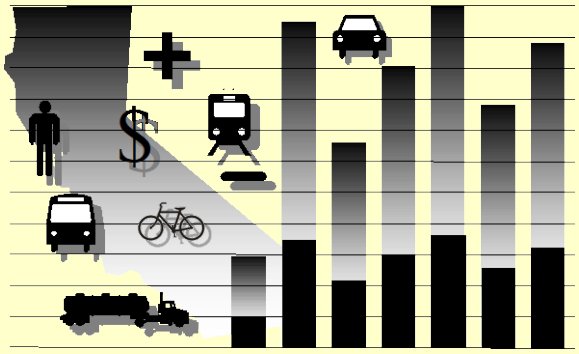
California Department Of Transportation

California Active Transportation Benefit/Cost Analysis Model for 2021 INFRA Applications

(Cal-B/C AT) Version 7.1



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BENEFIT-COST ANALYSIS OF ACTIVE TRANSPORTATION PROJECTS (Cal-B/C AT)

INTRODUCTION

This workbook is a benefit-cost analysis (BCA) tool to perform simple economic analyses of active transportation projects that improve travel options and conditions for cyclists and pedestrians. Users enter data into the tool, which computes lifecycle costs, annual and total benefits in several key categories, net present value, benefit-cost ratio, internal rate of return, and payback period. Benefits are also specifically estimated for children as part of Safe Route to School (SRTS) initiatives.

In addition to the BCA tool, a data entry form is provided for assessing non-infrastructure initiatives. Attributes of these initiatives are used in a multi-criteria scoring system to provide a common basis of comparison. Results of this scoring system are presented alongside, but not added to, the monetized benefits computed in the BCA tool.

The model contains worksheets with the following information, data, and results:

Worksheets	Contents
Instructions	General model description and assumptions
1a) Project Info	Input data for capital projects to improve or construct bike routes
1b) Non-Inf Program Info	Input data and scoring system for non-infrastructure initiatives
2) Model Inputs	Number of trips, users, and miles traveled by trip purpose based on data entered in Project Information worksheet and adjustable by user
3) Results	Summary results of analysis
Journey Quality	Calculation of journey quality impacts for improved travel
Intersection Delay	Calculation of travel time savings where bike and pedestrian facilities cross improved intersections
Intersection Safety	Calculation of changes in user accident risks at improved intersections on existing facilities
Auto Accident Costs	Calculation of changes in auto accident costs from diversions to active transportation
Health - Absenteeism	Calculation of health benefits for employers due to reduced absenteeism based on increased productivity
Health - Reduced Mortality	Calculation of user health benefits associated with reduced risk of mortality
Emissions	Calculation of changes in highway emissions costs from diversions to active transportation
Final Calculations	Calculation of net present value, internal rate of return, and payback period

Parameters	Economic assumptions, lookup tables, and other model parameters consistent with Cal-B/C

Tool users enter data primarily on the Project Information or Non-Infrastructure Program Information sheets, depending on project type. These worksheets cover information that drives the impacts of infrastructure and non-infrastructure initiatives, respectively. Infrastructure projects are categorized as one of four bike facility classes (i.e., I - Bike Paths, II - Bike Lanes, III - Bike Route, and IV - Separated Bikeways, and Cycle Tracks). Characteristics of facility users (i.e., number of cycling and walking users, trip purpose, and average distance traveled) are influential in estimating facility benefits.

Separate data are required for estimating the benefits of improvements to existing routes and the construction of new bike routes. The model can include projects with elements of both new and improved facilities. Additional data on the number of school-aged children are also collected to estimate benefits from a *Safe Route to School* initiative, if applicable. Benefits are compared with lifecycle costs to determine economic metrics, such as a benefit-cost ratio and net present value.

Non-infrastructure initiatives include a variety of education and outreach programs. Attributes that reflect the programmatic impact of these initiatives include the numbers of people in the target audience, the characteristics of the promotional effort, the type of impact or messaging, and the frequency of outreach effort. Evaluations of these initiatives are performed with a multi-criteria framework that determines overall program scores consistent with the potential for reaching new users through a variety of mechanisms and frequency. The scoring system determines overall program impact scores. The scoring system allows initiatives to be compared by the estimated average lifecycle cost per new potential user.

Cal-B/C AT is designed so that the user generally needs to insert data only in the green boxes on the Project Information and Non-Infrastructure Program Information sheets. Summary results are shown on the Results worksheet. The remaining worksheets are provided for the user to see, but the model performs calculations automatically.

In the process of economic analysis, some generally accepted economic assumptions are necessary. These assumptions include the real and nominal discount rates, unit user costs (e.g., value of time), consumption rates (e.g., fuel consumption and vehicle emissions), and accident rates. These assumptions are given in the Parameters worksheet and should not be changed by the user.

After reading the instructions in this worksheet, the user should proceed to the Project Information worksheet and input data for the specific project in the green boxes (light gray when printed). The model provides default values in the red boxes (medium gray when printed). These values can be changed by the user, if information specific to the project is available. The model calculates some values based on relationships or assumptions, with results shown in the blue boxes (dark gray when printed). These values can be changed by the user.

INSTRUCTIONS FOR INFRASTRUCTURE PROJECTS

The user can analyze most projects by entering limited data on the Project Information sheet. The Model Inputs sheet allows the user to enter more detailed data or adjust estimated annual trips, number of users, and total miles traveled. The analysis results are calculated automatically and displayed on the Results sheet. The section below explains the input data required to analyze infrastructure projects.

PROJECT AND SITE CHARACTERISTICS (Box 1A)

This section provides general information about the project. At the top of the sheet, the user can insert information, such as the project name, Caltrans District, and funding information.

Type of Project

1 Select whether the project is a facility upgrade or a new facility.

Total Project Length

2 Enter total new construction mileage for existing and new bike and pedestrian facilities. If the project type matches the project lengths entered, the data entry indicators will read "OK."

Project Location

3 Insert a 1, 2, or 3 for the appropriate region of California. This information is used to select average bicycle and pedestrian trip data for determining health risk benefits. Characteristics include average travel distance, trip purpose, and ages of users.

Safe Route to School

4 Indicate if the project involves a Safe Route to School.

Programmatic Initiatives

5 Indicate whether the project includes any non-infrastructure, programmatic initiatives.

Construction

6 Insert the number of construction years before benefits begin. This must be a whole number (round to the next higher integer). The number of years should correspond with the cost data are entered in Boxes 1F and 1G.

EXISTING SEGMENT IMPROVEMENTS AND TRIP VOLUME (Box 1B)

This section provides specific information about the existing bike facility segment to be improved.

Existing Facility Length

7 Enter lengths for each class of existing bike facility (e.g., bike paths (Class I), bike lanes (Class II) bike routes (Class III), and separated bikeways, cycle tracks (Class IV). The sum of the facility lengths for No Build and Build scenarios should equal the total length of existing facility in Box 1A. If the total miles are entered correctly, and match mileage of potentially different facility classes, the data entry indicators will read "OK." Otherwise, the adjacent cell will read "Not OK."

Pedestrian Improvements

8 Indicate if the project design includes one or more of the following: street lighting, curb level, crowding, pavement evenness, information panels, benches, and directional signage.

Trip Data

9 Indicate the current number of 1-way trips and the annual growth rate in trips in the No Build and Build scenarios. These parameters are used to estimate trips in the first year after construction (depending on the expected number of years until construction is completed) and 20 years after construction. Blue cells can be overwritten if better data are available (e.g., an expectation that demand jumps in the first year of operations).

INTERSECTIONS IMPROVEMENTS – TIME SAVINGS AND ACCIDENT REDUCTION (Box 1C)

Improvements at existing intersections between bike and pedestrian facilities and roadways can generate benefits from time savings by avoiding delays and from reduced crashes. This section allows the user to enter the data required to estimate these benefits.

Reduced Delay Due to Intersection Improvements

These data are used to compute the number of intersections crossed by users (based on average trip lengths) and the reduced delay at intersections. Improvements can include signals for bike facility users as well as bridges for bike and pedestrian facilities over roadways. The average number of intersections crossed is computed from the number of intersections improved and average distance per trip.

10 Enter the number of improved intersections.
11 Estimate the time savings in minutes at each improved intersection (based on intersection traffic conditions and existing bike facility crossing characteristics).
12 Indicate if the intersection improvements occur for children as part of an SRTS initiative.

Accident Rates – Current Conditions

These benefits are already covered for new bike and pedestrian facilities because the improved journey quality captures the value of safety. For existing facilities with explicit safety improvements, enter 5-year average data for accidents involving cyclists or pedestrians. Baseline data should indicate the number of fatality, injury, and property damage only accidents.

If available, data on the annual percent growth in accidents should be provided. Annual accident rates are determined based on the years available, if other than 5 years. Improvements at intersections can take several forms (e.g., signals, lane markings, etc.). Each improvement provides a different crash reduction rate. The three most effective measures are used to estimate reductions in accidents and the associated monetized benefits.

13 Provide baseline accident rates for crashes involving cyclists and pedestrians in terms of:
   a. Number of Years of Data
   b. Fatal Accidents (Fat) (#)
   c. Injury Accidents (Inj) (#)
   d. Property Damage Only (PDO) Accidents (#)
   e. Annual Growth Rate in Accidents (%).

Safety Countermeasures (improvements to existing facilities only)

14 Indicate which countermeasures are included in the facility improvement.

GENERAL USER CHARACTERISTICS (Box 1D)

This section reports on mode-specific trip characteristics for walking and cycling for a new or existing facility. Reported default values on trip purpose by percentage of total and average distance traveled per trip are provided. Separate trip distances are provided for children and can be used as default values for SRTS initiatives. These values can be overwritten by the user. Other default values (e.g., ages of users, diversion of riders from personal vehicles, and traveling speeds) are included in the Parameters worksheet.

Trip Purpose

15 Indicate the percent trips taken by trip purpose and mode. If the user changes percentages, the sum of new values must be 100%.

Trip Characteristics

16 Provide the average distance traveled per trip in miles for SRTS trips and other trips.

NEW FACILITY IMPROVEMENTS AND TRIP VOLUME (Box 1E)

This section provides specific information about the new segment to be improved in the project. For new segments, riders are assumed to use the road in the No Build condition. The No Build option is assumed to be equal to the length of the new facility. Data need to be filled in for projects that involve construction of new bike and pedestrian facilities or improvements to existing facilities that connect to newly constructed ones.

New Facility Length

17 Enter lengths of each class of new bike facility for: Bike Paths (Class I), Bike Lanes (Class II), Bike Routes (Class III), Separated Bikeways, Cycle Tracks (Class IV). If total miles are entered correctly and match the total mileage of different facility classes, the data entry indicators will read "OK." Otherwise, the adjacent cells will read "Not OK."

Pedestrian Improvements

18 Indicate with a "1" for Yes, if the project design involves one or more of the following improvements: street lighting, curb level, crowding, pavement evenness, information panels, benches, and directional signage. These features are assumed to be located throughout the bike facility so all users will have the opportunity to use them when on the path.

Trip Data

19 Indicate current number of one-way trips and annual growth rate in trips in the No Build and Build contexts. These parameters are used to estimate numbers of trips in first year after construction (depending on expected number of years until construction is completed), and 20 years after construction. Blue cells can be overwritten if better data are available (e.g., if there is an expectation that demand jumps in the first year of operations).

PROJECT COSTS (Box 1F)

This section allows the user to input costs for infrastructure projects. Total project costs should be entered in the years they are expected to occur. Costs should be inserted for construction period and for

a 20-year operating period after construction completion. Construction Year 1 is the first year that costs are incurred. All costs should be in thousands of dollars.

20 Insert the project's initial costs in constant dollars for project development, right-of-way, and construction. The number of construction years should equal the length of the construction period
21 Insert estimated future incremental maintenance/operating and rehabilitation costs in constant dollars. These figures should be entered for all years after the project opens.
22 Insert any other costs not already included.

NON-INFRASTRUCTURE PROGRAM COSTS (Box 1G)

This section allows the user to input costs for non-infrastructure programs. Total program costs should be entered in the years that they are expected to occur. Costs should be inserted for initial capital costs and for a 20-year operating period after the initial years of implementation. Year 1 is the first year that capital costs are incurred. All costs should be in thousands of dollars.

23 Insert program's initial costs in constant dollars for any costs related to program development and set-up.
24 Insert estimated future program costs in constant dollars for all years.
25 Enter any other costs not already included.

DATA CHECKS - PROJECT LENGTH, DAILY TRIPS (Box 1H)

This section contains data checks to make sure that data are entered correctly. The user does not need to enter anything in this table. The data checks evaluate No Build and Build project lengths for each type of relevant project (e.g., new and existing). All of these cells should read "OK." Errors indicate that prior inputs should be modified.

INSTRUCTIONS FOR NON-INFRASTRUCTURE PROGRAMS

Non-infrastructure programs are intended to reach target audiences through a variety of outreach and training mechanisms. The Non-Infrastructure Program Information sheet collects information about the proposed initiative and applies a scoring framework to determine the overall program score per cost.

The impact score is based on the number of people reached who are not currently engaging in active transportation. Four criteria are established to assess the effectiveness of the initiative, each with a different measure of relative value. The criteria have equal weights. The scoring system is designed to provide a maximum potential score of 1.0, with values ranging as percentages from 0% to 100%. The percentage is applied to the number of currently non-active transportation mode users, to develop a total program impact score.

Program costs should be entered into the Project Information sheet (Box 1G). If a proposed program does not include capital investments, the anticipated impact on user demand from the program can be entered in the trip volumes in Box 1B. If the program is combined with an infrastructure project, it is assumed that the demand impact is already captured by the infrastructure project. To avoid overestimating demand, no additional demand from the program alone should be included in the Project Information sheet. Non-infrastructure initiatives are assumed to stimulate demand and safety for 20 years. If this is not the case, adjustments should be made for the appropriate number of years in

each benefit calculation page. In this case, the project type should be set to 1 to reflect the use of only existing facilities.

NON-INFRASTRUCTURE PROGRAM CHARACTERISTICS (Box 1I)

This section allows the user to provide information about the non-infrastructure program.

Scale of Initiative - Participants / Beneficiaries

26 Enter the number of people likely to be reached annually by the initiative.
27 Enter the % of active cyclists reached each year.
28 Enter the % of active pedestrians reached each year.

Scoring System
For each criterion, enter data corresponding to the question:

29 Insert the percent of the target audience in each age group.
30 Enter 1 as yes for all of the promotional efforts that are part of the initiative.
31 Enter 1 as yes for each of the types of impacts and messaging that are part of the initiative.
32 Select the most applicable frequency of outreach.

NEXT STEPS

Once the required values are entered into the Project Information and Non-Infrastructure Program sheets, as applicable, the aggregate results of the analysis are automatically compiled on the Results sheet. This sheet also includes a toggle to select whether benefits for recreational users are included in the analysis. A more detailed breakdown of the results by year and benefit type is available on the Final Calculations sheet.

There is also a Parameters page, identical to the one found in Cal-B/C. Since Cal-B/C requires additional parameters for highway projects, several of the values found on the Cal-B/C AT parameters page are not used. This design is intentional, so the same parameters page can be used in both models. A few cells (e.g., project type) are left blank to avoid Excel error messages.

Definitions

Several definitions require clarification in evaluating facility use, either improved existing or new facilities. This section provides definitions for terms that are used in this tool with respect to “trip types” and “user types). In addition, not all users benefit from projects in the same way. Definitions about benefit categories are elaborated upon below. Relevance of benefit categories depends on trip purpose and type of project (i.e., existing facility upgrade and new construction).

Trip Types	Definitions
Trips	One-way travel to a destination for commuting, or other purposes and is assumed to counted for both directions of travel (and subsequently modeled) for a specific location.
Roundtrips	Most trips have a return journey using the same mode and some can include other unlinked side trips. This "roundtrip" measure divides Trips by the average number of unlinked trips to determine the is used to identify the number of users that take trips.
Existing Trips	Baseline trips, either on an existing facility or unmarked street, where the project will create a new facility with specific improvements
Induced Trips	Additional trips above the baseline that arise because of the improvements to existing or new facilities
Trip Forecasts	Forecasts are developed for existing facilities and new locations (if applicable), model users determine numbers of current and induced trips, and other characteristics (e.g., roundtrip probability, purpose, distance, etc.)

Trip Purposes	Definitions
Commute to Work	Users who are taking the facility to or from work. These users are primarily adult or young-adult aged. Use by college students would be classified under "other destinations"
Safe Route to School	Users who are school-aged, i.e. 18 or under years old, and taking the facility to or from school.
Other Destinations	Users who are taking the facility to reach a variety of other destinations besides work, such as shopping, meeting friends, college classes, etc. These are trips that would be otherwise taken by some type of motor vehicle
Recreational	Users who are taking the facility purely as a loop-trip for exercise purposes. These trips would not be otherwise taken by motor vehicle since the purpose is for fitness and recreation.

Benefit Categories	Definitions
Journey Quality	Improvements in the quality of the trip for pedestrians and cyclists that arise from a greater feeling of safety, comfort, aesthetics, and other types of improvements. Improvements to existing and new facilities can generate benefits for current trips and induced trips. Benefits to induced users are estimated using "rule of half" approximation. Journey quality is assumed to have a zero value for existing users along routes where there is no existing facility. The value of journey quality includes the perception of safety improvement and thus, to avoid double counting, additional accident reduction value along the routes is excluded. However, safety improvements at intersections along existing facilities generate additional benefits that are discussed below.
Intersection Delay (Time Savings from Improved Intersections on Existing Facilities)	Improvements to existing intersections (e.g. lights, bridges, etc.) can lead to time savings for trips by reducing waiting time at intersections, for say a break in vehicular traffic. Time savings benefits can arise for existing and induced pedestrians and cyclists at each intersection that they cross. The number of intersections crossed by users of a facility on each trip is determined by the total length of the existing facility the average distance traveled per user type, and the number of intersections with improvements. Benefits to induced users are estimated using "rule of half" approximation.
Intersection Safety (Accident Reduction at Improved Intersections of Existing Facilities)	Improvements to existing intersections (e.g. lights, bridges, etc.) can lead to reduced accidents at intersections. Benefits can arise for existing and induced pedestrians and cyclists at each intersection crossed. The number of intersections crossed per trip is determined by the total length of the existing facility, the average distance traveled per user type, and the number of intersections with improvements. The magnitude of impacts is determined by the percent reduction in existing accidents due to specific safety measures. Induced trips benefits apply "rule of half" approximation.
Auto Accident Costs and Auto Emissions	Some of the induced pedestrian and cycling trips entail diversions from auto use. Benefits from reduced auto use include reduced frequency of accidents and level of auto emissions. Benefits are estimated for each diverted auto trip by using standard methods and data for estimating the value of auto use externalities.
Health Benefits - Reduced Absenteeism of Commuters	Health benefits related to reduced absenteeism are generated by induced walking and cycling commuters. The benefits are monetized by higher productivity due to fewer sick days. Benefits to these induced users are not estimated using "rule of half" approximation since the value is observed by the employer.
Health Benefits - Reduced Mortality Risk	Health benefits related to improved long-term health and reduced risk of disease and early death. These benefits are derived from parameters established by the World Health Organization (WHO) and formalized in their online HEAT tool and documentation. Benefits are derived from reduced mortality risk in populations that range from 20-64 for cyclists and 20-74 for pedestrians. Reduced mortality risk depends on the amount of cycling (average distance) undertaken over a one year period.

Benefit Categories by Facility Type

The matrix below indicates the applicability of benefits by to different types of trips and projects. Projects include existing facility improvements and new construction. Trips differ between current trips already being taken and new, induced trips that arise because of improvements.

Benefit Categories by Facility Type	Existing Facility Improvement		New Construction	
	Existing Trips	Induced Trips	Existing Trips	Induced Trips
Journey Quality	Yes	Yes	Yes	Yes
Intersection Delay (Time Savings from Improved Intersections on Existing Facilities)	Yes	Yes		
Intersection Safety (Accident Reduction at Improved Intersections of Existing Facilities)	Yes	Yes		
Auto Accident Costs and Auto Emissions		Yes		Yes
Health Benefits - Reduced Absenteeism of Commuters		Yes (Commuters, only)		Yes (Commuters, only)
Health Benefits - Reduced Mortality Risk		Yes (Age dependent)		Yes (Age dependent)

District: 4

PROJECT: SFMTA - Howard Street Streetscape Project

EA:

PPNO:

1A

PROJECT AND SITE CHARACTERISTICS

Type of Project

Existing facility upgrade only = 1
New facility only, no existing facility work = 2
Existing facility upgrade and new facility extension = 3

3

Total Project Length

		Project Type Data Check
Total Existing Facility Length (miles)	1	OK
Total New Facility Length (miles)	1	OK

Characteristics

Project Location (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural): 2

Safe Route to School? (enter 1 for Yes, 0 for No): 0

Programmatic Initiatives? (enter 1 for Yes, 0 for No): 0

Construction

		Constr. Years Data Check
Length of Construction Period (years)	4	OK

1B

EXISTING SEGMENT IMPROVEMENTS AND TRIP VOLUME

Improvement Characteristics

Existing Facility Length, if Applicable	Class	No Build	Build	Project Length Data Check
Bike Paths (miles)	I	0	0	OK
Bike Lanes (miles)	II	0	0	
Bike Route (miles)	III	0	0	
Separated Bikeways, Cycle Tracks (miles)	IV	1	1	
Total		1	1	

Pedestrian Improvements	Yes =1 or No=0	Yes =1 or No=0
Street Lighting	0	1
Curb Level	0	1
Crowding	0	1
Pavement Evenness	0	1
Information Panels	0	1
Benches	0	1
Directional Signage	0	1

Trip Data - Adults

Cycling

Daily Trips - Current	1,030	
Projected Annual Growth Rates from Year 1 (%)	4%	4%
Daily Trips - Year 1 (post-construction)	1,210	1,464
Daily Trips - Year 20 (post-construction)	2,702	3,269

Pedestrian

Daily Trips - Current	7,389	
Projected Annual Growth Rates from Year 1 (%)	5%	5%
Daily Trips - Year 1 (post-construction)	9,050	11,675
Daily Trips - Year 20 (post-construction)	24,944	32,178

Trip Data - Children - SRTS

Cycling

Daily Trips - Current	0	
Projected Annual Growth Rates from Year 1 (%)		
Daily Trips - Year 1 (post-construction)	0	0
Daily Trips - Year 20 (post-construction)	0	0

Pedestrian

Daily Trips - Current	0	
Projected Annual Growth Rates from Year 1 (%)		
Daily Trips - Year 1 (post-construction)	0	0
Daily Trips - Year 20 (post-construction)	0	0

1C

INTERSECTION IMPROVEMENTS - TIME SAVINGS AND ACCIDENT REDUCTION DATA

Reduced Delay Due to Intersection Improvements

Time Savings Parameters

Number of Improved Intersections	8
Time Savings per Improved Intersection (min.)	0
Intersection improvements on SRTS? (enter 1 for Yes, 0 for No)	0

Accident Rate - Current Conditions

Cyclists

	Count (No.)	Rate per Year
Number of Years of Data	6.00	
Existing Conditions		
Total Number of Accidents (Tot)	34	5.7
Number of Fatal Accidents (Fat)	2	0.3
Number of Injury Accidents (Inj)	1	0.2
Number of \Property Damage Only (PDO) Accidents	31	5.2
Annual Growth Rate in Accidents (%/year)	2.7%	0.0045

Pedestrians

	Count (No.)	Rate per Year
Number of Years of Data	6.00	
Existing Conditions		
Total Number of Accidents (Tot)	41	6.8
Number of Fatal Accidents (Fat)	1	0.2
Number of Injury Accidents (Inj)	2	0.3
Number of \Property Damage Only (PDO) Accidents	38	6.3
Annual Growth Rate in Accidents (%/year)	5.5%	0.009166667

Safety Countermeasures (improvements to existing facilities only)

Signalized Intersection	Yes =1
Pedestrian Countdown Signal Heads	1
Pedestrian Crossing	1

Advance Stop Bar before Crosswalk	1
Install Overpass/Underpass	0
Unsignalized Intersection	
Raised Medians/Refuge Islands	0
Pedestrian Crossing (new signs and markings only)	1
Pedestrian Crossing (safety features/curb extensions)	1
Pedestrian Signals	0
Roadways - relevant for pedestrian improvements, such as sidewalks	
Sidewalk/Pathway (to avoid walking along roadway)	1
Pedestrian Crossing (with enhanced safety features)	1
Pedestrian Crossing	1
Other Reduction Factor Countermeasures	1

1D

GENERAL USER CHARACTERISTICS (BASED ON PROJECT LOCATION)

Cycling

Trip Purpose	No Build	Build
Commuting Trip Purpose (%)	11%	11%
Recreational Trip Purpose (%)	13%	13%
Other Destinations Trip Purpose (%)	76%	76%
General Trip Characteristics		
Overall Average Distance Traveled / Trip (mi)	1.85	1.85
Children - SRTS - Distance Traveled / Trip (mi)	1.03	1.03

Pedestrian

Trip Purpose		
Commuting Trip Purpose (%)	9%	9%
Recreational Trip Purpose (%)	10%	10%
Other Destination Trip Purpose (%)	81%	81%
General Trip Characteristics		
Overall Average Distance Traveled / Trip (mi)	0.66	0.66
Children - SRTS - Distance Traveled / Trip (mi)	0.58	0.58

1E

NEW FACILITY IMPROVEMENTS AND TRIP VOLUME

Improvement Characteristics

New Facility Length	Class	No Build	Build	Project Length
No Facility	0	1		OK
Bike Paths (miles)	I		0	
Bike Lanes (miles)	II		0	
Bike Route (miles)	III		0	
Separated Bikeways, Cycle Tracks (miles)	IV		1	
Total		1	1	

Pedestrian Improvements	Yes =1
Street Lighting	0
Curb Level	0
Crowding	0
Pavement Evenness	0
Information Panels	0
Benches	0
Directional Signage	0

Trip Data - Adults

Cycling	No Build	Build
Daily Trips - Current	0	
Projected Annual Growth Rates from Year 1 (%)	0%	4%
Daily Trips - Year 1 (post-construction)	0	121
Daily Trips - Year 20 (post-construction)	0	270

Pedestrian

Daily Trips - Current	0	
Projected Annual Growth Rates from Year 1 (%)		
Daily Trips - Year 1 (post-construction)	0	0
Daily Trips - Year 20 (post-construction)	0	0

Trip Data - Children - SRTS

Cycling

	No Build	Build
Daily Trips - Current	0	
Projected Annual Growth Rates from Year 1 (%)		
Daily Trips - Year 1 (post-construction)	0	0
Daily Trips - Year 20 (post-construction)	0	0

Pedestrian

Daily Trips - Current	0	
Projected Annual Growth Rates from Year 1 (%)		
Daily Trips - Year 1 (post-construction)	0	0
Daily Trips - Year 20 (post-construction)	0	0

Enter all project and program costs (in today's dollars) in the two tables shown below . Costs during construction should be entered in the first row.
Project costs (including maintenance and operating costs) should be net of costs without project.

1F

PROJECT COSTS AND REQUESTED FUNDS (enter in thousands of dollars)

Col. no.

Year	Construction Years	DIRECT PROJECT COSTS						TOTAL COSTS (in dollars)	
		INITIAL COSTS			SUBSEQUENT COSTS				
		Project Support	R / W	Construction	Maint./ Op.	Rehab.		Constant Dollars	Present Value
Infrastructure Program Costs									
1	1	$4,200.0		$25,000.0	<-- Must enter a cost			$29,200,000	$29,200,000
2	1			$2,900.0				2,900,000	2,710,280
3	1			$16,000.0				16,000,000	13,975,020
4	1			$1,100.0				1,100,000	897,928
5	0							0	0
6	0							0	0
7	0							0	0
8	0							0	0
Annual Infrastructure O&M Costs									
1					$168			$167,500	$127,785
2					$168			167,500	119,425
3					$168			167,500	111,612
4					$168			167,500	104,311
5					$168			167,500	97,487
6					$168			167,500	91,109
7					$168			167,500	85,149
8					$168			167,500	79,578
9					$168			167,500	74,372
10					$168			167,500	69,507
11					$168			167,500	64,959
12					$168			167,500	60,710
13					$168			167,500	56,738
14					$168			167,500	53,026
15					$168			167,500	49,557
16					$168			167,500	46,315
17					$168			167,500	43,285
18					$168			167,500	40,453
19					$168			167,500	37,807
20					$168			167,500	35,334
Total		$4,200	$0	$45,000	$3,350	$0		$52,550,000	$48,231,746

ATP REQUESTED FUNDS			
Total			

1G

PROGRAM COSTS AND REQUESTED FUNDS (enter in thousands of dollars)

Year	Construction Years	DIRECT PROJECT COSTS						TOTAL COSTS (in dollars)	
		INITIAL COSTS			SUBSEQUENT COSTS				
		Project Support	R / W	Construction	Maint./ Op.	Rehab.		Constant Dollars	Present Value

Non-Infrastructure Program Costs									
1					<-- Must enter a cost			$0	$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
Annual Non-Infrastructure O&M Costs									
1								$0	$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
9								0	0
10								0	0
11								0	0
12								0	0
13								0	0
14								0	0
15								0	0
16								0	0
17								0	0
18								0	0
19								0	0
20								0	0
Total		$0	$0	$0	$0	$0		$0	$0

ATP REQUESTED FUNDS			
Total			

1H

DATA CHECKS - PROJECT LENGTH, DAILY TRIPS

	No Build Project Length	Build Project Length
Existing Facility Length Check	OK	OK
New Facility Length Check	OK	OK

	Cycling Daily Trips per Mile	Pedestrian Daily Trips per
Existing Facility Users	1,030	7,389
New Facility Users	0	0

	Safety Measures - Existing only
Existing Facility Characteristics	OK

District:	4		
PROJECT:	SFMTA - Howard Street Streetscape Project	EA:	0
		PPNO:	0

1I

NON-INFRASTRUCTURE PROGRAM CHARACTERISTICS

Programmatic Initiatives? — No

Scale of Initiative

Participants / Beneficiaries

		Data Check on Initiative
Numbers of People Reached per Year		OK
Average Percentage of Current Active Bicyclists Reached per Year		
Average Percentage of Current Active Pedestrians Reached per Year		

Scoring Criteria

Total Number of Criteria	4
Total Criteria Weight Sum	100%

1) Target Audience — Criteria Weight: 25%

Indicators	(mark as %; sum must equal 100%)	Indicator Weight
Younger than 10		10%
10-12		20%
13-24		25%
25-55		15%
55+		5%
Indicator-Weighted Score	**Sum must equal 100%**	

2) Characteristics Promotional Effort — Criteria Weight: 25%

Indicators	(enter 1 for Yes on all that apply)	Indicator Weight
Effort Targets 5 E's or 5 P's		5%
Knowledgeable Staff/Educator		5%
Partnership/Volunteers		5%
Creates Community Ownership/Relationship		5%
Part of Bigger Effort (e.g., political support)		5%
Indicator-Weighted Score	**0**	

3) Type of Impact and Messaging — Criteria Weight: 25%

Indicators	(enter 1 for Yes on all that apply)	Indicator Weight
Outreach is Hands-on (self-efficacy)		5%
Overcome Barriers (e.g., dist., time, etc.)		5%
Eliminates Hazards/Threats (speed, crime, etc.)		5%
Connected or Addresses Connectivity Challenges		5%
Creating Value in Using Active Transportation		5%
Indicator-Weighted Score	**0**	

4) Frequency of Outreach Effort		Criteria Weight
		25%
Indicators	(enter 1 for Yes for only one option)	Indicator Weight
One Day		5%
One Month		10%
One Year		15%
Multiple Years		20%
Continuous Effort		25%
Indicator-Weighted Score	0	

Projected New Active Transportation Cyclists	
Number of Potential New Facility Users	0
Weighted Impact Score of Outreach	
Program Impact Score	
Years of Outreach	0.0
Multi-year Program Impact Score	

Cost Effectiveness	
Total Discounted Cost	$0
Cost per Program Impact Score	

Projected New Active Transportation Pedestrians	
Number of Potential New Facility Users	0
Weighted Impact Score of Outreach	
Program Impact Score	
Years of Outreach	0.0
Multi-year Program Impact Score	

Cost Effectiveness	
Total Discounted Cost	$0
Cost per Program Impact Score	

2A

ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - CYCLING - Existing Facility Segment

No Build - Cycling

Year 1

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
Annual Trips - Commuting	48,565		48,565	
Annual Trips - Other Destinations	335,542		335,542	
Annual Trips - Recreational	57,395		0	Recreational Users not Included in Benefits
Users - Commuting	69		69	
Users - Other Destinations	476		476	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	93,731		93,731	
Total Miles - Other Destinations	647,596		647,596	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

Year 20

Trips - Commuting	108,478		108,478	
Trips - Other Destinations	749,482		749,482	
Trips - Recreational	128,201		0	Recreational Users not Included in Benefits
Users - Commuting	154		154	
Users - Other Destinations	1,064		1,064	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	209,362		209,362	
Total Miles - Other Destinations	1,446,500		1,446,500	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

Build - Cycling

Year 1

Annual Trips - Commuting	58,764		58,764	
Annual Trips - Other Destinations	406,006		406,006	
Annual Trips - Recreational	69,448		0	Recreational Users not Included in Benefits
Users - Commuting	83		83	
Users - Other Destinations	576		576	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	113,414		113,414	
Total Miles - Other Destinations	783,591		783,591	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

Year 20

Annual Trips - Commuting	131,258		131,258	
Annual Trips - Other Destinations	906,873		906,873	
Annual Trips - Recreational	155,123		0	Recreational Users not Included in Benefits
Users - Commuting	186		186	
Users - Other Destinations	1,287		1,287	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	253,328		253,328	
Total Miles - Other Destinations	1,750,265		1,750,265	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

2B

ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - CYCLING - New Facility Segment

	Calculated by Model		Used for Proj. Eval.	Reason for Change
No Build - Cycling				
Year 1				
Annual Trips - Commuting	0		0	
Annual Trips - Other Destinations	0		0	
Annual Trips - Recreational	0		0	Recreational Users not Included in Benefits
Users - Commuting	0		0	
Users - Other Destinations	0		0	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	0		0	
Total Miles - Other Destinations	0		0	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Year 20				
Trips - Commuting	0		0	
Trips - Other Destinations	0		0	
Trips - Recreational	0		0	Recreational Users not Included in Benefits
Users - Commuting	0		0	
Users - Other Destinations	0		0	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	0		0	
Total Miles - Other Destinations	0		0	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Build - Cycling				
Year 1				
Annual Trips - Commuting	4,858		4,858	
Annual Trips - Other Destinations	33,565		33,565	
Annual Trips - Recreational	5,741		0	Recreational Users not Included in Benefits
Users - Commuting	7		7	
Users - Other Destinations	48		48	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	9,376		9,376	
Total Miles - Other Destinations	64,781		64,781	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Year 20				
Annual Trips - Commuting	10,851		10,851	
Annual Trips - Other Destinations	74,973		74,973	
Annual Trips - Recreational	12,824		0	Recreational Users not Included in Benefits
Users - Commuting	15		15	
Users - Other Destinations	106		106	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	20,943		20,943	
Total Miles - Other Destinations	144,698		144,698	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

2C ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - CYCLING - New Safe Routes To School

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build - Cycling				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Build - Cycling				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	

2D ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - CYCLING - Existing Safe Routes To School

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build - Cycling				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Build - Cycling				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
PROPORTIONS OF SRTS IN TOTAL BENEFITS				
SRTS Trip-Mile / Total Trip-Mile	0.00%		0.00%	

2E ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - PEDESTRIAN - Existing Facility Segment

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build - Pedestrian				
Year 1				
Annual Trips - Commuting	297,293		297,293	
Annual Trips - Other Destinations	2,675,633		2,675,633	
Annual Trips - Recreational	330,325		0	Recreational Users not Included in Benefits
Users - Commuting	342		342	
Users - Other Destinations	3,080		3,080	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	466,987		466,987	
Total Miles - Other Destinations	4,202,884		4,202,884	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Year 20				
Annual Trips - Commuting	819,405		819,405	
Annual Trips - Other Destinations	7,374,648		7,374,648	
Annual Trips - Recreational	910,450		0	Recreational Users not Included in Benefits
Users - Commuting	943		943	
Users - Other Destinations	8,489		8,489	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	1,287,122		1,287,122	
Total Miles - Other Destinations	11,584,097		11,584,097	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Build - Pedestrian				
Year 1				
Annual Trips - Commuting	383,507		383,507	
Annual Trips - Other Destinations	3,451,566		3,451,566	
Annual Trips - Recreational	426,119		0	Recreational Users not Included in Benefits
Users - Commuting	441		441	
Users - Other Destinations	3,973		3,973	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	602,413		602,413	
Total Miles - Other Destinations	5,421,720		5,421,720	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Year 20				
Annual Trips - Commuting	1,057,033		1,057,033	
Annual Trips - Other Destinations	9,513,296		9,513,296	
Annual Trips - Recreational	1,174,481		0	Recreational Users not Included in Benefits
Users - Commuting	1,217		1,217	
Users - Other Destinations	10,951		10,951	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	1,660,387		1,660,387	
Total Miles - Other Destinations	14,943,486		14,943,486	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

2F

ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - PEDESTRIAN - New Facility Segment

	Calculated by Model		Used for Proj. Eval.	Reason for Change
No Build - Pedestrian				
Year 1				
Annual Trips - Commuting	0		0	
Annual Trips - Other Destinations	0		0	
Annual Trips - Recreational	0		0	Recreational Users not Included in Benefits
Users - Commuting	0		0	
Users - Other Destinations	0		0	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	0		0	
Total Miles - Other Destinations	0		0	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Year 20				
Annual Trips - Commuting	0		0	
Annual Trips - Other Destinations	0		0	
Annual Trips - Recreational	0		0	Recreational Users not Included in Benefits
Users - Commuting	0		0	
Users - Other Destinations	0		0	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	0		0	
Total Miles - Other Destinations	0		0	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Build - Pedestrian				
Year 1				
Annual Trips - Commuting	0		0	
Annual Trips - Other Destinations	0		0	
Annual Trips - Recreational	0		0	Recreational Users not Included in Benefits
Users - Commuting	0		0	
Users - Other Destinations	0		0	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	0		0	
Total Miles - Other Destinations	0		0	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits
Year 20				
Annual Trips - Commuting	0		0	
Annual Trips - Other Destinations	0		0	
Annual Trips - Recreational	0		0	Recreational Users not Included in Benefits
Users - Commuting	0		0	
Users - Other Destinations	0		0	
Users - Recreational	0		0	Recreational Users not Included in Benefits
Total Miles - Commuting	0		0	
Total Miles - Other Destinations	0		0	
Total Miles - Recreational	0		0	Recreational Users not Included in Benefits

2G ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - PEDESTRIAN - New Safe Routes To School

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build - Pedestrian				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Build - Pedestrian				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	

2H ACTIVE TRANSPORTATION DAILY VOLUME INPUTS - PEDESTRIAN - Existing Safe Routes To School

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
No Build - Pedestrian				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Build - Pedestrian				
Year 1				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
Year 20				
Annual Trips - SRTS	0		0	
SRTS Users	0		0	
Total Miles - SRTS	0		0	
PROPORTIONS OF SRTS IN TOTAL BENEFITS				
SRTS Trip-Mile / Total Trip-Mile	0.00%		0.00%	

District: 4

PROJECT: SFMTA - Howard Street Streetscape Project

EA:
PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$48.2
Life-Cycle Benefits (mil. $)	$144.1
Net Present Value (mil. $)	$95.8
Benefit / Cost Ratio:	3.0
Rate of Return on Investment:	18.9%
Payback Period:	5 years

NON-INFRASTRUCTURE IMPLEMENTATION COST

Per Bike Program Impact Score	N/A
Per Ped Program Impact Score	N/A

ITEMIZED BENEFITS (mil. $)	Total Over 20 Years	Average Annual
Journey Quality	$10.9	$0.5
Additional Delay Savings	$0.0	$0.0
Additional Safety Benefits	$47.0	$2.4
Health Benefits	$86.0	$4.3
Emission Cost Savings	$0.1	$0.0
TOTAL BENEFITS	**$144.1**	**$7.2**

SRTS-SPECIFIC BENEFITS (mil. $)		
Journey Quality	N/A	N/A
Additional Delay Savings	N/A	N/A
Additional Safety Benefits	N/A	N/A
TOTAL SRTS BENEFITS	**N/A**	**N/A**

Factors that Differentiate Benefits and Performance Measures

Safe Route to School	No
Intersection Improvements on SRTS	No
Programmatic Initiatives	No
Recreational Benefits	0

(enter 1 for Yes, 0 for No)

EMISSIONS REDUCTION	Tons: Total Over 20 Years	Tons: Average Annual	Value (mil. $): Total Over 20 Years	Value (mil. $): Average Annual
CO Emissions Saved	12	1	$0.0	$0.0
CO_2 Emissions Saved	4,038	202	$0.1	$0.0
NO_X Emissions Saved	1	0	$0.0	$0.0
$PM_{2.5}$ Emissions Saved	0	0	$0.0	$0.0
SO_X Emissions Saved	0	0	$0.0	$0.0
VOC Emissions Saved	0	0	$0.0	$0.0

C

TOTAL

Existing Facility

Year	Constant Dollars	Present Value
1	$739,144	$563,890
20	$2,037,249	$429,751

1	$739,144	$563,890
2	$807,466	$575,712
3	$875,787	$583,574
4	$944,108	$587,943
5	$1,012,430	$589,243
6	$1,080,751	$587,857
7	$1,149,072	$584,130
8	$1,217,393	$578,375
9	$1,285,715	$570,873
10	$1,354,036	$561,877
11	$1,422,357	$551,615
12	$1,490,679	$540,291
13	$1,559,000	$528,087
14	$1,627,321	$515,168
15	$1,695,643	$501,679
16	$1,763,964	$487,751
17	$1,832,285	$473,497
18	$1,900,606	$459,021
19	$1,968,928	$444,413
20	$2,037,249	$429,751

Total	**$10,714,747**

New Facility

Year	Constant Dollars	Present Value
1	$14,863	$11,339
20	$33,199	$7,003

1	$14,863	$11,339
2	$15,828	$11,285
3	$16,793	$11,190
4	$17,758	$11,059
5	$18,723	$10,897
6	$19,688	$10,709
7	$20,653	$10,499
8	$21,618	$10,271
9	$22,583	$10,027
10	$23,548	$9,772
11	$24,513	$9,507
12	$25,479	$9,235
13	$26,444	$8,957
14	$27,409	$8,677
15	$28,374	$8,395
16	$29,339	$8,112
17	$30,304	$7,831
18	$31,269	$7,552
19	$32,234	$7,276
20	$33,199	$7,003

Total	**$189,593**

F

TOTAL

Existing SRTS Facility

Year	Constant Dollars	Present Value
1	$0	$0
20	$0	$0

1	$0	$0
2	$0	$0
3	$0	$0
4	$0	$0
5	$0	$0
6	$0	$0
7	$0	$0
8	$0	$0
9	$0	$0
10	$0	$0
11	$0	$0
12	$0	$0
13	$0	$0
14	$0	$0
15	$0	$0
16	$0	$0
17	$0	$0
18	$0	$0
19	$0	$0
20	$0	$0

Total	**$0**

C

TOTAL

New SRTS Facility

Year	Constant Dollars	Present Value
1	$0	$0
20	$0	$0

1	$0	$0
2	$0	$0
3	$0	$0
4	$0	$0
5	$0	$0
6	$0	$0
7	$0	$0
8	$0	$0
9	$0	$0
10	$0	$0
11	$0	$0
12	$0	$0
13	$0	$0
14	$0	$0
15	$0	$0
16	$0	$0
17	$0	$0
18	$0	$0
19	$0	$0
20	$0	$0

Total	**$0**

C

TOTAL

Existing Facility

Year	Constant Dollars	Present Value
1	$0	$0
20	$0	$0

1	$0	$0
2	$0	$0
3	$0	$0
4	$0	$0
5	$0	$0
6	$0	$0
7	$0	$0
8	$0	$0
9	$0	$0
10	$0	$0
11	$0	$0
12	$0	$0
13	$0	$0
14	$0	$0
15	$0	$0
16	$0	$0
17	$0	$0
18	$0	$0
19	$0	$0
20	$0	$0

Total	**$0**

F

TOTAL

Existing Facility

Year	Constant Dollars	Present Value
1	$0	$0
20	$0	$0

1	$0	$0
2	$0	$0
3	$0	$0
4	$0	$0
5	$0	$0
6	$0	$0
7	$0	$0
8	$0	$0
9	$0	$0
10	$0	$0
11	$0	$0
12	$0	$0
13	$0	$0
14	$0	$0
15	$0	$0
16	$0	$0
17	$0	$0
18	$0	$0
19	$0	$0
20	$0	$0

Total	**$0**

C

TOTAL

Existing Facility

	Dollars	Value
1	$3,978,039	$3,034,827
20	$8,115,121	$1,711,860

1	$3,978,039	$3,034,827
2	$4,123,794	$2,940,208
3	$4,275,593	$2,849,008
4	$4,433,717	$2,761,096
5	$4,598,457	$2,676,344
6	$4,770,122	$2,594,630
7	$4,949,035	$2,515,838
8	$5,135,534	$2,439,855
9	$5,329,978	$2,366,574
10	$5,532,740	$2,295,890
11	$5,744,213	$2,227,705
12	$5,964,810	$2,161,922
13	$6,194,967	$2,098,450
14	$6,435,139	$2,037,200
15	$6,685,805	$1,978,088
16	$6,947,470	$1,921,033
17	$7,220,663	$1,865,956
18	$7,505,940	$1,812,783
19	$7,803,888	$1,761,440
20	$8,115,121	$1,711,860

Total	$46,050,708

D

SRTS Benefits Share

Existing Facility

Year	Share of Cycling Benefits	Share of Ped Benefits	Sum of Benefits
	0.00%	0.00%	
	SRTS Cycling Benefits - Present Value	SRTS Ped Benefits - Present Value	
1	$0.0	$0.0	$0.0
20	$0.0	$0.0	$0.0

1	$0.0	$0.0	$0.0
2	$0.0	$0.0	$0.0
3	$0.0	$0.0	$0.0
4	$0.0	$0.0	$0.0
5	$0.0	$0.0	$0.0
6	$0.0	$0.0	$0.0
7	$0.0	$0.0	$0.0
8	$0.0	$0.0	$0.0
9	$0.0	$0.0	$0.0
10	$0.0	$0.0	$0.0
11	$0.0	$0.0	$0.0
12	$0.0	$0.0	$0.0
13	$0.0	$0.0	$0.0
14	$0.0	$0.0	$0.0
15	$0.0	$0.0	$0.0
16	$0.0	$0.0	$0.0
17	$0.0	$0.0	$0.0
18	$0.0	$0.0	$0.0
19	$0.0	$0.0	$0.0
20	$0.0	$0.0	$0.0

Total	$0	$0	$0

A

REDUCED ACCIDENT BENEFITS - HIGHWAY USERS

Total

Year	AVERAGE ANNUAL VOLUME (trip-miles/yr.) Induced Trips, Cycling	AVERAGE ANNUAL VOLUME (trip-miles/yr.) Induced Trips, Pedestrians	REDUCED VMT (veh-miles/yr.) Induced Trips, Cyclists, Pedestrians	ACCIDENT BENEFITS ($/yr.) Induced Trips	Constant Dollars	Present Value
1	220,309	569,018	315,731	$69,950	$69,950	$53,365
20	492,093	1,568,342	824,174	$182,596	$182,596	$38,518
1	220,309	569,018	315,731	$69,950	$69,950	$53,365
2	234,614	621,614	342,491	$75,879	$75,879	$54,101
3	248,918	674,210	369,251	$81,808	$81,808	$54,512
4	263,222	726,806	396,011	$87,736	$87,736	$54,638
5	277,527	779,402	422,771	$93,665	$93,665	$54,514
6	291,831	831,998	449,532	$99,594	$99,594	$54,172
7	306,136	884,594	476,292	$105,522	$105,522	$53,642
8	320,440	937,190	503,052	$111,451	$111,451	$52,950
9	334,744	989,786	529,812	$117,380	$117,380	$52,118
10	349,049	1,042,382	556,572	$123,309	$123,309	$51,169
11	363,353	1,094,978	583,332	$129,237	$129,237	$50,120
12	377,658	1,147,574	610,093	$135,166	$135,166	$48,990
13	391,962	1,200,170	636,853	$141,095	$141,095	$47,794
14	406,266	1,252,766	663,613	$147,023	$147,023	$46,544
15	420,571	1,305,362	690,373	$152,952	$152,952	$45,253
16	434,875	1,357,958	717,133	$158,881	$158,881	$43,932
17	449,180	1,410,554	743,893	$164,810	$164,810	$42,590
18	463,484	1,463,150	770,654	$170,738	$170,738	$41,236
19	477,789	1,515,746	797,414	$176,667	$176,667	$39,876
20	492,093	1,568,342	824,174	$182,596	$182,596	$38,518
Total						**$980,033**

C

TOTAL

Total

Year	Constant Dollars	Present Value
1	$7,089	$5,408
20	$18,882	$3,983

1	$7,089	$5,408
2	$7,709	$5,497
3	$8,330	$5,551
4	$8,951	$5,574
5	$9,571	$5,571
6	$10,192	$5,544
7	$10,813	$5,497
8	$11,434	$5,432
9	$12,054	$5,352
10	$12,675	$5,260
11	$13,296	$5,156
12	$13,916	$5,044
13	$14,537	$4,924
14	$15,158	$4,799
15	$15,778	$4,668
16	$16,399	$4,534
17	$17,020	$4,398
18	$17,640	$4,260
19	$18,261	$4,122
20	$18,882	$3,983

Total	**$100,573**

C

TOTAL

Existing

Year	Constant Dollars	Present Value
1	$5,797,993	$4,423,261
20	$15,755,324	$3,323,536

1	$5,797,993	$4,423,261
2	$6,322,063	$4,507,544
3	$6,846,133	$4,561,868
4	$7,370,203	$4,589,792
5	$7,894,273	$4,594,539
6	$8,418,343	$4,579,021
7	$8,942,413	$4,545,869
8	$9,466,483	$4,497,458
9	$9,990,553	$4,435,925
10	$10,514,623	$4,363,195
11	$11,038,693	$4,280,996
12	$11,562,763	$4,190,878
13	$12,086,834	$4,094,229
14	$12,610,904	$3,992,289
15	$13,134,974	$3,886,165
16	$13,659,044	$3,776,839
17	$14,183,114	$3,665,186
18	$14,707,184	$3,551,977
19	$15,231,254	$3,437,894
20	$15,755,324	$3,323,536

Total	**$83,298,462**

F

TOTAL

New

Year	Constant Dollars	Present Value
1	$205,328	$156,644
20	$458,630	$96,747

1	$205,328	$156,644
2	$218,660	$155,901
3	$231,991	$154,586
4	$245,323	$152,775
5	$258,655	$150,539
6	$271,986	$147,943
7	$285,318	$145,041
8	$298,650	$141,886
9	$311,981	$138,523
10	$325,313	$134,993
11	$338,645	$131,332
12	$351,976	$127,572
13	$365,308	$123,742
14	$378,640	$119,868
15	$391,971	$115,970
16	$405,303	$112,070
17	$418,635	$108,183
18	$431,967	$104,326
19	$445,298	$100,510
20	$458,630	$96,747

Total	**$2,619,151**

A

REDUCED EMISSIONS BENEFITS

Total

Year	AVERAGE ANNUAL VOLUME (trip-miles/yr.) Induced Trips, Cycling	Induced Trips, Pedestrians	REDUCED VMT (veh-miles/yr.) Induced Trips	AVERAGE SPEED (mph) Induced Trips	RUNNING EMISSIONS ($/yr.) Induced Trips	Constant Dollars	Present Value	CO
1	220,309	569,018	315,731	25	$9,541	$9,541	$7,279	1
20	492,093	1,568,342	824,174	25	$18,937	$18,937	$3,995	1
1	220,309	569,018	315,731	25	$9,541	$9,541	$7,279	1
2	234,614	621,614	342,491	25	$10,497	$10,497	$7,484	1
3	248,918	674,210	369,251	25	$11,479	$11,479	$7,649	1
4	263,222	726,806	396,011	25	$12,486	$12,486	$7,776	1
5	277,527	779,402	422,771	25	$13,521	$13,521	$7,869	1
6	291,831	831,998	449,532	25	$14,583	$14,583	$7,932	1
7	306,136	884,594	476,292	25	$15,674	$15,674	$7,968	1
8	320,440	937,190	503,052	25	$9,602	$9,602	$4,562	0
9	334,744	989,786	529,812	25	$10,269	$10,269	$4,560	0
10	349,049	1,042,382	556,572	25	$10,955	$10,955	$4,546	0
11	363,353	1,094,978	583,332	25	$11,659	$11,659	$4,522	0
12	377,658	1,147,574	610,093	25	$12,383	$12,383	$4,488	0
13	391,962	1,200,170	636,853	25	$13,127	$13,127	$4,447	0
14	406,266	1,252,766	663,613	25	$13,892	$13,892	$4,398	0
15	420,571	1,305,362	690,373	25	$14,677	$14,677	$4,342	0
16	434,875	1,357,958	717,133	25	$15,484	$15,484	$4,282	0
17	449,180	1,410,554	743,893	25	$16,313	$16,313	$4,216	1
18	463,484	1,463,150	770,654	25	$17,164	$17,164	$4,145	1
19	477,789	1,515,746	797,414	25	$18,039	$18,039	$4,072	1
20	492,093	1,568,342	824,174	25	$18,937	$18,937	$3,995	1
Total							**$110,530**	**12**

CO_2
159
253

159
172
185
199
212
226
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154
162
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179
187
195
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245
253

4,038

A

NET PRESENT VALUE CALCULATION

Year	PRESENT VALUE OF USER BENEFITS					Present Value of Total Benefits	Present Value of Total Costs	NET PRESENT VALUE	CUMULATIVE NET PRESENT VALUE
	Journey Quality	Additional Delay Savings	Additional Safety Benefits	Health Benefits	Emission Cost Savings				
Construction Period									
1						$0	$29,200,000	($29,200,000)	($29,200,000)
2						$0	$2,710,280	($2,710,280)	($31,910,280)
3						$0	$13,975,020	($13,975,020)	($45,885,300)
4						$0	$897,928	($897,928)	($46,783,228)
5						$0	$0	$0	($46,783,228)
6						$0	$0	$0	($46,783,228)
7						$0	$0	$0	($46,783,228)
8						$0	$0	$0	($46,783,228)
Project Open									
1	$575,229	$0	$3,088,191	$4,585,313	$7,279	$8,256,012	$127,785	$8,128,227	$8,128,227
2	$586,997	$0	$2,994,309	$4,668,942	$7,484	$8,257,732	$119,425	$8,138,306	$16,266,533
3	$594,764	$0	$2,903,520	$4,722,004	$7,649	$8,227,937	$111,612	$8,116,324	$24,382,858
4	$599,002	$0	$2,815,734	$4,748,141	$7,776	$8,170,653	$104,311	$8,066,342	$32,449,200
5	$600,140	$0	$2,730,858	$4,750,649	$7,869	$8,089,516	$97,487	$7,992,030	$40,441,230
6	$598,566	$0	$2,648,803	$4,732,507	$7,932	$7,987,808	$91,109	$7,896,699	$48,337,929
7	$594,629	$0	$2,569,480	$4,696,407	$7,968	$7,868,485	$85,149	$7,783,336	$56,121,265
8	$588,646	$0	$2,492,805	$4,644,776	$4,562	$7,730,789	$79,578	$7,651,211	$63,772,476
9	$580,900	$0	$2,418,692	$4,579,801	$4,560	$7,583,952	$74,372	$7,509,580	$71,282,057
10	$571,649	$0	$2,347,059	$4,503,448	$4,546	$7,426,701	$69,507	$7,357,195	$78,639,251
11	$561,121	$0	$2,277,825	$4,417,484	$4,522	$7,260,952	$64,959	$7,195,993	$85,835,244
12	$549,525	$0	$2,210,912	$4,323,494	$4,488	$7,088,420	$60,710	$7,027,710	$92,862,954
13	$537,045	$0	$2,146,243	$4,222,895	$4,447	$6,910,630	$56,738	$6,853,892	$99,716,846
14	$523,845	$0	$2,083,744	$4,116,955	$4,398	$6,728,942	$53,026	$6,675,916	$106,392,762
15	$510,074	$0	$2,023,342	$4,006,803	$4,342	$6,544,561	$49,557	$6,495,004	$112,887,766
16	$495,863	$0	$1,964,965	$3,893,444	$4,282	$6,358,553	$46,315	$6,312,238	$119,200,004
17	$481,328	$0	$1,908,546	$3,777,768	$4,216	$6,171,858	$43,285	$6,128,573	$125,328,577
18	$466,573	$0	$1,854,018	$3,660,563	$4,145	$5,985,300	$40,453	$5,944,847	$131,273,424
19	$451,689	$0	$1,801,316	$3,542,526	$4,072	$5,799,602	$37,807	$5,761,795	$137,035,219
20	$436,755	$0	$1,750,378	$3,424,266	$3,995	$5,615,393	$35,334	$5,580,059	$142,615,278
Total	$10,904,340	$0	$47,030,741	$86,018,186	$110,530	$144,063,797	$48,231,746	$95,832,051	

tons	$ PV	
12	$0	CO Saved

Total Construction Costs **$46,783,228**

B

SRTS BENEFITS

Year	PRESENT VALUE OF USER BENEFITS		
	Journey Quality	Additional Delay Savings	Additional Safety Benefits
Construction Period			
1			
2			
3			
4			
5			
6			
7			
8			
Project Open			
1	$0	$0	$0
2	$0	$0	$0
3	$0	$0	$0
4	$0	$0	$0
5	$0	$0	$0
6	$0	$0	$0
7	$0	$0	$0
8	$0	$0	$0
9	$0	$0	$0
10	$0	$0	$0
11	$0	$0	$0
12	$0	$0	$0
13	$0	$0	$0
14	$0	$0	$0
15	$0	$0	$0
16	$0	$0	$0
17	$0	$0	$0
18	$0	$0	$0
19	$0	$0	$0
20	$0	$0	$0
Total	$0	$0	$0

C INTERNAL RATE OF RETURN ON INVESTMENT AND PAYBACK PERIOD

Year	USER BENEFITS IN CONSTANT DOLLARS					Total Benefits - Constant Dollars	Total Costs - Constant Dollars	Annual Returns on Investment	Cumulative Costs and Benefits
	Journey Quality	Additional Delay Savings	Additional Safety Benefits	Health Benefits	Emission Cost Savings				
Construction Period									
1						$0	$29,200,000	($29,200,000)	($29,200,000)
2						$0	$2,900,000	($2,900,000)	($32,100,000)
3						$0	$16,000,000	($16,000,000)	($48,100,000)
4						$0	$1,100,000	($1,100,000)	($49,200,000)
5						$0	$0	$0	($49,200,000)
6						$0	$0	$0	($49,200,000)
7						$0	$0	$0	($49,200,000)
8						$0	$0	$0	($49,200,000)
Project Open									
1	$754,008	$0	$4,047,989	$6,010,410	$9,541	$10,821,947	$167,500	$10,654,447	$10,654,447
2	$823,294	$0	$4,199,673	$6,548,432	$10,497	$11,581,896	$167,500	$11,414,396	$22,068,843
3	$892,580	$0	$4,357,401	$7,086,454	$11,479	$12,347,914	$167,500	$12,180,414	$34,249,257
4	$961,867	$0	$4,521,453	$7,624,477	$12,486	$13,120,283	$167,500	$12,952,783	$47,202,040
5	$1,031,153	$0	$4,692,122	$8,162,499	$13,521	$13,899,295	$167,500	$13,731,795	$60,933,835
6	$1,100,439	$0	$4,869,716	$8,700,522	$14,583	$14,685,260	$167,500	$14,517,760	$75,451,595
7	$1,169,726	$0	$5,054,557	$9,238,544	$15,674	$15,478,500	$167,500	$15,311,000	$90,762,596
8	$1,239,012	$0	$5,246,986	$9,776,567	$9,602	$16,272,166	$167,500	$16,104,666	$106,867,262
9	$1,308,298	$0	$5,447,358	$10,314,589	$10,269	$17,080,514	$167,500	$16,913,014	$123,780,276
10	$1,377,585	$0	$5,656,048	$10,852,611	$10,955	$17,897,199	$167,500	$17,729,699	$141,509,974
11	$1,446,871	$0	$5,873,450	$11,390,634	$11,659	$18,722,614	$167,500	$18,555,114	$160,065,088
12	$1,516,157	$0	$6,099,977	$11,928,656	$12,383	$19,557,173	$167,500	$19,389,673	$179,454,761
13	$1,585,444	$0	$6,336,062	$12,466,679	$13,127	$20,401,311	$167,500	$20,233,811	$199,688,573
14	$1,654,730	$0	$6,582,162	$13,004,701	$13,892	$21,255,485	$167,500	$21,087,985	$220,776,558
15	$1,724,016	$0	$6,838,757	$13,542,723	$14,677	$22,120,174	$167,500	$21,952,674	$242,729,232
16	$1,793,303	$0	$7,106,351	$14,080,746	$15,484	$22,995,883	$167,500	$22,828,383	$265,557,615
17	$1,862,589	$0	$7,385,472	$14,618,768	$16,313	$23,883,142	$167,500	$23,715,642	$289,273,257
18	$1,931,875	$0	$7,676,679	$15,156,791	$17,164	$24,782,509	$167,500	$24,615,009	$313,888,266
19	$2,001,162	$0	$7,980,555	$15,694,813	$18,039	$25,694,568	$167,500	$25,527,068	$339,415,334
20	$2,070,448	$0	$8,297,717	$16,232,835	$18,937	$26,619,937	$167,500	$26,452,437	$365,867,771
Total	$28,244,554	$0	$118,270,484	$222,432,451	$270,283	$369,217,771	$52,550,000	$316,667,771	

Total Construction Costs **$49,200,000**

Years of Project Implementation and Operation	Annual Returns on Investment
1	($29,200,000)
2	($2,900,000)
3	($16,000,000)
4	($1,100,000)
5	$10,654,447
6	$11,414,396
7	$12,180,414
8	$12,952,783
9	$13,731,795
10	$14,517,760
11	$15,311,000
12	$16,104,666
13	$16,913,014
14	$17,729,699
15	$18,555,114
16	$19,389,673
17	$20,233,811
18	$21,087,985
19	$21,952,674
20	$22,828,383
21	$23,715,642
22	$24,615,009
23	$25,527,068
24	$26,452,437
25	$0
26	$0
27	$0
28	$0

Internal Rate of Return **18.91%**

The INTERNAL RATE OF RETURN (IRR) is the discount rate at which benefits and costs break even (are equal). For a project with an IRR greater than the Discount Rate, benefits are greater than costs, and the project has a positive economic value. The IRR allows projects with different costs, different benefit flows, and different time periods to be compared.

Payback Period **5 years**

The PAYBACK PERIOD is the number of years it takes for the net benefits (benefits minus costs) to equal, or payback, the initial construction costs. For a project with a Payback Period longer than the life-cycle of the project, initial construction costs are not recovered. The Payback Period varies inversely with the Benefit-Cost Ratio: shorter Payback Period yields higher Benefit-Cost.

Parameters

This page contains all economic values and rate tables.
To update economic values automatically, change "Economic Update Factor."

General Economic Parameters

Year of Current Dollars for Model	2019	
Economic Update Factor (Using GDP Deflator)	1.00	1
Real Discount Rate	7.0%	2

Travel Time Parameters

	Value	Units	
Statewide Average Hourly Wage	$ 35.80	$/hr	3
Heavy and Light Truck Drivers			
Average Hourly Wage	$ 22.16	$/hr	3
Benefits and Costs	$ 11.59	$/hr	4
Value of Time			
Automobile	$ 17.90	$/hr/per	5
Truck	$ 30.80	$/hr/veh	5
Auto & Truck Composite	$ 23.95	$/hr/veh	6
Transit	$ 17.90	$/hr/per	5
Out-of-Vehicle Travel	2	times	5
Incident-Related Travel	3	times	7
Travel Time Uprater	0.0%	annual incr	

Vehicle Operating Cost Parameters

Average Fuel Price			
Automobile (regular unleaded)	$ 3.57	$/gal	8
Truck (diesel)	$ 3.84	$/gal	8
Sales and Fuel Taxes			
State Sales Tax (gasoline)	2.25%	%	9
State Sales Tax (diesel)	13.00%	%	9
Average Local Sales Tax	0.50%	%	9
Federal Fuel Excise Tax (gasoline)	$ 0.184	$/gal	9
Federal Fuel Excise Tax (diesel)	$ 0.244	$/gal	9
State Fuel Excise Tax (gasoline)	$ 0.505	$/gal	9
State Fuel Excise Tax (diesel)	$ 0.385	$/gal	9
Fuel Cost Per Gallon (Exclude Taxes)			
Automobile	$ 2.80	$/gal	
Truck	$ 2.75	$/gal	
Non-Fuel Cost Per Mile			
Automobile	$ 0.351	$/mi	10
Truck	$ 0.438	$/mi	11
Idling Speed for Op. Costs and Emissions	5	mph	

Accident Cost Parameters

Cost of a Fatality	$ 10,900,000	$/event	12
Cost of an Injury			
Level A (Severe)	$ 521,300	$/event	12
Level B (Moderate)	$ 142,000	$/event	12
Level C (Minor)	$ 72,500	$/event	12
Cost of Property Damage	$ 4,500	$/event	13
Cost of Highway Accident			
Fatal Accident	$ 12,000,000	$/accident	
Injury Accident	$ 169,000	$/accident	
PDO Accident	$ 16,200	$/accident	
Average Cost	$ 211,000	$/accident	
Statewide Highway Accident Rates			
Fatal Accident	0.006	per mil veh-mi	14
Injury Accident	0.29	per mil veh-mi	14
PDO Accident	0.55	per mil veh-mi	14
Non-Freeway	1.05	per mil veh-mi	15

Sources: 1) Office of Management and Budget (OMB), 2) Review of OMB and State Treasurer's Office data, 3) Bureau of Labor Statistics (BLS) OES, 4) BLS Employment Cost Index, 5) USDOT Department Guidance, 6) California Department of Transportation TSI and Traffic Operations, 7) IDAS model, 8) AAA Daily Fuel Gauge Report, 9) California Board of Equalization, 10) AAA Your Driving Costs, 11) American Transportation Research Institute, 12) USDOT VSL, 13) NHTSA, 14) TASAS summary 2013, 15) TASAS summary 2009

Highway Operations Parameters

	Value	Units	
Maximum V/C Ratio	1.56	-	16
Percent ADT in Peak Period		%	
Percent ADT in Average Peak Hour		%	
Annualization Factor	365	days/yr	

	Alpha	Beta	Capacity (vphpl)	Dep. Rate (vphpl)	
Freeway	0.20	10	2,000	1,800	16, 17
Expressway	0.20	10	2,000	1,800	16, 17
Conventional Highway	0.05	10	800	1,400	17
HOV Lanes	0.55	8	1,600		18

Non-HOV Lanes	Alpha	Beta	Capacity (vphpl)
No Build			
Build			

Sources: 16) Highway Capacity Manual, 17) NCHRP 387, 18) PeMS data

Active Transportation Parameters

General Travel Activity Characteristics Parameters	Value	Units	
Cycling Days per Year	365	days	
Walking Days per Year	365	days	
School Days per Year	180	days	
Vehicle Statistics			
Average Vehicle Speed	25	mph	
Average Vehicle Occupancy	1.25	persons / veh	*19*
Active Transportation User Characteristics			
Average Cycling Speed	11.80	mph	*20*
Average Walking Speed	3.00	mph	*21*
Number of Unlinked Cycling Trips per Day	1.93	trips	*19*
Number of Unlinked Pedestrian Trips per Day	2.38	trips	*19*
Diversion of Cyclists from Personal Vehicles	50%	assumption	
Diversion of Pedestrians from Personal Vehicles	50%	assumption	
Value of Travel Time			
Adults	$ 17.90	$/hr/per	
Children	$ 17.90	$/hr/per	
Cycling Journey Quality - Facility Preference Factors as Function of Distance by Facility Class			
Class I	0.57	-	*20*
Class II	0.49	-	*20*
Class III	0.92	-	*20*
Class IV	0.49	-	*20*
Note: Class IV assumed to be the same as Class II			
Walking Journey Quality Values per Mile by Amentity			
Street Lighting	$0.110	$/mi	*22*
Curb Level	$0.078	$/mi	*22*
Crowding	$0.055	$/mi	*22*
Pavement Evenness	$0.026	$/mi	*22*
Information Panels	$0.026	$/mi	*22*
Benches	$0.017	$/mi	*22*
Directional Signage	$0.017	$/mi	*22*
Health (Absenteeism Reduction)			
Average Absence of Employees	3.60	days/yr	*23*
Percentage Covered by Short-Term Sick Leave	95%	%	*24*
Percentage of Sick Days Reduced When Active at Least 30 Minutes per Day	6%	%	*25*
Health (Mortality Reduction)			
Percentage of Cyclists Aged 16-64	73.4%	%	*26*
Percentage of Pedestrians Aged 16-74	80.7%	%	*26*
Percentage Reduction in Mortality per 365 Annual Cycling Miles	4.5%	%	*27*
Percentage Reduction in Mortality per 365 Annual Walking Miles	9.0%	%	*27*
Morality Rate - All Causes (Aged 20-64)	266	#/100,000 people	*28*
Morality Rate - All Causes (Aged 20-74)	395	#/100,000 people	*28*

Sources: 19) 2000-2001 California Statewide Travel Survey, 20) Hood et al., 2011, 21) WHO HEAT Model, 2012, 22) Heuman et al., 2005, 23) CDC, 2007, 24) UK TAG, 2014, 25) WHO, 2003, 26) 2010-2012 California Household Transporation Survey, 27) WHO HEAT Model, 2016, 28) California Department of Health, 2010-2014 Death Rates, Table 5.2

Travel Demand Tables

Project Types

Highway Capacity Expansion			Please select a type of highway project
General Highway	FALSE	GenHwy	
HOV Lane Addition	FALSE	HOV	Enter HOV restriction in section 1B
HOT Lane Addition	FALSE	HOT	Include toll payers as HOVs & check AVOs
Passing Lane	FALSE	Passing	Enter a truck speed in section 1B
Truck Only Lane	FALSE	TruckLane	Remember to run macro for truck lane
Intersection	FALSE	Intersect	Remember to run model for both roads
Bypass	FALSE	Bypass	Remember to run model for both roads
Queuing	FALSE	Queuing	Add arrival rate & check departure rate in 1B
Pavement	FALSE	Pavement	Enter pavement condition in section 1B
Rail or Transit Cap Expansion			Please select a type of rail or transit project
Passenger Rail	FALSE	PassRail	Enter data in both sections 1B & 1E
Light-Rail (LRT)	FALSE	LRT	Enter data in both sections 1B & 1E
Bus	FALSE	Bus	Enter data in both sections 1B & 1E
Hwy-Rail Grade Crossing	FALSE	HwyRail	Put hwy design in 1B, safety in 1C & crossing in 1D
Hwy Operational Improvement			Please select a type of op. improvement
Auxiliary Lane	FALSE	AuxLane	Enter ramp design speed & on-ramp volume
Freeway Connector	FALSE	FreeConn	Check percent traffic in weave in section 1B
HOV Connector	FALSE	HOVConn	Check percent traffic in weave in section 1B
HOV Drop Ramp	FALSE	HOVDrop	Check percent traffic in weave in section 1B
Off-Ramp Widening	FALSE	OffRamp	Check percent traffic in weave in section 1B
On-Ramp Widening	FALSE	OnRamp	Enter on-ramp volume & metering strategy
HOV-2 to HOV-3 Conv	FALSE	HOV2to3	Check AVOs & trips in sections 1B & 2D
HOT Lane Conversion	FALSE	HOTConv	Check AVOs & trips in sections 1B & 2D
Transp Mgmt Systems (TMS)			Please select a type of TMS project
Ramp Metering	FALSE	RM	Enter model data, if avail, in sections 2A & 2C
Ramp Metering Signal Coord	FALSE	AM	Enter model data, if avail, in sections 2A & 2C
Incident Management	FALSE	IM	Enter model data, if avail, in sections 2A & 2C
Traveler Information	FALSE	TI	Enter model data, if avail, in sections 2A & 2C
Arterial Signal Management	FALSE	ASM	Complete only sections 1A, 1E & 2C
Transit Vehicle Location (AVL)	FALSE	AVL	Enter transit agency costs in section 1D
Transit Vehicle Signal Priority	FALSE	SigPriority	Check travel time in section 1D
Bus Rapid Transit (BRT)	FALSE	BRT	Enter free-flow bus lane speed in section 1B
TMS Lookup Code		TMSLookup	
User Modified Inputs		UserAdjInputs	

DEMAND FOR TRAVEL IN PEAK PERIOD

(percent of total daily travel)

Number of Hours in Peak Period	Urban				Rural	
	So. California		No. California			
	Fwy/Exp	Other	Fwy/Exp	Other	Fwy/Exp	Other
1	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%
2	16.8%	16.8%	16.8%	16.8%	16.8%	16.8%
3	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
4	32.8%	32.8%	32.8%	32.8%	32.8%	32.8%
5	40.3%	40.3%	40.3%	40.3%	40.3%	40.3%
6	47.4%	47.4%	47.4%	47.4%	47.4%	47.4%
7	54.2%	54.2%	54.2%	54.2%	54.2%	54.2%
8	60.8%	60.8%	60.8%	60.8%	60.8%	60.8%
9	67.1%	67.1%	67.1%	67.1%	67.1%	67.1%
10	73.4%	73.4%	73.4%	73.4%	73.4%	73.4%
11	79.0%	79.0%	79.0%	79.0%	79.0%	79.0%
12	84.3%	84.3%	84.3%	84.3%	84.3%	84.3%
13	88.6%	88.6%	88.6%	88.6%	88.6%	88.6%
14	91.6%	91.6%	91.6%	91.6%	91.6%	91.6%
15	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%
16	96.4%	96.4%	96.4%	96.4%	96.4%	96.4%
17	97.6%	97.6%	97.6%	97.6%	97.6%	97.6%
18	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%
19	99.1%	99.1%	99.1%	99.1%	99.1%	99.1%
20	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%
21	99.7%	99.7%	99.7%	99.7%	99.7%	99.7%
22	99.8%	99.8%	99.8%	99.8%	99.8%	99.8%
23	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
24	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: California Department of Transportation, 2010-2012 California Household Travel Survey, Final Report Appendix, June 2013

AGE COHORTS FOR MORTALITY RISK REDUCTION

(percent of population)

Mode	Age Cohort	Urban		Rural
		South	North	
Cycling	Age 16-64	70.5%	73.4%	66.0%
Walking	Age 16-74	76.2%	80.7%	70.0%

AVERAGE DISTANCE PER ACTIVE TRANSPORTATION TRIP

(miles/trip)

Mode	Age Cohort	Urban		Rural
		South	North	
Cycling	Adults	1.83	1.85	2.91
	Children <16	0.88	1.03	1.66
Walking	Adults	0.52	0.66	0.29
	Children <16	0.46	0.58	0.42

TRIP PURPOSE FOR ACTIVE TRANSPORTATION TRIPS

(percent of trips)

Mode	Trip Purpose	Urban		Rural
		South	North	
Cycling	Commuting	8%	11%	7%
	Recreation	15%	13%	15%
	Other Destination	77%	76%	78%
Walking	Commuting	5%	9%	4%
	Recreation	10%	10%	15%
	Other Destination	85%	81%	81%

Source: California Department of Transportation, 2010-2012 California Household Travel Survey database, 2012

FUEL CONSUMPTION RATES

(gal/veh-mi)

Speed	Auto*	Truck
5	0.1024	0.2112
6	0.0971	0.2056
7	0.0919	0.2000
8	0.0867	0.1944
9	0.0815	0.1888
10	0.0763	0.1832
11	0.0727	0.1707
12	0.0691	0.1583
13	0.0656	0.1459
14	0.0620	0.1335
15	0.0584	0.1211
16	0.0560	0.1181
17	0.0536	0.1150
18	0.0513	0.1120
19	0.0489	0.1089
20	0.0465	0.1059
21	0.0449	0.1011
22	0.0433	0.0963
23	0.0417	0.0916
24	0.0401	0.0868
25	0.0384	0.0821
26	0.0374	0.0804
27	0.0363	0.0788
28	0.0352	0.0771
29	0.0341	0.0755
30	0.0330	0.0738
31	0.0323	0.0750
32	0.0316	0.0763
33	0.0310	0.0774
34	0.0303	0.0786
35	0.0296	0.0799
36	0.0292	0.0796
37	0.0288	0.0794
38	0.0284	0.0792
39	0.0280	0.0790
40	0.0276	0.0788
41	0.0274	0.0796
42	0.0272	0.0804
43	0.0270	0.0812
44	0.0268	0.0820
45	0.0266	0.0828
46	0.0266	0.0826
47	0.0266	0.0824
48	0.0266	0.0821
49	0.0266	0.0819
50	0.0266	0.0817
51	0.0268	0.0826
52	0.0270	0.0834
53	0.0272	0.0842
54	0.0274	0.0850
55	0.0275	0.0858
56	0.0279	0.0839
57	0.0283	0.0820
58	0.0286	0.0802
59	0.0290	0.0783
60	0.0293	0.0764
61	0.0300	0.0756
62	0.0306	0.0749
63	0.0312	0.0741
64	0.0319	0.0734
65	0.0325	0.0726
66	0.0331	0.0765
67	0.0337	0.0804
68	0.0343	0.0842
69	0.0350	0.0881
70	0.0356	0.0920

** Includes motorcycles & motorhomes*

Note: Five mph is best estimate for idling

Source: California Air Resources Board, EMFAC2014, 2016 & 2036 average

Accident Tables

HIGHWAY INJURY SEVERITY FREQUENCY
(percent of injuries)

Event	Urban	Suburban	Rural	Average
Severe Injury (A)	4.78%	4.78%	4.78%	4.78%
Other Visible Injury (B)	25.54%	25.54%	25.54%	25.54%
Complaint of Pain (C)	69.68%	69.68%	69.68%	69.68%

Source: 2013 SWITRS Annual Report, Table 8C

NUMBER OF FATALITIES
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.09	1.08	1.14	1.11

NUMBER OF INJURIES
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	0.81	0.82	1.12	0.95
Injury Accident	1.44	1.43	1.50	1.44

NUMBER OF VEHICLES INVOLVED
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.51	1.69	1.58	1.63
Injury Accident	1.82	2.10	1.59	1.99
PDO Accident	1.80	2.03	1.59	1.96

DISTRIBUTION OF ACCIDENT TYPES
(percent of accidents)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.18%	0.45%	1.92%	0.71%
Injury Accident	34.93%	33.09%	38.25%	33.98%
PDO Accident	63.89%	66.45%	59.83%	65.31%

Source: California Department of Transportation, TASAS Unit, 2010 to 2013 average

COST OF HIGHWAY ACCIDENTS
($/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	$12,000,000	$11,900,000	$12,600,000	$12,200,000
Injury Accident	$169,000	$169,200	$174,700	$169,800
PDO Accident	$16,200	$18,300	$14,300	$17,600
All Types	$211,000	$121,700	$317,300	$155,800

Source: Combination of above four tables

RATES FOR TRANSIT ACCIDENT EVENTS
(events/million veh-mi)

Event	Pass Train	Light Rail	Bus	Freight Rail
Fatality	0.0555	0.2480	0.0349	0.9917
Injury	0.2519	3.9469	3.6535	7.7862
All Accidents	0.2775	5.3817	2.6733	13.5424

Sources: USDOT, Transportation Statistics Annual Report, Table 2-33, 2003 to 2012 average
FRA, Office of Safety Analysis, Table 1.13, 2008 to 2017 YTD average.

COST OF TRANSIT ACCIDENT EVENTS
($/event)

Event	Pass Train	Light Rail	Bus	Freight Rail
Fatality	$10,900,000	$10,900,000	$10,900,000	$10,900,000
Injury	$201,800	$201,800	$201,800	$201,800
Prop Damage	$78,800	$12,400	$3,800	$147,600

Sources: FTA, Transit Safety & Security Statistics, 2002 to 2011 average
FRA, Office of Safety Analysis, Table 3.16, 2014 to 2016 average.

COSTS OF TRANSIT ACCIDENTS
($/million veh-mi)

Value	Pass Train	Light Rail	Bus	Freight Rail
Cost	$677,700	$3,566,400	$1,127,800	$14,379,600

Source: Combination of above two tables

HIGHWAY-RAIL GRADE CROSSING INCIDENTS
(units in table)

Value	Incident	Fatality	Injury
Total Events	799	94	515
Avg per Incident		0.1176	0.6446
Cost per Event		$10,900,000	$201,800

Source: FRA, Office of Safety Analysis, 5.10 - Hwy/Rail Incidents Summary Table, California, Motor Vehicles, Public Crossings, Jan 2007 to Dec 2016

PASSING LANE ACCIDENT REDUCTION FACTORS
(rate with passing lane/rate without passing lane)

Minimum ADT	Fatality	Injury	PDO
0	25.0%	69.4%	92.6%
5,000	19.2%	80.3%	96.5%
10,000	84.0%	57.7%	97.8%

Source: Taylor and Jain, 1991

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2016

Mode	Speed	CO	CO_2	NO_x	$PM_{2.5}$	SO_x	VOC	$PM_{2.5}$
Auto	0	3.4104	81.98	0.2740	0.0026	0.0009	0.2826	0.0026
	5	3.6818	1213.16	0.3465	0.0123	0.0122	0.3386	0.0123
	6	3.5051	1148.57	0.3282	0.0114	0.0115	0.3105	0.0114
	7	3.3284	1083.98	0.3099	0.0104	0.0109	0.2824	0.0104
	8	3.1516	1019.40	0.2917	0.0095	0.0102	0.2543	0.0095
	9	2.9749	954.81	0.2734	0.0086	0.0096	0.2262	0.0086
	10	2.7982	890.22	0.2552	0.0077	0.0089	0.1982	0.0077
	11	2.7335	850.65	0.2497	0.0072	0.0085	0.1864	0.0072
	12	2.6688	811.08	0.2443	0.0067	0.0081	0.1747	0.0067
	13	2.6041	771.51	0.2389	0.0062	0.0077	0.1630	0.0062
	14	2.5395	731.95	0.2335	0.0057	0.0073	0.1512	0.0057
	15	2.4748	692.38	0.2281	0.0052	0.0070	0.1395	0.0052
	16	2.4099	664.13	0.2225	0.0049	0.0067	0.1314	0.0049
	17	2.3450	635.88	0.2168	0.0046	0.0064	0.1232	0.0046
	18	2.2801	607.62	0.2112	0.0043	0.0061	0.1150	0.0043
	19	2.2153	579.37	0.2056	0.0040	0.0058	0.1069	0.0040
	20	2.1504	551.12	0.1999	0.0037	0.0055	0.0987	0.0037
	21	2.0928	532.04	0.1948	0.0035	0.0053	0.0934	0.0035
	22	2.0353	512.95	0.1897	0.0033	0.0052	0.0881	0.0033
	23	1.9777	493.87	0.1846	0.0031	0.0050	0.0828	0.0031
	24	1.9202	474.78	0.1795	0.0029	0.0048	0.0775	0.0029
	25	1.8626	455.70	0.1744	0.0027	0.0046	0.0722	0.0027
	26	1.8252	442.81	0.1719	0.0026	0.0045	0.0693	0.0026
	27	1.7878	429.93	0.1693	0.0025	0.0043	0.0663	0.0025
	28	1.7504	417.04	0.1668	0.0024	0.0042	0.0633	0.0024
	29	1.7130	404.16	0.1643	0.0023	0.0041	0.0603	0.0023
	30	1.6756	391.27	0.1617	0.0021	0.0039	0.0573	0.0021
	31	1.6579	383.46	0.1613	0.0021	0.0039	0.0559	0.0021
	32	1.6402	375.65	0.1608	0.0020	0.0038	0.0544	0.0020
	33	1.6225	367.83	0.1603	0.0019	0.0037	0.0529	0.0019
	34	1.6048	360.02	0.1598	0.0019	0.0036	0.0515	0.0019
	35	1.5870	352.21	0.1593	0.0018	0.0035	0.0500	0.0018
	36	1.5734	347.40	0.1594	0.0017	0.0035	0.0491	0.0017
	37	1.5598	342.60	0.1594	0.0017	0.0034	0.0482	0.0017
	38	1.5462	337.79	0.1594	0.0017	0.0034	0.0474	0.0017
	39	1.5326	332.99	0.1594	0.0016	0.0033	0.0465	0.0016
	40	1.5190	328.18	0.1594	0.0016	0.0033	0.0456	0.0016
	41	1.5076	325.84	0.1598	0.0015	0.0033	0.0452	0.0015
	42	1.4963	323.50	0.1602	0.0015	0.0033	0.0449	0.0015
	43	1.4849	321.16	0.1607	0.0015	0.0032	0.0445	0.0015
	44	1.4736	318.82	0.1611	0.0015	0.0032	0.0441	0.0015
	45	1.4622	316.48	0.1615	0.0015	0.0032	0.0438	0.0015
	46	1.4550	316.61	0.1623	0.0014	0.0032	0.0438	0.0014
	47	1.4478	316.74	0.1631	0.0014	0.0032	0.0438	0.0014
	48	1.4405	316.87	0.1639	0.0014	0.0032	0.0437	0.0014
	49	1.4333	317.01	0.1647	0.0014	0.0032	0.0437	0.0014
	50	1.4261	317.14	0.1655	0.0014	0.0032	0.0437	0.0014
	51	1.4181	319.34	0.1663	0.0014	0.0032	0.0439	0.0014
	52	1.4101	321.54	0.1671	0.0014	0.0032	0.0442	0.0014
	53	1.4022	323.75	0.1678	0.0014	0.0033	0.0444	0.0014
	54	1.3942	325.95	0.1686	0.0014	0.0033	0.0446	0.0014
	55	1.3862	328.15	0.1694	0.0014	0.0033	0.0448	0.0014
	56	1.3680	332.21	0.1680	0.0015	0.0033	0.0448	0.0015
	57	1.3497	336.27	0.1666	0.0015	0.0034	0.0448	0.0015
	58	1.3315	340.33	0.1651	0.0015	0.0034	0.0448	0.0015
	59	1.3132	344.39	0.1637	0.0015	0.0035	0.0448	0.0015
	60	1.2950	348.45	0.1623	0.0015	0.0035	0.0448	0.0015
	61	1.3020	356.51	0.1640	0.0015	0.0036	0.0462	0.0015
	62	1.3089	364.56	0.1658	0.0016	0.0037	0.0477	0.0016
	63	1.3159	372.62	0.1675	0.0016	0.0037	0.0491	0.0016
	64	1.3229	380.68	0.1693	0.0016	0.0038	0.0505	0.0016
	65	1.3299	388.74	0.1710	0.0017	0.0039	0.0519	0.0017
	66	1.3750	397.41	0.1757	0.0017	0.0040	0.0544	0.0017
	67	1.4201	406.07	0.1804	0.0017	0.0041	0.0568	0.0017
	68	1.4653	414.74	0.1850	0.0018	0.0042	0.0592	0.0018
	69	1.5104	423.41	0.1897	0.0018	0.0043	0.0616	0.0018
	70	1.5555	432.08	0.1944	0.0018	0.0043	0.0640	0.0018

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2036

Mode	Speed	CO	CO_2	NO_x	$PM_{2.5}$	SO_x	VOC	$PM_{2.5}$
Auto	0	0.6940	45.66	0.0331	0.0013	0.0005	0.0462	0.0013
	5	1.0344	735.07	0.0699	0.0061	0.0074	0.1171	0.0061
	6	1.0041	696.96	0.0674	0.0056	0.0070	0.1088	0.0056
	7	0.9737	658.86	0.0650	0.0052	0.0066	0.1004	0.0052
	8	0.9434	620.76	0.0626	0.0047	0.0062	0.0920	0.0047
	9	0.9130	582.66	0.0601	0.0043	0.0058	0.0837	0.0043
	10	0.8827	544.56	0.0577	0.0038	0.0054	0.0753	0.0038
	11	0.8622	519.72	0.0564	0.0036	0.0052	0.0706	0.0036
	12	0.8416	494.88	0.0550	0.0033	0.0050	0.0659	0.0033
	13	0.8211	470.04	0.0537	0.0030	0.0047	0.0612	0.0030
	14	0.8006	445.20	0.0524	0.0028	0.0045	0.0565	0.0028
	15	0.7800	420.36	0.0510	0.0025	0.0042	0.0517	0.0025
	16	0.7621	403.50	0.0499	0.0024	0.0040	0.0486	0.0024
	17	0.7441	386.63	0.0489	0.0022	0.0039	0.0456	0.0022
	18	0.7261	369.76	0.0478	0.0021	0.0037	0.0425	0.0021
	19	0.7082	352.89	0.0467	0.0019	0.0035	0.0394	0.0019
	20	0.6902	336.02	0.0456	0.0018	0.0034	0.0363	0.0018
	21	0.6767	324.45	0.0448	0.0017	0.0032	0.0345	0.0017
	22	0.6632	312.87	0.0440	0.0016	0.0031	0.0327	0.0016
	23	0.6497	301.30	0.0431	0.0015	0.0030	0.0309	0.0015
	24	0.6362	289.73	0.0423	0.0014	0.0029	0.0291	0.0014
	25	0.6227	278.16	0.0415	0.0013	0.0028	0.0273	0.0013
	26	0.6110	270.26	0.0409	0.0013	0.0027	0.0261	0.0013
	27	0.5993	262.35	0.0402	0.0012	0.0026	0.0250	0.0012
	28	0.5877	254.45	0.0395	0.0011	0.0025	0.0238	0.0011
	29	0.5760	246.55	0.0389	0.0011	0.0025	0.0227	0.0011
	30	0.5643	238.64	0.0382	0.0010	0.0024	0.0215	0.0010
	31	0.5571	233.62	0.0380	0.0010	0.0023	0.0208	0.0010
	32	0.5500	228.61	0.0378	0.0009	0.0023	0.0201	0.0009
	33	0.5428	223.59	0.0376	0.0009	0.0022	0.0194	0.0009
	34	0.5356	218.57	0.0374	0.0009	0.0022	0.0187	0.0009
	35	0.5284	213.55	0.0372	0.0008	0.0021	0.0180	0.0008
	36	0.5216	210.51	0.0370	0.0008	0.0021	0.0176	0.0008
	37	0.5148	207.47	0.0368	0.0008	0.0021	0.0171	0.0008
	38	0.5079	204.43	0.0366	0.0008	0.0020	0.0167	0.0008
	39	0.5011	201.39	0.0364	0.0008	0.0020	0.0162	0.0008
	40	0.4943	198.35	0.0362	0.0007	0.0020	0.0158	0.0007
	41	0.4899	196.95	0.0362	0.0007	0.0020	0.0156	0.0007
	42	0.4855	195.54	0.0362	0.0007	0.0020	0.0155	0.0007
	43	0.4811	194.14	0.0363	0.0007	0.0019	0.0154	0.0007
	44	0.4768	192.74	0.0363	0.0007	0.0019	0.0152	0.0007
	45	0.4724	191.33	0.0363	0.0007	0.0019	0.0151	0.0007
	46	0.4679	191.33	0.0364	0.0007	0.0019	0.0150	0.0007
	47	0.4634	191.33	0.0364	0.0007	0.0019	0.0149	0.0007
	48	0.4589	191.33	0.0364	0.0007	0.0019	0.0149	0.0007
	49	0.4544	191.33	0.0364	0.0007	0.0019	0.0148	0.0007
	50	0.4500	191.32	0.0365	0.0006	0.0019	0.0147	0.0006
	51	0.4455	192.68	0.0365	0.0007	0.0019	0.0148	0.0007
	52	0.4410	194.05	0.0365	0.0007	0.0019	0.0148	0.0007
	53	0.4365	195.41	0.0365	0.0007	0.0020	0.0149	0.0007
	54	0.4320	196.77	0.0365	0.0007	0.0020	0.0150	0.0007
	55	0.4275	198.13	0.0365	0.0007	0.0020	0.0150	0.0007
	56	0.4226	200.79	0.0363	0.0007	0.0020	0.0152	0.0007
	57	0.4178	203.46	0.0362	0.0007	0.0020	0.0154	0.0007
	58	0.4130	206.12	0.0360	0.0007	0.0021	0.0156	0.0007
	59	0.4082	208.79	0.0359	0.0007	0.0021	0.0157	0.0007
	60	0.4034	211.45	0.0358	0.0007	0.0021	0.0159	0.0007
	61	0.4063	215.99	0.0367	0.0007	0.0022	0.0166	0.0007
	62	0.4093	220.54	0.0377	0.0007	0.0022	0.0173	0.0007
	63	0.4123	225.08	0.0387	0.0008	0.0023	0.0180	0.0008
	64	0.4152	229.62	0.0396	0.0008	0.0023	0.0188	0.0008
	65	0.4182	234.17	0.0406	0.0008	0.0023	0.0195	0.0008
	66	0.4203	238.62	0.0401	0.0008	0.0024	0.0197	0.0008
	67	0.4224	243.08	0.0396	0.0008	0.0024	0.0200	0.0008
	68	0.4246	247.54	0.0391	0.0008	0.0025	0.0203	0.0008
	69	0.4267	252.00	0.0386	0.0008	0.0025	0.0206	0.0008
	70	0.4288	256.46	0.0382	0.0009	0.0026	0.0209	0.0009

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2016

Mode	Speed	CO	CO_2	NO_x	$PM_{2.5}$	SO_x	VOC	$PM_{2.5}$
Auto	0	3.4104	81.98	0.2740	0.0026	0.0009	0.2826	0.0026
	5	3.6818	1213.16	0.3465	0.0123	0.0122	0.3386	0.0123
	6	3.5051	1148.57	0.3282	0.0114	0.0115	0.3105	0.0114
	7	3.3284	1083.98	0.3099	0.0104	0.0109	0.2824	0.0104
	8	3.1516	1019.40	0.2917	0.0095	0.0102	0.2543	0.0095
Truck	0	4.8572	39.19	1.7997	0.0013	0.2774	0.4175	0.0013
	5	5.1803	2187.60	7.9756	0.1087	0.0202	1.0547	0.1087
	6	4.9501	2147.78	7.8499	0.1089	0.0199	1.0224	0.1089
	7	4.7200	2107.96	7.7242	0.1092	0.0195	0.9901	0.1092
	8	4.4898	2068.13	7.5986	0.1095	0.0192	0.9579	0.1095
	9	4.2597	2028.31	7.4729	0.1098	0.0189	0.9256	0.1098
	10	4.0295	1988.49	7.3473	0.1101	0.0185	0.8934	0.1101
	11	3.7759	1843.50	6.7599	0.1015	0.0173	0.8082	0.1015
	12	3.5223	1698.51	6.1725	0.0929	0.0160	0.7230	0.0929
	13	3.2687	1553.51	5.5851	0.0843	0.0147	0.6378	0.0843
	14	3.0151	1408.52	4.9977	0.0757	0.0134	0.5525	0.0757
	15	2.7615	1263.53	4.4103	0.0671	0.0121	0.4673	0.0671
	16	2.6560	1263.49	4.4801	0.0674	0.0121	0.4442	0.0674
	17	2.5504	1263.44	4.5499	0.0677	0.0121	0.4210	0.0677
	18	2.4449	1263.40	4.6197	0.0679	0.0121	0.3979	0.0679
	19	2.3394	1263.35	4.6895	0.0682	0.0121	0.3747	0.0682
	20	2.2339	1263.31	4.7593	0.0685	0.0121	0.3516	0.0685
	21	2.1458	1237.01	4.6190	0.0647	0.0119	0.3310	0.0647
	22	2.0577	1210.72	4.4786	0.0610	0.0116	0.3105	0.0610
	23	1.9697	1184.43	4.3383	0.0572	0.0114	0.2900	0.0572
	24	1.8816	1158.13	4.1979	0.0534	0.0111	0.2695	0.0534
	25	1.7935	1131.84	4.0576	0.0497	0.0108	0.2489	0.0497
	26	1.7441	1138.52	4.0783	0.0496	0.0109	0.2424	0.0496
	27	1.6947	1145.20	4.0990	0.0495	0.0110	0.2358	0.0495
	28	1.6453	1151.87	4.1197	0.0495	0.0110	0.2293	0.0495
	29	1.5959	1158.55	4.1404	0.0494	0.0111	0.2227	0.0494
	30	1.5465	1165.23	4.1611	0.0493	0.0111	0.2162	0.0493
	31	1.5050	1199.22	4.2631	0.0503	0.0114	0.2128	0.0503
	32	1.4634	1233.21	4.3651	0.0513	0.0117	0.2095	0.0513
	33	1.4219	1267.20	4.4671	0.0524	0.0120	0.2061	0.0524
	34	1.3803	1301.19	4.5691	0.0534	0.0123	0.2028	0.0534
	35	1.3387	1335.18	4.6711	0.0544	0.0126	0.1994	0.0544
	36	1.3027	1331.17	4.6418	0.0550	0.0126	0.1934	0.0550
	37	1.2667	1327.17	4.6126	0.0556	0.0125	0.1873	0.0556
	38	1.2306	1323.16	4.5833	0.0562	0.0125	0.1812	0.0562
	39	1.1946	1319.16	4.5540	0.0567	0.0125	0.1751	0.0567
	40	1.1586	1315.15	4.5247	0.0573	0.0125	0.1690	0.0573
	41	1.1260	1312.39	4.5116	0.0572	0.0124	0.1638	0.0572
	42	1.0934	1309.62	4.4984	0.0571	0.0124	0.1585	0.0571
	43	1.0609	1306.85	4.4852	0.0570	0.0124	0.1533	0.0570
	44	1.0283	1304.08	4.4720	0.0569	0.0124	0.1480	0.0569
	45	0.9958	1301.32	4.4589	0.0567	0.0124	0.1428	0.0567
	46	0.9927	1264.42	4.3777	0.0556	0.0120	0.1381	0.0556
	47	0.9897	1227.52	4.2964	0.0545	0.0117	0.1334	0.0545
	48	0.9866	1190.62	4.2152	0.0534	0.0114	0.1287	0.0534
	49	0.9836	1153.73	4.1340	0.0523	0.0110	0.1240	0.0523
	50	0.9805	1116.83	4.0528	0.0512	0.0107	0.1193	0.0512
	51	0.9565	1133.04	4.1049	0.0541	0.0109	0.1190	0.0541
	52	0.9324	1149.25	4.1569	0.0569	0.0110	0.1188	0.0569
	53	0.9083	1165.46	4.2090	0.0597	0.0112	0.1185	0.0597
	54	0.8842	1181.67	4.2610	0.0626	0.0113	0.1182	0.0626
	55	0.8601	1197.87	4.3131	0.0654	0.0115	0.1179	0.0654
	56	0.8633	1184.58	4.2356	0.0672	0.0114	0.1175	0.0672
	57	0.8665	1171.29	4.1582	0.0689	0.0112	0.1170	0.0689
	58	0.8696	1158.00	4.0807	0.0707	0.0111	0.1166	0.0707
	59	0.8728	1144.71	4.0032	0.0725	0.0110	0.1162	0.0725
	60	0.8760	1131.42	3.9257	0.0742	0.0109	0.1157	0.0742
	61	0.8894	1131.74	3.9251	0.0718	0.0109	0.1151	0.0718
	62	0.9028	1132.07	3.9244	0.0694	0.0109	0.1145	0.0694
	63	0.9163	1132.39	3.9237	0.0669	0.0109	0.1139	0.0669
	64	0.9297	1132.72	3.9230	0.0645	0.0109	0.1133	0.0645
	65	0.9431	1133.04	3.9224	0.0621	0.0109	0.1127	0.0621
	66	0.9190	1151.08	3.9095	0.0587	0.0110	0.1098	0.0587
	67	0.8949	1169.12	3.8966	0.0554	0.0112	0.1070	0.0554
	68	0.8707	1187.17	3.8837	0.0521	0.0114	0.1042	0.0521
	69	0.8466	1205.21	3.8708	0.0487	0.0115	0.1014	0.0487
	70	0.8225	1223.25	3.8579	0.0454	0.0117	0.0986	0.0454

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2036

Mode	Speed	CO	CO_2	NO_x	$PM_{2.5}$	SO_x	VOC	$PM_{2.5}$
Auto	0	0.6940	45.66	0.0331	0.0013	0.0005	0.0462	0.0013
	5	1.0344	735.07	0.0699	0.0061	0.0074	0.1171	0.0061
	6	1.0041	696.96	0.0674	0.0056	0.0070	0.1088	0.0056
	7	0.9737	658.86	0.0650	0.0052	0.0066	0.1004	0.0052
	8	0.9434	620.76	0.0626	0.0047	0.0062	0.0920	0.0047
Truck	0	1.8187	31.73	3.5930	0.0005	0.0003	0.1107	0.0005
	5	4.6433	2312.07	10.1441	0.0123	0.0198	0.4427	0.0123
	6	4.3680	2256.43	9.6372	0.0119	0.0194	0.4211	0.0119
	7	4.0927	2200.78	9.1303	0.0114	0.0190	0.3996	0.0114
	8	3.8174	2145.13	8.6234	0.0109	0.0186	0.3780	0.0109
	9	3.5421	2089.48	8.1165	0.0105	0.0183	0.3564	0.0105
	10	3.2668	2033.84	7.6096	0.0100	0.0179	0.3349	0.0100
	11	2.9097	1905.69	6.8507	0.0098	0.0169	0.3092	0.0098
	12	2.5527	1777.54	6.0919	0.0096	0.0159	0.2835	0.0096
	13	2.1957	1649.39	5.3330	0.0093	0.0150	0.2578	0.0093
	14	1.8386	1521.24	4.5742	0.0091	0.0140	0.2322	0.0091
	15	1.4816	1393.10	3.8153	0.0089	0.0130	0.2065	0.0089
	16	1.3940	1385.68	3.6087	0.0085	0.0130	0.1945	0.0085
	17	1.3064	1378.26	3.4020	0.0081	0.0129	0.1824	0.0081
	18	1.2188	1370.84	3.1953	0.0078	0.0129	0.1704	0.0078
	19	1.1312	1363.42	2.9887	0.0074	0.0129	0.1583	0.0074
	20	1.0436	1356.00	2.7820	0.0070	0.0128	0.1463	0.0070
	21	0.9988	1325.74	2.5267	0.0068	0.0125	0.1372	0.0068
	22	0.9541	1295.48	2.2714	0.0067	0.0122	0.1282	0.0067
	23	0.9093	1265.22	2.0161	0.0065	0.0119	0.1192	0.0065
	24	0.8646	1234.96	1.7608	0.0063	0.0116	0.1101	0.0063
	25	0.8198	1204.71	1.5055	0.0062	0.0113	0.1011	0.0062
	26	0.7917	1207.23	1.4248	0.0060	0.0114	0.0973	0.0060
	27	0.7637	1209.75	1.3441	0.0059	0.0114	0.0936	0.0059
	28	0.7356	1212.27	1.2634	0.0057	0.0114	0.0898	0.0057
	29	0.7075	1214.80	1.1827	0.0056	0.0115	0.0861	0.0056
	30	0.6794	1217.32	1.1020	0.0054	0.0115	0.0823	0.0054
	31	0.6715	1233.43	1.0586	0.0053	0.0116	0.0796	0.0053
	32	0.6636	1249.54	1.0152	0.0052	0.0117	0.0769	0.0052
	33	0.6556	1265.65	0.9719	0.0051	0.0118	0.0742	0.0051
	34	0.6477	1281.76	0.9285	0.0050	0.0119	0.0715	0.0050
	35	0.6398	1297.87	0.8851	0.0049	0.0120	0.0688	0.0049
	36	0.6063	1289.71	0.8393	0.0048	0.0120	0.0653	0.0048
	37	0.5729	1281.55	0.7935	0.0047	0.0119	0.0619	0.0047
	38	0.5394	1273.38	0.7477	0.0047	0.0119	0.0584	0.0047
	39	0.5060	1265.22	0.7020	0.0046	0.0118	0.0549	0.0046
	40	0.4725	1257.05	0.6562	0.0045	0.0118	0.0515	0.0045
	41	0.4512	1253.52	0.6306	0.0045	0.0117	0.0493	0.0045
	42	0.4299	1249.98	0.6050	0.0044	0.0117	0.0471	0.0044
	43	0.4086	1246.45	0.5795	0.0044	0.0117	0.0450	0.0044
	44	0.3873	1242.91	0.5539	0.0044	0.0117	0.0428	0.0044
	45	0.3660	1239.37	0.5283	0.0043	0.0117	0.0406	0.0043
	46	0.3462	1218.01	0.5072	0.0043	0.0115	0.0385	0.0043
	47	0.3263	1196.64	0.4861	0.0043	0.0113	0.0364	0.0043
	48	0.3065	1175.28	0.4649	0.0043	0.0111	0.0343	0.0043
	49	0.2866	1153.91	0.4438	0.0042	0.0110	0.0322	0.0042
	50	0.2668	1132.54	0.4226	0.0042	0.0108	0.0301	0.0042
	51	0.2573	1134.57	0.4082	0.0042	0.0108	0.0288	0.0042
	52	0.2478	1136.59	0.3937	0.0041	0.0108	0.0275	0.0041
	53	0.2383	1138.62	0.3792	0.0041	0.0109	0.0262	0.0041
	54	0.2288	1140.64	0.3648	0.0040	0.0109	0.0250	0.0040
	55	0.2193	1142.66	0.3503	0.0040	0.0109	0.0237	0.0040
	56	0.2078	1127.35	0.3362	0.0039	0.0108	0.0227	0.0039
	57	0.1963	1112.03	0.3221	0.0039	0.0106	0.0217	0.0039
	58	0.1848	1096.71	0.3080	0.0038	0.0105	0.0207	0.0038
	59	0.1733	1081.40	0.2939	0.0037	0.0103	0.0197	0.0037
	60	0.1618	1066.08	0.2798	0.0037	0.0102	0.0188	0.0037
	61	0.1650	1070.20	0.2846	0.0037	0.0102	0.0192	0.0037
	62	0.1682	1074.31	0.2895	0.0038	0.0103	0.0196	0.0038
	63	0.1715	1078.43	0.2943	0.0039	0.0103	0.0200	0.0039
	64	0.1747	1082.54	0.2992	0.0039	0.0104	0.0204	0.0039
	65	0.1779	1086.66	0.3040	0.0040	0.0104	0.0208	0.0040
	66	0.1760	1103.78	0.3088	0.0040	0.0106	0.0212	0.0040
	67	0.1741	1120.90	0.3135	0.0041	0.0107	0.0216	0.0041
	68	0.1721	1138.02	0.3183	0.0041	0.0109	0.0220	0.0041
	69	0.1702	1155.14	0.3231	0.0041	0.0110	0.0224	0.0041
	70	0.1683	1172.25	0.3278	0.0042	0.0112	0.0228	0.0042

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2016

Mode	Speed	CO	CO_2	NO_x	$PM_{2.5}$	SO_x	VOC	$PM_{2.5}$
Auto	0	3.4104	81.98	0.2740	0.0026	0.0009	0.2826	0.0026
	5	3.6818	1213.16	0.3465	0.0123	0.0122	0.3386	0.0123
	6	3.5051	1148.57	0.3282	0.0114	0.0115	0.3105	0.0114
	7	3.3284	1083.98	0.3099	0.0104	0.0109	0.2824	0.0104
	8	3.1516	1019.40	0.2917	0.0095	0.0102	0.2543	0.0095
Bus	0	10.6824	82.09	2.0123	0.0011	0.0010	0.6855	0.0011
	5	19.5713	3427.66	22.0894	0.3975	0.0272	3.1109	0.3975
	6	18.6137	3345.92	21.1559	0.3798	0.0267	2.9232	0.3798
	7	17.6561	3264.17	20.2224	0.3621	0.0261	2.7356	0.3621
	8	16.6985	3182.43	19.2889	0.3444	0.0255	2.5480	0.3444
	9	15.7409	3100.68	18.3553	0.3266	0.0250	2.3604	0.3266
	10	14.7833	3018.94	17.4218	0.3089	0.0244	2.1728	0.3089
	11	13.9614	2881.27	16.5060	0.2902	0.0232	1.9877	0.2902
	12	13.1394	2743.60	15.5903	0.2714	0.0220	1.8026	0.2714
	13	12.3175	2605.93	14.6745	0.2527	0.0208	1.6175	0.2527
	14	11.4955	2468.25	13.7588	0.2339	0.0196	1.4324	0.2339
	15	10.6736	2330.58	12.8430	0.2152	0.0184	1.2473	0.2152
	16	10.6229	2266.47	12.7712	0.2097	0.0175	1.1680	0.2097
	17	10.5723	2202.36	12.6993	0.2043	0.0167	1.0886	0.2043
	18	10.5216	2138.25	12.6275	0.1988	0.0158	1.0093	0.1988
	19	10.4710	2074.14	12.5556	0.1934	0.0150	0.9300	0.1934
	20	10.4204	2010.03	12.4838	0.1879	0.0141	0.8506	0.1879
	21	8.8913	1886.19	11.1329	0.1617	0.0139	0.7311	0.1617
	22	7.3623	1762.35	9.7821	0.1355	0.0137	0.6115	0.1355
	23	5.8333	1638.51	8.4313	0.1092	0.0134	0.4920	0.1092
	24	4.3043	1514.66	7.0804	0.0830	0.0132	0.3724	0.0830
	25	2.7753	1390.82	5.7296	0.0568	0.0130	0.2529	0.0568
	26	2.7002	1372.44	5.6622	0.0550	0.0128	0.2422	0.0550
	27	2.6250	1354.06	5.5948	0.0533	0.0126	0.2315	0.0533
	28	2.5498	1335.67	5.5273	0.0516	0.0124	0.2208	0.0516
	29	2.4746	1317.29	5.4599	0.0499	0.0123	0.2102	0.0499
	30	2.3995	1298.91	5.3925	0.0482	0.0121	0.1995	0.0482
	31	2.3420	1282.69	5.3486	0.0470	0.0120	0.1915	0.0470
	32	2.2845	1266.48	5.3046	0.0459	0.0118	0.1836	0.0459
	33	2.2270	1250.27	5.2607	0.0448	0.0117	0.1757	0.0448
	34	2.1695	1234.05	5.2168	0.0437	0.0116	0.1678	0.0437
	35	2.1120	1217.84	5.1728	0.0426	0.0114	0.1598	0.0426
	36	2.0857	1213.36	5.0993	0.0418	0.0114	0.1557	0.0418
	37	2.0594	1208.88	5.0258	0.0410	0.0113	0.1516	0.0410
	38	2.0332	1204.40	4.9523	0.0402	0.0113	0.1475	0.0402
	39	2.0069	1199.92	4.8788	0.0395	0.0112	0.1434	0.0395
	40	1.9806	1195.43	4.8052	0.0387	0.0112	0.1393	0.0387
	41	1.9688	1187.57	4.7070	0.0380	0.0111	0.1362	0.0380
	42	1.9571	1179.70	4.6088	0.0372	0.0110	0.1330	0.0372
	43	1.9453	1171.83	4.5106	0.0365	0.0109	0.1298	0.0365
	44	1.9336	1163.96	4.4123	0.0358	0.0108	0.1267	0.0358
	45	1.9218	1156.09	4.3141	0.0351	0.0108	0.1235	0.0351
	46	1.8909	1152.61	4.2857	0.0353	0.0107	0.1221	0.0353
	47	1.8600	1149.13	4.2572	0.0355	0.0107	0.1208	0.0355
	48	1.8291	1145.65	4.2288	0.0356	0.0107	0.1194	0.0356
	49	1.7982	1142.17	4.2004	0.0358	0.0106	0.1180	0.0358
	50	1.7673	1138.69	4.1719	0.0360	0.0106	0.1166	0.0360
	51	1.7408	1137.05	4.2359	0.0372	0.0106	0.1169	0.0372
	52	1.7143	1135.42	4.2998	0.0384	0.0106	0.1172	0.0384
	53	1.6878	1133.78	4.3638	0.0396	0.0105	0.1175	0.0396
	54	1.6613	1132.15	4.4277	0.0408	0.0105	0.1178	0.0408
	55	1.6348	1130.51	4.4916	0.0420	0.0105	0.1181	0.0420
	56	1.6585	1135.25	4.5276	0.0431	0.0105	0.1215	0.0431
	57	1.6822	1139.98	4.5635	0.0442	0.0105	0.1249	0.0442
	58	1.7059	1144.71	4.5994	0.0454	0.0106	0.1283	0.0454
	59	1.7296	1149.45	4.6354	0.0465	0.0106	0.1317	0.0465
	60	1.7533	1154.18	4.6713	0.0476	0.0106	0.1351	0.0476
	61	1.7947	1155.82	4.5966	0.0468	0.0105	0.1380	0.0468
	62	1.8361	1157.45	4.5218	0.0460	0.0105	0.1409	0.0460
	63	1.8775	1159.09	4.4471	0.0452	0.0105	0.1439	0.0452
	64	1.9189	1160.73	4.3724	0.0445	0.0105	0.1468	0.0445
	65	1.9602	1162.37	4.2976	0.0437	0.0104	0.1497	0.0437
	66	2.1296	1155.48	4.0816	0.0408	0.0103	0.1552	0.0408
	67	2.2989	1148.59	3.8657	0.0379	0.0102	0.1606	0.0379
	68	2.4683	1141.70	3.6497	0.0350	0.0101	0.1660	0.0350
	69	2.6376	1134.81	3.4337	0.0321	0.0100	0.1715	0.0321
	70	2.8070	1127.92	3.2177	0.0292	0.0099	0.1769	0.0292

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2036

Mode	Speed	CO	CO_2	NO_x	$PM_{2.5}$	SO_x	VOC	$PM_{2.5}$
Auto	0	0.6940	45.66	0.0331	0.0013	0.0005	0.0462	0.0013
	5	1.0344	735.07	0.0699	0.0061	0.0074	0.1171	0.0061
	6	1.0041	696.96	0.0674	0.0056	0.0070	0.1088	0.0056
	7	0.9737	658.86	0.0650	0.0052	0.0066	0.1004	0.0052
	8	0.9434	620.76	0.0626	0.0047	0.0062	0.0920	0.0047
Bus	0	5.1788	80.98	2.5880	0.0011	0.0009	0.3524	0.0011
	5	9.8072	2999.55	5.2920	0.0351	0.0239	0.3870	0.0351
	6	9.1891	2922.57	5.0911	0.0332	0.0234	0.3644	0.0332
	7	8.5709	2845.60	4.8902	0.0313	0.0228	0.3417	0.0313
	8	7.9528	2768.62	4.6894	0.0295	0.0223	0.3191	0.0295
	9	7.3346	2691.64	4.4885	0.0276	0.0218	0.2964	0.0276
	10	6.7165	2614.67	4.2876	0.0257	0.0212	0.2738	0.0257
	11	6.1348	2484.67	3.9696	0.0240	0.0201	0.2512	0.0240
	12	5.5532	2354.67	3.6516	0.0224	0.0189	0.2286	0.0224
	13	4.9715	2224.67	3.3336	0.0207	0.0178	0.2060	0.0207
	14	4.3899	2094.67	3.0156	0.0190	0.0166	0.1833	0.0190
	15	3.8082	1964.68	2.6976	0.0173	0.0154	0.1607	0.0173
	16	3.6563	1904.74	2.5064	0.0172	0.0145	0.1489	0.0172
	17	3.5044	1844.81	2.3152	0.0171	0.0135	0.1370	0.0171
	18	3.3525	1784.88	2.1240	0.0170	0.0126	0.1251	0.0170
	19	3.2006	1724.95	1.9328	0.0168	0.0116	0.1133	0.0168
	20	3.0487	1665.02	1.7416	0.0167	0.0107	0.1014	0.0167
	21	2.5385	1582.49	1.6010	0.0142	0.0109	0.0929	0.0142
	22	2.0284	1499.96	1.4603	0.0116	0.0111	0.0843	0.0116
	23	1.5183	1417.43	1.3197	0.0091	0.0114	0.0758	0.0091
	24	1.0082	1334.89	1.1791	0.0065	0.0116	0.0673	0.0065
	25	0.4981	1252.36	1.0384	0.0039	0.0118	0.0587	0.0039
	26	0.4776	1237.58	0.9754	0.0038	0.0117	0.0559	0.0038
	27	0.4571	1222.81	0.9124	0.0037	0.0115	0.0531	0.0037
	28	0.4366	1208.03	0.8493	0.0036	0.0114	0.0503	0.0036
	29	0.4162	1193.25	0.7863	0.0035	0.0113	0.0474	0.0035
	30	0.3957	1178.47	0.7233	0.0034	0.0111	0.0446	0.0034
	31	0.3799	1165.30	0.6873	0.0034	0.0110	0.0424	0.0034
	32	0.3642	1152.13	0.6513	0.0033	0.0109	0.0401	0.0033
	33	0.3485	1138.97	0.6154	0.0032	0.0108	0.0379	0.0032
	34	0.3327	1125.80	0.5794	0.0032	0.0106	0.0356	0.0032
	35	0.3170	1112.63	0.5435	0.0031	0.0105	0.0334	0.0031
	36	0.3098	1109.21	0.5225	0.0031	0.0105	0.0319	0.0031
	37	0.3026	1105.78	0.5015	0.0030	0.0104	0.0305	0.0030
	38	0.2955	1102.35	0.4805	0.0030	0.0104	0.0290	0.0030
	39	0.2883	1098.92	0.4595	0.0029	0.0104	0.0276	0.0029
	40	0.2811	1095.50	0.4385	0.0029	0.0103	0.0262	0.0029
	41	0.2757	1088.64	0.4217	0.0028	0.0103	0.0249	0.0028
	42	0.2702	1081.79	0.4050	0.0028	0.0102	0.0237	0.0028
	43	0.2648	1074.94	0.3882	0.0027	0.0101	0.0224	0.0027
	44	0.2593	1068.09	0.3715	0.0027	0.0100	0.0212	0.0027
	45	0.2539	1061.24	0.3548	0.0026	0.0100	0.0199	0.0026
	46	0.2474	1059.07	0.3451	0.0026	0.0100	0.0193	0.0026
	47	0.2410	1056.90	0.3354	0.0026	0.0099	0.0187	0.0026
	48	0.2346	1054.73	0.3257	0.0026	0.0099	0.0181	0.0026
	49	0.2281	1052.56	0.3160	0.0025	0.0099	0.0175	0.0025
	50	0.2217	1050.39	0.3063	0.0025	0.0099	0.0169	0.0025
	51	0.2164	1048.76	0.3035	0.0026	0.0098	0.0165	0.0026
	52	0.2111	1047.14	0.3006	0.0026	0.0098	0.0161	0.0026
	53	0.2059	1045.51	0.2977	0.0026	0.0098	0.0157	0.0026
	54	0.2006	1043.88	0.2948	0.0027	0.0098	0.0152	0.0027
	55	0.1954	1042.25	0.2919	0.0027	0.0098	0.0148	0.0027
	56	0.1959	1045.09	0.2934	0.0028	0.0098	0.0148	0.0028
	57	0.1963	1047.93	0.2949	0.0028	0.0098	0.0149	0.0028
	58	0.1968	1050.76	0.2965	0.0029	0.0098	0.0149	0.0029
	59	0.1973	1053.60	0.2980	0.0029	0.0098	0.0149	0.0029
	60	0.1978	1056.44	0.2995	0.0030	0.0098	0.0149	0.0030
	61	0.2010	1057.33	0.2952	0.0029	0.0098	0.0151	0.0029
	62	0.2041	1058.23	0.2909	0.0029	0.0098	0.0153	0.0029
	63	0.2073	1059.13	0.2867	0.0029	0.0098	0.0154	0.0029
	64	0.2105	1060.03	0.2824	0.0028	0.0098	0.0156	0.0028
	65	0.2137	1060.93	0.2781	0.0028	0.0098	0.0158	0.0028
	66	0.2299	1055.18	0.2781	0.0027	0.0096	0.0162	0.0027
	67	0.2461	1049.43	0.2780	0.0027	0.0095	0.0166	0.0027
	68	0.2623	1043.68	0.2780	0.0026	0.0094	0.0170	0.0026
	69	0.2785	1037.93	0.2780	0.0026	0.0093	0.0174	0.0026
	70	0.2947	1032.18	0.2779	0.0025	0.0092	0.0178	0.0025

Source: California Air Resources Board, EMFAC 2014

Notes: 1) Zero mph corresponds to starts, 2) Other emissions factors include idling emissions and exclude diurnal and evaporative emissions, 3) Five mph is best estimate for idling

HEALTH COST OF TRANSPORTATION EMISSIONS

($/ton)

Area	Proj Loc	CO	CO_2e	NO_x	PM_{10}	SO_x	VOC
LA/South Coast	1	$0	$47	$14,400	$673,900	$37,500	$0
CA Urban Area	2	$0	$47	$14,400	$673,900	$37,500	$0
CA Rural Area	3	$0	$47	$14,400	$673,900	$37,500	$0

CO_2e Uprater 1.7% increase in value per year

Sources: McCubbin and Delucchi, 1996 for emissions other than CO2e
Interagency Working Group on Social Cost of Carbon, United States Government, 2016 for CO2e

PASSENGER TRAIN EMISSIONS FACTORS

(g/train-mile)

Mode	Year	CO	CO_2	NO_x	PM_{10}	SO_x	VOC	$PM_{2.5}$
Passenger Train	2002	45.67		583.58	62.02		19.73	
	2022	45.67		250.11	31.01		19.73	

LIGHT RAIL EMISSIONS FACTORS

(g/veh-mile)

Mode	Year	CO	CO_2	NO_x	PM_{10}	SO_x	VOC	$PM_{2.5}$
Light Rail	2002	0.14		1.13	0.17		0.06	
	2022	0.14		1.14	0.17		0.06	

FREIGHT LOCOMOTIVE EMISSIONS FACTORS

(g/gal)

Mode	Year	CO	CO_2	NO_x	PM_{10}	SO_x	VOC	$PM_{2.5}$
Freight Rail	2030		10,206	28.10	0.43			
	2030		10,206	28.10	0.43			

Freight Rail Fuel Efficiency 468 ton-miles/gal
Fuel Burned at Idle 4 gal/hr

Sources: California Air Resources Board
Association of American Railroads, The Environmental Benefits of Moving Freight by Rail, June 2017
California Environmental Protection Agency / Air Resources Board, Technology Assessment: Freight Locomotives, November 2016

Pavement Adjustments (used only for pavement projects)

PAVEMENT DETERIORATION

(IRI in inches/mile)

	Year 20, By Loading		
Year 0	Light	Medium	Heavy
0	125	150	350
25	150	200	500
50	175	250	675
75	200	300	750
100	275	400	750
125	325	475	750
150	400	575	750
175	500	700	750
200	575	750	750
225	650	750	750
250	750	750	750
275	750	750	750
300	750	750	750
325	750	750	750
350	750	750	750
375	750	750	750
400	750	750	750
425	750	750	750
450	750	750	750

Source: Paterson, 1987

VEHICLE OPERATING SPEED

(percent adjustment)

IRI	Auto	Truck
0	1.000	1.025
25	1.000	1.025
50	1.000	1.025
75	1.000	1.025
100	1.000	1.025
125	1.000	1.025
150	1.000	1.013
175	1.000	1.000
200	1.000	0.980
225	1.000	0.949
250	1.000	0.919
275	0.991	0.890
300	0.981	0.862
325	0.971	0.834
350	0.961	0.808
375	0.952	0.782
400	0.942	0.758
425	0.932	0.734
450	0.923	0.709

Source: Botterill, 1996 and 1997

FUEL CONSUMPTION

(percent adjustment)

IRI	Auto	Truck
0	0.971	0.961
25	0.977	0.965
50	0.980	0.970
75	0.982	0.975
100	0.985	0.980
125	0.990	0.986
150	0.995	0.993
175	1.000	1.000
200	1.005	1.007
225	1.012	1.017
250	1.019	1.026
275	1.027	1.036
300	1.034	1.047
325	1.041	1.058
350	1.050	1.070
375	1.061	1.085
400	1.072	1.100
425	1.082	1.114
450	1.093	1.129

Source: Texas Transportation Institute, 1994

NON-FUEL COSTS

(percent adjustment)

IRI	Auto	Truck
0	1.000	1.000
25	1.000	1.000
50	1.000	1.000
75	1.000	1.000
100	1.000	1.000
125	1.000	1.000
150	1.017	1.018
175	1.034	1.038
200	1.052	1.058
225	1.070	1.078
250	1.088	1.097
275	1.105	1.117
300	1.123	1.137
325	1.141	1.156
350	1.159	1.176
375	1.176	1.196
400	1.194	1.216
425	1.212	1.235
450	1.230	1.255

Source: ARRB Research Board TR VOC Model

Weaving Adjustments (used only for freeway connector, HOV connector, and HOV drop ramp projects)

VEHICLE OPERATING SPEED
(percent adjustment)

Percent Weaving	Freeway Conn	HOV Project
0.000	1.000	1.000
0.002	0.982	0.988
0.004	0.964	0.976
0.006	0.945	0.964
0.008	0.927	0.952
0.010	0.909	0.939
0.012	0.891	0.927
0.014	0.873	0.915
0.016	0.855	0.903
0.018	0.836	0.891
0.020	0.789	0.879
0.022	0.747	0.867
0.024	0.706	0.855
0.026	0.664	0.842
0.028	0.623	0.817
0.030	0.581	0.789
0.032	0.540	0.761
0.034	0.498	0.734
0.036	0.476	0.706
0.038	0.473	0.678
0.040	0.471	0.650
0.042	0.468	0.623
0.044	0.466	0.595
0.046	0.463	0.567
0.048	0.460	0.540
0.050	0.458	0.512
0.052	0.455	0.484
0.054	0.453	0.476
0.056	0.453	0.474
0.058	0.453	0.473
0.060	0.453	0.471
0.062	0.453	0.469
0.064	0.453	0.467
0.066	0.453	0.466
0.068	0.453	0.464
0.070	0.453	0.462
0.072	0.453	0.460
0.074	0.453	0.459
0.076	0.453	0.457
0.078	0.453	0.455
0.080	0.453	0.453

Source: Fitzpatrick, Brewer, and Venglar, 2003

TMS Adjustments (used only for ramp metering, ramp metering signal coordination, incident management, traveler information projects, AVL, transit priority, and BRT projects)

PEAK PERIOD SPEED, VOLUME, AND NON-HIGHWAY BENEFITS
(percent adjustment)

TMS	Without		With		Non-Highway Benefits			Total
Strategy	Speed	Volume	Speed	Volume	TT	VOC	Em	Benefit
AMoth	1.02	0.95	1.02	0.95	-5.05	12.81	1.37	0.74
AMsev	1.53	0.94	1.53	0.94	1.21	1.38	-0.37	1.00
IMoth	0.88	1.18	0.98	0.96	0.51	0.15	0.06	0.74
IMsev	1.01	0.97	1.01	0.95	0.30	0.31	0.30	1.00
NoAdj	1.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00
ORoth	0.98	1.03	1.00	1.00	-0.07	-0.03	-0.07	
ORsev	0.95	1.03	1.00	1.00	0.00	0.00	5.67	
RMoth	1.00	1.00	1.03	0.97	-0.07	-0.03	-0.07	1.00
RMsev	1.00	1.00	1.05	0.97	0.00	0.00	5.67	1.00
TIoth	1.00	1.00	1.02	0.97	-0.11	-0.12	-0.35	1.00
TIsev	1.00	1.00	1.01	0.97	-0.39	-0.39	-0.35	1.00

Source: California Department of Transportation TMS Master Plan, 2003
29) Chaudhary and Messer, 2000

TRANSIT TRAVEL TIME AND AGENCY COST SAVINGS
(percent savings)

TMS Strategy	Travel Time	Agency Costs	
		Capital	O&M
Transit Vehicle Location (AVL)	15%	2%	8%
Transit Vehicle Signal Priority	10%	-	-
Bus Rapid Transit (BRT)	29%	-	-

Sources: FHWA ITS Deployment Analysis System (IDAS), California PATH