or implementation plan submission, as sites of violation or possible violation.

In addition, the *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* also describes projects that are not considered a local air quality concern under 40 CFR 93.123(b)(1)(i) and (ii). The project would be consistent with the following definition:

- Any new or expanded highway project that primarily services gasoline vehicle traffic (i.e., does not involve a significant number or increase in the number of diesel vehicles), including such projects involving congested intersections operating at LOS D, E, or F.

The US 50 HOV project falls within the category of new or expanded highway projects that do not involve a significant number or increase in the number of diesel vehicles. The previous 2006 *Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* defined significant diesel volumes as being 8% of annual average daily traffic (EPA 2006b).[17] The 2040 horizon year average annual daily traffic (AADT), along some segments of US 50 Highway within the project limits are projected to be above 150,000 average daily traffic, as shown in Table 4-6a. The average diesel truck percentage along segments of US 50 within the project limit (see Table 4-6b) range from 3.4% to 7.5% in 2040. This is less than the percentage of diesel trucks (i.e., 8%) considered to be significant pursuant to the PM Guidance. Furthermore, the projected fleet mix will not change significantly through the horizon year.

[17] EPA. 2006. *Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*. Available at : https://www.fhwa.dot.gov/environment/air_quality/conformity/policy_and_guidance/pmhotspotguidatt.cfm. Accessed October 10, 2015.

Table 4-6a. Average Daily Traffic and Truck Traffic along the US 50 Studied Segments for Design Option 1 Alternatives for Base Year (2013), and Horizon Year (2040)

Roadway Segment	Base Year	No Project	Add HOV Lane				Add Mixed Lane			
	ADT	ADT	ADT	%Truck	Truck ADT	Change in Truck ADT from No Project	ADT	%Truck	Truck ADT	Change in Truck ADT from No Project
Eastbound US 50 -- Segment between										
Jeffereson Blvd On and Off Ramps	62,629	71,553	69,715	7.3%	5,103	-71	69,654	7.3%	5,112	-62
Jeffereson Blvd On Ramp and S. River Rd On Ramp	82,292	103,315	89,736	7.3%	6,545	-932	89,726	7.3%	6,588	-889
Jefferson Blvd and I-5 Connectors	91,639	113,296	120,461	7.3%	8,786	587	120,537	7.3%	8,850	651
Connector to I-5 and 5th St Off Ramp	65,740	83,586	88,785	7.3%	6,475	426	88,895	7.3%	6,527	478
5th St Off Ramp and Connectors from I-5	62,013	74,921	81,866	7.3%	5,971	549	81,915	7.3%	6,013	591
Connectors from I-5 and 10th St	126,714	147,649	**155,493**	7.5%	**11,676**	551	**155,630**	7.6%	**11,768**	643
15th St Off Ramp and 10th St On Ramp	119,015	142,511	148,351	7.5%	**11,165**	453	148,678	7.5%	**11,213**	501
15th St & 16th St	128,618	**156,408**	**161,638**	7.1%	**11,464**	389	**161,856**	7.1%	**11,484**	408
16th St & Connectors to SR 51 & 99	149,830	**175,498**	**183,030**	6.8%	**12,446**	493	**183,424**	6.8%	**12,499**	546
Connectors to SR 51 & 99 and 26th St On Ramp	83,088	104,908	111,801	6.8%	7,609	432	112,078	6.8%	7,606	429
26th St On Ramp and 34th St Off Ramp	87,409	114,028	121,321	6.4%	7,742	396	121,574	6.4%	7,743	397
34th St and Connectors from SR 51 & 99	73,566	100,155	106,031	6.4%	6,767	304	106,267	6.4%	6,782	319
Connectors from SR 51 & 99 and Stockton Blvd	91,207	121,940	129,624	5.5%	7,155	414	129,686	5.6%	7,199	457
Stockton Blvd and 59th St	97,255	128,960	136,364	5.3%	7,289	422	136,503	5.4%	7,332	465
59th St and 65th St	90,263	119,188	127,278	5.3%	6,800	462	127,679	5.4%	6,865	527
65th St Off Ramp and 65th St Loop On Ramp	81,627	108,813	115,429	5.3%	6,166	387	115,613	5.4%	6,218	439
65th St Loop On Ramp and 65th St On Ramp	88,391	116,559	125,512	5.2%	6,538	496	125,703	5.2%	6,591	549
65th St and Howe Ave / Hornet Dr	95,678	126,681	133,413	4.9%	6,570	366	133,639	5.0%	6,617	412
Howe Ave Off Ramp and Howe Ave Loop On Ramp	71,652	93,761	97,676	4.9%	4,826	216	97,411	5.0%	4,823	213
Howe Ave Loop On Ramp and Howe Ave On Ramp	82,952	105,446	109,652	4.8%	5,283	190	109,411	4.9%	5,352	258
Howe Ave and Watt Ave	92,580	115,659	119,840	5.0%	6,001	169	119,644	5.1%	6,097	265
Watt Ave Off and On Ramps	77,154	105,171	108,474	5.0%	5,465	141	108,365	5.1%	5,528	204
Watt Ave and Bradshaw Rd	80,765	132,165	135,073	4.9%	6,660	176	135,015	5.0%	6,723	239
Westbound US 50 -- Segment between										
Watt Ave and Bradshaw Rd	81,331	127,013	130,282	3.7%	4,835	-21	130,336	3.7%	4,820	-36
Watt Ave Off and On Ramps	77,099	104,654	108,186	3.7%	3,984	-16	108,192	3.7%	3,977	-24
Watt Ave Loop On Ramp and Watt Ave Slip On Ramp	84,070	110,190	115,357	4.0%	4,603	23	115,365	4.0%	4,604	24
Watt Ave and Howe Ave	97,847	122,927	127,783	3.9%	5,022	83	127,716	4.0%	5,046	107
Howe Ave Off Ramp and Howe Ave On Ramp Ramp	75,314	96,480	101,257	3.9%	3,972	100	101,230	3.9%	3,974	103
Howe Ave Loop On Ramp and Howe Ave Slip On Ramp	84,604	108,754	114,364	4.1%	4,713	143	114,748	4.1%	4,712	141
Howe Ave and Hornet Dr	92,487	116,270	122,531	4.1%	5,026	170	123,011	4.1%	5,088	232
Hornet Dr and 65th St	99,323	128,967	135,751	4.1%	5,560	253	135,964	4.1%	5,619	312
65th St Off Ramp and 65th St Loop On Ramp	81,673	107,168	113,824	4.1%	4,678	270	113,959	4.1%	4,723	315
65th St Loop On Ramp and 65th St Slip On Ramp	82,916	110,091	119,681	4.0%	4,842	387	120,104	4.1%	4,905	450
65th St and 59th St	85,832	112,720	120,929	4.0%	4,788	337	121,347	4.0%	4,858	408
59th St and Stockton Blvd	95,999	125,186	132,557	3.9%	5,112	286	132,865	3.9%	5,202	376
Stockton Blvd Off and On Ramps	88,481	115,761	123,218	4.1%	5,087	621	123,466	4.5%	5,611	1,145
Stockton Blvd and Connectors to SR 51 & 99	99,637	126,265	133,384	3.7%	4,976	353	133,709	3.8%	5,060	437
Connectors to SR 51 and SR 99	93,563	118,133	124,669	3.7%	4,632	317	125,025	3.8%	4,721	405
Connector to SR 99 and 26th St Off	81,082	104,240	109,648	3.7%	4,094	303	109,933	3.8%	4,149	358
26th St and Connectors from SR 51 & 99	73,801	80,387	85,762	3.7%	3,194	272	85,914	3.8%	3,243	320
Connectors from SR 99 & SR 51	135,905	145,149	149,974	3.7%	5,506	373	**150,286**	3.7%	5,615	482
Connectors from SR 51 & 99 and 16th St	135,905	145,149	149,974	3.7%	5,477	375	**150,286**	3.7%	5,526	424
16th St and 15th St	125,362	142,801	145,481	3.7%	5,339	302	147,689	3.7%	5,429	393
10th St Off and 15th St On Ramp	115,966	139,293	142,037	3.7%	5,188	299	142,303	3.7%	5,203	313
10th St and Connectors to I-5	132,740	**157,288**	**162,194**	3.5%	5,697	374	**162,326**	3.5%	5,741	418
Connectors to I-5 and 5th St	66,775	92,074	94,911	3.6%	3,378	288	94,931	3.5%	3,330	240
5th St and Connectors from I-5	69,690	92,074	94,911	3.4%	3,246	243	94,931	3.4%	3,197	194
Connectors from I-5 and Jefferson Blvd	91,596	121,617	123,263	4.3%	5,249	251	123,277	4.2%	5,155	157

Table 4-6b. Comparison of Average Daily Traffic Truck Percentage for Design Option 1 (Opening Year 2020 and Horizon Year 2040)

	Location	Truck Percentage					Change in Truck Percentages			Truck Percentage				Change in Truck Percentages		
		2013	2020 - Opening Year							2040 - Horizon Year						
		Base Year No Project	No Project	Add HOV Lane	Add Mixed Flow Lane	Take-a-Lane	Add HOV Lane	Add Mixed Flow Lane	Take-a Lane	No Project	Add HOV Lane	Add Mixed Flow Lane	Take-a-Lane	Add HOV Lane	Add Mixed Flow Lane	Take-a Lane
	EB US 50 Mainline b/w Jefferson Blvd and I-5 Connectors	7.3%	7.3%	7.3%	7.3%	7.3%	0.027%	0.044%	0.026%	7.2%	7.3%	7.3%	7.3%	0.089%	0.108%	0.091%
	EB US 50 Mainline b/w Connector to I-5 and 5th St Off	7.4%	7.2%	7.3%	7.3%	7.4%	0.065%	0.060%	0.158%	7.2%	7.3%	7.3%	7.4%	0.056%	0.105%	0.114%
	EB US 50 Mainline b/w 5th St Off and Connectors from I-5	7.4%	7.2%	7.3%	7.3%	7.4%	0.088%	0.077%	0.165%	7.2%	7.3%	7.3%	7.3%	0.056%	0.103%	0.106%
	EB US 50 Mainline b/w Connectors from I-5 and 10th St	7.7%	7.6%	7.7%	7.6%	7.7%	0.062%	0.010%	0.097%	7.5%	7.5%	7.6%	7.5%	-0.026%	0.027%	0.002%
	EB US 50 Mainline b/w 10th St and 15th St	7.7%	7.6%	7.7%	7.6%	7.7%	0.085%	0.017%	0.104%	7.5%	7.5%	7.5%	7.5%	0.009%	0.025%	0.017%
	EB US 50 Mainline b/w 15th St & 16th St	7.2%	7.2%	7.2%	7.2%	7.3%	0.067%	0.012%	0.087%	7.1%	7.1%	7.1%	7.1%	0.011%	0.014%	0.021%
	EB US 50 Mainline b/w 16th St & Connectors to SR 51 & 99	7.0%	6.9%	7.0%	6.9%	7.0%	0.057%	0.002%	0.083%	6.8%	6.8%	6.8%	6.8%	-0.011%	0.003%	0.008%
	EB US 50 Mainline b/w Connectors to SR 51 & 99 and 26th St On	7.0%	6.9%	7.0%	6.9%	7.0%	0.050%	0.000%	0.059%	6.8%	6.8%	6.8%	6.8%	-0.036%	-0.055%	-0.044%
	EB US 50 Mainline b/w 26th St On and 34th St Off	6.5%	6.5%	6.6%	6.5%	6.6%	0.040%	-0.015%	0.039%	6.4%	6.4%	6.4%	6.3%	-0.060%	-0.073%	-0.095%
	EB US 50 Mainline b/w 34th St and Connectors from SR 51 & 99	6.5%	6.5%	6.6%	6.5%	6.6%	0.046%	-0.015%	0.050%	6.5%	6.4%	6.4%	6.3%	-0.071%	-0.071%	-0.109%
	EB US 50 Mainline b/w Connectors from SR 51 & 99 and Stockton Blvd	5.6%	5.6%	5.6%	5.6%	5.6%	0.061%	0.008%	0.028%	5.5%	5.5%	5.6%	5.5%	-0.009%	0.022%	-0.039%
	EB US 50 Mainline b/w Stockton Blvd and 59th St	5.4%	5.4%	5.4%	5.4%	5.4%	0.050%	0.021%	0.018%	5.3%	5.3%	5.4%	5.3%	0.020%	0.046%	-0.033%
	EB US 50 Mainline b/w 59th St and 65th St	5.4%	5.4%	5.4%	5.4%	5.4%	0.049%	0.036%	0.019%	5.3%	5.3%	5.4%	5.3%	0.025%	0.059%	-0.040%
	EB US 50 Mainline b/w 65th St Off and 65th St Loop On	5.4%	5.4%	5.4%	5.4%	5.4%	0.049%	0.051%	0.028%	5.3%	5.3%	5.4%	5.3%	0.031%	0.067%	-0.021%
	EB US 50 Mainline b/w 65th St Loop On and 65th St On	5.2%	5.2%	5.3%	5.3%	5.3%	0.057%	0.062%	0.039%	5.2%	5.2%	5.2%	5.2%	0.026%	0.060%	-0.023%
	EB US 50 Mainline b/w 65th St and Howe Ave / Hornet Dr	5.0%	5.0%	5.0%	5.0%	5.0%	0.051%	0.057%	0.033%	4.9%	4.9%	5.0%	4.9%	0.027%	0.053%	-0.015%
	EB US 50 Mainline b/w Howe Ave Off and Howe Ave Loop On	5.0%	5.0%	5.0%	5.1%	5.0%	0.010%	0.057%	-0.002%	4.9%	4.9%	5.0%	4.9%	0.024%	0.035%	-0.014%
	EB US 50 Mainline b/w Howe Ave Loop On and Howe Ave On	4.9%	4.9%	4.9%	5.0%	4.9%	0.032%	0.080%	0.007%	4.8%	4.8%	4.9%	4.8%	-0.012%	0.061%	-0.022%
	EB US 50 Mainline b/w Howe Ave and Watt Ave	5.1%	5.1%	5.1%	5.1%	5.1%	0.036%	0.053%	0.007%	5.0%	5.0%	5.1%	5.0%	-0.035%	0.054%	-0.001%
	EB US 50 Mainline b/w Watt Ave Off/On Ramps	5.1%	5.1%	5.1%	5.1%	5.1%	0.023%	0.032%	-0.006%	5.1%	5.0%	5.1%	5.0%	-0.024%	0.039%	-0.015%
	EB US 50 Mainline b/w Watt Ave and Bradshaw Rd	4.9%	5.0%	5.0%	5.0%	5.0%	0.019%	0.032%	0.006%	4.9%	4.9%	5.0%	4.9%	0.024%	0.073%	0.016%
WB	WB Mainline b/w Watt Ave and Bradshaw Rd	3.8%	3.7%	3.6%	3.8%	3.6%	-0.078%	0.066%	-0.074%	3.8%	3.7%	3.7%	3.8%	-0.112%	-0.125%	-0.035%
WB	WB Mainline b/w Watt Ave Off/On Ramps	3.8%	3.7%	3.6%	3.8%	3.6%	-0.085%	0.051%	-0.086%	3.8%	3.7%	3.7%	3.8%	-0.140%	-0.147%	-0.057%
WB	WB Mainline b/w Watt Ave Loop On and Watt Ave Slip On	4.1%	4.0%	4.0%	4.1%	3.9%	-0.082%	0.047%	-0.095%	4.2%	4.0%	4.0%	4.2%	-0.166%	-0.166%	0.008%
WB	WB Mainline b/w Watt Ave and Howe Ave	4.0%	4.0%	3.9%	4.0%	3.9%	-0.066%	0.049%	-0.076%	4.0%	3.9%	4.0%	4.0%	-0.088%	-0.067%	-0.015%
WB	WB Mainline b/w Howe Ave Off and Howe Ave On	4.0%	4.0%	3.9%	4.0%	3.9%	-0.058%	0.066%	-0.088%	4.0%	3.9%	3.9%	4.0%	-0.091%	-0.087%	-0.024%
WB	WB Mainine b/w Howe Ave Loop On and Howe Ave Slip On	4.2%	4.1%	4.1%	4.2%	4.1%	-0.026%	0.067%	-0.040%	4.2%	4.1%	4.1%	4.2%	-0.081%	-0.097%	-0.014%
WB	WB Mainline b/w Howe Ave and Hornet Dr	4.2%	4.1%	4.1%	4.2%	4.1%	-0.010%	0.073%	-0.027%	4.2%	4.1%	4.1%	4.1%	-0.075%	-0.040%	-0.043%
WB	WB Mainline b/w Hornet Dr and 65th St	4.1%	4.1%	4.1%	4.1%	4.0%	-0.008%	0.045%	-0.034%	4.1%	4.1%	4.1%	4.1%	-0.019%	0.018%	-0.031%
WB	WB Mainline b/w 65th St Off and 65th St Loop On	4.1%	4.1%	4.1%	4.1%	4.0%	-0.008%	0.041%	-0.052%	4.1%	4.1%	4.1%	4.1%	-0.003%	0.031%	-0.026%
WB	WB Mainline b/w 65th St Loop On and 65th St Slip On	4.0%	4.0%	4.0%	4.1%	4.0%	-0.011%	0.039%	-0.060%	4.0%	4.0%	4.1%	4.0%	0.000%	0.038%	-0.015%
WB	WB Mainline b/w 65th St and 59th St	4.0%	4.0%	3.9%	4.0%	3.9%	-0.011%	0.030%	-0.060%	3.9%	4.0%	4.0%	3.9%	0.011%	0.056%	-0.009%
WB	WB Mainline b/w 59th St and Stockton Blvd	3.9%	3.9%	3.9%	3.9%	3.8%	-0.020%	0.022%	-0.074%	3.9%	3.9%	3.9%	3.8%	0.002%	0.060%	-0.015%
WB	WB Mainline b/w Stockton Blvd Off/On Ramps	3.9%	3.9%	3.9%	3.9%	3.8%	-0.026%	0.016%	-0.082%	3.9%	4.1%	4.5%	3.8%	0.271%	0.687%	-0.015%
WB	WB Mainline b/w Stockton Blvd and Connectors to SR 51 & 99	3.7%	3.7%	3.7%	3.8%	3.7%	-0.027%	0.023%	-0.084%	3.7%	3.7%	3.8%	3.7%	0.069%	0.123%	0.001%
WB	WB Mainline b/w Connectors to SR 51 and SR 99	3.7%	3.7%	3.7%	3.8%	3.7%	-0.036%	0.020%	-0.087%	3.7%	3.7%	3.8%	3.7%	0.063%	0.123%	0.004%
WB	WB Mainline b/w Connector to SR 99 and 26th St Off	3.7%	3.7%	3.7%	3.8%	3.6%	-0.051%	0.011%	-0.098%	3.6%	3.7%	3.8%	3.7%	0.097%	0.137%	0.015%
WB	WB Mainline b/w 26th St and Connectors from SR 51 & 99	3.7%	3.8%	3.7%	3.7%	3.7%	-0.081%	-0.031%	-0.115%	3.6%	3.7%	3.8%	3.7%	0.089%	0.139%	0.020%
WB	WB Mainline b/w Connectors from SR 99 & SR 51	3.6%	3.7%	3.6%	3.6%	3.6%	-0.062%	-0.020%	-0.092%	3.5%	3.7%	3.7%	3.6%	0.135%	0.200%	0.054%
WB	WB Mainline b/w Connectors from SR 51 & 99 and 16th St	3.6%	3.6%	3.6%	3.6%	3.6%	-0.065%	-0.032%	-0.087%	3.5%	3.7%	3.7%	3.6%	0.137%	0.162%	0.065%
WB	WB Mainline b/w 16th St and 15th St	3.6%	3.6%	3.6%	3.6%	3.6%	-0.061%	-0.025%	-0.081%	3.5%	3.7%	3.7%	3.6%	0.143%	0.149%	0.057%
WB	WB Mainline b/w 10th St Off and 15th St On	3.6%	3.6%	3.6%	3.6%	3.5%	-0.060%	-0.021%	-0.072%	3.5%	3.7%	3.7%	3.6%	0.143%	0.146%	0.057%
WB	WB Mainline b/w 10th St and Connectors to I-5	3.5%	3.5%	3.5%	3.5%	3.5%	-0.060%	-0.027%	-0.066%	3.4%	3.5%	3.5%	3.4%	0.128%	0.152%	0.065%
WB	WB Mainline b/w Connectors to I-5 and 5th St	3.5%	3.5%	3.4%	3.5%	3.4%	-0.084%	-0.003%	-0.066%	3.4%	3.6%	3.5%	3.4%	0.203%	0.152%	0.062%
WB	WB Mainline b/w 5th St and Connectors from I-5	3.4%	3.4%	3.3%	3.4%	3.3%	-0.067%	0.014%	-0.066%	3.3%	3.4%	3.4%	3.3%	0.159%	0.107%	0.023%
WB	WB Mainline b/w Connectors from I-5 and Jefferson Blvd	4.3%	4.3%	4.2%	4.3%	4.2%	-0.042%	0.028%	-0.039%	4.1%	4.3%	4.2%	4.1%	0.149%	0.072%	0.009%

Implementation of the proposed project is anticipated to increase VMT on the affected portion of US 50; however, the roadway projects such as the proposed project would not generate more diesel truck traffic and segments would operate at a higher LOS. The proposed project is not a land use that would require additional diesel truck traffic as part of its operation. Therefore, the proposed project is not considered to have a significant amount of diesel truck traffic and would not increase diesel truck traffic along the affected portions of US 50.

According to the PM Guidance, the proposed project would not be a POAQC and would not increase the potential for a PM hot spot. The project will also affect several intersections with LOS E and F, as shown in Table 4-2; however, there is not considerable LOS change between No Project and the project build alternatives. Implementation of the proposed project would not degrade intersections to LOS D, E, or F with a significant number of diesel vehicles. In addition, the proposed project does not include the construction of a new bus or rail terminal, nor expand an existing bus or rail terminal. Lastly, the proposed project is not located within and would not affect sites that are identified as sites of possible $PM_{2.5}$ violations pursuant to the $PM_{2.5}$ applicable implementation plan.

Based on the information provided above, the proposed project is not expected to introduce significant amount of diesel truck traffic, and is in compliance with the SIP and MTIP. Therefore the project would be considered “Not a POAQC” based on the definition contained in 40 CFR 93.123(b)(1).

4.1.2.2. MOBILE SOURCE AIR TOXICS

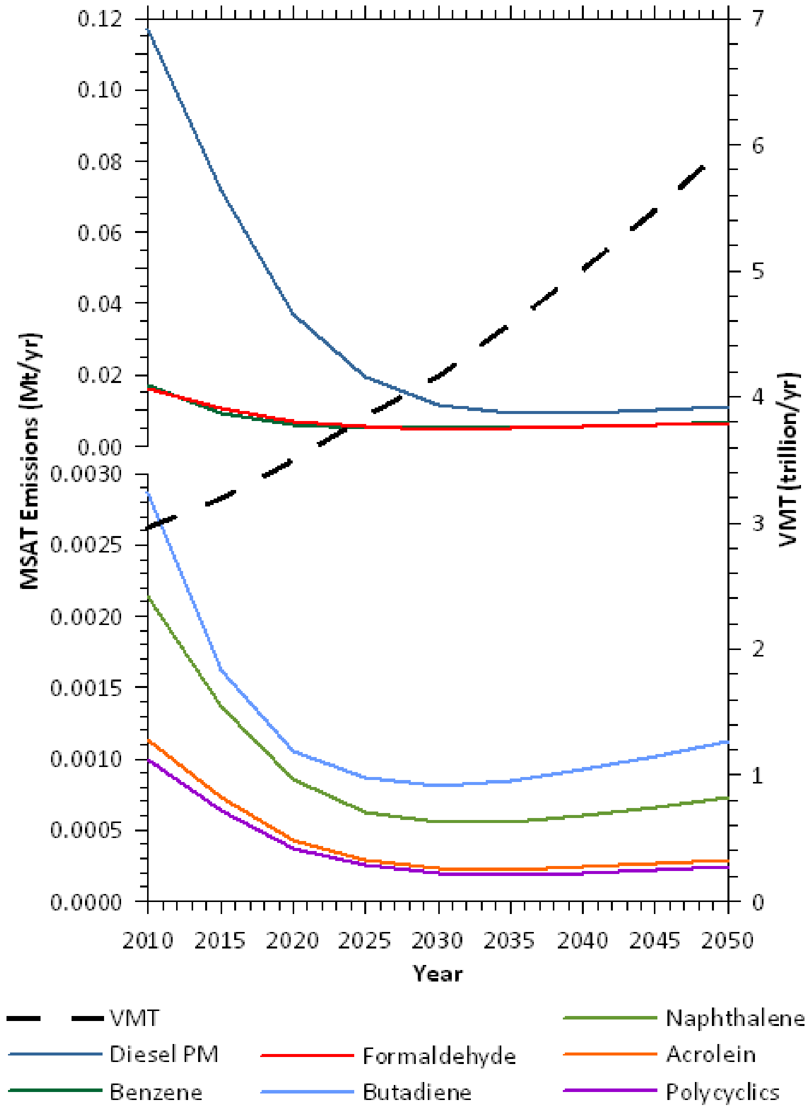
As described in Section 2.2.1 through 2.2.3, control of TAC is required by federal, state and local regulations. The air districts currently provide rules and policies that are designed to evaluate and minimize TACs from land use projects. Because the main sources of project toxics emissions are mobile sources, the methodology and information used for analyzing project MSATs were employed from FHWA and Caltrans.

In February 2006, FHWA issued its FHWA Interim Guidance (FHWA 2006b) to advise when and how to analyze MSATs in the NEPA process for highways. However, EPA recommends following its report: *Analyzing, Documenting, and Communicating the Impacts of Mobile Source Air Toxic Emissions in the NEPA Process* (AASHTO 2007). In September 2009, FHWA released an update to the FHWA Interim Guidance (2009 Guidance, [FHWA 2009]). The 2009 Guidance did not change any project analysis standard levels, recommendations, or guidelines; however, seven updated primary MSATs were identified as having significant contributions from mobile sources that are among the national- and regional-scale cancer risk drivers. In December 2012, FHWA released Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA, as an update to the 2009 FHWA Interim Guidance (2012 Guidance, [FHWA 2012]).

The 2012 Guidance document reflects recent changes in methodology for conducting emissions analysis and updates of research in the MSAT arena. The interim guidance update reflects recent regulatory changes, addresses stakeholder requests to broaden the horizon years of emission trends, and updates stakeholders on the status of scientific research on air toxics. The guidance is described as interim because MSAT science is still evolving. As the science progresses, FHWA will update the guidance accordingly. The 2012 update supersedes the September 2009 Interim Guidance and should be referenced in air quality analyses. This analysis follows the most recent FHWA guidance update (i.e., 2012 Guidance).

As previously discussed, several studies have concluded that mobile sources (i.e., on-road and non-road combined) are responsible for most of the excess cancer risk associated with exposure to urban air toxics. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. Currently, the tools and techniques for assessing project-specific health impacts from MSATs are limited. Furthermore, neither EPA nor CARB have established regulatory concentration targets for the six relevant MSAT pollutants appropriate for use in the project development process. For the same reason, states are neither required to achieve an identified level of air toxics in the ambient air nor identify air toxics reduction measures in the SIP. Developing strategies for reduction of MSATs is a cooperative effort between federal and local authorized agencies. The CAA provides EPA with the authority to establish and regulate emission standards for engines and vehicles. The State of California also has certain rights to adopt its own emission regulations, which are often more stringent than the federal rules. To reduce mobile source emissions, mandatory and incentive-based programs are developed in conjunction with new engine emission regulations; additional emission testing requirements (i.e., supplemental emission test [SET], not-to-exceed [NTE] limits); and limiting fuel sulfur content. These programs are implemented by all levels of government: federal, state, and local. Currently, FHWA's most recent interim guidance update (FHWA, 2012) is used for analysis of potential impacts of MSATs to be included in environmental documents.

The 2007 EPA rule mentioned in Section 2.2.1 (Control of Hazardous Air Pollutants from Mobile Sources [Federal Register, Vol. 72, No. 37, Page 8430, February 20, 2007]), require controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to an FHWA analysis, even if VMT increases by 102% as assumed from 2010 to 2050, a combined reduction of 83% in the total annual emissions for the priority MSAT is projected for the same time period, as shown in Figure 4-1.



Source: FHWA, 2012

Figure 4-1. National MSAT Emission Trends 2010 – 2050 for Vehicles Operating on Roadways

California's vehicle emission control and fuel standards are more stringent than federal standards and are effective sooner, so the effect of combined state and federal regulations is expected to result in greater reduction of MSATs in earlier time than the FHWA analysis predict.

Incomplete or Unavailable Information for Project Specific MSAT Health Impact Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, https://www.epa.gov/iris/). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's *Interim Guidance Update on Mobile source Air Toxic Analysis in NEPA Documents*. Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI Web site, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts – each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine a “safe” or “acceptable” level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA’s approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than safe or acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

4.1.2.3. ASSESSMENT OF THE PROPOSED PROJECT MSAT EFFECTS

Based on the FHWA's tiered approach in their 2012 Guidance, the proposed project does not meet the Category 1 criteria for projects with no potential for meaningful MSAT effects. Segments of US 50 that would be affected by the proposed project operate above the AADT levels of 140,000 to 150,000 daily vehicle trips. For some segments of US 50 within the project corridor, in horizon year 2040, the maximum ADT for the No Project alternative is 175,500, and the Build alternatives result in a maximum ADT of 183,000. The average ADT increase on US 50 within the project corridor from the No Project alternative conditions, as a result of the Add HOV and Add Mixed lane alternatives would be 4.4% and 4.5% , respectively. The Take-a-Lane alternative would result in an average ADT decrease of 0.5% along the project corridor from the No Project alternative and a 4.6% decrease in average ADT from the Add HOV Lane. Only two segments of US 50 in the project corridor show an increase of approximately 9% for the add HOV lane alternative. However, overall VMT within the project corridor would increase by approximately 4.4% as a result of the proposed Build alternatives. The proposed project would add HOV or mixed lanes and serve to improve operations of highway within the project corridor (i.e., reduced congestion and improved average speed compared with no project scenario); however, without creating a facility that is likely to increase MSAT emissions considerably, as discussed below.

The description of the proposed project is consistent with Category 2 projects that would require qualitative analysis for projects with low potential MSAT effects. However, since the traffic volumes with the proposed project would be greater than the FHWA criteria of 140,000 to 150,000 AADT, and there are residential uses in proximity of some segments of the project corridor, this analysis includes quantification of MSAT emissions.

For each alternative in this analysis, the amount of MSATs emitted would be proportional to the VMT, assuming that other variables such as fleet mix are the same for each alternative. The traffic volumes and subsequent VMT estimated for each of the Build alternatives are slightly higher than those for the No Build alternative, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network (e.g., local roadways).

Analysis of MSATs

A quantitative mass daily emission analysis was performed for the seven air toxics that are identified as priority MSATs by the EPA. The EMFAC2014 model and the latest version of the Caltrans model CT-EMFAC (Version 5.0, 2013) were used to estimate and compare the priority MSAT emissions from the project alternatives, including the No Project alternative. Because the latest CT-EMFAC (Version 5.0), at the time of preparation of this report was based on EMFAC2011, adjustments of MSAT emission rates were implemented to reflect EMFAC2014 model data and emission rates.

Methodology

To make the adjustments for calculating MSAT emissions with EMFAC2014 model, four main steps were used in the analysis. For each analysis year:

1. The EMFAC2014 model was used to generate the emissions and emission factors of criteria pollutants total organic gases (TOG), reactive organic gases (ROG), and PM_{10} in the Sacramento County;
2. CT-EMFAC (Version 5.0) model was used to generate criteria pollutant (TOG, ROG, PM_{10}) and MSAT emissions factors;
3. The developed scaling factors were used to obtain MSATs emission factors from EMFAC2014 data (adjusted emission factors).
4. Using the adjusted emission factors and the project-specific VMT per speed bin distribution, daily emissions MSATs were calculated for the project corridor.

For example for the 2020 analysis year, from running CT-EMFAC model (step 2), data for TOG by speed bin[18] and benzene by speed bin, show that the benzene factors are 2.2% of the TOG emission factors for a given speed bin. This 2.2% scaling factor is then applied to the corresponding TOG emission factor (same speed bin) from EMFAC2014 (step 1 results) to obtain the benzene emission factor based on EMFAC2014. This approach used for the four of the seven MSATs including *Benzene, Acrolein, 1,3-Butadiene and Formaldehyde*.

[18] Emissions per speed bin used in EMFAC and CT-EMFAC models is the emission rates at average speeds with 5 miles per hour (mph) increments (i.e., 5, 10, 15, ….., 70, 75).

The methodology for calculating *Naphthalene and POM* emissions were based on the Caltrans document: *Guidance for Estimating Naphthalene and Polycyclic Organic Matter Emissions from Transportation Projects* (Sonoma Technology, Inc., June 30, 2010). These guidelines provide a method to scale PM_{10} and ROG emissions to derive naphthalene and POM emissions. The 2010 guidance document used EPA's National Mobile Inventory Model (NMIM) which includes speciation information for exhaust emissions, and evaporative emissions, to develop equations for calculating naphthalene and POM emissions.

EMFAC2014 results were used in Equation 1 (for naphthalene emissions) and Equation 2 (for POM emissions) from the 2010 Guidance document, to calculate naphthalene and POM emissions along studied roadway corridor.

$$Naphthalene = PM_{10} \times m_{naphthalene} + TOG \times (ROG/TOG\ ratio) \times evapGas\ \ ratio \qquad \text{Equation 1}$$

$$POM = PM_{10} \times m_{POM} \qquad \text{Equation 2}$$

Where:

PM_{10} = total project-level PM_{10} emissions from EMFAC2014 and project traffic data, (lbs/day);

$m_{naphthalene}$ = naphthalene multiplier (obtained from Table 3-2 based on % trucks and % diesel-fueled vehicles within the truck fleet;

m_{POM} = POM multiplier (obtained from Table 3-3 based on % trucks and % diesel-fueled vehicles within the truck fleet

TOG = total project-level TOG emissions from EMFAC2014 and project traffic data (lbs/day);

ROG/TOG = ROG emissions to TOG emissions ratio calculated from EMFAC2014 results;

evapGas ratio = 0.0004 (based on EPA's NMIM speciation data for evaporative naphthalene emissions from gasoline-powered vehicles.

For *DPM* emissions, the data obtained from EMFAC2014 were processed to calculate PM_{10} and TOG emissions from diesel-powered vehicles. These data were used to estimate the project-level DPM emissions. The Sacramento County default fleet mix distribution was used for non-trucks and trucks with 2 or more axles. More detailed methodology and calculation worksheets are provided in Appendix B.

Analysis Results

Table 4-7 and Figures 4-2a and 4-2b, present the estimated emissions of priority MSATs from operations of the preferred Design Option 1 build alternatives – Add HOV lanes, Add Mixed Flow lanes, and Take-a-Lane alternatives. The projected data are presented for the existing conditions (2013), and project alternatives in Opening Year (2020) and

Horizon Year (2040). Detailed methodology and additional data are included in Appendix B.

As the estimated data in Table 4-7 and Figures 4-2a and 4-2b show,

- A considerable decrease in MSAT emissions can be expected for the proposed project alternatives from the base year (2013) through future years. This decrease is prevalent for all of the priority MSATs, and is consistent with EPA's study that projects MSAT emissions will decline markedly in the future. This is directly due to the improved pollution emission performance of a modernizing fleet of all diesel- and gasoline-fueled vehicles, which is a trend that is anticipated to continue throughout the planning horizon. This is consistent with the FHWA projected trend, shown in Figure 4-1.

Table 4-7. Priority MSATs Emissions for the Project Corridor, No Build and Design Option 1 Alternatives (pounds per day)

Year	Scenario	Benzene	Acrolein	Formaldehyde	Butadiene	Naphthalene	POM	Diesel PM
2013	Baseline	18.21	0.59	16.40	2.66	5.66	0.75	55.78
2020	No Project	8.79	0.23	7.13	1.05	1.69	0.21	11.07
	Option 1_ Add HOV Lane	9.28	0.26	7.22	1.14	1.72	0.21	10.72
	Option 1_Add Mixed Lane	9.22	0.25	7.27	1.12	1.74	0.22	11.07
	Option 1_Take-a-Lane	8.82	0.24	7.02	1.06	1.70	0.21	11.19
2040	No Project	4.90	0.13	4.72	0.58	0.55	0.06	1.71
	Option 1_ Add HOV Lane	5.34	0.15	4.73	0.65	0.58	0.07	1.80
	Option 1_Add Mixed Lane	5.32	0.14	4.84	0.65	0.59	0.07	1.90
	Option 1_Take-a-Lane	5.02	0.13	4.64	0.60	0.55	0.06	1.81
Project Increment (change from No Project Scenario)								
2020	Option 1_ Add HOV Lane	0.49	0.02	0.09	0.09	0.03	0.0	-0.35
	Option 1_Add Mixed Lane	0.43	0.02	0.13	0.07	0.05	0.01	-0.01
	Option 1_Take-a-Lane	0.03	0.01	-0.11	0.01	0.01	0.0	0.12
2040	Option 1_ Add HOV Lane	0.44	0.02	0.01	0.07	0.03	0.01	0.10
	Option 1_Add Mixed Lane	0.43	0.01	0.12	0.06	0.03	0.01	0.20
	Option 1_Take-a-Lane	0.12	0.0	-0.08	0.02	0.0	0.0	0.10

Notes: POM – polycyclic organic matter;
Detailed calculations for all alternatives are provided in Appendix B.
Values may not add exactly, due to rounding.

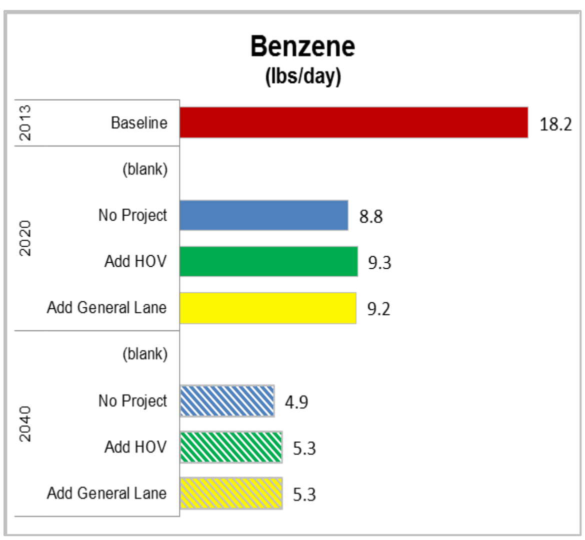
Source: Analysis/modeling performed by AECOM, 2015

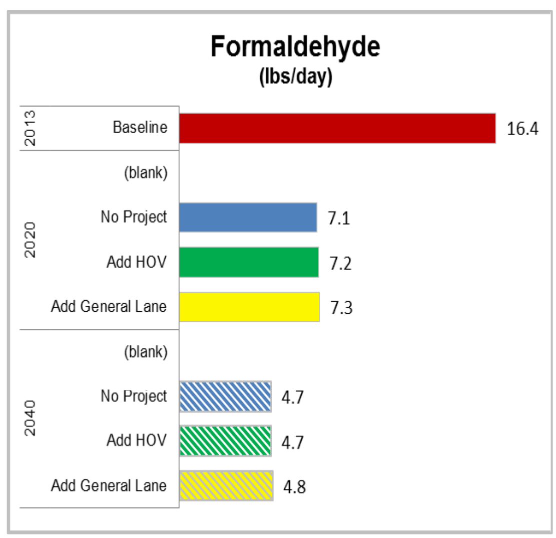
- For each build alternative in this analysis, a slight increase in MSAT emissions are estimated compared with the No Build alternative. Because the project would add lanes to the proposed corridor of US 50, the traffic volumes and VMT within the project corridor would increase for each Build alternative, compared to the No Build alternative.

- For the studied corridor of US 50, the two build alternatives would be comparable in level of MSAT emissions. It should be noted that the projected emissions were modeled with the assumption that the amount of MSATs emitted would be proportional to the VMT and would vary based on average vehicle speed of daily traffic. Other variables such as fleet mix, fleet turnover, and emission standards are assumed to stay constant for each alternative.

- The Take-a-Lane alternative would also result in a net increase in most MSATs compared to the No Build alternative, except for Formaldehyde, which would decrease in opening year 2020 and horizon year 2040. However, with respect to the Add HOV Lane alternative, the Take-a-Lane alternative would result a decrease in all MSATs for opening year 2020 and horizon year 2040.

In summary, regardless of the design option and alternative selected, the analysis determined that consistent with the EPA projections emission levels of all seven primary MSATs would continue a downward trend from existing conditions through the future years. Comparison of the data in Tables 4-7 and Figures 4-2a and 4-2b indicates that even with increase in traffic volume (and VMT), MSAT emissions would continue to decline from opening year (2020) to horizon year (2040).





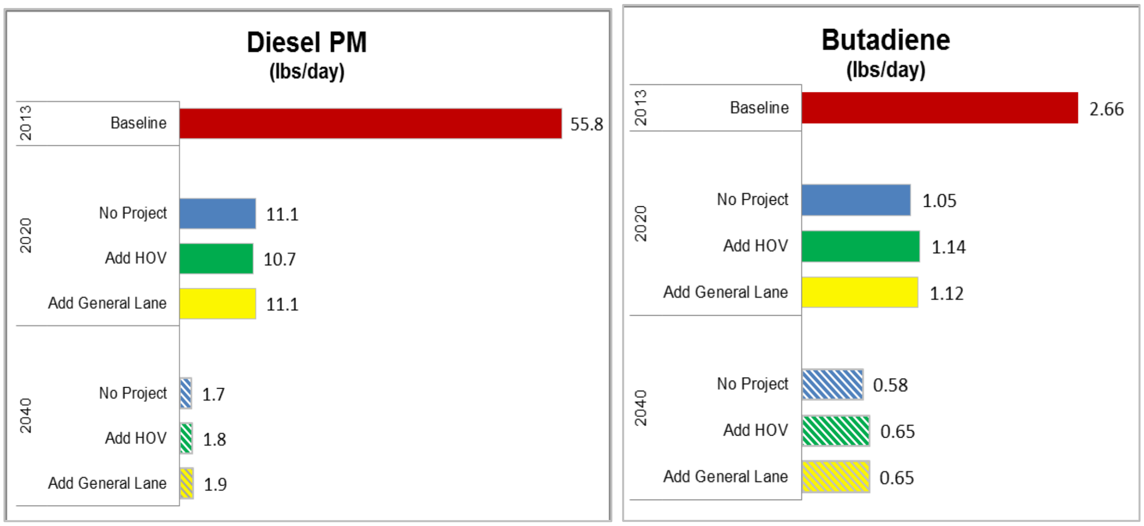
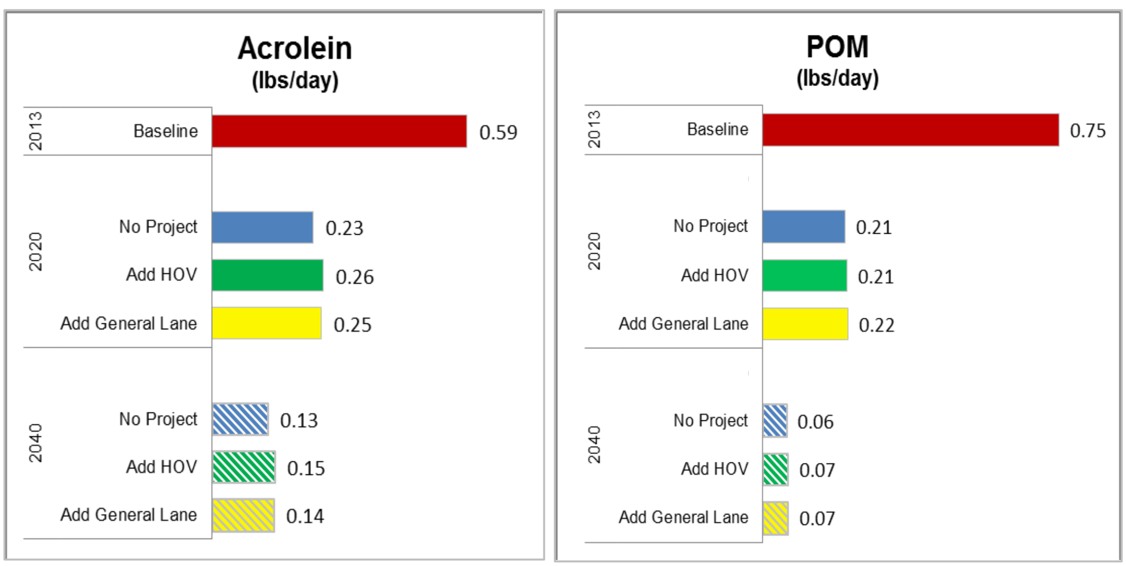


Figure 4-2a. Estimated Emissions of Priority MSATs Benzene, Formaldehyde, Diesel PM, and Butadiene for Design Option 1 Alternatives "Add HOV and Add Mixed Flow Lane" and Scenarios: Base Year (2013), Opening Year (2020) and Horizon Year (2040)



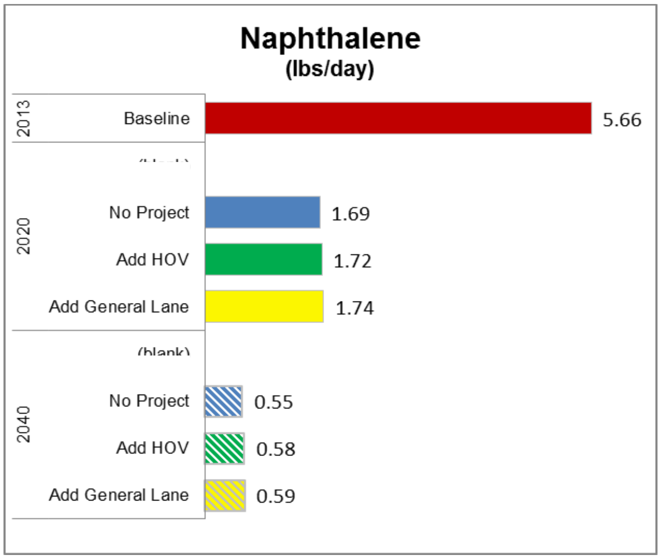


Figure 4-2b. Estimated Emissions of Priority MSATs Acrolein, and Polycyclic Organic Matter (POM), and Naphthalene for Design Option 1 Alternatives "Add HOV and Add Mixed Lane" and Scenarios: Base Year (2013), Opening Year (2020) and Horizon Year (2040)

The change in MSAT emission levels associated with the Build alternatives from the No Project alternative would be less than 5% for all MSATS except for benzene. For diesel PM, the Build alternatives in the opening year (2020) would result in slight decreases from the No Project alternative, while the Take-a-Lane alternative would result in a net increase from the No Project alternative. In the horizon year (2040), all Build alternatives and the Take-a-Lane alternative would result in net increases of diesel PM emissions from the No Project alternative. Benzene emissions associated with the Build alternatives would range from 5% to 9% higher than the No Project alternative in opening (2020) and horizon years (2040). Under the Take-a-Lane alternative, benzene emissions would only increase approximately 0.3% and 2% from the No Project alternative in opening (2020) and horizon (2040) years, respectively.

It should be noted that the considerable decrease in DPM data is due to the fact that the EMFAC2014 model has incorporated revisions in PM emissions (and emission factors) based on the projected increase in use of clean cars and PM filters (that have been found to be more effective than originally projected in EMFAC2011), into the future years' emission estimations.

Furthermore, as discussed above, the study of mobile source air toxics, dose-response effects, and modeling tools are currently in a state where accurate information is unavailable or incomplete. This is relevant to making a viable prediction of any reasonably foreseeable adverse effects on the human environment. Studies are currently being conducted to clarify some of these unknowns; however, the information is not yet available.

4.2. Construction Impacts

According to NEPA, for projects having a construction schedule less than 5 years, air emissions are considered temporary with no potential adverse effect. Based on this criterion, quantitative estimation of construction emissions is not required by Caltrans and FHWA for the proposed project, which has an estimated construction schedule of approximately 15 months. However, for the purposes of full disclosure, a quantitative analysis of construction emissions was conducted to demonstrate the project CEQA impact.

4.2.1. Construction Emissions

Construction of the project has the potential to create temporary air quality impacts through the use of heavy-duty construction equipment within the construction site, and through vehicle trips generated from haul trucks and construction workers traveling to and from the project site. In addition, fugitive dust emissions would result from earthwork (e.g., grading, excavation) and on-site construction activities. Off-road (on-site) mobile source emissions, primarily NOx and CO, would result from the use of construction equipment such as excavators, bulldozers, and loaders. During paving operations asphalt application would release reactive organic compounds. Construction emissions can vary substantially from day to day, depending on the level of activity; the specific mix of construction equipment; and, for dust, the prevailing weather conditions.

Construction-related emissions of criteria pollutants were estimated using the *Road Construction Emission Model, Version 7.1.5.1* (the latest updated version, which was released in December 2013). The model was developed for the Sacramento Metropolitan Air Quality Management District (SMAQMD) and approved by the CARB. Table 4-8 summarizes the calculated mass daily emissions (in pounds per day) and the annual emissions (in tons) for comparison with the SMAQMD limits on pollutant emission levels from projects construction activities. As shown in Table 4-8, the maximum daily emissions of pollutants from construction activities do not exceed the SMAQMD's standard levels.

Table 4-8 Estimated Construction Emissions

Construction Stage (Duration)	Construction Daily Emissions (pounds/day)							
	ROG	CO	NO_x	PM_{10} Exhaust	PM_{10} Total	$PM_{2.5}$ Exhaust	$PM_{2.5}$ Total	CO_2
Grubbing/ Land Clearing *(1.5 months)*	1.4	11.0	14.2	0.7	18.2	0.6	4.2	2,482
Grading/Excavation *(6.75 months)*	7.6	42.5	82.8	4.0	21.5	3.6	7.2	10,281
Drainage/Utilities/Sub-grade *(4.5 months)*	5.1	30.0	45.9	2.7	20.2	2.4	6.0	6,177
Paving/ Finish Work *(2.25 months)*	2.0	15.7	16.7	1.1	1.1	1.0	1.0	3,609
Maximum Daily	7.6	42.5	82.8	4.0	21.5	3.6	7.2	10,281
SMAQMD Significance Standard level (lbs/day)	-	-	*85*	-	*80*	-	*82*	-
	Construction Emissions (tons/Construction Period)							
Tons per Construction Duration (15 months)	0.9	5.2	9.1	0.5	2.9	0.4	0.9	1,080*
Tons per Year	0.7	4.2	7.3	0.4	2.3	0.3	0.7	864*
SMAQMD Standard Levels (tons/year)	-	-	-	-	*14.6*	-	*15*	*1,100**

ROG – Reactive Organic Gases; CO – Carbon Monoxide; NOx – Nitrogen Oxides; PM_{10} – Particulate Matter less than 10 microns in diameter; $PM_{2.5}$ – Particulate Matter less than 2.5 microns in diameter.

Emissions were estimated using Road Construction Model, version 7.1.5.1 (SMAQMD, 2013).

- *No values indicate that no standard level is set in those units (e.g., NOx standard levelss are set for maximum daily emissions and not for annual construction emissions).*
- *CO_2 data with (*) are in metric tons.*
- *A copy of the model sheets is provided in Appendix D.*

Source: Analysis/modeling performed by AECOM, 2015

4.3. Avoidance, Minimization and/or Mitigation

Construction (Short-Term) Impacts

It should be noted that the proposed project would comply with the requirements of Caltrans requirements and SMAQMD rules and Best Management Practices (BMPs), which would further reduce emissions during construction activities. The project would implement the following practices during construction:

- Construction contractors would comply with Caltrans Standard Specification Provisions which uses newer/retrofit engines for construction equipment;
- Comply with District’s Rule 403 for fugitive dust emissions;
- Prohibit truck idling in excess of 10 minutes, whenever practical;
- Use only well-maintained equipment; utilize proper planning to reduce rework and multiple handling of earth materials.

Operations (Long Term) Impacts

The proposed project would help to reduce congestion and improve traffic flow and mobility along the HOV and general-purpose lanes of the US 50 project segments, thereby reducing the operational emissions in the project area and in the SVAB.

Based on the above analysis there would be no adverse effect from the project operational emissions at the regional level. As shown in Table 4-1, under all Build alternatives, the net increase in operational emissions in Year 2020 and 2040 would remain below SMAQMD standard levels.

At the project level, there is no potential for generation of CO hot-spot from project operational emissions; the proposed Build alternatives would not increase the potential for a PM (PM_{10} and $PM_{2.5}$) hot spot and would be considered "Not a POAQC".

Although a slight increase in MSAT emissions are estimated compared with the No Build alternative, the Build alternatives would be comparable in level of MSAT emissions. Comparison of the MSAT emissions from the proposed project indicates that even with the increase in traffic volume (and VMT), MSAT emissions would continue to decline from opening year (2020) to horizon year (2040). Future levels of each pollutant are projected to be lower than existing levels as newer, cleaner vehicles become a larger portion of the vehicle fleet, despite expected increases in VMT.

Based on the above summary, no minimization/mitigation measures would be required for project operational emissions. However, Caltrans is committed to implementing measures to help reduce the potential effects of the projects

Chapter 5. Climate Change

An introduction and Regulatory Setting relating to climate change and greenhouse gas emissions are provided in previous sections of this air quality report.

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 participate in a potential impact through its incremental contribution combined with the contributions of all other sources of GHGs. Assessment of cumulative impacts must determine if a project's incremental contribution to a greater effect is "cumulatively considerable."

5.1. Estimation of Project GHG Emissions

GHG emissions for transportation projects can be divided into those produced during construction and those produced during operations.

5.1.1. Construction Emissions

Construction GHG emissions include emissions produced as a result of onsite construction equipment, material delivery and haul trucks trips, construction worker vehicles, and 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. Project construction emissions of CO_2 were estimated using the SMAQMD's Road Construction Model (Version 7.1.5.1, December 2013) and the results are presented above in Table 4-8. As shown, annual CO_2 emissions from project construction would be below the local standard levels (SMAQMD standard levels of 1,100 metric tons per year). Furthermore, with innovations such as longer pavement lives, improved traffic management plans, and changes in materials, the GHG emissions produced during construction would even be lower than the estimated values in Table 4-8. Section 4.3 above, identifies measures included in the project or recommended to address construction emissions, no specific measure for GHG emissions reduction would be required.

5.1.2. Operational Emissions

The proposed project is a transportation facility; therefore, the GHG emissions would only include the direct GHG emissions that would be generated by the construction and operational activities of the project. Construction emissions of CO_2 are temporary in nature and generally much smaller than operational emissions, therefore these emissions were not included for analysis. Operational GHG emissions are associated with vehicle traffics along the freeway segments and ramps, within the project corridor.

In May 2013, Caltrans published a *Greenhouse Gas Analysis Protocol for Transportation Projects* (*GHG Protocol,* Caltrans, 2013), which includes guidelines for qualitative or quantitative assessment methods based on project-level analysis principles.

Based on the Protocol guidelines, a qualitative analysis is not applicable to use for project. The proposed project is a capacity-increasing project, although the project itself would not generate additional traffic as a land use development project would, but rather is intended to accommodate projected regional growth while maintaining acceptable roadway operations. However, it is anticipated that as a result of the increased vehicle flow, some vehicles would divert their routes from local roadways to the project's segments of US 50. As determined in the traffic study, the proposed project could result in an average 4.4% increase in mainline ADT volumes on US 50 in 2040 compared to No Build alternative.

According to Caltrans *Climate Action Program* (Caltrans 2006), one of the main strategies in the program for reducing 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 to 25 mph) and speeds over 55 mph (see Figure 5-1). 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.

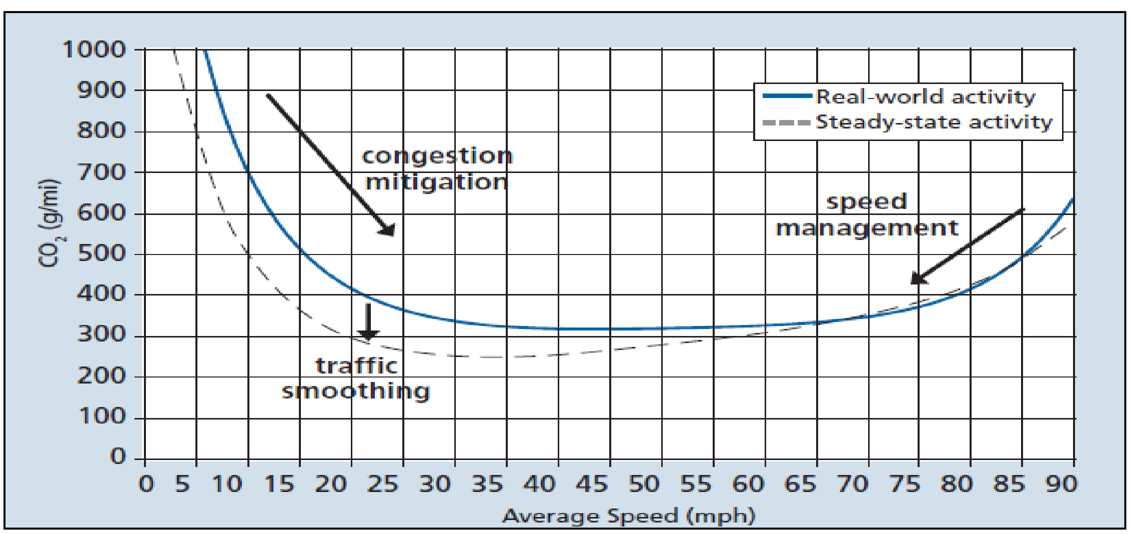


Figure 5-1. Possible Effect of Traffic Operation Strategies in Reducing On-Road CO2 Emissions

Pursuant to the Climate Action Program, the proposed project would improve road operations by reducing traffic congestion on the segments of US 50 along the project corridor. The potential also exists for vehicles that currently qualify to use the HOV lanes but drive in the general-purpose lanes to transfer to the more efficient HOV lanes, which would also allow the general-purpose lanes to operate more efficiently. In addition, as described above, the vehicles that would divert their route from local roadways (where stop-and-go speeds are the primary flow of traffic) to US 50 would reduce GHG emissions by operating at more efficient speeds. Hence, the proposed project would contribute to reducing fuel consumption from idling vehicles by minimizing stop-and-go activity and allowing smoother traffic flow on HOV and general-purpose lanes of the US 50 project segment. Although it is projected that certain project segments of US 50 could experience additional traffic, it is anticipated that the increased efficiency of vehicles on the project segments of US 50 would offset those increases, compared with No Project alternative.

Project-related GHG emissions (No Project and Option 1 preferred alternatives), were calculated using the emission factors from EMFAC2014 Model, with project-specific total VMT by speed bin distribution. The quantitative analysis was performed following the guidelines outlined in the GHG Protocol, and separate model runs were conducted for existing conditions as well as the opening year and horizon year for the build and no-build alternatives. The results are presented in Table 5-1. Table 5-1 indicates that:

- The annual operational emissions of CO_2 in 2020 would decrease under the No Project alternative and slightly increase under the build alternatives, compared with the base year 2013, even with increase in VMT.

- The horizon year (2040) GHG emissions for the project build alternatives and No Project alternative, will decrease compared with the existing conditions (2013). This is due to the statewide implementation of the control measures to comply with the goal of state regulations such as AB-32 and AB-1493 (Pavley I), low carbon fuel standard (LCFS), and Low-Emission Vehicle (LEV III GHG) standards[19]. EMFAC2014 incorporates these changes in calculation of emission factors for future years.

[19] Clean Car Standard (Pavley I) – reduces GHG emissions in model years 2009 through 2016 passenger vehicles;

Low Carbon Fuel Standard (LCFS) – calls for a reduction of at least 10% of the carbon intensity of California's transportation fuels by year 2020; and

Third stage of Low-Emission Vehicle standards (LEV III GHG) – reduces GHG emissions in model years 2017 through 2025 passenger vehicles.

Table 5-1. Annual CO_2 Emissions for Existing Conditions (2013) and Future No Build and Design Option 1 Build Alternatives (Opening Year [2020] and Horizon Year [2040])

Year	Scenario	VMT (miles) Daily	VMT (miles) Annual	CO_2 Emission (metric tons/year)	% Change from 2013 emission
2013	Base Year	1,979,279	722,436,780	312,292	-
Opening Year 2020	No Project	2,216,162	808,899,013	302,005	-3.3%
	Option 1 – Add HOV Lanes	2,282,138	832,980,538	320,096	2.5%
	Option 1 – Add Mixed Flow Lanes	2,285,628	834,254,111	317,995	1.8%
	Option 1 – Take-a-Lane	2,202,424	803,884,636	305,356	2.2%
	Change from No-Build (Emission Increment and % change)				
	Option 1 – Add HOV Lanes			18,091 (6%)	
	Option 1 – Add Mixed Flow Lanes			15,990 (5.3%)	
	Option 1 – Take-a-Lane			3,351 (1.1%)	
Horizon Year 2040	No Project	2,617,566	955,411,725	257,671	-17.5%
	Option 1 – Add HOV Lanes	2,730,769	996,730,601	279,731	-10.4%
	Option 1 – Add Mixed Flow Lanes	2,733,443	997,706,779	280,298	-10.2%
	Option 1 – Take-a-Lane	2,602,167	949,790,970	262,169	-16.1%
	Change from No-Build (Emission Increment and % change)				
	Option 1 – Add HOV Lanes			22,060 (8.6%)	
	Option 1 – Add Mixed Flow Lanes			22,627 (8.8%)	
	Option 1 – Take-a-Lane			4,498 (1.7%)	

EMFAC2014 was used in combination with the VMT speed distribution and daily and Annual VMTs, and model default for fleet mix in Sacramento County. Calculations worksheet is provided in Appendix D.

Source: Analysis performed by AECOM, 2015.

- As Table 5-1 shows, for future studied years the build alternatives' annual GHG operational emissions show a relatively small increase compared with the No Project alternative, ranging from approximately 5% to 9% increases. This increase is due to the proposed new additional lanes causing an increase in traffic volumes and VMT along the project corridor.

- The Take-a-Lane alternative also results in a net increase in annual GHG emissions compared to the No Project alternative in the 2020 opening year and 2040 horizon year. When compared to the Add HOV Lane alternative, the Take-a-Lane alternative would result in a 4.6% and 6.3% reduction in annual GHG emissions in year 2020 and 2040, respectively.

The SACOG 2035 MTP/SCS estimated regional GHG emissions to demonstrate that the plan meets the SB 375 targets set by ARB. The SB 375 emission reduction targets are 7% below 2005 emissions levels by 2020 and 16% below 2005 levels by 2035. The 2012 MTP/SCS estimated that the per capita emissions for the region would be 10% below 2005 emissions levels in 2020 from 2005, and 16% below 2005 emissions levels in 2035. The design concept and scope of the proposed project is consistent with the project description in the MTP and the GHG analysis. Therefore, although the project could result in a slight increase in GHG emissions compared with the No-Project scenario, the effect of the proposed project has been accounted for by SACOG when determining if the region will meet SB 375 GHG reduction targets. Because SACOG has determined in its current 2035 MTP/SCS that it would meet its GHG reduction targets and accounts for the proposed project, the proposed project would not impede regional GHG reduction goals.

5.2. Greenhouse Gas Reduction Strategies

5.2.1. AB 32 Compliance

Caltrans continues to be actively involved on the Governor's Climate Action Team as CARB 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 Caltrans is using to help meet the targets in AB 32 come from the California Strategic Growth Plan, which is updated each year. Former Governor Arnold Schwarzenegger's Strategic Growth Plan calls for a $222 billion infrastructure improvement program to fortify the state's transportation system, education, housing, and waterways, including $107 billion in transportation funding during the next decade. The Strategic Growth Plan targets a significant decrease in traffic congestion below today's level and a corresponding reduction in GHG emissions. The Strategic Growth Plan proposes to do this while accommodating growth in population and the economy. A suite of investment options has been created that combined together yield the promised reduction in congestion. The Strategic Growth Plan relies on a complete systems approach to attain CO_2 reduction goals: system monitoring and evaluation, maintenance and preservation, smart land use and demand management, and operational improvements as depicted in Figure 5-2, the Mobility Pyramid.

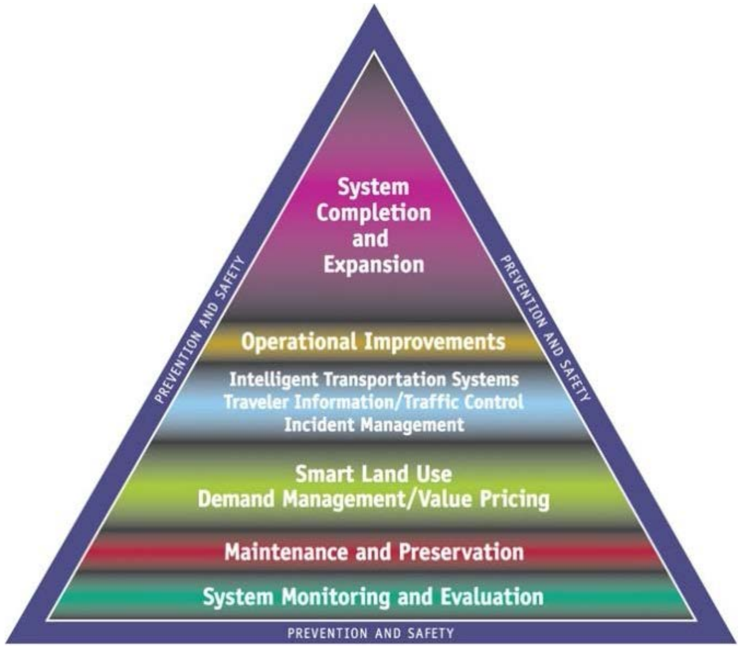


Figure 5-2. The Mobility Pyramid

Caltrans is supporting efforts to reduce VMT by planning and implementing smart land use strategies: job/housing proximity, developing transit-oriented communities, and high-density housing along transit corridors. Caltrans works closely with local jurisdictions on planning activities, but does not have local land use planning authority. Caltrans 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 EPA and CARB.

Caltrans 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 AB 32.

The California Transportation Plan (CTP) is a statewide, long-range transportation plan to meet our future mobility needs and reduce 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 5-2 summarizes Caltrans 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)[20] provides a comprehensive overview of activities undertaken by Caltrans statewide to reduce greenhouse gas emissions resulting from agency operations.

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

- Caltrans and the California Highway Patrol are working with regional agencies to implement intelligent transportation systems (ITS) to help 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.

- In addition, the Sacramento County of Governments provides ridesharing services and park-and-ride facilities to help manage the growth in demand for highway capacity.

Table 5-2. Climate Change/CO_2 Reduction Strategies

Strategy	Program	Partnership		Method/Process	Estimated CO2 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

[20] http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/projects_and_studies.shtml

Table 5-2. Climate Change/CO_2 Reduction Strategies

Strategy	Program	Partnership		Method/Process	Estimated CO2 Savings Million Metric Tons(MMT)	
		Lead	Agency		2010	2020
	Regional Plans and Blueprint Planning	Regional Agencies	Caltrans	Regional plans and application process	0.975	7.8
Operational Improvements & Intelligent Transportation System (ITS) Deployment	Strategic Growth Plan	Caltrans	Regions	State ITS; Congestion Management Plan	0.07	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, CARB, 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	0.0045	0.0065 0.045 0.0225
Non-vehicular Conservation Measures	Energy Conservation Program	Green Action Team		Energy Conservation Opportunities	0.117	0.34
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 0.36	4.2 3.6
Goods Movement	Office of Goods Movement	CalEPA, CARB, BT&H, MPOs		Goods Movement Action Plan	Not Estimated	Not Estimated
Total					2.72	18.18

- Landscaping reduces surface warming, and through photosynthesis, decreases CO2. The project proposes planting in the intersection slopes, drainage channels, and seeding in areas next to frontage roads as well as planting a variety of different-sized plant material and scattered skyline trees where appropriate but not to obstruct the view of the mountains. The Department has committed to planting at least 40 trees. These trees will help offset any potential CO2 emissions increase.

- The project will utilize energy efficient lighting, which will be defined during final design.

5.2.2. Adaptation Strategies

"Adaptation strategies" refer to how Caltrans and others can plan for the effects of climate change on California'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, storm surges and intensity, and the frequency and intensity of wildfires. These changes may affect the transportation infrastructure in various ways, such as damaging roadbeds by 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. Economic and strategic ramifications may result from 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[21], 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 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, then-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)[22], 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.

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21 http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation

22 http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF

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[23] to recommend how California should plan for future sea level rise. 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.

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

23 Sea Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future (2012), available at http://www.nap.edu/catalog.php?record_id=13389.

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 outside the coastal zone and direct impacts to transportation facilities due to projected sea level rise are not expected.

Sea level rise effects have been evaluated and mapped by the California Natural Resources Agency and California Energy Commission through the Cal-Adapt program[24], which does not include measurements for the project area as the area is not within the risk of sea-level rise. The project changes (adding traffic lane within the right-of-way of US 50 highway) would not affect drainage or surface water runoff within the area of estimated future sea level rise, and therefore no effect on flood elevations as a result of project would be expected. Given these minor changes in the roadway configurations considered in the proposed project, incorporating additional preventive components to address future sea level rise as part of the project, is considered beyond the scope of the proposed project.

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, Caltrans 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 impacts, Caltrans 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, Caltrans will be able to 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

[24] Cal-Adapt – Exploring California's Climate Change Research. Climate Tools available online at: http://cal-adapt.org/tools/#sealevel Accessed December 2015.

increased precipitation and flooding, the increased frequency and intensity of storms and wildfires, rising temperatures, and rising sea levels. Caltrans is an active participant in the efforts being conducted in response to Executive Order S-13-08 and is mobilizing to be able to respond to the National Academy of Science report on Sea Level Rise Assessment.

Summary of GHG Impact Assessment

Based on the above analysis, GHG emissions from project Build alternatives would not increase substantially compared with the No Build alternative, moreover, the project implementation would:

- Provide congestion relief in order to improve traffic flow and mobility within the proposed corridor of US 50;
- Improve traffic operations, efficiency and safety within the project corridor;
- Comply with the goals of the current SACOG plan (2035 MTP/SCS) to meet the GHG reduction targets within the region.

Furthermore, the project changes (i.e., adding traffic lane within the right-of-way of US 50 highway) would not affect drainage or surface water runoff within the area of estimated future sea level rise, and therefore no effect on flood elevations as a result of project would be expected.

Chapter 6. References

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Appendices

A Operation Emissions – Criteria Pollutants

A1 Operational Emission Calculations

- **Calculation worksheets**
- **Traffic Data – VMT per speed bin**

A2 CO Localized Emissions

- **Screening Flow Charts from CO Protocol**
- **CO Modeling Results Summary**

A3 Qualitative PM Analysis for Conformity Determination

- **Truck percent Changes**
- **Roadway Segments LOS for project Alternatives**

B Operation Emissions – Mobile Source Air Toxics

C Project in Regional Transportation Plans

D Construction Emissions Estimates

E Greenhouse Gas Emissions – Calculation Worksheets

Appendix A

Operation Emissions – Criteria Pollutants

A1 Operational Emissions Calculation

- **Methodology**
- **Calculation Worksheets**
- **Traffic Data for Emissions Calculation**

A2 CO Localized Emissions

- **Screening Analysis Flow Charts from CO Protocol**
- **CO Modeling Results Summary for**
  - **Opening Year 2020**
  - **Horizon Year 2040**

A3 Qualitative PM Analysis for Conformity Determination

- **Truck percent Changes for Project Alternatives**
- **Roadway Segments LOS for Project Alternatives**

A1 Operational Emissions Calculations

- **Methodology**
- **Calculation Worksheets**
- **Roadway Traffic Data for Emissions Calculation**

Methodology

Calculation of operational emissions is based on several data components including traffic data (Wood Rodgers, 2015), EMFAC2014 emission model, Caltrans CT-EMFAC model and the EPA AP-42 5th Edition Section 13.2.1 for re-entrained road dust (EPA, revised January 2011). Methodology and operational emissions of air toxics are discussed in Appendix B.

Traffic Data

Traffic data from the project traffic study (Wood Rodgers, 2015) were provided for segments of US 50 Highway within the proposed project limit. For each project Alternative (including a No Project, Design Options 0, 1 and 2 with the corresponding lane addition/configuration alternatives), the emission data was projected according to alternative, and daily VMT distribution per speed bins of 5 mph interval. The VMT data were provided for direction of traffic (NB/SB) along the US 50 within the project corridor limit. For fleet mix, (vehicle class as trucks and non-trucks categories) the default values from EMFAC2014 for Sacramento County were used in this analysis.

Operational Emissions Calculation

EMFAC2014 On-Road Vehicle Emissions Model Data

The EMFAC2014 Web Database was used to obtain emission data for Sacramento County for each analysis year (2013, 2020, and 2040) to estimate emission factors per speed intervals of 5 mph (i.e., 5, 10, 15, ….) for project emissions analysis. The EMFAC2014 model output contains traffic fleet mix data for all vehicle classes within Sacramento County including daily emissions (tons/day) and vehicle miles travelled (VMT). EMFAC2014 outputs were further processed to aggregate vehicle emissions and VMT data into a composite of vehicle classes. Daily emissions and VMT were summed for all vehicle classes, and an average (composite) emission rate (lbs/mile) was calculated by vehicle speed in 5 mile-per-hour increments.

Emissions Calculation

For each alternative, pollutant emissions along the project corridor of US 50 were calculated based on the composite emission rates calculated above, and daily VMT per speed bin from traffic study information.

For particulate matter (PM_{10} and $PM_{2.5}$), the total emissions include PM in vehicle exhaust emission, tire wear and brake wear, as well as re-entrained road dust. The PM emission rates from vehicle exhaust, tire wear and brake wear, were obtained from EMFAC2014. Emission factors for PM_{10} re-entrained road dust were calculated using the empirical equation provided in EPA's AP-42:

$$E = [\, k\,(sL)^{0.91} \times (W)^{1.02}\,]\,(1 - P/4N)$$ ***Equation 2***

Where,

E = re-entrained particulate emission factor, and:

Parameter Description	Value used in calculations
k=particle size multiplier;	0.0022 lb/VMT
sL=road surface silt loading;	Freeways: 0.02 g/m^2
W=average weight of vehicles traveling the road;	2.4 tons default for Sacramento

P=number of days per year with at least 0.01 inch rain;	57 days/year (Sacramento County)
N=days per period;	365 days/year

The emission factors for intersections CO hot spot analysis were obtained using winter season (worst case for CO emissions from vehicle exhaust) and the fleet aggregate emission rate for different vehicle speeds, to use with CALINE model. (It should be noted that EMFAC2011 emission factors were used for CO hot spot conformity analysis due to the fact that at the time of preparation of this report EPA had not yet adopted EMFAC2014 for conformity analysis. Moreover, according to ARB, the substantial change in EMFAC2014 is mainly for particulate emission rates and there is not substantial change for CO emission rates between EMFAC2011 and EMFAC2014.)

Emission Rates Calculation

				(mph)	(miles/ day)	Running Exhaust Emissiions Using EMFAC2014 (tons/day)						
Region	CalYr	Vehicle Class	Model Yr	Speed	VMT	ROG_RUNEX	TOG_RUNEX	CO_RUNEX	NOx_RUNEX	CO2_RUNEX	PM10_RUNEX	PM2_5_RUNE
Sacramento	2020	All	Aggregate	5	37,059	0.02684	0.05771	0.18247	0.21903	82.5	0.00232	0.00221
Sacramento	2020	All	Aggregate	10	229,081	0.08682	0.16280	0.69519	0.71854	349.9	0.00771	0.00733
Sacramento	2020	All	Aggregate	15	563,845	0.10894	0.17393	1.20126	0.83287	534.3	0.01091	0.01035
Sacramento	2020	All	Aggregate	20	1,638,742	0.18939	0.36558	3.19971	1.59533	1,198.7	0.01786	0.01689
Sacramento	2020	All	Aggregate	25	4,442,172	0.27169	0.36367	6.54593	1.24434	2,191.8	0.01960	0.01829
Sacramento	2020	All	Aggregate	30	3,183,460	0.16405	0.21873	4.27653	1.09719	1,442.0	0.01350	0.01267
Sacramento	2020	All	Aggregate	35	5,449,718	0.22221	0.29930	6.75000	1.37950	2,169.2	0.01676	0.01567
Sacramento	2020	All	Aggregate	40	6,601,361	0.22996	0.30757	7.56696	1.36208	2,386.9	0.01738	0.01624
Sacramento	2020	All	Aggregate	45	2,703,616	0.09471	0.12586	2.87427	0.98541	1,097.5	0.01029	0.00971
Sacramento	2020	All	Aggregate	50	2,834,207	0.09987	0.13041	2.85465	1.26963	1,173.9	0.01253	0.01185
Sacramento	2020	All	Aggregate	55	4,853,406	0.15907	0.20917	4.73819	1.46920	1,888.1	0.01794	0.01692
Sacramento	2020	All	Aggregate	60	3,672,750	0.12474	0.16597	3.50330	0.82086	1,446.0	0.01485	0.01401
Sacramento	2020	All	Aggregate	65	557,773	0.02164	0.02869	0.53460	0.18534	264.0	0.00277	0.00262
Sacramento	2020	All	Aggregate	70	135,372	0.00536	0.00709	0.13219	0.01645	56.1	0.00028	0.00026
Sacramento	2040	All	Aggregate	5	31,057	0.01189	0.03244	0.12754	0.17213	71.6	0.00038	0.00036
Sacramento	2040	All	Aggregate	10	232,462	0.04296	0.08991	0.43150	0.56561	301.3	0.00156	0.00147
Sacramento	2040	All	Aggregate	15	573,419	0.05364	0.08367	0.56936	0.46545	426.8	0.00254	0.00238
Sacramento	2040	All	Aggregate	20	1,801,849	0.09594	0.16027	1.48157	0.73499	989.3	0.00473	0.00442
Sacramento	2040	All	Aggregate	25	5,047,424	0.15644	0.20786	3.25445	0.42811	1,698.8	0.00768	0.00712
Sacramento	2040	All	Aggregate	30	3,616,749	0.09409	0.12537	2.13765	0.34444	1,164.9	0.00479	0.00446
Sacramento	2040	All	Aggregate	35	6,278,387	0.13224	0.17907	3.44205	0.44534	1,775.4	0.00645	0.00598
Sacramento	2040	All	Aggregate	40	7,619,985	0.13619	0.18064	3.83316	0.42218	1,938.1	0.00656	0.00608
Sacramento	2040	All	Aggregate	45	3,141,996	0.05608	0.07438	1.46431	0.25594	987.6	0.00324	0.00303
Sacramento	2040	All	Aggregate	50	3,234,987	0.05429	0.06998	1.39025	0.25036	1,030.1	0.00354	0.00331
Sacramento	2040	All	Aggregate	55	5,614,037	0.09053	0.11672	2.34994	0.32511	1,616.3	0.00514	0.00479
Sacramento	2040	All	Aggregate	60	4,251,752	0.07122	0.09251	1.71439	0.20121	1,196.8	0.00358	0.00332
Sacramento	2040	All	Aggregate	65	651,841	0.01252	0.01618	0.26234	0.04207	232.5	0.00071	0.00066
Sacramento	2040	All	Aggregate	70	155,804	0.00324	0.00422	0.06549	0.00577	42.2	0.00013	0.00012
Sacramento	2013	All	Aggregate	5	55,615	0.06984	0.11638	0.39771	0.32942	112.0	0.00859	0.00820
Sacramento	2013	All	Aggregate	10	259,483	0.22028	0.33953	1.44822	1.10202	416.4	0.02987	0.02852
Sacramento	2013	All	Aggregate	15	607,180	0.24150	0.35383	2.49516	1.38434	630.0	0.03249	0.03098
Sacramento	2013	All	Aggregate	20	1,687,930	0.40590	0.70569	6.43889	2.80179	1,384.0	0.05089	0.04845
Sacramento	2013	All	Aggregate	25	3,946,859	0.53263	0.68762	11.81073	2.31138	2,285.6	0.03665	0.03459
Sacramento	2013	All	Aggregate	30	2,604,789	0.31171	0.39869	7.15032	2.01837	1,381.8	0.03159	0.02999
Sacramento	2013	All	Aggregate	35	4,408,016	0.42841	0.54874	11.23959	2.59464	2,051.9	0.04024	0.03815
Sacramento	2013	All	Aggregate	40	5,029,351	0.42398	0.54113	11.91691	2.58243	2,137.8	0.04015	0.03807
Sacramento	2013	All	Aggregate	45	2,595,216	0.23016	0.29012	5.91489	2.10089	1,169.0	0.03764	0.03586
Sacramento	2013	All	Aggregate	50	2,809,861	0.24521	0.30738	6.09629	2.70314	1,294.4	0.04447	0.04239
Sacramento	2013	All	Aggregate	55	4,153,260	0.35393	0.44393	8.97457	3.16245	1,855.9	0.06271	0.05975
Sacramento	2013	All	Aggregate	60	3,920,647	0.33428	0.42352	8.45978	2.11512	1,760.4	0.04636	0.04410
Sacramento	2013	All	Aggregate	65	481,542	0.05147	0.06459	1.13900	0.42734	260.0	0.01092	0.01042
Sacramento	2013	All	Aggregate	70	146,940	0.01352	0.01712	0.33209	0.04201	72.0	0.00040	0.00037

Emission Rates Calculation

	(mph)	Emission Rate (lbs/mile)						
CalYr	Speed	ROG_RUNEX	TOG_RUNEX	CO_RUNEX	NOx_RUNEX	CO2_RUNEX	PM10_RUNEX	PM2_5_RUNEX
2020	5	0.0014484	0.0031143	0.009848	0.0118205	4.45233	1.250E-04	1.193E-04
2020	10	0.0007580	0.0014213	0.006069	0.0062732	3.05525	6.731E-05	6.402E-05
2020	15	0.0003864	0.0006169	0.004261	0.0029543	1.89518	3.870E-05	3.672E-05
2020	20	0.0002311	0.0004462	0.003905	0.0019470	1.46295	2.180E-05	2.061E-05
2020	25	1.223E-04	1.637E-04	0.002947	0.0005602	0.98683	8.823E-06	8.234E-06
2020	30	1.031E-04	1.374E-04	0.002687	0.0006893	0.90595	8.483E-06	7.958E-06
2020	35	8.155E-05	1.098E-04	0.002477	0.0005063	0.79608	6.151E-06	5.752E-06
2020	40	6.967E-05	9.319E-05	0.002293	0.0004127	0.72316	5.265E-06	4.920E-06
2020	45	7.006E-05	9.311E-05	0.002126	0.0007290	0.81188	7.615E-06	7.184E-06
2020	50	7.047E-05	9.202E-05	0.002014	0.0008959	0.82836	8.842E-06	8.364E-06
2020	55	6.555E-05	8.620E-05	0.001953	0.0006054	0.77804	7.392E-06	6.971E-06
2020	60	6.793E-05	9.038E-05	0.001908	0.0004470	0.78745	8.089E-06	7.628E-06
2020	65	7.758E-05	1.029E-04	0.001917	0.0006646	0.94655	9.940E-06	9.389E-06
2020	70	7.919E-05	1.047E-04	0.001953	0.0002430	0.82829	4.118E-06	3.798E-06
2040	5	0.0007654	0.0020893	0.008213	0.0110850	4.61041	2.466E-05	2.341E-05
2040	10	0.0003696	0.0007736	0.003712	0.0048662	2.59215	1.342E-05	1.265E-05
2040	15	0.0001871	0.0002918	0.001986	0.0016234	1.48876	8.847E-06	8.314E-06
2040	20	0.0001065	0.0001779	0.001644	0.0008158	1.09813	5.245E-06	4.904E-06
2040	25	6.199E-05	8.236E-05	0.001290	0.0001696	0.67315	3.044E-06	2.819E-06
2040	30	5.203E-05	6.933E-05	0.001182	0.0001905	0.64419	2.651E-06	2.465E-06
2040	35	4.212E-05	5.704E-05	0.001096	0.0001419	0.56555	2.053E-06	1.906E-06
2040	40	3.575E-05	4.741E-05	0.001006	0.0001108	0.50868	1.722E-06	1.596E-06
2040	45	3.570E-05	4.734E-05	0.000932	0.0001629	0.62867	2.062E-06	1.929E-06
2040	50	3.357E-05	4.326E-05	0.000860	0.0001548	0.63682	2.186E-06	2.049E-06
2040	55	3.225E-05	4.158E-05	0.000837	0.0001158	0.57582	1.830E-06	1.706E-06
2040	60	3.350E-05	4.352E-05	0.000806	0.0000946	0.56299	1.684E-06	1.563E-06
2040	65	3.841E-05	4.964E-05	0.000805	0.0001291	0.71329	2.184E-06	2.036E-06
2040	70	4.165E-05	5.412E-05	0.000841	0.0000741	0.54185	1.724E-06	1.587E-06
2013	5	0.0025115	0.0041852	0.014302	0.0118465	4.02595	3.089E-04	2.949E-04
2013	10	0.0016978	0.0026170	0.011162	0.0084940	3.20921	2.302E-04	2.198E-04
2013	15	0.0007955	0.0011655	0.008219	0.0045599	2.07513	1.070E-04	1.021E-04
2013	20	0.0004809	0.0008362	0.007629	0.0033198	1.63988	6.030E-05	5.740E-05
2013	25	2.699E-04	3.484E-04	0.005985	0.0011712	1.15819	1.857E-05	1.753E-05
2013	30	2.393E-04	3.061E-04	0.005490	0.0015497	1.06097	2.426E-05	2.303E-05
2013	35	1.944E-04	2.490E-04	0.005100	0.0011772	0.93097	1.826E-05	1.731E-05
2013	40	1.686E-04	2.152E-04	0.004739	0.0010269	0.85013	1.597E-05	1.514E-05
2013	45	1.774E-04	2.236E-04	0.004558	0.0016190	0.90089	2.901E-05	2.763E-05
2013	50	1.745E-04	2.188E-04	0.004339	0.0019240	0.92132	3.166E-05	3.017E-05
2013	55	1.704E-04	2.138E-04	0.004322	0.0015229	0.89373	3.020E-05	2.877E-05
2013	60	1.705E-04	2.160E-04	0.004316	0.0010790	0.89802	2.365E-05	2.249E-05
2013	65	2.138E-04	2.683E-04	0.004731	0.0017749	1.07995	4.537E-05	4.326E-05
2013	70	1.840E-04	2.330E-04	0.004520	0.0005718	0.98023	5.491E-06	5.091E-06

Operational Emissions Calculations
No Project Alternative

Year	Speed bin (mph)	Daily VMT	No Build Alternatve Emissions (lbs/day)												
			Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10}_e	$PM_{2.5}$_	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	61,722	5.0	6.8	152.9	31.2	49136	0.4	0.4	9.1	1.4	6.9	2.7	16.3	4.5
2020	40	136,042	9.5	12.7	311.9	56.1	98381	0.7	0.7	20.0	3.0	15.2	6.0	35.9	9.7
2020	45	262,870	18.4	24.5	558.9	191.6	213418	2.0	1.9	38.6	5.8	29.4	11.7	70.0	19.4
2020	50	360,613	25.4	33.2	726.4	323.1	298717	3.2	3.0	53.0	7.9	40.3	16.0	96.4	27.0
2020	55	413,713	27.1	35.7	807.8	250.5	321885	3.1	2.9	60.8	9.1	46.2	18.4	110.0	30.4
2020	60	469,658	31.9	42.4	896.0	209.9	369831	3.8	3.6	69.0	10.3	52.4	20.9	125.2	34.8
2020	65	414,770	32.2	42.7	795.1	275.6	392602	4.1	3.9	60.9	9.1	46.3	18.4	111.3	31.5
2020	70	96,774	7.7	10.1	189.0	23.5	80157	0.4	0.4	14.2	2.1	10.8	4.3	25.4	6.8
Year Total		***2,216,162***	***157.2***	***208.0***	***4438.0***	***1361.7***	***1,824,126***	*17.7*	*16.7*	*325.4*	*48.8*	*247.5*	*98.4*	***590.6***	***163.9***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,512	2.2	2.9	45.8	6.0	23905	0.1	0.1	5.2	0.8	3.9	1.6	9.2	2.4
2040	30	74,009	3.9	5.1	87.5	14.1	47676	0.2	0.2	10.9	1.6	8.2	3.2	19.2	5.1
2040	35	139,004	5.9	7.9	152.4	19.7	78614	0.3	0.3	20.4	3.1	15.3	6.1	36.0	9.4
2040	40	516,036	18.4	24.5	519.2	57.2	262498	0.9	0.8	75.8	11.4	57.0	22.6	133.6	34.8
2040	45	445,486	15.9	21.1	415.2	72.6	280063	0.9	0.9	65.4	9.8	49.2	19.5	115.5	30.2
2040	50	541,603	18.2	23.4	465.5	83.8	344903	1.2	1.1	79.5	11.9	59.8	23.7	140.5	36.8
2040	55	327,806	10.6	13.6	274.4	38.0	188755	0.6	0.6	48.1	7.2	36.2	14.4	84.9	22.1
2040	60	358,594	12.0	15.6	289.2	33.9	201885	0.6	0.6	52.7	7.9	39.6	15.7	92.9	24.2
2040	65	179,516	6.9	8.9	144.5	23.2	128047	0.4	0.4	26.4	4.0	19.8	7.9	46.6	12.2
2040	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Year Total		***2,617,566***	***93.9***	***123.1***	***2393.7***	***348.5***	***1,556,346***	*5.2*	*4.8*	*384.4*	*57.7*	*289.0*	*114.7*	***678.5***	***177.2***
2013	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	35	27,119	5.3	6.8	138.3	31.9	25247	0.5	0.5	4.0	0.6	3.1	1.2	7.6	2.3
2013	40	110,383	18.6	23.8	523.1	113.4	93840	1.8	1.7	16.2	2.4	12.6	5.0	30.6	9.1
2013	45	146,401	26.0	32.7	667.3	237.0	131891	4.2	4.0	21.5	3.2	16.7	6.7	42.4	13.9
2013	50	403,295	70.4	88.2	1750.0	776.0	371564	12.8	12.2	59.2	8.9	46.0	18.3	118.0	39.4
2013	55	408,607	69.6	87.4	1765.9	622.3	365183	12.3	11.8	60.0	9.0	46.6	18.6	119.0	39.3
2013	60	273,897	46.7	59.2	1182.0	295.5	245966	6.5	6.2	40.2	6.0	31.2	12.5	77.9	24.7
2013	65	551,991	118.0	148.1	2611.3	979.7	596120	25.0	23.9	81.1	12.2	63.0	25.1	169.1	61.2
2013	70	57,587	10.6	13.4	260.3	32.9	56449	0.3	0.3	8.5	1.3	6.6	2.6	15.3	4.2
Year Total		***1,979,279***	***365.2***	***459.5***	***8898.2***	***3088.7***	***1,886,259***	*63.4*	*60.4*	*290.7*	*43.6*	*225.8*	*90.0*	***579.9***	***194.1***

Operational Emissions Calculations

Design Option 0 Alternatives

Year	Speed bin (mph)	Option 0 - Add HOV Lanes Alternatve Emissions (lbs/day)													
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	90,898	7.4	10.0	225.2	46.0	72362	0.6	0.5	13.3	2.0	10.2	4.0	24.1	6.6
2020	40	82,088	5.7	7.6	188.2	33.9	59363	0.4	0.4	12.1	1.8	9.2	3.6	21.7	5.9
2020	45	106,196	7.4	9.9	225.8	77.4	86218	0.8	0.8	15.6	2.3	11.9	4.7	28.3	7.8
2020	50	205,174	14.5	18.9	413.3	183.8	169958	1.8	1.7	30.1	4.5	22.9	9.1	54.9	15.4
2020	55	411,720	27.0	35.5	803.9	249.3	320335	3.0	2.9	60.5	9.1	46.0	18.3	109.5	30.2
2020	60	419,071	28.5	37.9	799.5	187.3	329996	3.4	3.2	61.5	9.2	46.8	18.6	111.7	31.0
2020	65	644,406	50.0	66.3	1235.3	428.3	609966	6.4	6.1	94.6	14.2	72.0	28.6	173.0	48.9
2020	70	314,314	24.9	32.9	613.9	76.4	260341	1.3	1.2	46.2	6.9	35.1	14.0	82.6	22.1
Year Total		***2,273,868***	***165.4***	***219.0***	***4505.0***	***1282.4***	***1,908,539***	*17.7*	*16.7*	*333.9*	*50.1*	*253.9*	*101.0*	***605.6***	***167.8***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,759	2.2	2.9	46.1	6.1	24071	0.1	0.1	5.3	0.8	3.9	1.6	9.3	2.5
2040	30	89,593	4.7	6.2	105.9	17.1	57715	0.2	0.2	13.2	2.0	9.9	3.9	23.3	6.1
2040	35	94,254	4.0	5.4	103.3	13.4	53305	0.2	0.2	13.8	2.1	10.4	4.1	24.4	6.4
2040	40	193,234	6.9	9.2	194.4	21.4	98294	0.3	0.3	28.4	4.3	21.3	8.5	50.0	13.0
2040	45	261,140	9.3	12.4	243.4	42.5	164170	0.5	0.5	38.3	5.8	28.8	11.4	67.7	17.7
2040	50	515,560	17.3	22.3	443.1	79.8	328319	1.1	1.1	75.7	11.4	56.9	22.6	133.8	35.0
2040	55	412,984	13.3	17.2	345.7	47.8	237802	0.8	0.7	60.6	9.1	45.6	18.1	107.0	27.9
2040	60	488,941	16.4	21.3	394.3	46.3	275269	0.8	0.8	71.8	10.8	54.0	21.4	126.6	33.0
2040	65	517,986	19.9	25.7	416.9	66.9	369474	1.1	1.1	76.1	11.4	57.2	22.7	134.4	35.2
2040	70	103,205	4.3	5.6	86.8	7.6	55922	0.2	0.2	15.2	2.3	11.4	4.5	26.7	7.0
Year Total		***2,712,656***	***98.3***	***128.1***	***2380.1***	***348.9***	***1,664,342***	*5.4*	*5.1*	*398.4*	*59.8*	*299.5*	*118.9*	***703.3***	***183.7***

Operational Emissions Calculations

Design Option 0 Alternatives

Year	Speed bin (mph)	Option 0 - Add Mixed Flow Lanes Alternatve Emissions (lbs/day)													
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	98,706	8.0	10.8	244.5	50.0	78578	0.6	0.6	14.5	2.2	11.0	4.4	26.1	7.1
2020	40	80,283	5.6	7.5	184.1	33.1	58058	0.4	0.4	11.8	1.8	9.0	3.6	21.2	5.7
2020	45	123,506	8.7	11.5	262.6	90.0	100272	0.9	0.9	18.1	2.7	13.8	5.5	32.9	9.1
2020	50	246,337	17.4	22.7	496.2	220.7	204055	2.2	2.1	36.2	5.4	27.5	10.9	65.9	18.4
2020	55	465,601	30.5	40.1	909.1	281.9	362256	3.4	3.2	68.4	10.3	52.0	20.7	123.8	34.2
2020	60	459,982	31.2	41.6	877.5	205.6	362212	3.7	3.5	67.5	10.1	51.4	20.4	122.6	34.1
2020	65	564,646	43.8	58.1	1082.4	375.3	534468	5.6	5.3	82.9	12.4	63.1	25.1	151.6	42.8
2020	70	237,967	18.8	24.9	464.8	57.8	197104	1.0	0.9	34.9	5.2	26.6	10.6	62.5	16.7
Year Total		***2,277,028***	***164.1***	***217.2***	***4521.1***	***1314.4***	***1,897,003***	*17.9*	*16.9*	*334.4*	*50.2*	*254.3*	*101.1*	***606.6***	***168.2***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,752	2.2	2.9	46.1	6.1	24066	0.1	0.1	5.3	0.8	3.9	1.6	9.3	2.5
2040	30	89,550	4.7	6.2	105.9	17.1	57687	0.2	0.2	13.2	2.0	9.9	3.9	23.3	6.1
2040	35	113,734	4.8	6.5	124.7	16.1	64322	0.2	0.2	16.7	2.5	12.6	5.0	29.5	7.7
2040	40	227,939	8.1	10.8	229.3	25.3	115948	0.4	0.4	33.5	5.0	25.2	10.0	59.0	15.4
2040	45	320,785	11.5	15.2	299.0	52.3	201667	0.7	0.6	47.1	7.1	35.4	14.1	83.2	21.7
2040	50	618,369	20.8	26.8	531.5	95.7	393789	1.4	1.3	90.8	13.6	68.3	27.1	160.4	42.0
2040	55	416,208	13.4	17.3	348.4	48.2	239659	0.8	0.7	61.1	9.2	45.9	18.2	107.8	28.1
2040	60	393,332	13.2	17.1	317.2	37.2	221443	0.7	0.6	57.8	8.7	43.4	17.2	101.8	26.5
2040	65	469,735	18.0	23.3	378.1	60.6	335056	1.0	1.0	69.0	10.4	51.9	20.6	121.9	31.9
2040	70	28,951	1.2	1.6	24.3	2.1	15687	0.0	0.0	4.3	0.6	3.2	1.3	7.5	2.0
Year Total		***2,714,354***	***97.9***	***127.7***	***2404.6***	***360.7***	***1,669,325***	*5.5*	*5.1*	*398.6*	*59.8*	*299.7*	*118.9*	***703.8***	***183.9***

Operational Emissions Calculations

Design Option 0 Alternatives

Year	Speed bin (mph)	Option 0 - Take a Lane Alternatve Emissions (lbs/day)													
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	$PM_{10\_}$	$PM_{2.5\_}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	61,691	5.0	6.8	152.8	31.2	49111	0.4	0.4	9.1	1.4	6.9	2.7	16.3	4.5
2020	40	86,343	6.0	8.0	197.9	35.6	62440	0.5	0.4	12.7	1.9	9.6	3.8	22.8	6.2
2020	45	163,394	11.4	15.2	347.4	119.1	132656	1.2	1.2	24.0	3.6	18.2	7.3	43.5	12.0
2020	50	346,682	24.4	31.9	698.4	310.6	287177	3.1	2.9	50.9	7.6	38.7	15.4	92.7	25.9
2020	55	448,223	29.4	38.6	875.2	271.4	348736	3.3	3.1	65.8	9.9	50.1	19.9	119.2	32.9
2020	60	420,934	28.6	38.0	803.0	188.2	331463	3.4	3.2	61.8	9.3	47.0	18.7	112.2	31.2
2020	65	539,707	41.9	55.5	1034.6	358.7	510862	5.4	5.1	79.3	11.9	60.3	24.0	144.9	40.9
2020	70	137,373	10.9	14.4	268.3	33.4	113784	0.6	0.5	20.2	3.0	15.3	6.1	36.1	9.7
Year Total		***2,204,346***	***157.7***	***208.5***	***4377.6***	***1348.2***	***1,836,228***	*17.8*	*16.8*	*323.7*	*48.6*	*246.2*	*97.9*	***587.7***	***163.3***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,519	2.2	2.9	45.8	6.0	23910	0.1	0.1	5.2	0.8	4.0	1.6	9.3	2.5
2040	30	70,274	3.7	4.9	83.1	13.4	45270	0.2	0.2	10.3	1.5	7.8	3.1	18.4	4.8
2040	35	58,478	2.5	3.3	64.1	8.3	33072	0.1	0.1	8.6	1.3	6.5	2.6	15.2	4.0
2040	40	284,589	10.2	13.5	286.3	31.5	144765	0.5	0.5	41.8	6.3	31.8	12.6	74.1	19.4
2040	45	380,702	13.6	18.0	354.8	62.0	239335	0.8	0.7	55.9	8.4	42.5	16.9	99.2	26.0
2040	50	606,452	20.4	26.2	521.2	93.9	386201	1.3	1.2	89.1	13.4	67.7	26.9	158.1	41.5
2040	55	413,115	13.3	17.2	345.8	47.8	237878	0.8	0.7	60.7	9.1	46.1	18.4	107.6	28.2
2040	60	469,266	15.7	20.4	378.4	44.4	264192	0.8	0.7	68.9	10.3	52.4	20.8	122.1	31.9
2040	65	282,506	10.9	14.0	227.4	36.5	201508	0.6	0.6	41.5	6.2	31.5	12.5	73.7	19.3
2040	70	16,014	0.7	0.9	13.5	1.2	8677	0.0	0.0	2.4	0.4	1.8	0.7	4.2	1.1
Year Total		***2,616,914***	***93.0***	***121.4***	***2320.6***	***345.0***	***1,584,808***	*5.2*	*4.9*	*384.3*	*57.7*	*292.2*	*116.2*	***681.7***	***178.8***

Operational Emissions Calculations
Design Option 1 Alternatives

Year	Speed bin (mph)	Daily VMT	Option 1 - Add HOV Lanes Alternatve Emissions (lbs/day)												
			Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10}_e	$PM_{2.5}$_e	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	91,199	7.4	10.0	225.9	46.2	72601	0.6	0.5	13.4	2.0	10.2	4.1	24.1	6.6
2020	40	62,283	4.3	5.8	142.8	25.7	45041	0.3	0.3	9.1	1.4	7.0	2.8	16.4	4.4
2020	45	38,373	2.7	3.6	81.6	28.0	31154	0.3	0.3	5.6	0.8	4.3	1.7	10.2	2.8
2020	50	169,553	11.9	15.6	341.6	151.9	140451	1.5	1.4	24.9	3.7	18.9	7.5	45.3	12.7
2020	55	381,737	25.0	32.9	745.3	231.1	297007	2.8	2.7	56.1	8.4	42.6	17.0	101.5	28.0
2020	60	427,906	29.1	38.7	816.3	191.3	336953	3.5	3.3	62.8	9.4	47.8	19.0	114.1	31.7
2020	65	760,060	59.0	78.2	1457.0	505.1	719438	7.6	7.1	111.6	16.7	84.9	33.8	204.0	57.6
2020	70	351,026	27.8	36.8	685.6	85.3	290750	1.4	1.3	51.5	7.7	39.2	15.6	92.2	24.7
Year Total		***2,282,138***	***167.3***	***221.5***	***4496.1***	***1264.6***	***1,933,396***	*18.0*	*16.9*	*335.1*	*50.3*	*254.8*	*101.4*	***607.9***	***168.6***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,993	2.2	3.0	46.4	6.1	24229	0.1	0.1	5.3	0.8	4.0	1.6	9.4	2.5
2040	30	94,389	4.9	6.5	111.6	18.0	60804	0.3	0.2	13.9	2.1	10.4	4.1	24.5	6.4
2040	35	70,752	3.0	4.0	77.6	10.0	40014	0.1	0.1	10.4	1.6	7.8	3.1	18.3	4.8
2040	40	79,323	2.8	3.8	79.8	8.8	40350	0.1	0.1	11.6	1.7	8.8	3.5	20.5	5.3
2040	45	219,852	7.8	10.4	204.9	35.8	138214	0.5	0.4	32.3	4.8	24.3	9.6	57.0	14.9
2040	50	498,019	16.7	21.5	428.1	77.1	317149	1.1	1.0	73.1	11.0	55.0	21.8	129.2	33.8
2040	55	447,342	14.4	18.6	374.5	51.8	257586	0.8	0.8	65.7	9.9	49.4	19.6	115.9	30.2
2040	60	567,295	19.0	24.7	457.5	53.7	319382	1.0	0.9	83.3	12.5	62.6	24.9	146.9	38.2
2040	65	600,349	23.1	29.8	483.2	77.5	428222	1.3	1.2	88.2	13.2	66.3	26.3	155.8	40.8
2040	70	117,456	4.9	6.4	98.7	8.7	63644	0.2	0.2	17.2	2.6	13.0	5.1	30.4	7.9
Year Total		***2,730,769***	***98.9***	***128.7***	***2362.3***	***347.5***	***1,689,593***	*5.5*	*5.1*	*401.0*	*60.2*	*301.5*	*119.6*	***708.0***	***184.9***

Operational Emissions Calculations

Design Option 1 Alternatives

Year	Speed bin (mph)	Option 1 - Add Mixed Flow Lanes Alternatve Emissions (lbs/day)													
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10_e}	$PM_{2.5\_(}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	99,042	8.1	10.9	245.3	50.1	78845	0.6	0.6	14.5	2.2	11.1	4.4	26.2	7.2
2020	40	66,217	4.6	6.2	151.8	27.3	47886	0.3	0.3	9.7	1.5	7.4	2.9	17.5	4.7
2020	45	86,198	6.0	8.0	183.3	62.8	69982	0.7	0.6	12.7	1.9	9.6	3.8	22.9	6.3
2020	50	233,467	16.5	21.5	470.3	209.2	193395	2.1	2.0	34.3	5.1	26.1	10.4	62.4	17.5
2020	55	423,439	27.8	36.5	826.8	256.4	329452	3.1	3.0	62.2	9.3	47.3	18.8	112.6	31.1
2020	60	454,009	30.8	41.0	866.1	202.9	357508	3.7	3.5	66.7	10.0	50.7	20.2	121.0	33.6
2020	65	667,276	51.8	68.7	1279.1	443.5	631613	6.6	6.3	98.0	14.7	74.5	29.6	179.1	50.6
2020	70	255,980	20.3	26.8	499.9	62.2	212024	1.1	1.0	37.6	5.6	28.6	11.4	67.2	18.0
Year Total		***2,285,628***	***165.8***	***219.6***	***4522.7***	***1314.4***	***1,920,705***	*18.2*	*17.1*	*335.6*	*50.4*	*255.2*	*101.5*	***609.0***	***169.0***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,997	2.2	3.0	46.4	6.1	24231	0.1	0.1	5.3	0.8	4.0	1.6	9.4	2.5
2040	30	94,423	4.9	6.5	111.6	18.0	60826	0.3	0.2	13.9	2.1	10.4	4.1	24.5	6.5
2040	35	84,029	3.5	4.8	92.1	11.9	47522	0.2	0.2	12.3	1.9	9.3	3.7	21.8	5.7
2040	40	134,160	4.8	6.4	135.0	14.9	68245	0.2	0.2	19.7	3.0	14.8	5.9	34.7	9.0
2040	45	336,428	12.0	15.9	313.6	54.8	211501	0.7	0.6	49.4	7.4	37.1	14.7	87.2	22.8
2040	50	549,186	18.4	23.8	472.0	85.0	349733	1.2	1.1	80.6	12.1	60.6	24.1	142.5	37.3
2040	55	472,716	15.2	19.7	395.7	54.7	272197	0.9	0.8	69.4	10.4	52.2	20.7	122.5	31.9
2040	60	431,207	14.4	18.8	347.7	40.8	242766	0.7	0.7	63.3	9.5	47.6	18.9	111.7	29.1
2040	65	544,994	20.9	27.1	438.7	70.4	388738	1.2	1.1	80.0	12.0	60.2	23.9	141.4	37.0
2040	70	50,303	2.1	2.7	42.3	3.7	27257	0.1	0.1	7.4	1.1	5.6	2.2	13.0	3.4
Year Total		***2,733,443***	***98.6***	***128.5***	***2395.2***	***360.3***	***1,693,016***	*5.5*	*5.2*	*401.4*	*60.2*	*301.8*	*119.8*	***708.7***	***185.1***

Operational Emissions Calculations

Design Option 1 Alternatives

Year	Speed bin (mph)	Option 1 - Take a Lane Alternatve Emissions (lbs/day)													
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	61,673	5.0	6.8	152.8	31.2	49097	0.4	0.4	9.1	1.4	6.9	2.7	16.3	4.5
2020	40	74,545	5.2	6.9	170.9	30.8	53908	0.4	0.4	10.9	1.6	8.3	3.3	19.7	5.3
2020	45	148,680	10.4	13.8	316.1	108.4	120710	1.1	1.1	21.8	3.3	16.6	6.6	39.6	10.9
2020	50	330,123	23.3	30.4	665.0	295.8	273461	2.9	2.8	48.5	7.3	36.9	14.7	88.3	24.7
2020	55	453,635	29.7	39.1	885.7	274.6	352946	3.4	3.2	66.6	10.0	50.7	20.2	120.6	33.3
2020	60	383,292	26.0	34.6	731.2	171.3	301822	3.1	2.9	56.3	8.4	42.8	17.0	102.2	28.4
2020	65	598,747	46.5	61.6	1147.7	397.9	566747	6.0	5.6	87.9	13.2	66.9	26.6	160.7	45.4
2020	70	151,728	12.0	15.9	296.3	36.9	125674	0.6	0.6	22.3	3.3	16.9	6.7	39.8	10.7
Year Total		***2,202,424***	***158.1***	***209.2***	***4365.8***	***1346.9***	***1,844,365***	*17.9*	*16.8*	*323.4*	*48.5*	*245.9*	*97.8*	***587.2***	***163.2***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,510	2.2	2.9	45.8	6.0	23903	0.1	0.1	5.2	0.8	4.0	1.6	9.3	2.5
2040	30	70,255	3.7	4.9	83.0	13.4	45257	0.2	0.2	10.3	1.5	7.8	3.1	18.3	4.8
2040	35	58,465	2.5	3.3	64.1	8.3	33065	0.1	0.1	8.6	1.3	6.5	2.6	15.2	4.0
2040	40	245,901	8.8	11.7	247.4	27.2	125085	0.4	0.4	36.1	5.4	27.5	10.9	64.0	16.7
2040	45	380,571	13.6	18.0	354.7	62.0	239253	0.8	0.7	55.9	8.4	42.5	16.9	99.2	26.0
2040	50	579,666	19.5	25.1	498.2	89.7	369143	1.3	1.2	85.1	12.8	64.7	25.7	151.1	39.7
2040	55	484,683	15.6	20.2	405.8	56.1	279088	0.9	0.8	71.2	10.7	54.1	21.5	126.2	33.0
2040	60	408,821	13.7	17.8	329.7	38.7	230163	0.7	0.6	60.0	9.0	45.7	18.2	106.4	27.8
2040	65	322,288	12.4	16.0	259.4	41.6	229885	0.7	0.7	47.3	7.1	36.0	14.3	84.0	22.1
2040	70	16,007	0.7	0.9	13.5	1.2	8673	0.0	0.0	2.4	0.4	1.8	0.7	4.2	1.1
Year Total		***2,602,167***	***92.5***	***120.7***	***2301.6***	***344.3***	***1,583,515***	*5.2*	*4.8*	*382.1*	*57.3*	*290.6*	*115.6*	***677.9***	***177.8***

Operational Emissions Calculations

Design Option 2 Alternatives

Year	Speed bin (mph)	Option 2 - Add HOV Lanes Alternatve Emissions (lbs/day)													
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM	
			ROG	TOG	CO	NOx	CO_2	PM_{10}_e	$PM_{2.5}$_(	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	91,000	7.4	10.0	225.4	46.1	72443	0.6	0.5	13.4	2.0	10.2	4.0	24.1	6.6
2020	40	76,427	5.3	7.1	175.2	31.5	55269	0.4	0.4	11.2	1.7	8.5	3.4	20.2	5.5
2020	45	93,773	6.6	8.7	199.4	68.4	76132	0.7	0.7	13.8	2.1	10.5	4.2	25.0	6.9
2020	50	184,089	13.0	16.9	370.8	164.9	152492	1.6	1.5	27.0	4.1	20.6	8.2	49.2	13.8
2020	55	406,186	26.6	35.0	793.1	245.9	316029	3.0	2.8	59.6	9.0	45.4	18.0	108.0	29.8
2020	60	413,620	28.1	37.4	789.1	184.9	325704	3.3	3.2	60.7	9.1	46.2	18.4	110.3	30.6
2020	65	692,771	53.7	71.3	1328.0	460.4	655745	6.9	6.5	101.7	15.3	77.4	30.8	186.0	52.5
2020	70	332,600	26.3	34.8	649.6	80.8	275488	1.4	1.3	48.8	7.3	37.1	14.8	87.4	23.4
	Year Total	***2,290,467***	***167.1***	***221.3***	***4530.6***	***1282.9***	***1,929,303***	*17.9*	*16.9*	*336.4*	*50.5*	*255.8*	*101.7*	***610.0***	***169.1***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,480	2.2	2.9	45.8	6.0	23884	0.1	0.1	5.2	0.8	3.9	1.6	9.2	2.4
2040	30	89,153	4.6	6.2	105.4	17.0	57432	0.2	0.2	13.1	2.0	9.8	3.9	23.2	6.1
2040	35	94,240	4.0	5.4	103.3	13.4	53297	0.2	0.2	13.8	2.1	10.4	4.1	24.4	6.4
2040	40	174,287	6.2	8.3	175.3	19.3	88657	0.3	0.3	25.6	3.8	19.2	7.6	45.1	11.8
2040	45	212,694	7.6	10.1	198.2	34.7	133713	0.4	0.4	31.2	4.7	23.5	9.3	55.2	14.4
2040	50	520,422	17.5	22.5	447.3	80.6	331415	1.1	1.1	76.4	11.5	57.5	22.8	135.0	35.3
2040	55	401,358	12.9	16.7	336.0	46.5	231108	0.7	0.7	58.9	8.8	44.3	17.6	104.0	27.1
2040	60	521,136	17.5	22.7	420.3	49.3	293395	0.9	0.8	76.5	11.5	57.5	22.8	134.9	35.1
2040	65	569,309	21.9	28.3	458.3	73.5	406082	1.2	1.2	83.6	12.5	62.9	24.9	147.7	38.6
2040	70	111,315	4.6	6.0	93.6	8.3	60316	0.2	0.2	16.3	2.5	12.3	4.9	28.8	7.5
	Year Total	***2,729,395***	***99.0***	***129.0***	***2383.5***	***348.4***	***1,679,299***	*5.5*	*5.1*	*400.8*	*60.1*	*301.3*	*119.6*	***707.6***	***184.8***

Operational Emissions Calculations

Design Option 2 Alternatives

Year	Speed bin (mph)	Option 2 - Take a Lane Alternatve Emissions (lbs/day)														
		Daily VMT	Exhaust Emission							Road Dust		TW+BW		Total PM		
			ROG	TOG	CO	NOx	CO_2	PM_{10_e}	$PM_{2.5\_}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
2020	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020	35	61,678	5.0	6.8	152.8	31.2	49100	0.4	0.4	9.1	1.4	6.9	2.7	16.3	4.5
2020	40	92,078	6.4	8.6	211.1	38.0	66587	0.5	0.5	13.5	2.0	10.3	4.1	24.3	6.6
2020	45	164,527	11.5	15.3	349.8	119.9	133576	1.3	1.2	24.2	3.6	18.4	7.3	43.8	12.1
2020	50	353,483	24.9	32.5	712.1	316.7	292811	3.1	3.0	51.9	7.8	39.5	15.7	94.5	26.4
2020	55	432,738	28.4	37.3	844.9	262.0	336687	3.2	3.0	63.5	9.5	48.3	19.2	115.1	31.8
2020	60	415,659	28.2	37.6	793.0	185.8	327310	3.4	3.2	61.0	9.2	46.4	18.5	110.8	30.8
2020	65	554,279	43.0	57.0	1062.5	368.4	524655	5.5	5.2	81.4	12.2	61.9	24.6	148.8	42.0
2020	70	142,667	11.3	14.9	278.6	34.7	118169	0.6	0.5	21.0	3.1	15.9	6.3	37.5	10.0
	Year Total	***2,217,109***	***158.8***	***210.0***	***4404.8***	***1356.7***	***1,848,896***	*17.9*	*16.9*	*325.6*	*48.9*	*247.6*	*98.5*	***591.1***	***164.2***
2040	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040	25	35,177	2.2	2.9	45.4	6.0	23679	0.1	0.1	5.2	0.8	3.9	1.5	9.2	2.4
2040	30	69,765	3.6	4.8	82.5	13.3	44942	0.2	0.2	10.2	1.5	7.7	3.1	18.1	4.8
2040	35	58,505	2.5	3.3	64.1	8.3	33087	0.1	0.1	8.6	1.3	6.5	2.6	15.2	4.0
2040	40	290,141	10.4	13.8	291.9	32.1	147589	0.5	0.5	42.6	6.4	32.0	12.7	75.1	19.6
2040	45	408,205	14.6	19.3	380.5	66.5	256625	0.8	0.8	59.9	9.0	45.1	17.9	105.9	27.7
2040	50	562,093	18.9	24.3	483.1	87.0	357952	1.2	1.2	82.5	12.4	62.1	24.6	145.8	38.2
2040	55	445,606	14.4	18.5	373.0	51.6	256587	0.8	0.8	65.4	9.8	49.2	19.5	115.4	30.1
2040	60	420,377	14.1	18.3	339.0	39.8	236669	0.7	0.7	61.7	9.3	46.4	18.4	108.9	28.3
2040	65	306,167	11.8	15.2	246.4	39.5	218385	0.7	0.6	45.0	6.7	33.8	13.4	79.4	20.8
2040	70	16,362	0.7	0.9	13.8	1.2	8866	0.0	0.0	2.4	0.4	1.8	0.7	4.2	1.1
	Year Total	***2,612,396***	***93.0***	***121.4***	***2319.7***	***345.3***	***1,584,380***	*5.2*	*4.9*	*383.6*	*57.6*	*288.4*	*114.5*	***677.2***	***176.9***

Operational Emissions of Criteria Pollutants
for Existing Condition (2013), and future Years No Build and Option 0 Build Alternatives
(Opening Year, 2020 and Horizon Year, 2040)

Year / Alternative		Emissions (lbs/day) VOC (ROG)	TOG	CO	NOx	PM10	PM2.5	CO2 Emissions lbs/day	metric tons/year
Existing Year 2013									
Base Year		365.17	459.49	8898.15	3088.70	579.89	194.08	1,886,259	312,292
Opening Year 2020									
Alternative	No Project	157.21	208.04	4437.97	1361.67	590.59	163.93	1,824,126	302,005
	Add HOV Lanes	165.37	218.99	4504.96	1282.35	605.59	167.83	1,908,539	315,980
	Add Mixed Lanes	164.07	217.22	4521.14	1314.41	606.56	168.19	1,897,003	314,070
	Take-a-Lane	157.65	208.53	4377.59	1348.16	587.66	163.27	1,836,228	304,008
Change from No-Build (Project Emission Incement)									
Alternative	Add HOV Lanes	8.17	10.96	66.99	-79.32	15.00	3.89	84,413	13,976
	Add Mixed Lanes	6.87	9.18	83.17	-47.26	15.97	4.26	72,877	12,066
	Take-a-Lane	0.44	0.50	-60.38	-13.51	-2.93	-0.66	12,102	2,004
Horizon Year 2040									
Alternative	No Project	93.92	123.12	2393.72	348.51	678.55	177.19	1,556,346	257,671
	Add HOV Lanes	98.28	128.11	2380.06	348.88	703.26	183.68	1,664,342	275,551
	Add Mixed Lanes	97.87	127.69	2404.56	360.70	703.76	183.85	1,669,325	276,376
	Take-a-Lane	93.00	121.37	2320.55	345.05	681.73	178.76	1,584,808	262,383
Change from No-Build (Project Emission Incement)									
Alternative	Add HOV Lanes	4.36	4.99	-13.67	0.37	24.71	6.49	107,996	17,880
	Add Mixed Lanes	3.95	4.57	10.84	12.19	25.21	6.66	112,979	18,705
	Take-a-Lane	-0.91	-1.74	-73.17	-3.46	3.18	1.57	28,462	4,712
SMAQMD Significant Threshold		*65*	-	-	*65*	*80*	*82*	-	-
Exceeds Threshod?		No	-	-	No	No	No	-	-

Operational Emissions of Criteria Pollutants
for Existing Condition (2013), and future Years No Build and Option 1 Build Alternatives
(Opening Year, 2020 and Horizon Year, 2040)

Year Alternative		Emissions (lbs/day)						CO2 Emissions	
		VOC (ROG)	TOG	CO	NOx	PM10	PM2.5	lbs/day	metric tons/year
Existing Year 2013									
Base Year		365.17	459.49	8898.15	3088.70	579.89	194.08	1,886,259	312,292
Opening Year 2020									
Alternative	No Project	157.21	208.04	4437.97	1361.67	590.59	163.93	1,824,126	302,005
	Add HOV Lanes	167.27	221.54	4496.05	1264.56	607.94	168.58	1,933,396	320,096
	Add Mixed Lanes	165.82	219.56	4522.67	1314.43	609.05	169.01	1,920,705	317,995
	Take-a-Lane	158.15	209.18	4365.83	1346.89	587.22	163.20	1,844,365	305,356
Change from No-Build (Project Emission Incement)									
Alternative	Add HOV Lanes	10.06	13.51	58.08	-97.11	17.36	4.65	109,270	18,091
	Add Mixed Lanes	8.61	11.52	84.70	-47.23	18.46	5.08	96,579	15,990
	Take-a-Lane	0.94	1.15	-72.14	-14.77	-3.36	-0.74	20,239	3,351
Horizon Year 2040									
Alternative	No Project	93.92	123.12	2393.72	348.51	678.55	177.19	1,556,346	257,671
	Add HOV Lanes	98.91	128.70	2362.32	347.52	707.96	184.92	1,689,593	279,731
	Add Mixed Lanes	98.64	128.55	2395.22	360.33	708.71	185.15	1,693,016	280,298
	Take-a-Lane	92.53	120.69	2301.62	344.29	677.91	177.77	1,583,515	262,169
Change from No-Build (Project Emission Incement)									
Alternative	Add HOV Lanes	4.99	5.59	-31.40	-0.99	29.42	7.73	133,247	22,060
	Add Mixed Lanes	4.73	5.43	1.49	11.83	30.16	7.96	136,670	22,627
	Take-a-Lane	-1.39	-2.43	-92.10	-4.22	-0.64	0.58	27,169	4,498
SMAQMD Significant Threshold		*65*	-	-	*65*	*80*	*82*	-	-
Exceeds Threshod?		No	-	-	No	No	No	-	-

Operational Emissions of Criteria Pollutants
for Existing Condition (2013), and future Years No Build and Option 2 Build Alternatives
(Opening Year, 2020 and Horizon Year, 2040)

Year Alternative		Emissions (lbs/day)						CO2 Emissions	
		VOC (ROG)	TOG	CO	NOx	PM10	PM2.5	lbs/day	metric tons/year
Existing Year 2013									
Base Year		365.17	459.49	8898.15	3088.70	579.89	194.08	1,886,259	312,292
Opening Year 2020									
Alternative	No Project	157.21	208.04	4437.97	1361.67	590.59	163.93	1,824,126	302,005
	Add HOV Lanes	167.10	221.30	4530.57	1282.92	610.04	169.08	1,929,303	319,418
	Take-a-Lane	158.79	210.04	4404.80	1356.67	591.07	164.22	1,848,896	306,106
Change from No-Build (Project Emission Incement)									
Alternative	Add HOV Lanes	9.89	13.26	92.60	-78.75	19.45	5.15	105,177	17,413
	Take-a-Lane	1.58	2.01	-33.17	-4.99	0.48	0.29	24,770	4,101
Horizon Year 2040									
Alternative	No Project	93.92	123.12	2393.72	348.51	678.55	177.19	1,556,346	257,671
	Add HOV Lanes	99.01	128.98	2383.48	348.43	707.60	184.82	1,679,299	278,027
	Take-a-Lane	92.98	121.38	2319.74	345.34	677.24	176.87	1,584,380	262,312
Change from No-Build (Project Emission Incement)									
Alternative	Add HOV Lanes	5.09	5.86	-10.24	-0.07	29.05	7.63	122,953	20,356
	Take-a-Lane	-0.94	-1.74	-73.98	-3.17	-1.30	-0.31	28,034	4,641
SMAQMD Significant Threshold		*65*	-	-	*65*	*80*	*82*	-	-
Exceeds Threshod?		No	-	-	No	No	No	-	-

Daily Vehicle Miles Traveled (VMT) per Speed Distribution

Speed bin (miles/hr)	VMT (miles/day)								
	No Project Alternative			Option 1 Alternatives					
	2013	2020	2040	2020_HOV	2020_MF	2020-TL	2040_HOV	2040_MF	2040-TL
5	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
25	0	0	35,512	0	0	0	35,993	35,997	35,510
30	0	0	74,009	0	0	0	94,389	94,423	70,255
35	27,119	61,722	139,004	91,199	99,042	61,673	70,752	84,029	58,465
40	110,383	136,042	516,036	62,283	66,217	74,545	79,323	134,160	245,901
45	146,401	262,870	445,486	38,373	86,198	148,680	219,852	336,428	380,571
50	403,295	360,613	541,603	169,553	233,467	330,123	498,019	549,186	579,666
55	408,607	413,713	327,806	381,737	423,439	453,635	447,342	472,716	484,683
60	273,897	469,658	358,594	427,906	454,009	383,292	567,295	431,207	408,821
65	551,991	414,770	179,516	760,060	667,276	598,747	600,349	544,994	322,288
70+	57,587	96,774	0	351,026	255,980	151,728	117,456	50,303	16,007
Daily Total	1,979,279	2,216,162	2,617,566	2,282,138	2,285,628	2,202,424	2,730,769	2,733,443	2,602,167

Daily Vehicle Miles Traveled (VMT) per Speed Distribution

Speed bin (miles/hr)	VMT (miles/day)									
	Option 0 Alternatives						Option 2 Alternatives			
	2020_HOV	2020_MF	2020-TL	2040_HOV	2040_MF	2040-TL	2020_HOV	2020-TL	2040_HOV	2040-TL
5	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
25	0	0	0	35,759	35,752	35,519	0	0	35,480	35,177
30	0	0	0	89,593	89,550	70,274	0	0	89,153	69,765
35	90,898	98,706	61,691	94,254	113,734	58,478	91,000	61,678	94,240	58,505
40	82,088	80,283	86,343	193,234	227,939	284,589	76,427	92,078	174,287	290,141
45	106,196	123,506	163,394	261,140	320,785	380,702	93,773	164,527	212,694	408,205
50	205,174	246,337	346,682	515,560	618,369	606,452	184,089	353,483	520,422	562,093
55	411,720	465,601	448,223	412,984	416,208	413,115	406,186	432,738	401,358	445,606
60	419,071	459,982	420,934	488,941	393,332	469,266	413,620	415,659	521,136	420,377
65	644,406	564,646	539,707	517,986	469,735	282,506	692,771	554,279	569,309	306,167
70+	314,314	237,967	137,373	103,205	28,951	16,014	332,600	142,667	111,315	16,362
Daily Total	2,273,868	2,277,028	2,204,346	2,712,656	2,714,354	2,616,914	2,290,467	2,217,109	2,729,395	2,612,396

A2 CO Localized Emissions

- **Screening Analysis Flow Charts from CO Protocol**
- **CO Modeling Results Summary for**
  - **Opening Year 2020**
  - **Horizon Year 2040**

- **Screening Analysis Flow Charts from CO Protocol**

Figure 1 of CO Protocol:

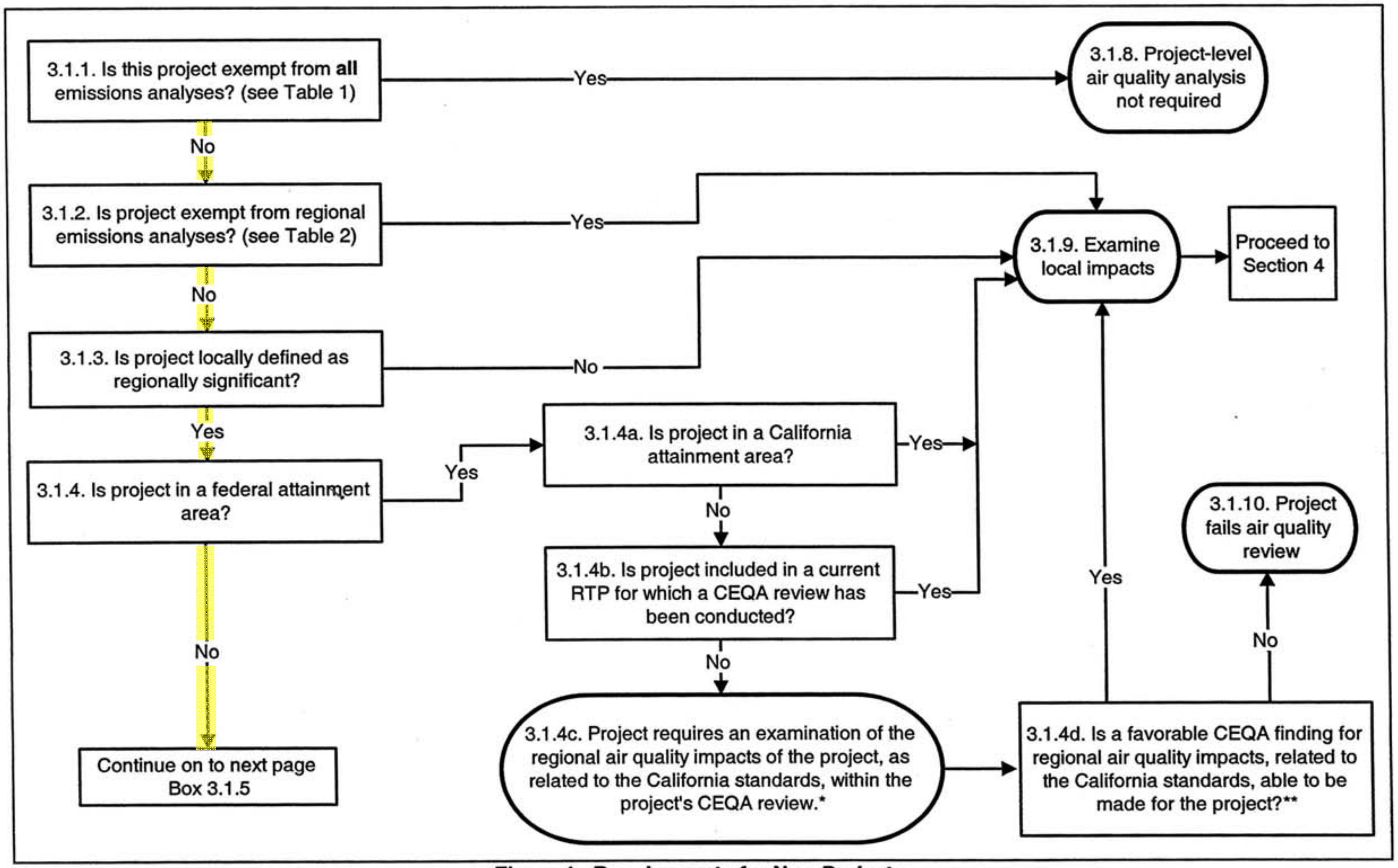


Figure 1. Requirements for New Projects

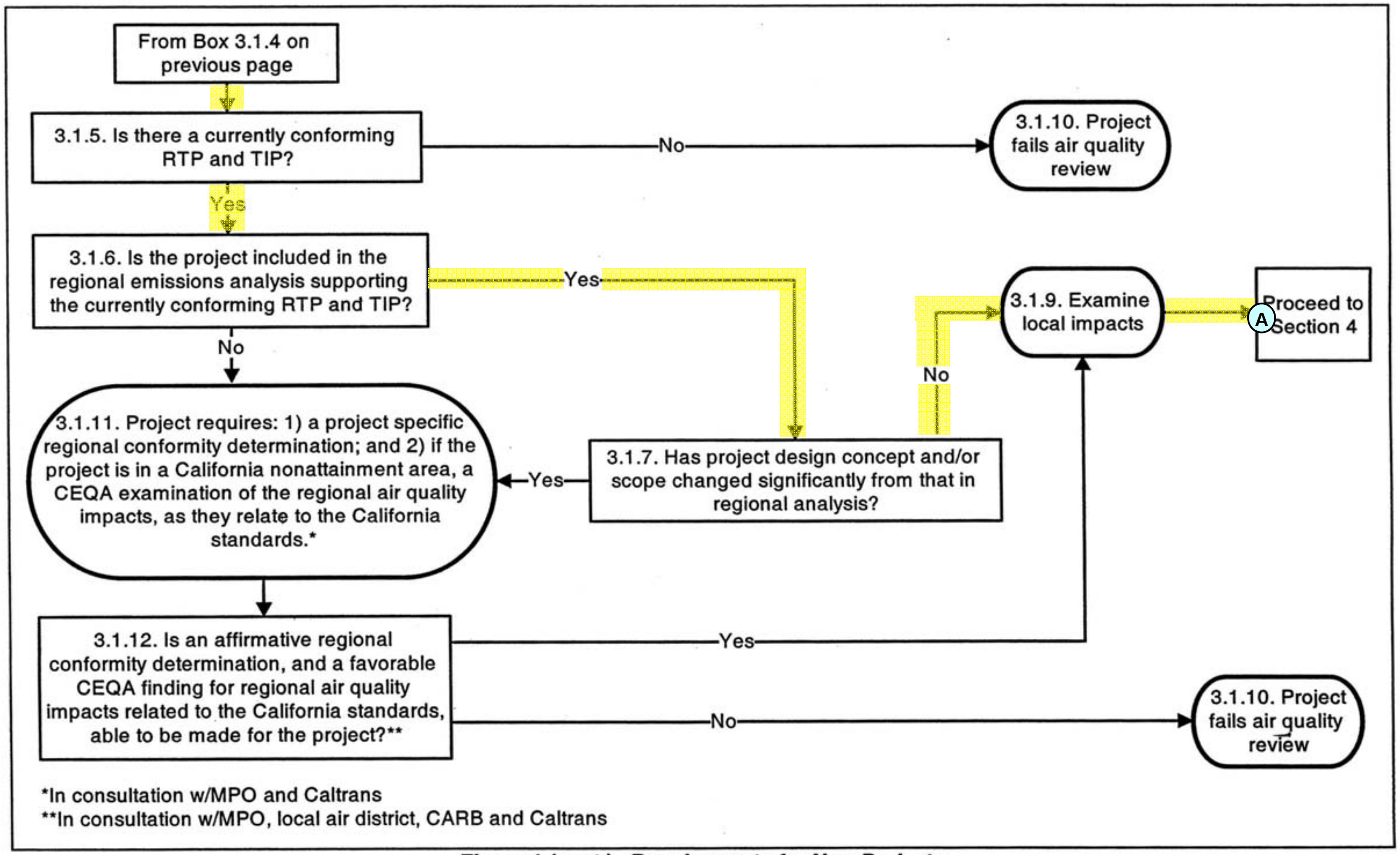


Figure 1 (cont.). Requirements for New Projects

Figure 3 of CO Protocol:

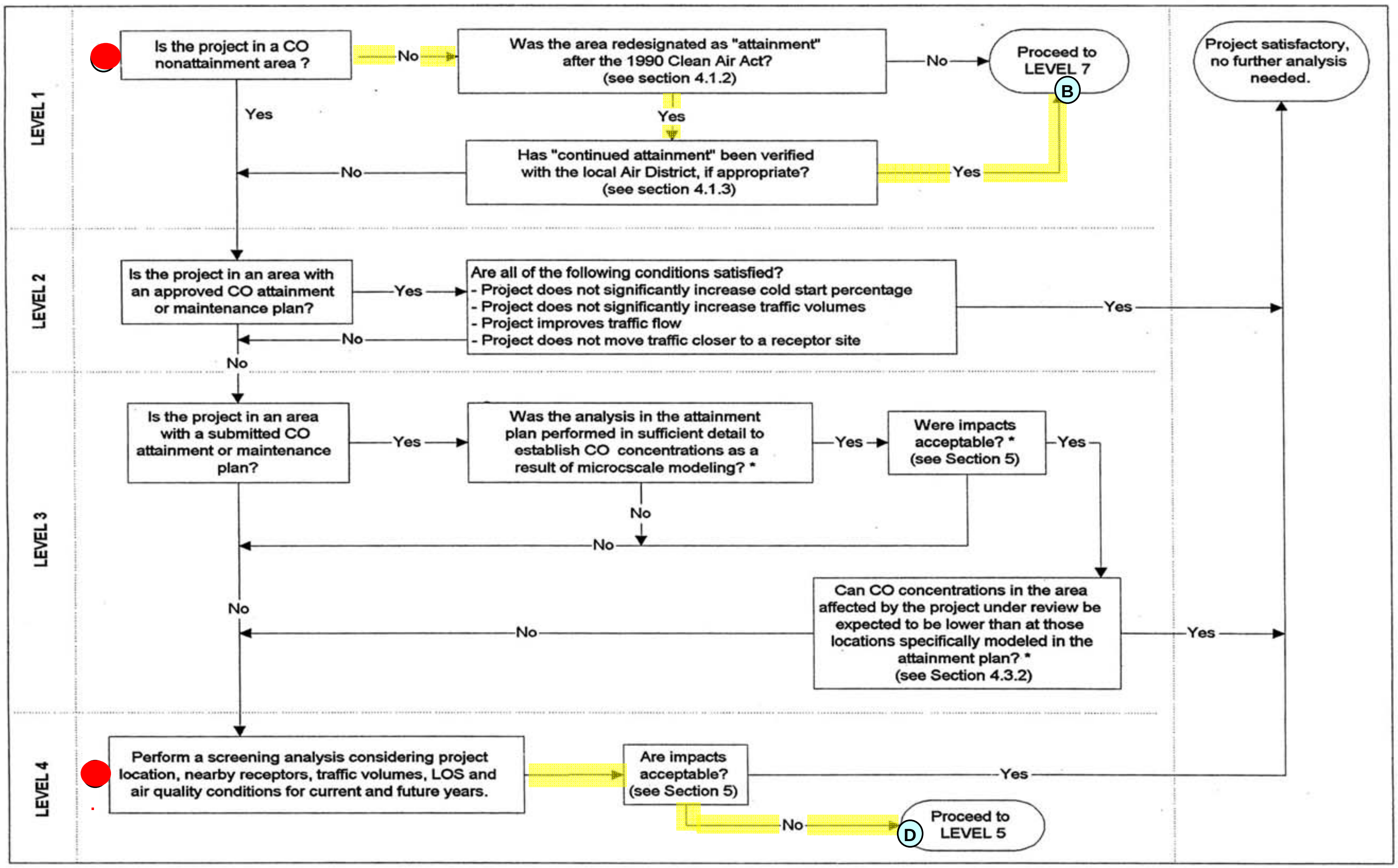


Figure 3. Local CO Analysis

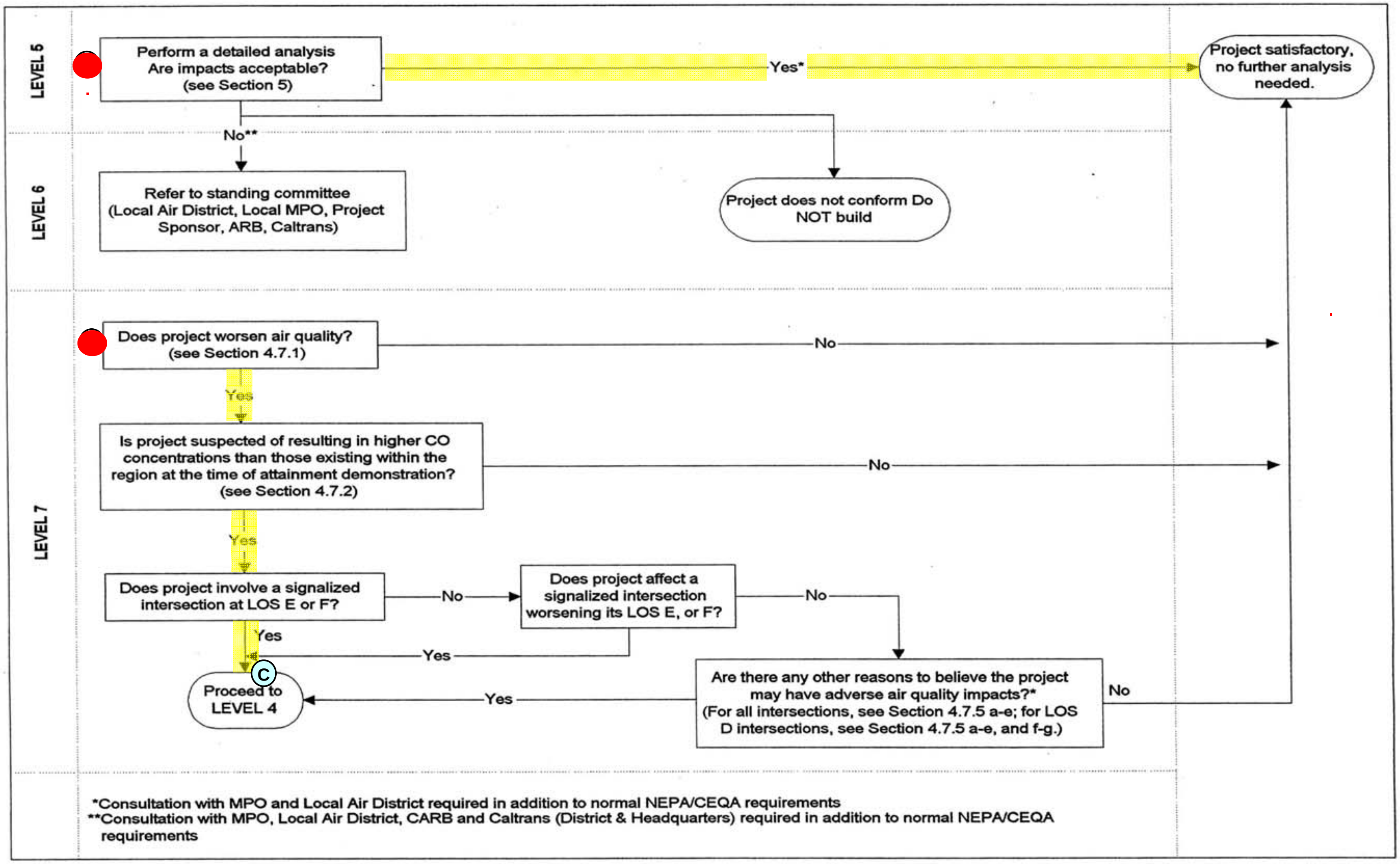


Figure 3 (cont.). Local CO Analysis

- **CO Modeling Results Summary for**
  - **Opening Year 2020**
  - **Horizon Year 2040**

US 50 HOV Project

CALINE4 Modeling Results and Estimated Local 1-hour & 8-hour Carbon Monoxide Concentrations (ppm)

Monitoring Station: Sacramento - 3535 El Camino & Watt

Year	**1-Hr Backround Concentration** (ppm)
2020	2.8

Intersection and Receptor Locations	Opening Year 2020 _ 1-Hour CO Concentration (ppm)							
	No Project		Option 1 _ Add HOV Lane			Option 1 _ Add Mixed Lane		
	Traffic CO Contribution	Estimated Local CO Concentration	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?
15th Street and W Street _ AM								
NE	0.4	3.2	0.4	3.2	NO	0.4	3.2	NO
SE	0.3	3.1	0.3	3.1	NO	0.3	3.1	NO
SW	1.5	4.3	1.6	4.4	NO	1.6	4.4	NO
NW	1.1	3.9	1.1	3.9	NO	1.1	3.9	NO
15th Street and W Street _ PM								
NE	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
SE	0.7	3.5	0.7	3.5	NO	0.7	3.5	NO
SW	1.2	4.0	1.3	4.1	NO	1.2	4.0	NO
NW	1.1	3.9	1.2	4.0	NO	1.2	4.0	NO
65th Street and US 50 WB Ramps/S Street _ AM								
NE	0.8	3.6	0.8	3.6	NO	0.8	3.6	NO
SE	0.6	3.4	0.6	3.4	NO	0.6	3.4	NO
SW	0.6	3.4	0.6	3.4	NO	0.5	3.3	NO
NW	0.8	3.6	0.8	3.6	NO	0.8	3.6	NO
65th Street and US 50 WB Ramps/S Street _ PM								
NE	0.7	3.5	0.7	3.5	NO	0.7	3.5	NO
SE	0.6	3.4	0.6	3.4	NO	0.6	3.4	NO
SW	0.6	3.4	0.6	3.4	NO	0.6	3.4	NO
NW	0.7	3.5	0.7	3.5	NO	0.7	3.5	NO
Howe Avenue and US 50 WB Ramps _ AM								
NE	1.1	3.9	1.1	3.9	NO	1.1	3.9	NO
SE	1.1	3.9	1.2	4.0	NO	1.2	4.0	NO
SW	0.8	3.6	0.9	3.7	NO	0.9	3.7	NO
NW	1.0	3.8	1.1	3.9	NO	1.1	3.9	NO
Howe Avenue and US 50 WB Ramps _ PM								
NE	1.0	3.8	1.1	3.9	NO	1.1	3.9	NO
SE	1.1	3.9	1.2	4.0	NO	1.2	4.0	NO
SW	0.9	3.7	0.9	3.7	NO	0.9	3.7	NO
NW	1.0	3.8	1.1	3.9	NO	1.1	3.9	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ AM								
NE	1.1	3.9	1.1	3.9	NO	1.1	3.9	NO
SE	0.9	3.7	0.9	3.7	NO	0.9	3.7	NO
SW	1.5	4.3	1.6	4.4	NO	1.6	4.4	NO
NW	1.0	3.8	1.0	3.8	NO	1.0	3.8	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ PM								
NE	1.0	3.8	1.0	3.8	NO	1.0	3.8	NO
SE	0.7	3.5	0.7	3.5	NO	0.8	3.6	NO
SW	1.0	3.8	1.0	3.8	NO	1.0	3.8	NO
NW	0.9	3.7	0.9	3.7	NO	0.9	3.7	NO

a Based on guidance provided by the AQMD Air Quality Analysis Guidance Handbook.

b The persistence factor is calculated as recommended in Table B.15 in the Transportation Project-Level Carbon Monoxide Protocol (UC Davis, Revised 1997). This is a generalized persistence factor likely to provide a conservative estimate in most situations.

c The estimated local concentration is the traffic contribution + the background concentration.

d The California Ambient Air Quality Standard for 1-hour and 8-hour CO concentrations are 20 ppm and 9.0 ppm, respectively.

US 50 HOV Project

CALINE4 Modeling Results and Estimatec

Monitoring Station:

Year	8-Hr Background Concentration (ppm)	Persistance Factor
2020	2.28	0.7

Intersection and Receptor Locations	Opening Year 2020 _ 8-Hour CO Concentration (ppm)							
	No Project		Option 1 _ Add HOV Lane			Option 1 _ Add Mixed Lane		
	Traffic CO Contribution	Estimated Local CO Concentration	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?
15th Street and W Street _ AM								
NE	0.3	2.6	0.3	2.6	NO	0.3	2.6	NO
SE	0.2	2.5	0.2	2.5	NO	0.2	2.5	NO
SW	1.1	3.3	1.1	3.4	NO	1.1	3.4	NO
NW	0.8	3.1	0.8	3.1	NO	0.8	3.1	NO
15th Street and W Street _ PM								
NE	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
SE	0.5	2.8	0.5	2.8	NO	0.5	2.8	NO
SW	0.8	3.1	0.9	3.2	NO	0.8	3.1	NO
NW	0.8	3.1	0.8	3.1	NO	0.8	3.1	NO
65th Street and US 50 WB Ramps/S Street _ AM								
NE	0.6	2.8	0.6	2.8	NO	0.6	2.8	NO
SE	0.4	2.7	0.4	2.7	NO	0.4	2.7	NO
SW	0.4	2.7	0.4	2.7	NO	0.4	2.6	NO
NW	0.6	2.8	0.6	2.8	NO	0.6	2.8	NO
65th Street and US 50 WB Ramps/S Street _ PM								
NE	0.5	2.8	0.5	2.8	NO	0.5	2.8	NO
SE	0.4	2.7	0.4	2.7	NO	0.4	2.7	NO
SW	0.4	2.7	0.4	2.7	NO	0.4	2.7	NO
NW	0.5	2.8	0.5	2.8	NO	0.5	2.8	NO
Howe Avenue and US 50 WB Ramps _ AM								
NE	0.8	3.1	0.8	3.1	NO	0.8	3.1	NO
SE	0.8	3.1	0.8	3.1	NO	0.8	3.1	NO
SW	0.6	2.8	0.6	2.9	NO	0.6	2.9	NO
NW	0.7	3.0	0.8	3.1	NO	0.8	3.1	NO
Howe Avenue and US 50 WB Ramps _ PM								
NE	0.7	3.0	0.8	3.1	NO	0.8	3.1	NO
SE	0.8	3.1	0.8	3.1	NO	0.8	3.1	NO
SW	0.6	2.9	0.6	2.9	NO	0.6	2.9	NO
NW	0.7	3.0	0.8	3.1	NO	0.8	3.1	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ AM								
NE	0.8	3.1	0.8	3.1	NO	0.8	3.1	NO
SE	0.6	2.9	0.6	2.9	NO	0.6	2.9	NO
SW	1.1	3.3	1.1	3.4	NO	1.1	3.4	NO
NW	0.7	3.0	0.7	3.0	NO	0.7	3.0	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ PM								
NE	0.7	3.0	0.7	3.0	NO	0.7	3.0	NO
SE	0.5	2.8	0.5	2.8	NO	0.6	2.8	NO
SW	0.7	3.0	0.7	3.0	NO	0.7	3.0	NO
NW	0.6	2.9	0.6	2.9	NO	0.6	2.9	NO

US 50 HOV Project

CALINE4 Modeling Results and Estimated Local 1-hour & 8-hour Carbon Monoxide Concentrations (ppm)

Monitoring Station: Sacramento - 3535 El Camino & Watt

Year	**1-Hr Backround Concentration** (ppm)
2040	2.8

Intersection and Receptor Locations	Horizon Year 2040 _ 1-Hour CO Concentration (ppm)							
	No Project		Option 1 _ Add HOV Lane			Option 1 _ Add Mixed Lane		
	Traffic CO Contribution	Estimated Local CO Concentration	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?
15th Street and W Street _ AM								
NE	0.2	3.0	0.2	3.0	NO	0.2	3.0	NO
SE	0.2	3.0	0.2	3.0	NO	0.2	3.0	NO
SW	0.7	3.5	0.8	3.6	NO	0.7	3.5	NO
NW	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
15th Street and W Street _ PM								
NE	0.3	3.1	0.3	3.1	NO	0.3	3.1	NO
SE	0.4	3.2	0.4	3.2	NO	0.4	3.2	NO
SW	0.7	3.5	0.8	3.6	NO	0.8	3.6	NO
NW	0.7	3.5	0.7	3.5	NO	0.7	3.5	NO
65th Street and US 50 WB Ramps/S Street _ AM								
NE	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
SE	0.4	3.2	0.4	3.2	NO	0.4	3.2	NO
SW	0.3	3.1	0.4	3.2	NO	0.4	3.2	NO
NW	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
65th Street and US 50 WB Ramps/S Street _ PM								
NE	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
SE	0.4	3.2	0.4	3.2	NO	0.4	3.2	NO
SW	0.4	3.2	0.4	3.2	NO	0.4	3.2	NO
NW	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
Howe Avenue and US 50 WB Ramps _ AM								
NE	0.6	3.4	0.6	3.4	NO	0.7	3.5	NO
SE	0.6	3.4	0.7	3.5	NO	0.7	3.5	NO
SW	0.5	3.3	0.6	3.4	NO	0.6	3.4	NO
NW	0.6	3.4	0.6	3.4	NO	0.6	3.4	NO
Howe Avenue and US 50 WB Ramps _ PM								
NE	0.7	3.5	0.7	3.5	NO	0.7	3.5	NO
SE	0.8	3.6	0.8	3.6	NO	0.8	3.6	NO
SW	0.6	3.4	0.7	3.5	NO	0.7	3.5	NO
NW	0.7	3.5	0.8	3.6	NO	0.8	3.6	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ AM								
NE	0.6	3.4	0.6	3.4	NO	0.6	3.4	NO
SE	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
SW	0.8	3.6	0.8	3.6	NO	0.8	3.6	NO
NW	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ PM								
NE	0.6	3.4	0.6	3.4	NO	0.6	3.4	NO
SE	0.5	3.3	0.5	3.3	NO	0.5	3.3	NO
SW	0.6	3.4	0.7	3.5	NO	0.7	3.5	NO
NW	0.5	3.3	0.5	3.3	NO	0.6	3.4	NO

a Based on guidance provided by the AQMD Air Quality Analysis Guidance Handbook.

b The persistence factor is calculated as recommended in Table B.15 in the Transportation Project-Level Carbon Monoxide Protocol (UC Davis, Revised 1997). This is a generalized persistence factor likely to provide a conservative estimate in most situations.

c The estimated local concentration is the traffic contribution + the background concentration.

d The California Ambient Air Quality Standard for 1-hour and 8-hour CO concentrations are 20 ppm and 9.0 ppm, respectively.

US 50 HOV Project

CALINE4 Modeling Results and Estimate

Monitoring Station:

Year	8-Hr Background Concentration (ppm)	Persistance Factor
2040	2.28	0.7

Intersection and Receptor Locations	Horizon Year 2040 _ 8-Hour CO Concentration (ppm)							
	No Project		Option 1 _ Add HOV Lane			Option 1 _ Add Mixed Lane		
	Traffic CO Contribution	Estimated Local CO Concentration	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?	Traffic CO Contribution	Estimated Local CO Concentration	Exceedance of Standard?
15th Street and W Street _ AM								
NE	0.1	2.4	0.1	2.4	NO	0.1	2.4	NO
SE	0.1	2.4	0.1	2.4	NO	0.1	2.4	NO
SW	0.5	2.8	0.6	2.8	NO	0.5	2.8	NO
NW	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
15th Street and W Street _ PM								
NE	0.2	2.5	0.2	2.5	NO	0.2	2.5	NO
SE	0.3	2.6	0.3	2.6	NO	0.3	2.6	NO
SW	0.5	2.8	0.6	2.8	NO	0.6	2.8	NO
NW	0.5	2.8	0.5	2.8	NO	0.5	2.8	NO
65th Street and US 50 WB Ramps/S Street _ AM								
NE	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
SE	0.3	2.6	0.3	2.6	NO	0.3	2.6	NO
SW	0.2	2.5	0.3	2.6	NO	0.3	2.6	NO
NW	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
65th Street and US 50 WB Ramps/S Street _ PM								
NE	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
SE	0.3	2.6	0.3	2.6	NO	0.3	2.6	NO
SW	0.3	2.6	0.3	2.6	NO	0.3	2.6	NO
NW	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
Howe Avenue and US 50 WB Ramps _ AM								
NE	0.4	2.7	0.4	2.7	NO	0.5	2.8	NO
SE	0.4	2.7	0.5	2.8	NO	0.5	2.8	NO
SW	0.4	2.6	0.4	2.7	NO	0.4	2.7	NO
NW	0.4	2.7	0.4	2.7	NO	0.4	2.7	NO
Howe Avenue and US 50 WB Ramps _ PM								
NE	0.5	2.8	0.5	2.8	NO	0.5	2.8	NO
SE	0.6	2.8	0.6	2.8	NO	0.6	2.8	NO
SW	0.4	2.7	0.5	2.8	NO	0.5	2.8	NO
NW	0.5	2.8	0.6	2.8	NO	0.6	2.8	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ AM								
NE	0.4	2.7	0.4	2.7	NO	0.4	2.7	NO
SE	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
SW	0.6	2.8	0.6	2.8	NO	0.6	2.8	NO
NW	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
Jefferson Blvd and Park Blvd / I-80 Ramps _ PM								
NE	0.4	2.7	0.4	2.7	NO	0.4	2.7	NO
SE	0.4	2.6	0.4	2.6	NO	0.4	2.6	NO
SW	0.4	2.7	0.5	2.8	NO	0.5	2.8	NO
NW	0.4	2.6	0.4	2.6	NO	0.4	2.7	NO

A3 Qualitative PM Analysis for Conformity Determination

- **Truck percent Changes for Project Alternatives**
- **Roadway Segments LOS for project Alternatives**

- **Truck percent Changes for Project Alternatives**

Option 1 – Average Daily Traffic (ADT) Truck Percentage Comparison

	Location	Truck Percentage					Change in Truck Percentages			Truck Percentage				Change in Truck Percentages		
		2013	2020 - Opening Year							2040 - Horizon Year						
		Base Year No Project	No Project	Add HOV Lane	Add Mixed Flow Lane	Take-a-Lane	Add HOV Lane	Add Mixed Flow Lane	Take-a Lane	No Project	Add HOV Lane	Add Mixed Flow Lane	Take-a-Lane	Add HOV Lane	Add Mixed Flow Lane	Take-a Lane
EB	EB US 50 Mainline b/w Jefferson Blvd and I-5 Connectors	7.3%	7.3%	7.3%	7.3%	7.3%	0.027%	0.044%	0.026%	7.2%	7.3%	7.3%	7.3%	0.089%	0.108%	0.091%
	EB US 50 Mainline b/w Connector to I-5 and 5th St Off	7.4%	7.2%	7.3%	7.3%	7.4%	0.065%	0.060%	0.158%	7.2%	7.3%	7.3%	7.4%	0.056%	0.105%	0.114%
	EB US 50 Mainline b/w 5th St Off and Connectors from I-5	7.4%	7.2%	7.3%	7.3%	7.4%	0.088%	0.077%	0.165%	7.2%	7.3%	7.3%	7.3%	0.056%	0.103%	0.106%
	EB US 50 Mainline b/w Connectors from I-5 and 10th St	7.7%	7.6%	7.7%	7.6%	7.7%	0.062%	0.010%	0.097%	7.5%	7.5%	7.6%	7.5%	-0.026%	0.027%	0.002%
	EB US 50 Mainline b/w 10th St and 15th St	7.7%	7.6%	7.7%	7.6%	7.7%	0.085%	0.017%	0.104%	7.5%	7.5%	7.5%	7.5%	0.009%	0.025%	0.017%
	EB US 50 Mainline b/w 15th St & 16th St	7.2%	7.2%	7.2%	7.2%	7.3%	0.067%	0.012%	0.087%	7.1%	7.1%	7.1%	7.1%	0.011%	0.014%	0.021%
	EB US 50 Mainline b/w 16th St & Connectors to SR 51 & 99	7.0%	6.9%	7.0%	6.9%	7.0%	0.057%	0.002%	0.083%	6.8%	6.8%	6.8%	6.8%	-0.011%	0.003%	0.008%
	EB US 50 Mainline b/w Connectors to SR 51 & 99 and 26th St On	7.0%	6.9%	7.0%	6.9%	7.0%	0.050%	0.000%	0.059%	6.8%	6.8%	6.8%	6.8%	-0.036%	-0.055%	-0.044%
	EB US 50 Mainline b/w 26th St On and 34th St Off	6.5%	6.5%	6.6%	6.5%	6.6%	0.040%	-0.015%	0.039%	6.4%	6.4%	6.4%	6.3%	-0.060%	-0.073%	-0.095%
	EB US 50 Mainline b/w 34th St and Connectors from SR 51 & 99	6.5%	6.5%	6.6%	6.5%	6.6%	0.046%	-0.015%	0.050%	6.5%	6.4%	6.4%	6.3%	-0.071%	-0.071%	-0.109%
	EB US 50 Mainline b/w Connectors from SR 51 & 99 and Stockton Blvd	5.6%	5.6%	5.6%	5.6%	5.6%	0.061%	0.008%	0.028%	5.5%	5.5%	5.6%	5.5%	-0.009%	0.022%	-0.039%
	EB US 50 Mainline b/w Stockton Blvd and 59th St	5.4%	5.4%	5.4%	5.4%	5.4%	0.050%	0.021%	0.018%	5.3%	5.3%	5.4%	5.3%	0.020%	0.046%	-0.033%
	EB US 50 Mainline b/w 59th St and 65th St	5.4%	5.4%	5.4%	5.4%	5.4%	0.049%	0.036%	0.019%	5.3%	5.3%	5.4%	5.3%	0.025%	0.059%	-0.040%
	EB US 50 Mainline b/w 65th St Off and 65th St Loop On	5.4%	5.4%	5.4%	5.4%	5.4%	0.049%	0.051%	0.028%	5.3%	5.3%	5.4%	5.3%	0.031%	0.067%	-0.021%
	EB US 50 Mainline b/w 65th St Loop On and 65th St On	5.2%	5.2%	5.3%	5.3%	5.3%	0.057%	0.062%	0.039%	5.2%	5.2%	5.2%	5.2%	0.026%	0.060%	-0.023%
	EB US 50 Mainline b/w 65th St and Howe Ave / Hornet Dr	5.0%	5.0%	5.0%	5.0%	5.0%	0.051%	0.057%	0.033%	4.9%	4.9%	5.0%	4.9%	0.027%	0.053%	-0.015%
	EB US 50 Mainline b/w Howe Ave Off and Howe Ave Loop On	5.0%	5.0%	5.0%	5.1%	5.0%	0.010%	0.057%	-0.002%	4.9%	4.9%	5.0%	4.9%	0.024%	0.035%	-0.014%
	EB US 50 Mainline b/w Howe Ave Loop On and Howe Ave On	4.9%	4.9%	4.9%	5.0%	4.9%	0.032%	0.080%	0.007%	4.8%	4.8%	4.9%	4.8%	-0.012%	0.061%	-0.022%
	EB US 50 Mainline b/w Howe Ave and Watt Ave	5.1%	5.1%	5.1%	5.1%	5.1%	0.036%	0.053%	0.007%	5.0%	5.0%	5.1%	5.0%	-0.035%	0.054%	-0.001%
	EB US 50 Mainline b/w Watt Ave Off/On Ramps	5.1%	5.1%	5.1%	5.1%	5.1%	0.023%	0.032%	-0.006%	5.1%	5.0%	5.1%	5.0%	-0.024%	0.039%	-0.015%
	EB US 50 Mainline b/w Watt Ave and Bradshaw Rd	4.9%	5.0%	5.0%	5.0%	5.0%	0.019%	0.032%	0.006%	4.9%	4.9%	5.0%	4.9%	0.024%	0.073%	0.016%
WB	WB Mainline b/w Watt Ave and Bradshaw Rd	3.8%	3.7%	3.6%	3.8%	3.6%	-0.078%	0.066%	-0.074%	3.8%	3.7%	3.7%	3.8%	-0.112%	-0.125%	-0.035%
	WB Mainline b/w Watt Ave Off/On Ramps	3.8%	3.7%	3.6%	3.8%	3.6%	-0.085%	0.051%	-0.086%	3.8%	3.7%	3.7%	3.8%	-0.140%	-0.147%	-0.057%
	WB Mainline b/w Watt Ave Loop On and Watt Ave Slip On	4.1%	4.0%	4.0%	4.1%	3.9%	-0.082%	0.047%	-0.095%	4.2%	4.0%	4.0%	4.2%	-0.166%	-0.166%	0.008%
	WB Mainline b/w Watt Ave and Howe Ave	4.0%	4.0%	3.9%	4.0%	3.9%	-0.066%	0.049%	-0.076%	4.0%	3.9%	4.0%	4.0%	-0.088%	-0.067%	-0.015%
	WB Mainline b/w Howe Ave Off and Howe Ave On	4.0%	4.0%	3.9%	4.0%	3.9%	-0.058%	0.066%	-0.088%	4.0%	3.9%	3.9%	4.0%	-0.091%	-0.087%	-0.024%
	WB Mainine b/w Howe Ave Loop On and Howe Ave Slip On	4.2%	4.1%	4.1%	4.2%	4.1%	-0.026%	0.067%	-0.040%	4.2%	4.1%	4.1%	4.2%	-0.081%	-0.097%	-0.014%
	WB Mainline b/w Howe Ave and Hornet Dr	4.2%	4.1%	4.1%	4.2%	4.1%	-0.010%	0.073%	-0.027%	4.2%	4.1%	4.1%	4.1%	-0.075%	-0.040%	-0.043%
	WB Mainline b/w Hornet Dr and 65th St	4.1%	4.1%	4.1%	4.1%	4.0%	-0.008%	0.045%	-0.034%	4.1%	4.1%	4.1%	4.1%	-0.019%	0.018%	-0.031%
	WB Mainline b/w 65th St Off and 65th St Loop On	4.1%	4.1%	4.1%	4.1%	4.0%	-0.008%	0.041%	-0.052%	4.1%	4.1%	4.1%	4.1%	-0.003%	0.031%	-0.026%
	WB Mainline b/w 65th St Loop On and 65th St Slip On	4.0%	4.0%	4.0%	4.1%	4.0%	-0.011%	0.039%	-0.060%	4.0%	4.0%	4.1%	4.0%	0.000%	0.038%	-0.015%
	WB Mainline b/w 65th St and 59th St	4.0%	4.0%	3.9%	4.0%	3.9%	-0.011%	0.030%	-0.060%	3.9%	4.0%	4.0%	3.9%	0.011%	0.056%	-0.009%
	WB Mainline b/w 59th St and Stockton Blvd	3.9%	3.9%	3.9%	3.9%	3.8%	-0.020%	0.022%	-0.074%	3.9%	3.9%	3.9%	3.8%	0.002%	0.060%	-0.015%
	WB Mainline b/w Stockton Blvd Off/On Ramps	3.9%	3.9%	3.9%	3.9%	3.8%	-0.026%	0.016%	-0.082%	3.9%	4.1%	4.5%	3.8%	0.271%	0.687%	-0.015%
	WB Mainline b/w Stockton Blvd and Connectors to SR 51 & 99	3.7%	3.7%	3.7%	3.8%	3.7%	-0.027%	0.023%	-0.084%	3.7%	3.7%	3.8%	3.7%	0.069%	0.123%	0.001%
	WB Mainline b/w Connectors to SR 51 and SR 99	3.7%	3.7%	3.7%	3.8%	3.7%	-0.036%	0.020%	-0.087%	3.7%	3.7%	3.8%	3.7%	0.063%	0.123%	0.004%
	WB Mainline b/w Connector to SR 99 and 26th St Off	3.7%	3.7%	3.7%	3.8%	3.6%	-0.051%	0.011%	-0.098%	3.6%	3.7%	3.8%	3.7%	0.097%	0.137%	0.015%
	WB Mainline b/w 26th St and Connectors from SR 51 & 99	3.7%	3.8%	3.7%	3.7%	3.7%	-0.081%	-0.031%	-0.115%	3.6%	3.7%	3.8%	3.7%	0.089%	0.139%	0.020%
	WB Mainline b/w Connectors from SR 99 & SR 51	3.6%	3.7%	3.6%	3.6%	3.6%	-0.062%	-0.020%	-0.092%	3.5%	3.7%	3.7%	3.6%	0.135%	0.200%	0.054%
	WB Mainline b/w Connectors from SR 51 & 99 and 16th St	3.6%	3.6%	3.6%	3.6%	3.6%	-0.065%	-0.032%	-0.087%	3.5%	3.7%	3.7%	3.6%	0.137%	0.162%	0.065%
	WB Mainline b/w 16th St and 15th St	3.6%	3.6%	3.6%	3.6%	3.6%	-0.061%	-0.025%	-0.081%	3.5%	3.7%	3.7%	3.6%	0.143%	0.149%	0.057%
	WB Mainline b/w 10th St Off and 15th St On	3.6%	3.6%	3.6%	3.6%	3.5%	-0.060%	-0.021%	-0.072%	3.5%	3.7%	3.7%	3.6%	0.143%	0.146%	0.057%
	WB Mainline b/w 10th St and Connectors to I-5	3.5%	3.5%	3.5%	3.5%	3.5%	-0.060%	-0.027%	-0.066%	3.4%	3.5%	3.5%	3.4%	0.128%	0.152%	0.065%
	WB Mainline b/w Connectors to I-5 and 5th St	3.5%	3.5%	3.4%	3.5%	3.4%	-0.084%	-0.003%	-0.066%	3.4%	3.6%	3.5%	3.4%	0.203%	0.152%	0.062%
	WB Mainline b/w 5th St and Connectors from I-5	3.4%	3.4%	3.3%	3.4%	3.3%	-0.067%	0.014%	-0.066%	3.3%	3.4%	3.4%	3.3%	0.159%	0.107%	0.023%
	WB Mainline b/w Connectors from I-5 and Jefferson Blvd	4.3%	4.3%	4.2%	4.3%	4.2%	-0.042%	0.028%	-0.039%	4.1%	4.3%	4.2%	4.1%	0.149%	0.072%	0.009%

- **Roadway Segments LOS for project Alternatives**

Option 1 – One-Hour PM Peak Model Level of Service Comparison
Improved segments by project implementation are shown in bold
One-Hour PM Peak (4:30 PM to 5:30 PM) Model Level of Service Comparison

		Location	Facility Type	Density-Based LOS												
				Year 2013 No Project	Year 2020 No Project	Year 2020 Add HOV Lane	Year 2020 Add Mixed Flow Lane	Year 2020 Take-a-Lane	Year 2030 No Project	Year 2030 Add HOV Lane	Year 2030 Add Mixed Flow Lane	Year 2030 Take-a-Lane	Year 2040 No Project	Year 2040 Add HOV Lane	Year 2040 Add Mixed Flow Lane	Year 2040 Take-a-Lane
EB	1	EB US 50 Mainline b/w Jefferson Blvd and I-5 Connectors	Mainline	D	D	D	D	D	E	E	F	E	F	F	F	F
	2	EB I-80/US 50 to NB I-5 Connector	Connector	B	C	C	C	C	C	C	C	C	C	C	C	B
	3	EB I-80/US 50 to SB I-5 Connector	Connector	E	F	F	F	F	F	F	F	F	F	F	F	E
	4	EB US 50 Mainline b/w Connector to I-5 and 5th St Off	Mainline	C	C	C	C	C	C	C	C	C	C	C	C	D
	5	EB US 50 Off-Ramp to 5th St	Off-Ramp	A	A	A	A	A	A	A	A	A	A	A	A	A
	6	**EB US 50 Mainline b/w 5th St Off and Connectors from I-5**	Mainline	C	D	C	D	D	D	C	C	D	E	C	C	E
	7	NB I-5 to EB I-80/US 50 Connector	Connector	E	E	E	E	E	F	F	F	F	F	F	F	F
	8	SB I-5 to EB I-80/US 50 Connector	Connector	F	E	E	E	E	F	F	F	F	F	F	F	F
	9	**EB US 50 Mainline b/w Connectors from I-5 and 10th St**	Mainline	E	D	D	D	D	F	F	F	F	F	F	F	F
	10	EB US 50 On-Ramp from 10th St-X St	On-Ramp	B	B	B	B	B	B	C	C	B	B	C	C	B
	11	**EB US 50 Mainline b/w 10th St and 15th St**	Mainline	E	E	D	E	E	F	F	F	F	F	F	E	F
	12	EB US 50 Off-Ramp to 15th St - X St	Off-Ramp	D	D	D	D	D	D	E	E	D	F	F	F	F
	13	**EB US 50 Mainline b/w 15th St & 16th St**	Mainline	F	E	E	E	F	F	E	E	F	F	E	E	F
	14	EB US 50 On-Ramp from 16th St - X St	On-Ramp	D	D	D	D	D	D	D	D	D	D	E	E	D
	15	**EB US 50 Mainline b/w 16th St & Connectors to SR 51 & 99**	Mainline	E	E	D	E	E	F	E	E	F	F	E	E	F
	16	EB US 50 to NB SR 51 Connector	Connector	C	C	C	C	C	C	C	C	C	C	C	C	C
	17	EB US 50 to SB SR 99 Connector	Connector	F	F	F	F	F	F	F	F	F	F	F	F	F
	18	**EB US 50 Mainline b/w Connectors to SR 51 & 99 and 26th St On**	Mainline	D	D	C	C	D	D	C	C	E	D	C	C	C
	19	EB US 50 On-Ramp from 26th St-X St	On-Ramp	B	C	C	C	C	C	C	C	C	C	D	D	D
	20	EB US 50 Mainline b/w 26th St On and 34th St Off	Mainline	C	C	C	C	C	C	C	C	D	C	C	C	C
	21	EB US 50 Off-Ramp to 34th St	Off-Ramp	A	A	A	A	A	A	A	A	A	A	A	A	A
	22	**EB US 50 Mainline b/w 34th St and Connectors from SR 51 & 99**	Mainline	C	C	C	C	C	D	C	C	E	C	C	C	C
	23	SB SR 51 to EB US 50 Connector	Connector	B	B	B	B	B	B	C	C	C	B	C	B	B
	24	NB SR 99 to EB US 50 Connector	Connector	C	C	C	B	C	C	C	B	D	C	C	B	D
	25	**EB US 50 Mainline b/w Connectors from SR 51 & 99 and Stockton Blvd**	Mainline	E	E	D	D	F	E	E	D	F	E	D	D	F
	26	EB US 50 On-Ramp from Stockton Blvd	On-Ramp	C	C	C	C	C	C	C	C	C	C	C	C	C
	27	**EB US 50 Mainline b/w Stockton Blvd and 59th St**	Mainline	E	E	D	D	E	E	D	D	E	E	D	D	E
	28	EB US 50 Off-Ramp from 59th St	Off-Ramp	A	A	A	A	A	A	A	A	A	A	A	A	A
	29	**EB US 50 Mainline b/w 59th St and 65th St**	Mainline	E	E	D	D	F	F	E	E	F	E	D	E	E
	30	EB US 50 Off-Ramp to 65th St	Off-Ramp	B	B	B	B	B	B	B	B	B	B	B	B	B
	31	EB US 50 Mainline b/w 65th St Off and 65th St Loop On	Mainline	E	E	D	D	F	F	D	D	F	E	D	D	E
	32	**EB US 50 Loop On-Ramp from SB 65th St**	Off-Ramp	B	B	B	B	B	B	B	B	B	B	B	C	B
	33	**EB US 50 Mainline b/w 65th St Loop On and 65th St On**	Mainline	F	E	D	D	E	E	E	D	E	E	D	D	E
	34	EB US 50 On-Ramp from NB 65th St	On-Ramp	C	C	C	C	C	C	C	C	C	D	D	D	C
	35	EB US 50 Mainline b/w 65th St and Howe Ave / Hornet Dr	Mainline	E	D	D	C	D	D	D	D	E	D	D	D	D
	36	EB US 50 Off-Ramp to Hornet Dr	Off-Ramp	B	A	A	A	A	A	A	A	A	A	A	B	A
	37	EB US 50 Off-Ramp to Howe Ave	Off-Ramp	C	C	C	C	C	C	C	C	C	C	C	D	C
	38	**EB US 50 Mainline b/w Howe Ave Off and Howe Ave Loop On**	Mainline	D	D	C	C	E	D	D	C	F	D	C	C	E
	39	EB US 50 Loop On-Ramp from SB Howe Ave	On-Ramp	C	C	C	C	C	C	D	D	D	C	C	B	E
	40	**EB US 50 Mainline b/w Howe Ave Loop On and Howe Ave On**	Mainline	E	E	D	D	E	E	D	D	E	E	D	D	E
	41	EB US 50 On-Ramp from NB Howe Ave	On-Ramp	B	B	B	B	B	B	B	B	B	B	B	A	B
	42	EB US 50 Mainline b/w Howe Ave and Watt Ave	Mainline	E	E	D	D	E	E	E	D	E	E	D	D	E
	43	**EB US 50 Slip Off-Ramp to SB Watt Ave**	Off-Ramp	B	F	F	F	F	F	F	F	F	F	F	F	F
	44	EB US 50 Loop Off-Ramp to NB Watt Ave	Off-Ramp	E	F	F	F	F	F	F	F	F	F	F	F	F
	45	EB US 50 Mainline b/w Watt Ave Off/On Ramps	Mainline	D	D	C	C	D	D	C	C	D	D	C	C	D
	46	EB US 50 Loop On-Ramp from SB Watt Ave	On-Ramp	D	D	D	D	D	D	D	D	D	D	D	D	D
	47	EB US 50 Slip On-Ramp to NB Watt Ave	On-Ramp	B	B	B	B	B	B	B	B	B	B	B	B	B
	48	EB US 50 Mainline b/w Watt Ave and Bradshaw Rd	Mainline	D	D	C	C	D	D	D	D	D	D	C	C	D

Source: Wood Rodgers, Inc.

Option 1 – One-Hour PM Peak Model Level of Service Comparison
Improved segments by project implementation are shown in bold
One-Hour PM Peak (4:30 PM to 5:30 PM) Model Level of Service Comparison

		Location	Facility Type	Density-Based LOS												
				Year 2013 No Project	Year 2020 No Project	Year 2020 Add HOV Lane	Year 2020 Add Mixed Flow Lane	Year 2020 Take-a-Lane	Year 2030 No Project	Year 2030 Add HOV Lane	Year 2030 Add Mixed Flow Lane	Year 2030 Take-a-Lane	Year 2040 No Project	Year 2040 Add HOV Lane	Year 2040 Add Mixed Flow Lane	Year 2040 Take-a-Lane
WB	1	**WB Mainline b/w Watt Ave and Bradshaw Rd**	Mainline	D	D	C	C	F	F	E	D	F	F	F	F	F
WB	2	WB Slip Off-Ramp to NB Watt Ave	Off-Ramp	D	F	F	F	F	F	F	F	F	F	F	F	F
WB	3	WB Loop Off-Ramp to SB Watt Ave	Off-Ramp	B	C	C	C	B	B	C	C	B	C	C	D	B
WB	4	**WB Mainline b/w Watt Ave Off/On Ramps**	Mainline	D	E	C	C	F	F	F	D	E	F	F	F	E
WB	5	WB Loop On-Ramp from NB Watt Ave	On-Ramp	B	C	C	C	D	F	F	C	F	F	F	F	F
WB	6	WB Mainline b/w Watt Ave Loop On and Watt Ave Slip On	Mainline	D	E	D	D	F	F	F	D	E	F	F	F	F
WB	7	WB Slip On-Ramp from SB Watt Ave	On-Ramp	C	C	C	C	C	D	D	D	E	E	F	F	E
WB	8	**WB Mainline b/w Watt Ave and Howe Ave**	Mainline	D	F	C	C	E	F	F	D	E	F	F	F	E
WB	9	WB Off-Ramp to Howe Ave	Off-Ramp	B	B	B	B	B	B	B	B	B	B	B	C	B
WB	10	**WB Mainline b/w Howe Ave Off and Howe Ave On**	Mainline	D	F	C	C	F	F	F	E	F	F	F	F	F
WB	11	WB Loop On-Ramp from NB Howe Ave	On-Ramp	B	C	B	B	B	D	D	C	C	F	F	F	C
WB	12	WB Mainine b/w Howe Ave Loop On and Howe Ave Slip On	Mainline	D	F	D	D	F	F	F	F	F	F	F	F	F
WB	13	**WB Slip On-Ramp from SB Howe Ave**	On-Ramp	B	C	C	C	C	F	F	F	D	F	F	F	E
WB	14	**WB Mainline b/w Howe Ave and Hornet Dr**	Mainline	D	F	C	C	F	F	F	F	F	F	E	F	F
WB	15	WB On-Ramp from Hornet Dr	On-Ramp	C	C	C	C	C	F	F	F	D	F	F	F	E
WB	16	**WB Mainline b/w Hornet Dr and 65th St**	Mainline	D	F	D	D	F	F	F	F	F	F	F	F	F
WB	17	WB Off-Ramp to 65th St	Off-Ramp	D	D	D	D	C	D	F	F	C	D	F	F	C
WB	18	WB Mainline b/w 65th St Off and 65th St Loop On	Mainline	D	F	D	D	F	F	F	F	F	F	E	E	F
WB	19	**WB Loop On-Ramp from NB 65th St**	On-Ramp	A	A	A	A	A	A	A	A	A	A	A	A	A
WB	20	WB Mainline b/w 65th St Loop On and 65th St Slip On	Mainline	D	F	D	D	F	F	F	F	F	F	E	F	F
WB	21	WB Slip On-Ramp from SB 65th St	On-Ramp	A	A	A	A	A	A	A	A	A	B	B	B	B
WB	22	**WB Mainline b/w 65th St and 59th St**	Mainline	E	F	D	D	F	F	F	F	F	F	E	F	F
WB	23	WB On-Ramp from 59th St	On-Ramp	C	C	C	C	C	C	D	E	C	D	D	E	C
WB	24	WB Mainline b/w 59th St and Stockton Blvd	Mainline	E	F	F	D	F	F	F	F	F	F	F	F	F
WB	25	WB Off-Ramp to Stockton Blvd	Off-Ramp	B	C	C	C	B	B	C	D	B	B	C	D	B
WB	26	**WB Mainline b/w Stockton Blvd Off/On Ramps**	Mainline	D	E	E	D	E	F	E	E	F	F	E	E	F
WB	27	WB On-Ramp from Stockton Blvd	On-Ramp	D	D	D	D	D	F	F	F	F	F	F	F	F
WB	28	WB Mainline b/w Stockton Blvd and Connectors to SR 51 & 99	Mainline	E	F	F	D	F	F	F	F	F	F	E	E	F
WB	29	WB US 50 to NB SR 51 Connector	Connector	C	C	C	C	C	C	C	D	C	C	C	D	C
WB	30	**WB Mainline b/w Connectors to SR 51 and SR 99**	Mainline	E	F	F	D	F	F	F	F	F	F	F	E	E
WB	31	WB US 50 to SB SR 99 Connector	Connector	C	C	D	C	C	D	D	D	C	D	C	D	C
WB	32	WB Mainline b/w Connector to SR 99 and 26th St Off	Mainline	D	F	F	D	F	F	F	F	F	F	F	E	E
WB	33	WB Off-Ramp to 26th St - W St	Off-Ramp	B	B	B	B	B	B	C	C	B	B	B	C	B
WB	34	WB Mainline b/w 26th St and Connectors from SR 51 & 99	Mainline	D	F	F	D	F	F	F	F	F	F	F	F	E
WB	35	NB SR 99 to WB US 50 Connector	Connector	D	F	F	F	E	F	F	F	E	F	F	F	F
WB	36	WB Mainline b/w Connectors from SR 99 & SR 51	Mainline	D	F	F	F	F	F	F	F	F	F	F	F	F
WB	37	SB SR 51 to WB US 50 Connector	Connector	D	F	F	F	E	F	F	F	E	F	F	F	E
WB	38	WB Mainline b/w Connectors from SR 51 & 99 and 16th St	Mainline	D	F	F	F	F	F	F	F	F	F	F	F	F
WB	39	WB Off-Ramp to 16th St - W St	Off-Ramp	B	B	C	C	B	B	C	C	B	B	C	C	B
WB	40	WB Mainline b/w 16th St and 15th St	Mainline	E	F	F	F	F	F	F	F	F	F	F	F	F
WB	41	WB Off-Ramp to 10th St-W St	Off-Ramp	A	A	A	A	A	A	A	A	A	A	A	A	A
WB	42	WB Mainline b/w 10th St Off and 15th St On	Mainline	E	E	E	E	E	E	E	E	E	E	E	E	E
WB	43	WB On-Ramp from 15th St - W St	On-Ramp	D	E	E	E	E	E	E	E	E	E	E	E	E
WB	44	WB Mainline b/w 10th St and Connectors to I-5	Mainline	D	E	E	E	D	E	E	E	E	E	E	E	D
WB	45	WB I-80/US 50 to NB I-5 Connector / Q St Off	Connector	F	F	F	F	F	F	F	F	F	F	F	F	F
WB	46	WB I-80/US 50 to SB I-5 Connector	Connector	F	F	F	F	F	F	F	F	F	F	F	F	F
WB	47	WB Mainline b/w Connectors to I-5 and 5th St	Mainline	C	C	C	C	C	C	C	C	C	C	C	C	C
WB	48	WB On-Ramp from 5th St / W St	On-Ramp	D	E	E	E	E	F	F	F	F	F	F	F	F
WB	49	WB Mainline b/w 5th St and Connectors from I-5	Mainline	D	E	E	E	D	E	E	F	E	E	F	F	E
WB	50	SB I-5 to WB I-80/US 50 Connector	Connector	C	C	C	C	C	D	C	D	D	B	C	C	A
WB	51	NB I-5 to WB I-80/US 50 Connector	Connector	C	D	D	D	D	E	E	F	E	D	E	E	B
WB	52	WB Mainline b/w Connectors from I-5 and Jefferson Blvd	Mainline	E	F	F	F	F	F	F	F	F	F	F	F	E

Note: pcplpm = passenger cars per lane per mile, Avg. = Average
All results reported from up to ten VISSIM microsimulation model runs (per scenario).

Legend:

Color	LOS
(white)	A-D
(orange)	E
(red)	F

Source: Wood Rodgers, Inc.

Appendix B

Operation Emissions – Mobile Source Air Toxics

- **Methodology**
- **MSAT Emission Calculations**

MSAT Methodology

Mobile source air toxics emissions were estimated along the mainline US 50 within the project limits, for which the VMT per speed bin distributions were provided by the project traffic study (Wood Rodgers, 2015). Emission estimates were performed for opening year 2020 and the horizon year 2040, as well as for the base year 2013. For each future year, a No Project scenario and the proposed alternatives under each design options were analyzed for comparison.

The analysis was conducted for seven air toxics that are currently identified as priority MSATs by the EPA. The EMFAC2014 model and the latest version of the Caltrans' CT-EMFAC Model (Version 5.0 - Sonoma Technology, Inc. [STI], 2013) were used to estimate project-specific MSAT emissions.

As described in Appendix A1, the EMFAC2014 model was used to provide the emissions and emission factors of total organic gases (TOG) and PM_{10} in the Sacramento County for the considered analysis years.

The data obtained from EMFAC2014 were also processed to calculate PM_{10} and TOG emissions from diesel-powered vehicles. These data were used to estimate the priority MSAT termed as diesel particulate matter (DPM).

As the current version of CT-EMFAC (Version 5), is based on EMFAC2011 data, adjustment needed to be made to the MSAT data modeled using CT-EMFAC. Using EMFAC2014 data and CT-EMFAC results, the MSAT emissions data were adjusted to reflect the EMFAC2014 model data. The methodology is provided in the following paragraphs.

Emission Estimates for Benzene, Acrolein, 1,3-Butadiene, and Formaldehyde

The approach to calculate emissions of these compounds includes the following steps:

- Use the EMFAC2014 web-based data tool to calculate emission factors of total organic gases (TOG) and particulate matter (PM_{10})
- Use CT-EMFAC to generate TOG and MSAT emission factors
- Based on the data generated from CT-EMFAC, develop scaling factors for various MSATs using the ratios of each MSAT to the TOG emission rate data
- Apply the scaling factors obtained in the previous step to estimate MSAT emission rates from EMFAC2014.

For each analysis year, the scaling factors were developed for each MSAT compound per speed bin (average speeds with 5 miles per hour increments). The default fleet mix for Sacramento County (data from 2014 for vehicle classes) was used in calculations as a conservative assumption.

Emission Estimates for Naphthalene and Polycyclic Organic Matter (POM)

The methodology for calculating Naphthalene and POM was based on the Caltrans document: *Guidance for Estimating Naphthalene and Polycyclic Organic Matter Emissions from Transporta tion Projects* (Sonoma Technology, Inc., June 30, 2010). Emission factors from

EMFAC2014 were used in Equation 1 (for naphthalene emissions) and Equation 2 (for POM emissions) to calculate naphthalene and POM emissions along studied roadway corridor.

$$Naphthalene = PM_{10} \times m_{naphthalene} + TOG \times (VOC/TOG\ ratio) \times evapGas\ ratio \qquad \text{Equation 1}$$

$$POM = PM_{10} \times m_{POM} \qquad \text{Equation 2}$$

Where:

PM_{10} = total project-level PM_{10} emissions from EMFAC2014 and project traffic data, (lbs/day);

$m_{naphthalene}$ = naphthalene multiplier (obtained from Table 3-2 based on % trucks and % diesel-fueled vehicles within the truck fleet;

m_{POM} = POM multiplier (obtained from Table 3-3 based on % trucks and % diesel-fueled vehicles within the truck fleet

TOG = total project-level TOG emissions from EMFAC2014 and project traffic data (lbs/day);

VOC/TOG = VOC (ROG) emissions to TOG emissions ratio calculated from EMFAC2014 results;

evapGas ratio = 0.0004 (based on EPA's National Mobile Inventory Model [NMIM] speciation data for evaporative naphthalene emissions from gasoline-powered vehicles.

Emission Estimates for Diesel Particulate Matter

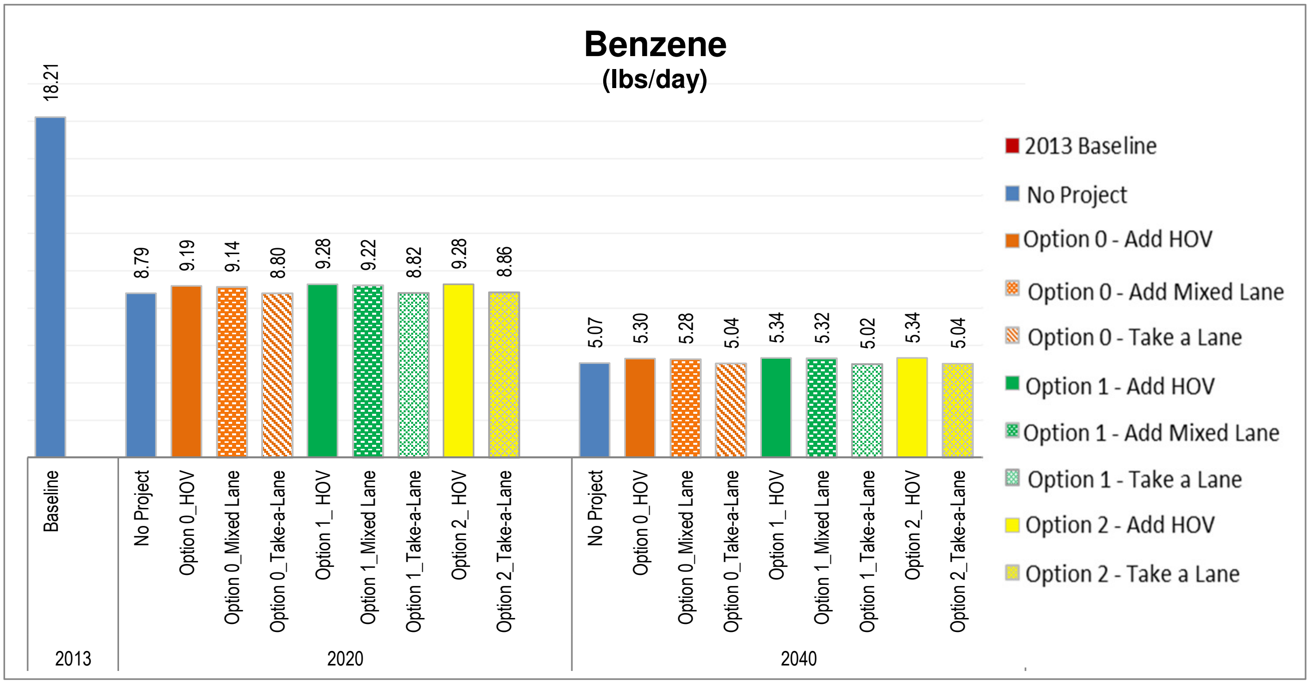
EMFAC2014 model for Sacramento County was used to generate PM_{10} and TOG emission factors by speed bin for diesel vehicles fleet. These emission factors were used for calculating project-level diesel particulate matter (Diesel PM) and diesel exhaust organic gases (DEOG) emissions.

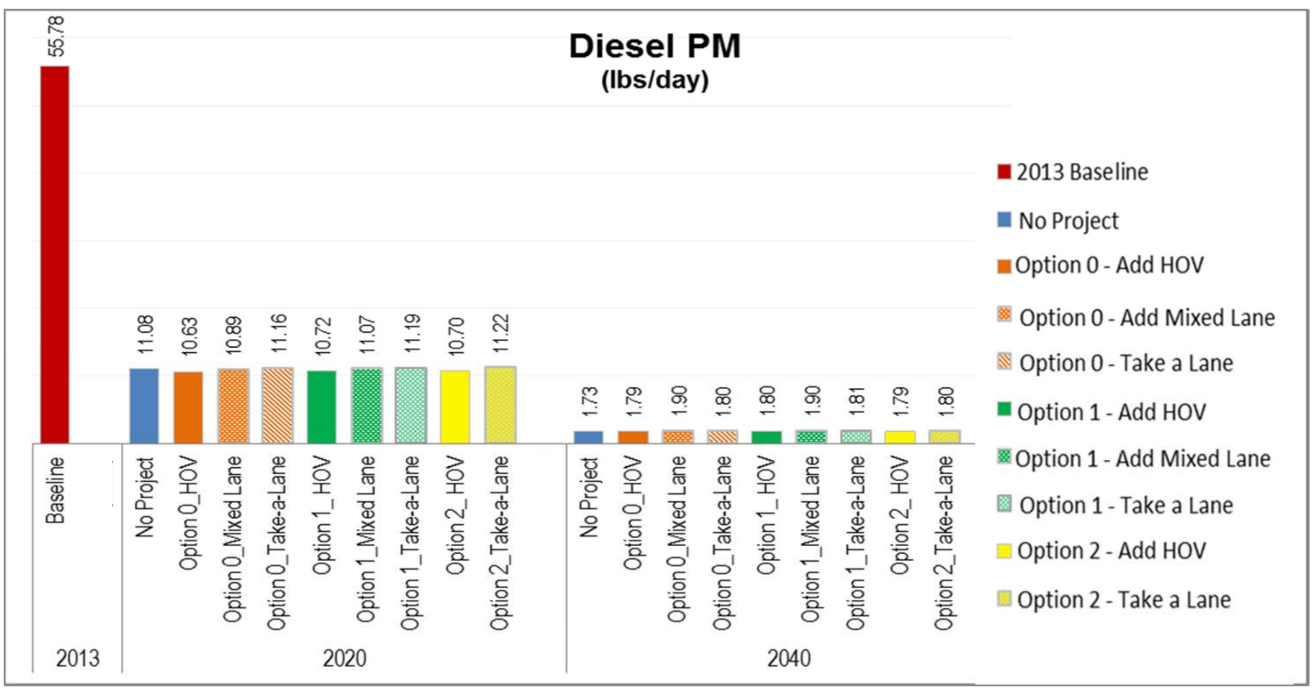
Priority MSAT Emissions for the Project Corridor
Summary Model Results - All Scenarios /Alternatives - (lbs/day)

Year	Scenario	Benzene	Acrolein	Formaldehyde	Butadiene	Naphthalene	POM	Diesel PM	DEOG
2013	Baseline	18.21	0.59	16.40	2.66	5.66	0.75	55.78	53.60
2020	No Project	8.79	0.23	7.13	1.05	1.69	0.21	11.08	33.96
2040	No Project	5.07	0.13	4.91	0.60	0.55	0.06	1.73	36.90
2020	Option 0_HOV	9.19	0.25	7.23	1.12	1.70	0.21	10.63	34.02
2020	Option 0_Mixed Lane	9.14	0.25	7.25	1.11	1.71	0.21	10.89	34.25
2020	Option 0_Take-a-Lane	8.80	0.24	7.04	1.06	1.70	0.21	11.16	33.23
2040	Option 0_HOV	5.30	0.14	4.80	0.64	0.58	0.06	1.79	35.75
2040	Option 0_Mixed Lane	5.28	0.14	4.88	0.64	0.58	0.07	1.90	36.41
2040	Option 0_Take-a-Lane	5.04	0.13	4.69	0.60	0.56	0.06	1.80	35.17
2020	Option 1_ HOV	9.28	0.26	7.22	1.14	1.72	0.21	10.72	33.77
2020	Option 1_Mixed Lane	9.22	0.25	7.27	1.12	1.74	0.22	11.07	34.15
2020	Option 1_Take-a-Lane	8.82	0.24	7.02	1.06	1.70	0.21	11.19	33.07
2040	Option 1_ HOV	5.34	0.15	4.73	0.65	0.58	0.07	1.80	35.18
2040	Option 1_Mixed Lane	5.32	0.14	4.84	0.65	0.59	0.07	1.90	35.99
2040	Option 1_Take-a-Lane	5.02	0.13	4.64	0.60	0.55	0.06	1.81	34.81
2020	Option 2_ HOV	9.28	0.26	7.28	1.14	1.72	0.21	10.70	34.15
2020	Option 2_Take-a-Lane	8.86	0.24	7.08	1.07	1.71	0.21	11.22	33.45
2040	Option 2_ HOV	5.34	0.14	4.79	0.65	0.58	0.06	1.79	35.70
2040	Option 2_Take-a-Lane	5.04	0.13	4.69	0.60	0.56	0.06	1.80	35.16

Priority MSATs Emission Charts

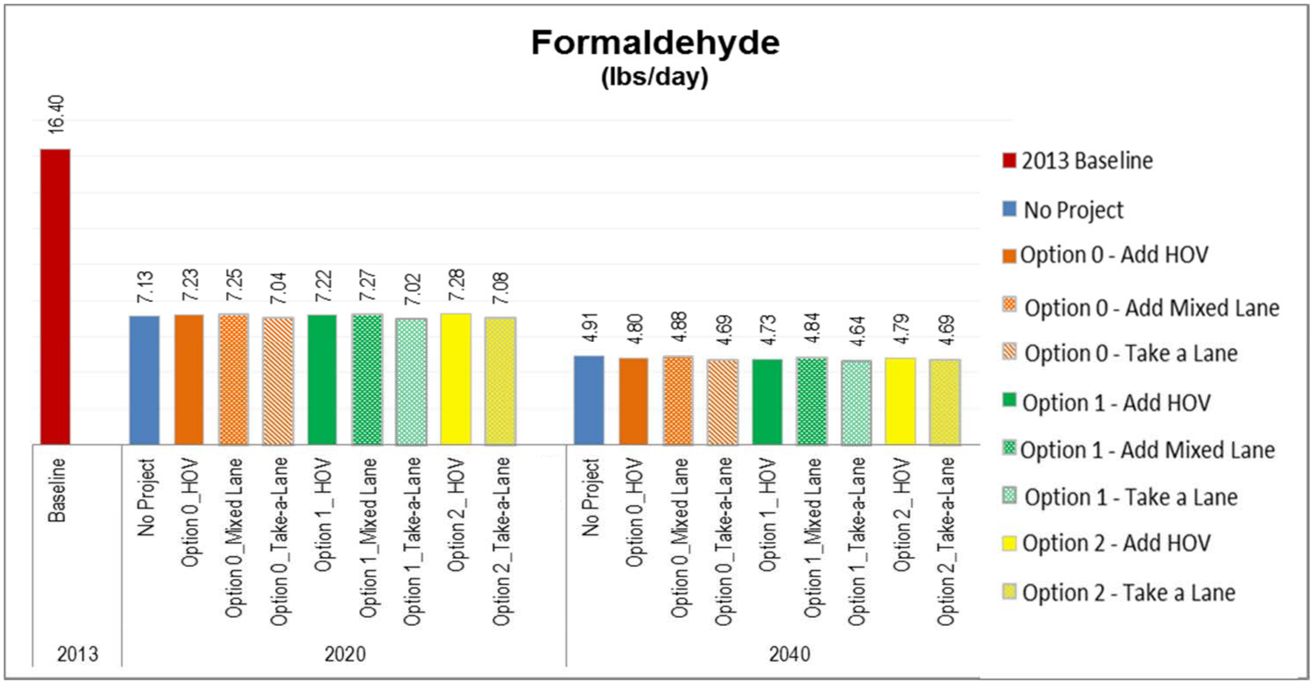
All Scenarios / Alternatives

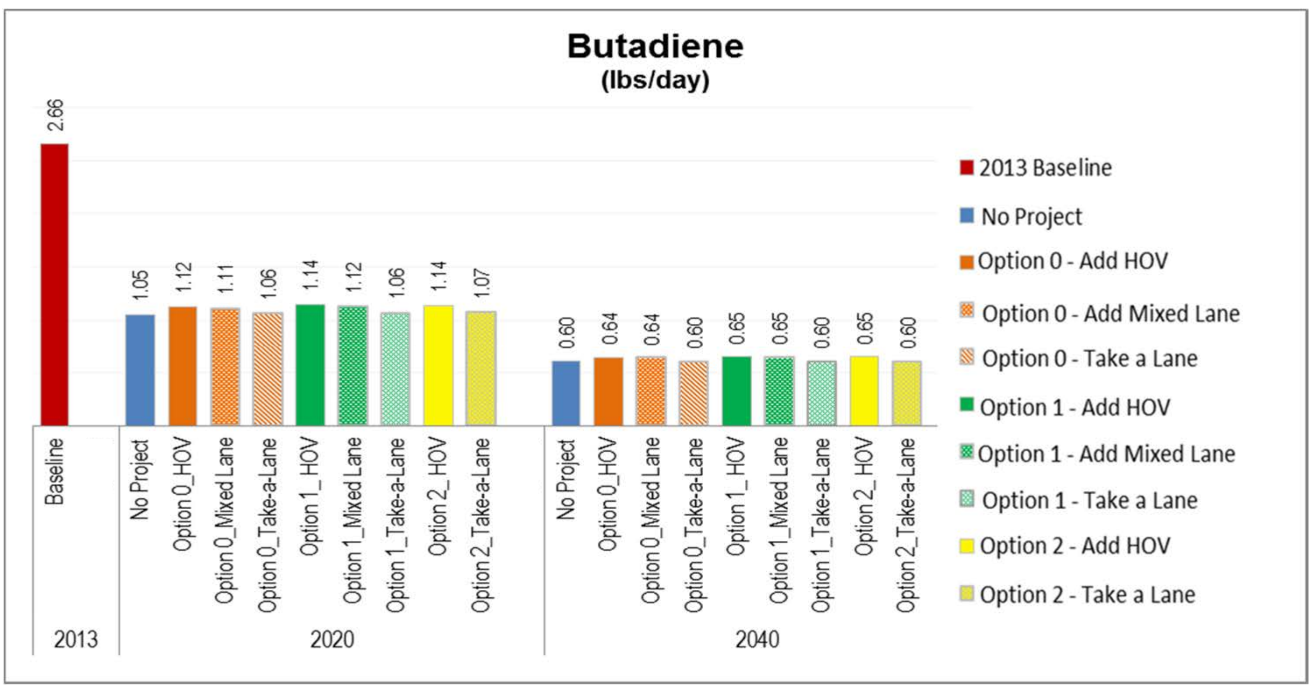


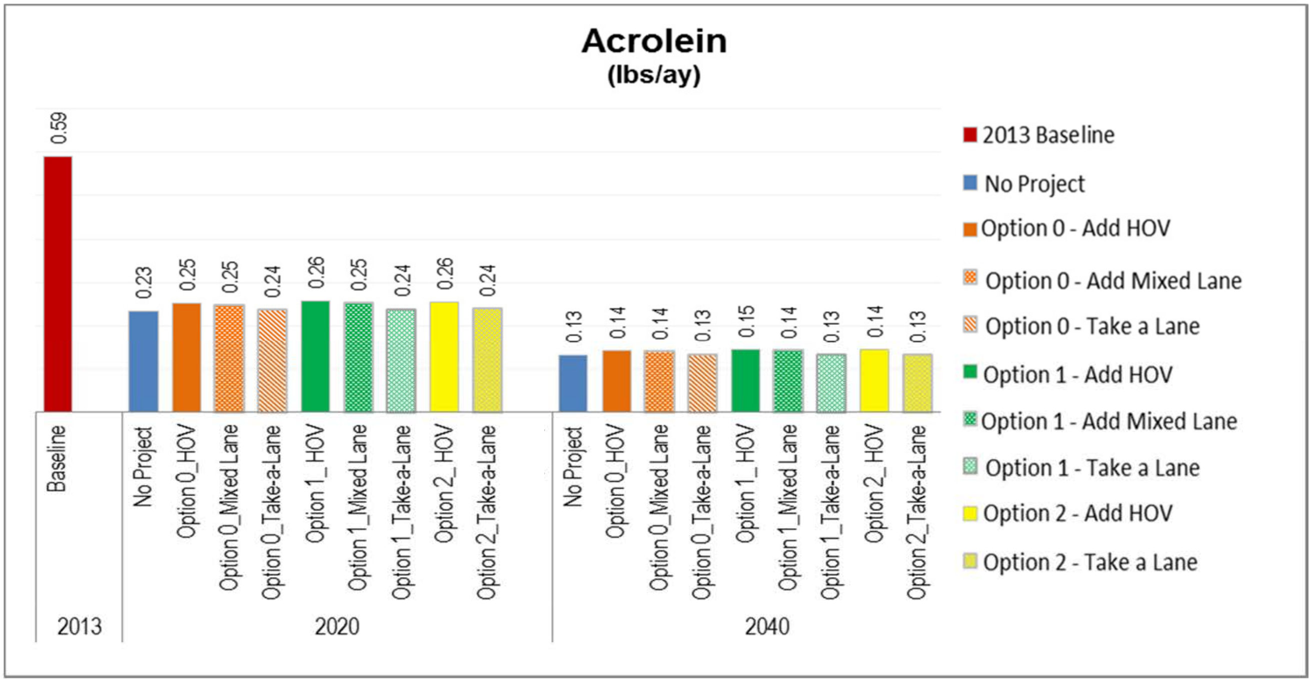


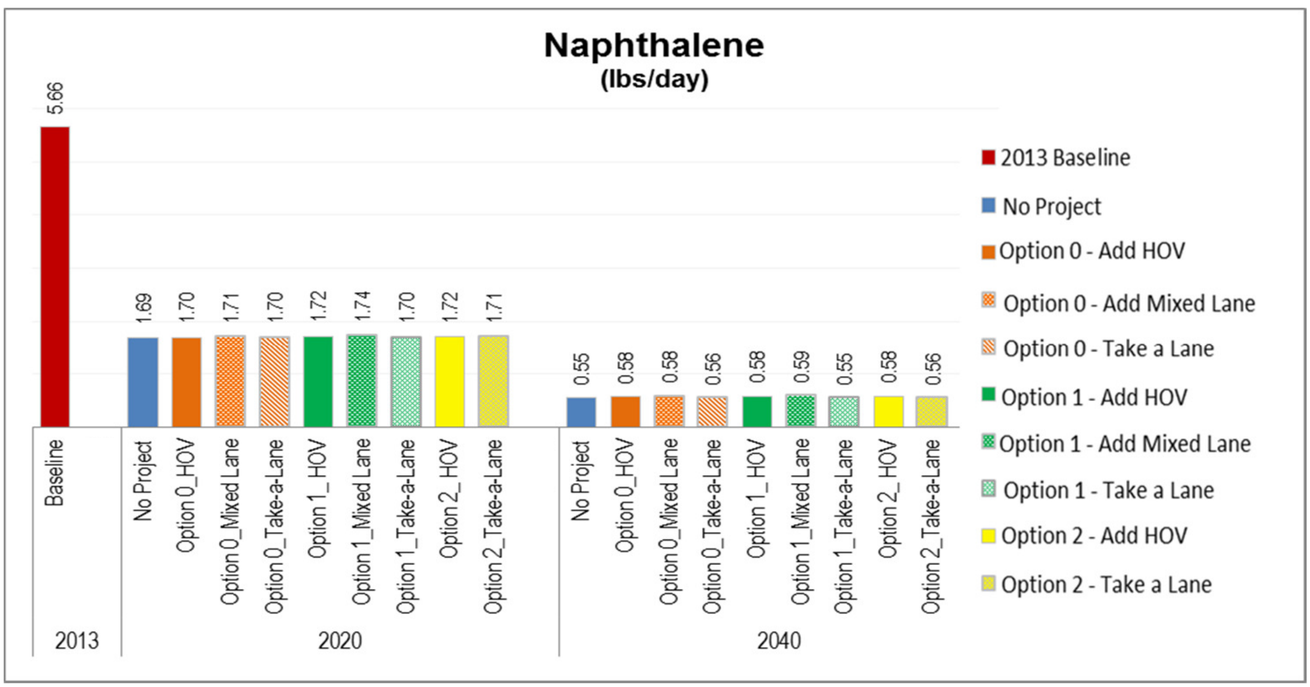
Priority MSATs Emission Charts

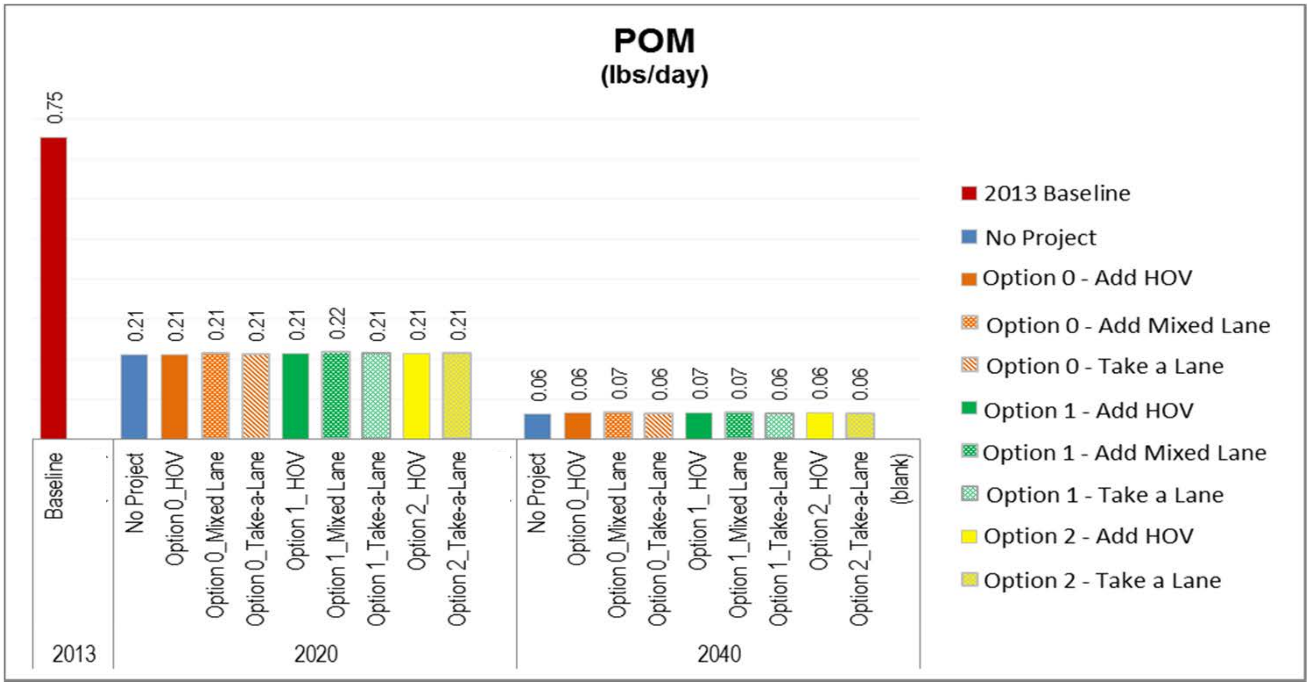
All Scenarios / Alternatives






Acrolein
(lbs/ay)
0.59
0.23
0.25
0.25
0.24
0.26
0.25
0.24
0.26
0.24
0.13
0.14
0.14
0.13
0.15
0.14
0.13
0.14
0.13
Baseline
No Project
Option 0_HOV
Option 0_Mixed Lane
Option 0_Take-a-Lane
Option 1_HOV
Option 1_Mixed Lane
Option 1_Take-a-Lane
Option 2_HOV
Option 2_Take-a-Lane
2013
2020
2040
2013 Baseline
No Project
Option 0 - Add HOV
Option 0 - Add Mixed Lane
Option 0 - Take a Lane
Option 1 - Add HOV
Option 1 - Add Mixed Lane
Option 1 - Take a Lane
Option 2 - Add HOV
Option 2 - Take a Lane


Naphthalene
(lbs/day)
5.66
1.69
1.70
1.71
1.70
1.72
1.74
1.70
1.72
1.71
0.55
0.58
0.58
0.56
0.58
0.59
0.55
0.58
0.56
Baseline
No Project
Option 0_HOV
Option 0_Mixed Lane
Option 0_Take-a-Lane
Option 1_HOV
Option 1_Mixed Lane
Option 1_Take-a-Lane
Option 2_HOV
Option 2_Take-a-Lane
2013
2020
2040
2013 Baseline
No Project
Option 0 - Add HOV
Option 0 - Add Mixed Lane
Option 0 - Take a Lane
Option 1 - Add HOV
Option 1 - Add Mixed Lane
Option 1 - Take a Lane
Option 2 - Add HOV
Option 2 - Take a Lane


POM
(lbs/day)
0.75
0.21
0.21
0.21
0.21
0.21
0.22
0.21
0.21
0.21
0.06
0.06
0.07
0.06
0.07
0.07
0.06
0.06
0.06
Baseline
No Project
Option 0_HOV
Option 0_Mixed Lane
Option 0_Take-a-Lane
Option 1_HOV
Option 1_Mixed Lane
Option 1_Take-a-Lane
Option 2_HOV
Option 2_Take-a-Lane
No Project
Option 0_HOV
Option 0_Mixed Lane
Option 0_Take-a-Lane
Option 1_HOV
Option 1_Mixed Lane
Option 1_Take-a-Lane
Option 2_HOV
Option 2_Take-a-Lane
(blank)
2013
2020
2040
2013 Baseline
No Project
Option 0 - Add HOV
Option 0 - Add Mixed Lane
Option 0 - Take a Lane
Option 1 - Add HOV
Option 1 - Add Mixed Lane
Option 1 - Take a Lane
Option 2 - Add HOV
Option 2 - Take a Lane

Appendix C

Project in Regional Transportation Plan (MTP/SCS) and Transportation Implementation Program (MTIP) project listings

Final Metropolitan Transportation Plan / Sustainable Communities Strategy Project List

/1/ Project Analysis projects are anticipated to begin early stages of development including project design, preliminary engineering, environmental clearance, and ROW acquisition by 2035. These projects remain eligible to seek federal and state funding, but under the financial constraint requirements for projecting revenues, the construction phase is not covered. If/when additional revenues for these projects become available, these projects will require future amendments to the MTP/SCS to reflect full construction costs.

COUNTY	LEAD AGENCY	TITLE	PROJECT DESCRIPTION	TOTAL COST (2010 DOLLARS)	TOTAL COST (YEAR OF EXPENDITURE DOLLARS)	MTP/SCS Status
Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB, American River Bridge to Exposition Blvd.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB, from Exposition Blvd. to SR 160.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: SB, from Exposition Blvd. to E St.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB and SB, from Marconi Ave. to Watt Ave.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 99 Interchange Improvements	Interchange Improvements: Mack Road, Florin Road, 47th Ave., 12th Ave.	$ 40,000,000	$ 67,046,315	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 99 Transition Lane	Transition Lane: NB, from 47th Ave. to Fruitridge Rd.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 99 Transition Lane	Transition Lane: NB from Florin Rd. to 47th Ave.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR 99 Transition Lane	Transition Lane: SB, from Martin Luther King Blvd. to 47th Ave.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans District 3	SR-99 Operational Improvements	In Sacramento County in the area from Calvine Road to just north of Mack Road - Construct and implement operational improvements, including lane extensions. (Project will use tapered matching funds.)	*MTIP Project: Year of Expenditure Costs Only*	$ 7,446,000	**Project complete by 2020**
Sacramento	Caltrans District 3	System Management/Traffic Operations System on SR 51 between U.S. 50 and I-80	Operational Improvements: traffic monitoring stations, closed circuit television, highway advisory radio, changeable message signs, and other system management infrastructure.	$ 3,000,000	$ 3,528,769	**Project complete by 2020**
Sacramento	Caltrans District 3	U.S. 50 / SR 99 / SR 51 Oak Park Interchange	Interchange Reconstruction: includes: bus/carpool lane freeway to freeway connectors.	$ 10,000,000	$ 13,705,955	**Project Analysis /1/**
Sacramento	Caltrans District 3	U.S. 50 Auxiliary Lane	Auxiliary Lane: EB and WB, from Sunrise Blvd. to Zinfandel Dr.	$ 5,000,000	$ 6,844,433	**Project complete by 2035**
Sacramento	Caltrans District 3	U.S. 50 HOV	U.S. 50, from Watt Ave. to Downtown Sacramento: Construct high occupancy vehicle (HOV) lanes.	$ 75,000,000	$ 93,643,626	**Project complete by 2035**
Sacramento	Caltrans District 3	U.S. 50 HOV & Community Enhancements	In Sacramento County and Rancho Cordova, on US 50: Construct high occupancy vehicle (HOV) lanes and community enhancements from Watt Avenue to Sunrise Boulevard. (Project is using tapered match. $10m of CMAQ is a loan from SACOG; this loan to be repaid with Local Funds - Measure A. Emission Benefits in kg/day are 52 NOx, 55 ROG, 7 PM10)	*MTIP Project: Year of Expenditure Costs Only*	$ 104,599,000	**Project complete by 2020**
Sacramento	Caltrans District 3	U.S. 50 Transition Lane	Transition Lane: NB, Howe Ave. on-ramp to SB Howe Ave. on-ramp.	$ 3,000,000	$ 3,745,745	**Project complete by 2035**
Sacramento	Caltrans District 3	U.S. 50 Transition Lane	Transition Lane: WB, from Sunrise Blvd. slip off-ramp to Sunrise Blvd. slip on-ramp.	$ 3,000,000	$ 4,106,660	**Project complete by 2035**
Sacramento	Caltrans Division of Rail	Elk Grove Intercity Rail Station	In Elk Grove, San Joaquin Rail Corridor, construct 100-space parking lot, 800 foot platform, and passenger shelter area for intercity passenger rail station.	*MTIP Project: Year of Expenditure Costs Only*	$ 8,500,000	**Project complete by 2020**

SACOG ID **CAL20501** **SAC** Lead Agency **Caltrans D3**

Project Title
SR 51 NB Transition Lane and Local Roadway Improvements

EA Number:3F750 Last Revised 15-00 Completion Year **2022**

Fed FY	Revenue Source	Engineering	Right of Way	Construction	Total Revenue
2016	RIP - STIP AC	$900,000			$900,000
>18		$530,000	$350,000	$6,520,000	$7,400,000
		$1,430,000	**$350,000**	**$6,520,000**	**$8,300,000**

Project Description
On SR 51 (Capital City Freeway), close E Street northbound onramp and extend the northbound transition lane from near E Street on-ramp to just south of Elvas Underpass near the American River. Modify intersection at E Street and 30th Street. Also build local roadway improvements on 30th St. (Toll Credits for PA&ED.) $900k STIP for PA&ED [CTIPS ID 107-0000-0940]. PS&E is not yet funded.

Other Total Cost **$8,300,000**

SACOG ID **CAL18838** **SAC** Lead Agency **Caltrans D3**

Project Title
US 50 HOV Lanes (SR 99 to Watt Ave.)

EA Number:3F360 Last Revised 15-00 Completion Year **2030**

Fed FY	Revenue Source	Engineering	Right of Way	Construction	Total Revenue
<15		$2,845,000			$2,845,000
2015	Sacramento County Measure A Sales Tax	$1,776,000	$930,000		$2,706,000
2016	Sacramento County Measure A Sales Tax	$1,785,000	$1,064,000		$2,849,000
2017	Sacramento County Measure A Sales Tax	$1,785,000	$930,000		$2,715,000
>18		$222,000		$56,978,000	$57,200,000
		$8,413,000	**$2,924,000**	**$56,978,000**	**$68,315,000**

Project Description
In Sacramento County, on US 50, from 0.3 mile west of SR 99 to 0.8 mile east of Watt Avenue - Construct high occupancy vehicle (HOV) lanes [PM L2.2/R6.1]

Other Total Cost **$68,315,000**

PROJECT ID	COUNTY	LEAD AGENCY	TITLE	PROJECT DESCRIPTION	TOTAL COST	2012	2014	2017	2018	2022	2025	2035	MTP or MTIP
NeedID-66	Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB, from E St. to American River Bridge.	$ 3,000,000					X	X	X	MTP
NeedID-65	Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB, American River Bridge to Exposition Blvd.	$ 3,000,000						X	X	MTP
NeedID-67	Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB, from Exposition Blvd. to SR 160.	$ 3,000,000						X	X	MTP
NeedID-68	Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: SB, from Exposition Blvd. to E St.	$ 3,000,000						X	X	MTP
NeedID-69	Sacramento	Caltrans District 3	SR 51 Transition Lane	Transition Lane: NB and SB, from Marconi Ave. to Watt Ave.	$ 3,000,000						X	X	MTP
NeedID-75	Sacramento	Caltrans District 3	SR 99 Interchange Improvements	Interchange Improvements: Mack Road, Florin Road, 47th Ave., 12th Ave.	$ 40,000,000							X	MTP
NeedID-72	Sacramento	Caltrans District 3	SR 99 Transition Lane	Transition Lane: NB, from 47th Ave. to Fruitridge Rd.	$ 3,000,000						X	X	MTP
NeedID-73	Sacramento	Caltrans District 3	SR 99 Transition Lane	Transition Lane: NB from Florin Rd. to 47th Ave.	$ 3,000,000						X	X	MTP
NeedID-74	Sacramento	Caltrans District 3	SR 99 Transition Lane	Transition Lane: SB, from Martin Luther King Blvd. to 47th Ave.	$ 3,000,000						X	X	MTP
NeedID-80	Sacramento	Caltrans District 3	U.S. 50 Auxiliary Lane	Auxiliary Lane: EB and WB, from Sunrise Blvd. to Zinfandel Dr.	$ 5,000,000						X	X	MTP
CAL18838	Sacramento	Caltrans District 3	U.S. 50 HOV	U.S. 50, from Watt Ave. to Downtown Sacramento: Construct high occupancy vehicle (HOV) lanes.	$ 75,000,000					X	X	X	MTP
NeedID-78	Sacramento	Caltrans District 3	U.S. 50 Transition Lane	Transition Lane: NB, Howe Ave. on-ramp to SB Howe Ave. on-ramp.	$ 3,000,000					X	X	X	MTP
NeedID-81	Sacramento	Caltrans District 3	U.S. 50 Transition Lane	Transition Lane: WB, from Sunrise Blvd. slip off-ramp to Sunrise Blvd. slip on-ramp.	$ 3,000,000						X	X	MTP
NeedID-438	Sacramento	City of Elk Grove Dept of Public Works	Bond Rd	Center 2 lanes & median; traffic signal from Waterman to Bradshaw	$ 552,300					X	X	X	MTP
SAC24073	Sacramento	City of Elk Grove Dept of Public Works	Bradshaw Rd.	Widen: 4 lanes from Sheldon Rd. to Calvine Rd.	$ 6,200,200					X	X	X	MTP
SAC24078	Sacramento	City of Elk Grove Dept of Public Works	Bruceville Rd.	Widen: 4 lanes from Sheldon Rd. to Laguna Blvd.	$ 3,770,700					X	X	X	MTP
SAC19010	Sacramento	City of Elk Grove Dept of Public Works	Bruceville Road Widening	In Elk Grove, from Whitelock Parkway to Bilby Road: Widen from 2 to 4 lanes.	$ 3,719,000					X	X	X	MTP
SAC24105	Sacramento	City of Elk Grove Dept of Public Works	Bruceville Road Widening	In Elk Grove, Bruceville Road from Bilby Road to Kammerer Road: Widen from 2 to 4 lanes.	$ 719,000					X	X	X	MTP
SAC24390	Sacramento	City of Elk Grove Dept of Public Works	Calvine Rd.	Widen: 6 lanes from Power Inn Rd. to Vineyard Rd. Includes: bicycle and pedestrian facilities, transit facilities, traffic signal modification(s), and ADA compliant installations.	$ 6,412,260						X	X	MTP

Appendix D

Construction Emissions
Road Construction Model Sheets

Road Construction Emissions Model

Version 7.1.5.1

Data Entry Worksheet

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.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type		
Project Name	US 50 HOV Lanes	
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	15.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	7.80	miles
Total Project Area	7.00	acres
Maximum Area Disturbed/Day	1.75	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.00	yd^3/day
Soil Exported	200.00	yd^3/day
Average Truck Capacity	20	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

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		1.50	0.00		0.00	0.00	0.00	0.00	0.00
Grading/Excavation		6.75	0.00		0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		4.50	0.00		0.00	0.00	0.00	0.00	0.00
Paving		2.25	0.00		0.00	0.00	0.00	0.00	0.00
Totals	0.00	15.00							

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.

Road Construction Emissions Model, Version 7.1.5.1

Emission Estimates for -> US 50 HOV Lanes 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	1.4	11.0	14.2	18.2	0.7	17.5	4.2	0.6	3.6	2,482.4
Grading/Excavation	7.6	42.5	82.8	21.5	4.0	17.5	7.2	3.6	3.6	10,280.6
Drainage/Utilities/Sub-Grade	5.1	29.9	45.9	20.2	2.7	17.5	6.0	2.4	3.6	6,175.8
Paving	2.0	15.7	16.7	1.1	1.1	-	1.0	1.0	-	3,274.0
Maximum (pounds/day)	7.6	42.5	82.8	21.5	4.0	17.5	7.2	3.6	3.6	10,280.6
Total (tons/construction project)	0.9	5.2	9.1	2.9	0.5	2.5	0.9	0.4	0.5	1,191.0

Notes: Project Start Year -> 2017
Project Length (months) -> 15
Total Project Area (acres) -> 7
Maximum Area Disturbed/Day (acres) -> 2
Total Soil Imported/Exported (yd^3/day)-> 200

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 -> US 50 HOV Lanes 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	0.6	5.0	6.4	8.3	0.3	8.0	1.9	0.3	1.7	1,128.4
Grading/Excavation	3.5	19.3	37.6	9.8	1.8	8.0	3.3	1.6	1.7	4,673.0
Drainage/Utilities/Sub-Grade	2.3	13.6	20.8	9.2	1.2	8.0	2.7	1.1	1.7	2,807.2
Paving	0.9	7.1	7.6	0.5	0.5	-	0.4	0.4	-	1,488.2
Maximum (kilograms/day)	3.5	19.3	37.6	9.8	1.8	8.0	3.3	1.6	1.7	4,673.0
Total (megagrams/construction project)	0.8	4.7	8.2	2.7	0.4	2.2	0.8	0.4	0.5	1,080.3

Notes: Project Start Year -> 2017
Project Length (months) -> 15
Total Project Area (hectares) -> 3
Maximum Area Disturbed/Day (hectares) -> 1
Total Soil Imported/Exported (meters^3/day)-> 153

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

Version 7.1.5.1

Data Entry Worksheet

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.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type		
Project Name	US 50 HOV Lanes	
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	15.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	7.80	miles
Total Project Area	7.00	acres
Maximum Area Disturbed/Day	1.75	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.00	yd^3/day
Soil Exported	200.00	yd^3/day
Average Truck Capacity	20	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

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
Grubbing/Land Clearing		1.50
Grading/Excavation		6.75
Drainage/Utilities/Sub-Grade		4.50
Paving		2.25
Totals	0.00	15.00

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		10
Vehicle miles traveled/day (calculated)		300

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.15	7.43	0.65	0.16	0.09	1652.56
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.10	4.91	0.43	0.10	0.06	1092.00
Tons per contruction period	0.01	0.36	0.03	0.01	0.00	81.08

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		24
No. of employees: Grading/Excavation		39
No. of employees: Drainage/Utilities/Sub-Grade		33
No. of employees: Paving		29

	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)	0.133	0.172	1.555	0.047	0.020	443.765
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.131	0.169	1.529	0.047	0.020	443.784
Emission rate - Paving (grams/mile)	0.120	0.154	1.399	0.047	0.020	443.880
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)	0.457	0.287	3.779	0.004	0.003	95.644
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.450	0.281	3.718	0.004	0.003	95.655
Emission rate - Paving (grams/trip)	0.415	0.255	3.410	0.004	0.003	95.711
Pounds per day - Grubbing/Land Clearing	0.325	0.391	3.650	0.098	0.042	938.591
Tons per const. Period - Grub/Land Clear	0.005	0.006	0.060	0.002	0.001	15.487
Pounds per day - Grading/Excavation	0.531	0.637	5.954	0.161	0.068	1531.385
Tons per const. Period - Grading/Excavation	0.039	0.047	0.442	0.012	0.005	113.705
Pounds per day - Drainage/Utilities/Sub-Grade	0.438	0.525	4.911	0.135	0.057	1284.443
Tons per const. Period - Drain/Util/Sub-Grade	0.022	0.026	0.243	0.007	0.003	63.580
Pounds per day - Paving	0.357	0.423	3.975	0.119	0.050	1136.488
Tons per const. Period - Paving	0.009	0.010	0.098	0.003	0.001	28.128
tons per construction period	0.075	0.090	0.844	0.023	0.010	220.900

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	7.43	0.65	0.16	0.09	1652.56
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.15	7.30	0.66	0.16	0.09	1647.90
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	0.01	0.00	0.00	0.00	2.40
Pound per day - Grading/Excavation	0.01	0.65	0.06	0.01	0.01	145.60
Tons per const. Period - Grading/Excavation	0.00	0.05	0.00	0.00	0.00	10.81
Pound per day - Drainage/Utilities/Subgrade	0.01	0.64	0.06	0.01	0.01	145.19
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.03	0.00	0.00	0.00	7.19

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		1.75	17.5	0.3	3.6	0.1
Fugitive Dust - Grading/Excavation		1.75	17.5	1.3	3.6	0.3
Fugitive Dust - Drainage/Utilities/Subgrade		1.75	17.5	0.9	3.6	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
1.00	2	Excavators	0.38	2.79	4.05	0.20	0.18	572.75
		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 Equipme	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipme	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
0.00	16	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		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	1.1	7.3	13.1	0.5	0.5	1398.2
	Grubbing/Land Clearing	tons per phase	0.0	0.1	0.2	0.0	0.0	23.1

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	0.71	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
1.00	3	Excavators	0.38	2.79	4.05	0.20	0.18	572.75
		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
1.00	2	Graders	1.00	3.47	9.64	0.54	0.50	669.23
		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 Equipme	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipmei	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	0.65	3.02	5.76	0.42	0.38	558.90
		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	0.50	3.12	6.05	0.21	0.19	662.79
	2	Scrapers	2.73	14.51	32.82	1.32	1.21	3215.90
0.00	16	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		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
3.00	4	Tractors/Loaders/Backhoes	1.00	4.71	9.17	0.69	0.63	1006.57
		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	7.0	36.1	76.6	3.7	3.4	7511.6
	Grading	tons per phase	0.5	2.7	5.7	0.3	0.3	557.7

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	0.63	3.41	4.08	0.33	0.30	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	0.46	2.97	3.61	0.25	0.23	487.07
	1	Graders	0.98	3.47	9.42	0.53	0.49	668.92
		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 Equipme	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipmei	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	0.39	2.45	2.98	0.21	0.19	396.14
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rough Terrain Forklifts	0.20	2.03	2.36	0.12	0.11	372.72
		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	1.34	7.26	16.02	0.64	0.59	1608.05
0.00	16	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		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
2.00	3	Tractors/Loaders/Backhoes	0.65	3.14	5.98	0.45	0.41	670.88
		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	4.7	24.9	44.7	2.5	2.3	4746.2
	Drainage	tons per phase	0.2	1.2	2.2	0.1	0.1	234.9

Paving 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
		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 Equipme	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipmei	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pavers	0.33	2.84	3.45	0.17	0.16	482.19
	1	Paving Equipment	0.24	2.69	2.59	0.13	0.12	426.37
		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	0.54	3.02	4.95	0.34	0.31	558.85
		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
0.00	16	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		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
2.00	3	Tractors/Loaders/Backhoes	0.56	3.14	5.28	0.37	0.34	670.05
		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	1.7	11.7	16.3	1.0	0.9	2137.5
	Paving	tons per phase	0.0	0.3	0.4	0.0	0.0	52.9
Total Emissions all Phases (tons per construction period) =>			0.8	4.3	8.5	0.4	0.4	868.6

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 E

Greenhouse Gas Emissions – Calculation Worksheets

- Calculation of operational CO_2 emissions performed with criteria pollutants emissions and the calculation worksheets are provided in Appendix A1.
- Construction emissions of CO_2 using Road Construction Model is provided in Appendix D.
- Summary of operational CO2 emissions for all scenarios/alternatives is provided below

CO_2 Emissions Calculations Summary
(Emissions and VMT Data per Scenario)

Year	Scenario	Total VMT (miles)		CO_2 Emission	
		Daily	Annual	lbs/day	metric tons/year
2013	Base Year	1,979,279	722,436,780	1,886,259	312,292
2020	No Project	2,216,162	808,899,013	1,824,126	302,005
2040	No Project	2,617,566	955,411,725	1,556,346	257,671
2020	Option 0 – Add HOV Lanes	2,273,868	829,961,667	1,908,539	315,980
	Option 0 – Add Mixed Flow Lanes	2,277,028	831,115,176	1,897,003	314,070
	Option 0 – Take-a-Lane	2,204,346	804,586,126	1,836,228	304,008
2040	Option 0 – Add HOV Lanes	2,730,769	990,119,305	1,664,342	275,551
	Option 0 – Add Mixed Flow Lanes	2,733,443	990,739,199	1,669,325	276,376
	Option 0 – Take-a-Lane	2,616,914	955,173,716	1,584,808	262,383
2020	Option 1 – Add HOV Lanes	2,282,138	832,980,538	1,933,396	320,096
	Option 1 – Add Mixed Flow Lanes	2,285,628	834,254,111	1,920,705	317,995
	Option 1 – Take-a-Lane	2,202,424	803,884,636	1,844,365	305,356
2040	Option 1 – Add HOV Lanes	2,730,769	996,730,601	1,689,593	279,731
	Option 1 – Add Mixed Flow Lanes	2,733,443	997,706,779	1,693,016	280,298
	Option 1 – Take-a-Lane	2,602,167	949,790,970	1,583,515	262,169
2020	Option 2 – Add HOV Lanes	2,290,467	836,020,601	1,929,303	319,418
	Option 2 – Take a Lane	2,217,109	809,244,938	1,848,896	306,106
2040	Option 2 – Add HOV Lanes	2,729,395	996,229,087	1,679,299	278,027
	Option 2 – Take a Lane	2,612,396	953,524,642	1,584,380	262,312