



# Cal-B/C Training Module 8b

## Cal-B/C Corridor

### Understanding Project Input Sheets and Data

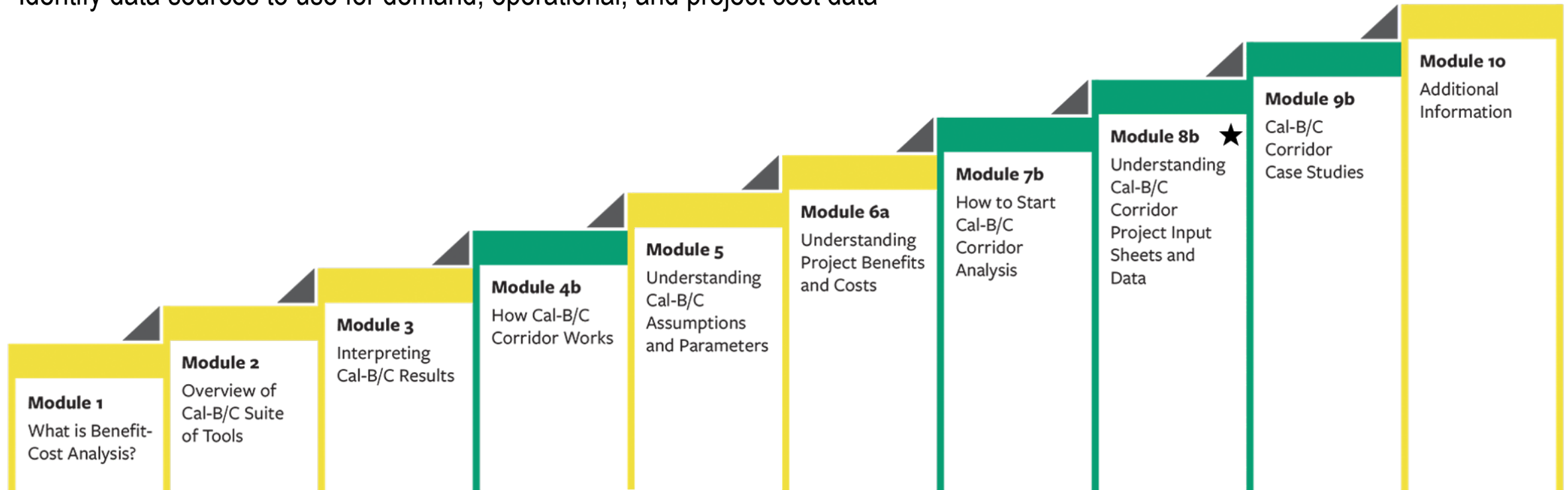


01

## **About This Module**

## This module will...

- Build on Modules 4b and 7b to provide more details on how to get data for your benefit-cost analysis (BCA) using Cal-B/C Corridor
- Identify data sources to use for demand, operational, and project cost data



★ *This module is covered in this presentation*

## Previous Modules...

- **Module 1** provided a basic introduction on benefit-cost analysis (BCA) and a general overview of how to conduct a BCA
- **Module 2** described the Cal-B/C suite of tools, discussed the types of projects that can be evaluated, and provided guidance on which tools to use for various project types
- **Module 3** presented the Cal-B/C results page, detailed what each output measure means, and explained how they are calculated
- **Module 4b** presented an overview of how Cal-B/C Corridor works including a review of all worksheets and inputs
  - This current module complements Module 4b
- **Module 5** highlighted the information in the Parameters worksheet and discussed key assumptions used by Cal-B/C
- **Module 6a** provided detailed information on how Cal-B/C calculates benefits
- **Module 7b** presented the 1-2-3 approach to starting a Cal-B/C Corridor analysis
  - This current module complements Module 7b

# Requirements for Making Full Use of This Module

- Basic understanding of traffic engineering and transportation planning methodologies, data and terminology
- Basic understanding of micro- or macro-simulation outputs, Highway Capacity Manual (HCM) tool outputs
- Ability to navigate websites and download relevant data
- Knowledge of Microsoft Excel and data analysis features

```

SR55AM_VMTAnalysis - Notepad
File Edit Format View Help
Scenario,Hour/TimePeriod,VehicleType,Dir,BottleneckArea,FacilityType,TravelTime(min),Speed
(mph),TotalDelay(veh-hrs),Volume,VHT(Hrs),VMT(Miles),Q-ratio,AvGOcc,PercentTrucks,Speed Bin
AM_Base,6,SOV,NB,1,Freeway,3.2,66.23,3.56,3248.67,140.41,9337.2,66.5,1,0%,65
AM_Base,6,HOV,NB,1,Freeway,3.32,63.9,0.19,307.33,14.58,939.14,64.39,2.38,0%,65
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```

## Model Data

Speed Bin	VehicleType	FacilityType	Sum of VMT(Miles)	Sum of VHT(Hrs)	Average of PercentTrucks	Model Group	Speed Bin	Vehicle Type	Facility Type	VMT	VHT	Speed	AVO	Percent Trucks
10	SOV	OnRamp	1461.06	105.83	0%	10mph_SOV_OnRamp	10	SOV	OnRamp	1,461.06	105.83	13.81	1.09	0%
10	Truck	OnRamp	24.3	1.74	100%	10mph_Truck_OnRamp	10	Truck	OnRamp	24.30	1.74	13.97	1.09	100%
15	HOV	OffRamp	72.7	4.81	0%	15mph_HOV_OffRamp	15	HOV	OffRamp	72.70	4.81	15.11	2.10	0%
15	HOV	OnRamp	350.76	23.64	0%	15mph_HOV_OnRamp	15	HOV	OnRamp	350.76	23.64	14.84	2.10	0%
15	SOV	Freeway	40067.67	2468.68	0%	15mph_SOV_Freeway	15	SOV	Freeway	40,067.67	2,468.68	16.23	1.09	0%
15	SOV	OffRamp	41.77	41.77	0%	15mph_SOV_OffRamp	15	SOV	OffRamp	41.77	41.77	1.09	1.09	0%
15	SOV	OnRamp	1708.25	117.08	0%	15mph_SOV_OnRamp	15	SOV	OnRamp	1,708.25	117.08	14.59	1.09	0%
15	Truck	Freeway	1042.49	71.43	100%	15mph_Truck_Freeway	15	Truck	Freeway	1,042.49	71.43	14.59	1.09	100%
15	Truck	OffRamp	10.27	0.65	100%	15mph_Truck_OffRamp	15	Truck	OffRamp	10.27	0.65	15.80	1.09	100%
15	Truck	OnRamp	102.04	6.23	100%	15mph_Truck_OnRamp	15	Truck	OnRamp	102.04	6.23	16.38	1.09	100%
20	HOV	OnRamp	1296.42	73.97	0%	20mph_HOV_OnRamp	20	HOV	OnRamp	1,296.42	73.97	17.53	2.10	0%
20	SOV	Freeway	67370.22	3527.48	0%	20mph_SOV_Freeway	20	SOV	Freeway	67,370.22	3,527.48	19.10	1.09	0%
20	SOV	OnRamp	11384.49	658.18	0%	20mph_SOV_OnRamp	20	SOV	OnRamp	11,384.49	658.18	17.30	1.09	0%
20	Truck	Freeway	679.09	36.54	100%	20mph_Truck_Freeway	20	Truck	Freeway	679.09	36.54	18.58	1.09	100%
20	Truck	OnRamp	137.67	7.86	100%	20mph_Truck_OnRamp	20	Truck	OnRamp	137.67	7.86	17.52	1.09	100%
25	HOV	OffRamp	80.95	3.46	0%	25mph_HOV_OffRamp	25	HOV	OffRamp	80.95	3.46	23.40	2.10	0%
25	HOV	OnRamp	1282.75	58.12	0%	25mph_HOV_OnRamp	25	HOV	OnRamp	1,282.75	58.12	22.07	2.10	0%
25	SOV	Freeway	26423.4	1152.47	0%	25mph_SOV_Freeway	25	SOV	Freeway	26,423.40	1,152.47	22.93	1.09	0%
25	SOV	OffRamp	1834.51	78.82	0%	25mph_SOV_OffRamp	25	SOV	OffRamp	1,834.51	78.82	23.27	1.09	0%
25	SOV	OnRamp	11092.11	494.89	0%	25mph_SOV_OnRamp	25	SOV	OnRamp	11,092.11	494.89	22.41	1.09	0%
25	Truck	Freeway	1933.33	90.99	100%	25mph_Truck_Freeway	25	Truck	Freeway	1,933.33	90.99	21.25	1.09	100%
25	Truck	OffRamp	26.15	1.17	100%	25mph_Truck_OffRamp	25	Truck	OffRamp	26.15	1.17	22.35	1.09	100%
25	Truck	OnRamp	180.27	8.06	100%	25mph_Truck_OnRamp	25	Truck	OnRamp	180.27	8.06	22.37	1.09	100%

Post Processed Data

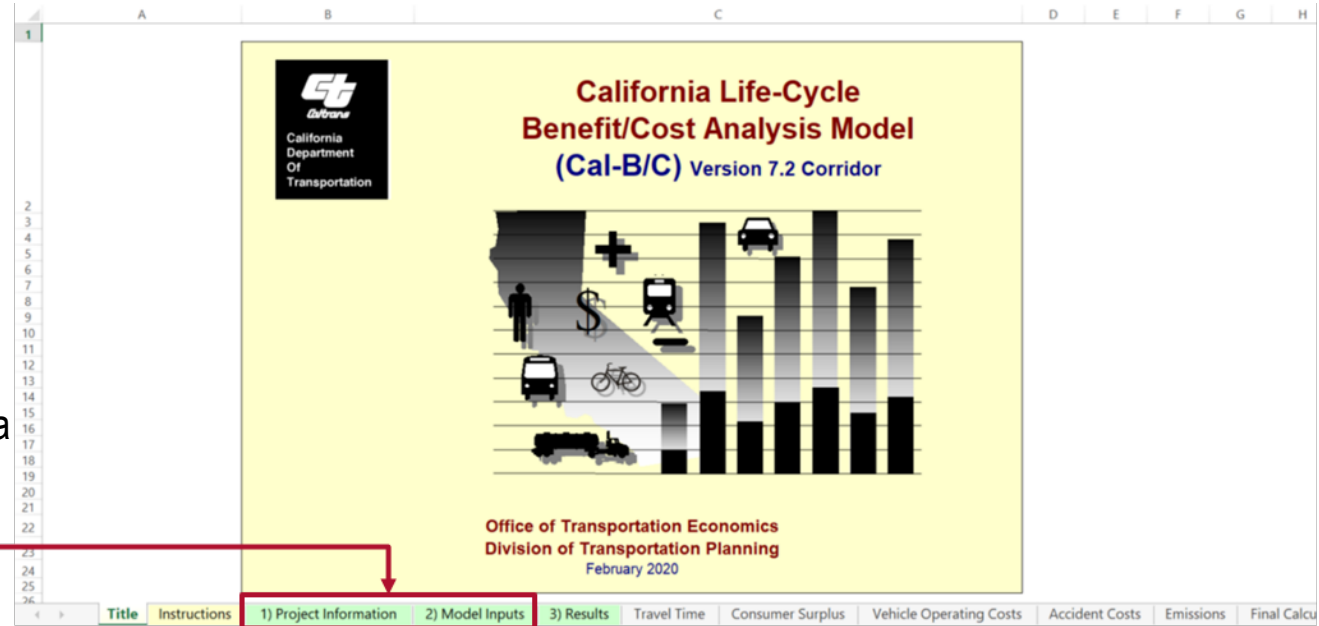
Formatted Data for Cal-B/C

02

## **Cal-B/C Corridor Data Entry Worksheets Overview**

# Cal-B/C Data Entry Worksheets

- For most analyses, two worksheets will be need for data entry
- Not all data entry needs will be covered such as:
  - Project specific information: project location, design and geometric data
  - How to extract travel demand/microsimulation model data




Worksheets where data will be entered


Worksheets where Cal-B/C performs calculations and tabulates results

Title	Instructions	1) Project Information	2) Model Inputs	3) Results	Travel Time	Consumer Surplus	Vehicle Operating Costs	Accident Costs	Emissions	Final Calculations	PARAMETERS
	Instructions	1) Project Information	2) Model Inputs	3) Results	Travel Time	Consumer Surplus	Vehicle Operating Costs	Accident Costs	Emissions	Final Calculations	Parameters
	Summary instructions on how to fill out each data item in Cal-B/C	<ul style="list-style-type: none"> <li>▪ Project Description/ Type of Project</li> <li>▪ Model Structure</li> <li>▪ Project Costs</li> </ul>	<ul style="list-style-type: none"> <li>▪ Model Data                             <ul style="list-style-type: none"> <li>○ VMT</li> <li>○ VHT</li> <li>○ # of Transit Trips</li> <li>○ AVO</li> <li>○ Percent Trucks</li> </ul> </li> <li>▪ Safety                             <ul style="list-style-type: none"> <li>○ Collision Rate</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ BCA results</li> <li>▪ Itemized Benefits (\$)</li> <li>▪ Emission Savings (Tons)</li> </ul>	Calculates total travel time benefits on highway and transit	Calculates consumer benefits associated with induced demand	Calculates highway No Build and Build fuel and non-fuel costs	Calculates No Build and Build collision costs	Calculates No Build and Build running and starting emissions and costs	Tabulates final results, including: <ul style="list-style-type: none"> <li>▪ Net present value</li> <li>▪ Internal rate of return</li> </ul>	Key default analysis parameters and assumptions for all Cal-B/C tools

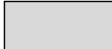
## Review: Cell Color-Coding

- Cal-B/C Corridor requires few user inputs, but allows you to enter more inputs when data is available
- Cells in the worksheets are color-coded:
  - **Green** cells indicate required data
    - You must input values for Cal-B/C to work for the type of analysis being performed
    - Cal-B/C descriptions tell you what cells need to be used for a given analysis
  - **Red** cells provide default values that you can change if needed
    - Default base year (2020) and forecast year (2040) can be overridden
  - **Blue** cells contain values calculated by the model
    - You can override the values in these cells if better data is available
  - **Gray** cells indicate not to enter any data
    - Based on mode of model group

 - User must enter data for Cal-B/C to work correctly.

 - Cal-B/C provides default values that can be overridden by the user if better data is available.

 - Cal-B/C calculates cell value, but user can override result if better data is available.

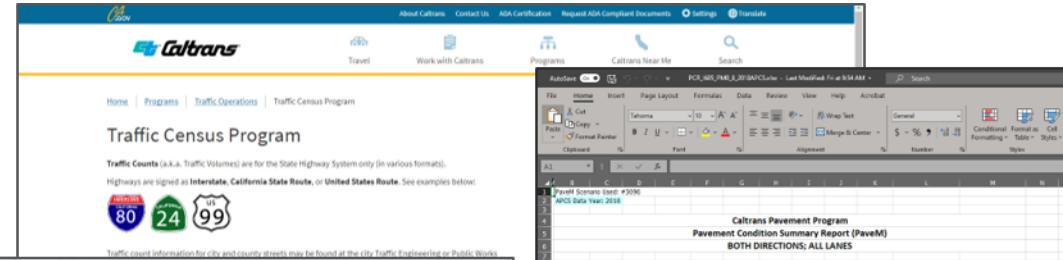
 - User must not enter any information



# Suggested Data Sources for Evaluations in Cal-B/C Corridor

## Model Data

- Travel Demand Model (TDM)/Microsimulation Model/HCM Tool Outputs
- Caltrans Division of Traffic Operations, Traffic Census Program Traffic Volumes
- Federal Transit Administration (FTA) National Transit Database
- Caltrans Managed Lane Annual Report
- American Community Survey



The screenshot shows a spreadsheet with a large red watermark that reads 'Model Data'. The spreadsheet has columns labeled A through O. The rows contain traffic data for various scenarios and time periods. The columns include Scenario, Hour/TimePeriod, VehicleType, Dir, Bottleneck/Area, FacilityType, TravelTime(min), Speed(mph), TotalDelay(Veh-hrs), Volume, VHT(Hrs), VMT(Miles), Q-ratio, AvgOcc, and PercentTrucks. The data is organized into a table with multiple rows and columns.

## Traffic Collision and Safety Data

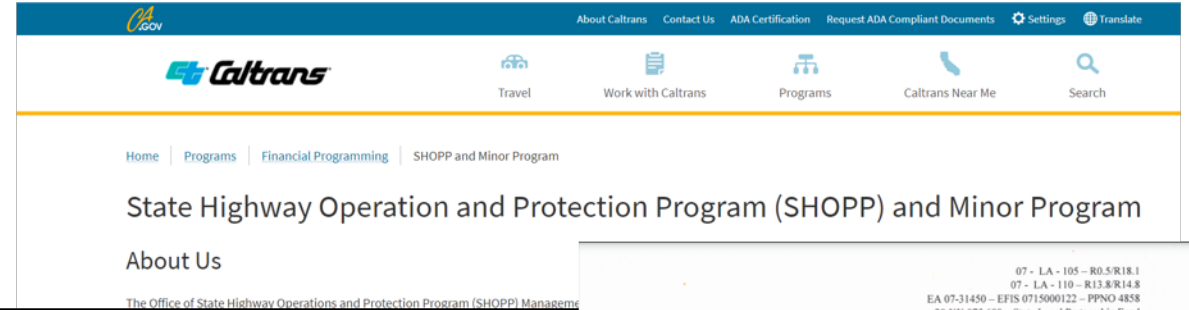
- Caltrans Traffic Accident Surveillance and Analysis System (TASAS)
- California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS)
- Other Sources (e.g., Transportation Research Board publications)

The screenshot shows the California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS) website. It features a navigation bar with 'Home', 'About', 'Services', and 'Contact Us'. The main content area is titled 'WELCOME TO THE CALIFORNIA HIGHWAY PATROL' and includes a sub-heading 'Statewide Integrated Traffic Records System'. There is a 'SWITRS Login' section with a 'User Name' field and a 'Password' field. Below the login section, there is a 'California Highway Patrol' logo and a 'SWITRS Login' button. The page also includes a 'Terms of Use' section and a 'Privacy Policy' section.

# Suggested Data Sources for Evaluations in Cal-B/C Corridor (cont.)

## Project Costing Data

- Project Study Report (PSR) or other documents
- Project Report (PR)
- Regional Transportation Improvement Program (RTIP)
- State Highway Operations and Protection Program (SHOPP)
- Caltrans Project Cost Website
- Federal Transit Administration (FTA) Capital cost database



The screenshot displays the FTA 'Cost Breakdown by Project' report. The project details are as follows:

- Project Name: Denver - Southwest Corridor
- City/State: Denver, CO
- Mode: Light Rail Transit
- Predominant Relationship to Grade: At Grade
- Year of Revenue Operation: 2090

The report includes a table with the following columns: Cost Category, Unit of Measure, Units, Unit Cost, Total Cost at Mid-Point of Construction (\$2000), Total National Average, User Selected Base Year (\$2000) 2015, and Percent of Total Cost. The total project cost is \$177,580,001.

Cost Category	Unit of Measure	Units	Unit Cost	Total Cost at Mid-Point of Construction (\$2000)	Total National Average, User Selected Base Year (\$2000) 2015	Percent of Total Cost
10 Guideway & Track Elements	LF Guideway	44687	\$2,109	\$83,360	\$94,234	23%
20 Stations, Stops, Terminals, Informa Data	Stations	5	\$8,895,598	\$19,900	\$44,428	11%
30 Support Facilities: Yards, Shops, Admin, Signs	Vehicles	18	\$51,343	\$490	\$335	6%
40 Street & Special Conditions	LF Guideway	44687	\$73	\$1,600	\$3,274	1%
50 Systems	Track-Foot	32544	\$293	\$11,600	\$27,124	7%
60 Rwy. Land, Existing Improvements	LF Guideway	44687	\$2,020	\$18,600	\$90,269	22%
70 Vehicles	Vehicles	18	\$4,247,936	\$32,700	\$76,463	18%
<b>Total Hard Costs</b>	<b>LF Guideway</b>	<b>44687</b>	<b>\$2,535</b>	<b>\$144,600</b>	<b>\$326,717</b>	<b>81%</b>

07 - LA - 105 - R0.5/R18.1  
07 - LA - 110 - R13.8/R14.8  
EA 07-31450 - EFIS 0715000122 - PPN0 4858  
20.XX.075.600 - State Local Partnership Fund  
April 2020

**Draft Project Report**

To

**Authorize Public Release of the Draft Environmental Document**

On Route: Interstate I-105  
Between: Imperial Highway and Sepulveda Boulevard Intersection  
West of I-405 in the City of Los Angeles (07-LA-105 - R0.5)  
And: Studebaker Road, East of I-605 in the City of Norwalk (07-LA - 105 - R18.1)

And

On Route: I-110  
Between: I-105 Separation in the City of Los Angeles (07-LA-110 - R13.8)  
And: 102<sup>nd</sup> Street in the City of Los Angeles (07-LA-110 - R14.8)

I have reviewed the right-of-way information contained in this report and the Right-of-Way Data Sheet attached hereto, completed by Los Angeles County Metropolitan Transportation Authority (Metro) and Consultants WSP and Epic Land Solutions, Inc., and find the data to be complete to form and procedures. No inference or assertions are made as to the validity of the data or the values implied by the Right-of-Way Data Sheet.

APPROVAL RECOMMENDED:

APPROVAL RECOMMENDED:

PROJECT APPROVED:

John Bulinski, DISTRICT DIRECTOR  
Caltrans District 7

DATE

# Cal-B/C Data Entry – Project Information Worksheet

- Not all cells require data entry
- Cal-B/C Corridor data item headers indicate if data is required
- Use “Create Model” button
- Once you create the model (see modules 4 & 7), you can now do data entry
- Number of model groups represents the number of travel demand/ microsimulation model output records to be input
- Model groups can be refined to represent various roadway/mode types (e.g., arterials, freeway general purpose/HOV lanes) and speed categories (e.g., speed bins, hourly, or peak period speeds)

The screenshot displays the 'Project Information Worksheet' spreadsheet. It is divided into three main sections: IA (Project Data), IB (Model Structure), and IC (Project Costs).

**Section IA: PROJECT DATA**

- District:** [Empty field]
- PROJECT:** [Empty field]
- EA:** [Empty field]
- PPND:** [Empty field]
- Type of Project:** [Dropdown menu]
- Project Location:** (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural) [Input: 1]
- Project Timing:**
  - Current Year: [Input: 2019]
  - Year Construction Begins: [Input: 2019]
  - Year Project Opens: [Input: 2020]

**Section IB: MODEL STRUCTURE**

*Values to This Model*

Number of Model Groups	10	1-500	1
Number of Safety Groups	10	1-500	1
Years	20	2-50	50

Press button below to create model after selecting the number of segments and years to include.

**Create Model** button

**Section IC: PROJECT COSTS (enter costs in thousands of dollars)**

*Enter all project costs (in today's dollars) in columns 1 to 7. Costs during construction should be entered in the first eight rows. Project costs (including maintenance and operating costs) should be net of costs without project.*

Year	DIRECT PROJECT COSTS							Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	Project Support	R / W	Construction	Maint./ Op.	Rehab.	Mitigation	Constant Dollars		Present Value	
<b>Construction Period</b>										
2019				Enter Construction Cost				\$0	\$0	
2020								0	0	
2021								0	0	
2022								0	0	
2023								0	0	
2024								0	0	
2025								0	0	
2026								0	0	
<b>Project Open</b>										
2029								\$0	\$0	
2021								0	0	
2022								0	0	
2023								0	0	
2024								0	0	
2025								0	0	
2026								0	0	
2027								0	0	
2028								0	0	
2029								0	0	
2030								0	0	
2031								0	0	
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2047								0	0	
2048								0	0	
2049								0	0	
2050								0	0	
2051								0	0	
2052								0	0	
2053								0	0	
2054								0	0	
2055								0	0	
2056								0	0	

Navigation tabs at the bottom: Title, Instructions, 1) Project Information, 2) Model Inputs, 3) Results, Travel Time, Consumer Surplus, Vehicle Operating Costs, Accident Costs, Emissions, Final Calculations, PARAMETERS.

# Cal-B/C Data Entry- Model Inputs Worksheet

- Required data:
  - Vehicle Miles Traveled (VMT) - refined by mode/facility/speed bin/time of day
  - Vehicle Hours Traveled (VHT) - using same model groups as for VMT
  - Average Vehicle Occupancy (AVO) - can come from model or from other source
  - Percent Trucks – can come from model or other source
  - Number of trips – if a transit model group

2A DEFINITIONS OF MODEL GROUPS AND YEARS

Model Group 1	Select Mode	Name	Description	Avg. Vehicle Occupancy (AVO)	Percent Trucks
Base Year	2020				
Forecast Year	2040				

2B AVERAGE PROFILE FOR DIVERTED TRIPS/INDUCED TRIPS

*Typical 'No Build' conditions for persons 'on the margin' who will divert from highway to transit in Build Scenario, or for induced trips. This profile should reflect a lower cost alternative than the average traffic profile entered in Table 2C and 2D.*

No Build	For Trips Diverting from Highway to Transit				Least Cost Alternative (for Induced Trips)			
	Average Speed in Year 2020 (mph)	Average Trip Length in Year 2020 (miles)	Average Speed in Year 2040 (mph)	Average Trip Length in Year 2040 (miles)	Average Speed in Year 2020 (mph)	Average Trip Length in Year 2020 (miles)	Average Speed in Year 2040 (mph)	Average Trip Length in Year 2040 (miles)
Model Group 1								

2C MODEL DATA - YEAR 2020

REQUIRED FOR TRANSIT		Vehicle Miles Traveled (VMT) *	Vehicle Hours Traveled (VHT)	Passenger Miles Traveled (PMT)	Passenger Hours Traveled (PHT)	Out-of-Pocket Cost (\$ per trip)	Speed	Average Vehicle Occupancy (AVO)	Percent Trucks
<b>No Build</b>									
1 Not Used		0	0	0	0		55.0	0.00	0.0%
<b>TOTAL</b>									
<b>Build</b>									
1 Not Used		0	0	0	0		55.0	0.00	0.0%
<b>TOTAL</b>									

2D MODEL DATA - YEAR 2040

REQUIRED FOR TRANSIT		Vehicle Miles Traveled (VMT) *	Vehicle Hours Traveled (VHT)	Passenger Miles Traveled (PMT)	Passenger Hours Traveled (PHT)	Out-of-Pocket Cost (\$ per trip)	Speed	Average Vehicle Occupancy (AVO)	Percent Trucks
<b>No Build</b>									
1 Not Used		0	0	0	0		55.0	0.00	0.0%
<b>TOTAL</b>									
<b>Build</b>									
1 Not Used		0	0	0	0		55.0	0.00	0.0%
<b>TOTAL</b>									

## Module 8b: Cal-B/C Corridor Data Input Overview

- Fatal, Injury, Property Damage Only (PDO)

2E

### DEFINITIONS OF SAFETY GROUPS AND YEARS

Select Mode	Name	Description	Fatal Reduction Factor	Injury Reduction Factor	PDO Reduction Factor
Safety Group 1	Highway				

Safety Base Year	2020
Safety Forecast Year	2040

2F

### SAFETY DATA - YEAR 2020

	Vehicle Miles Traveled (VMT)	Fatal Accident Rate Per MYM	Injury Accident Rate Per MYM	PDO Accident Rate Per MYM	Number of Fatal Accidents	Number of Injury Accidents	Number of PDO Accidents
<b>No Build</b>							
1 Not Used					0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in model groups equals total VMT in safety groups							
<b>Build</b>							
1 Not Used		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in model groups equals total VMT in safety groups							

2G

### SAFETY DATA - YEAR 2040

	Vehicle Miles Traveled (VMT)	Fatal Accident Rate Per MYM	Injury Accident Rate Per MYM	PDO Accident Rate Per MYM	Number of Fatal Accidents	Number of Injury Accidents	Number of PDO Accidents
<b>No Build</b>							
1 Not Used		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in traffic inputs equals total VMT in safety inputs							
<b>Build</b>							
1 Not Used		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	0				0.0000	0.0000	0.0000
Total VMT in traffic inputs equals total VMT in safety inputs							

## Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item

Section Title	Data Input Item		To Find, Look at Cell	Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)
1A) Project Data	Project Location		C12	Depends on proposed project
	Project Timing	Current Year	D16	Project Initiation Document (PID)/Project Study Report (PSR)/Project Report (PR) or other source
		Year Construction Begins	D18	
		Year Project Opens	D20	
1B) Model Structure	Number of Model Groups		M11	User-defined depending on proposed project. For example, could be based on roadway class (freeway, arterial), time of day (hourly, model period), speed bins (helps to better estimated emission benefits)
	Number of Safety Groups		M12	
	Years		M13	
1C) Program Costs	Direct Project Costs	Initial Project Costs (Support, R/W, Const.)	W12:Y13	Project Initiation Document (PID)/Project Study Report (PSR)/Project Report (PR) or other source
		Subsequent Costs (O&M, Rehab)	Z12:AA13	
	Mitigation		AB13	
	Transit Agency Cost Savings		AC10	

## Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item (cont.)

Section Title	Data Input Item		To Find, Look at Cell	Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)
2A) Definitions of Model Groups and Years	Select Mode		F10	User-defined, but needs to be data from Regional Travel Demand Model (specific output modes and formats requested from modelers)
	Name		G10	
	Description		I10	
	Avg. Vehicle Occupancy (AVO)		M10	
	Percent Trucks		N10	Regional Travel Demand Model, Caltrans Traffic Census, Field Data Collection
2B) Average Profile for Diverted Trips/Induced Trips	For Trips	Average Speed in Year [Base Year]	V10	Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor)
	Diverting from Highway to Transit	Average Trip Length in Year [Base Year]	W10	
		Average Speed in Year [Forecast Year]	X10	
	Least Cost Alternative (for Induced Trips)	Average Trip Length in Year [Forecast Year]	Y10	
		Average Speed in Year [Base Year]	AA10	
		Average Trip Length in Year [Base Year]	AB10	
		Average Speed in Year [Forecast Year]	AC10	
	Average Trip Length in Year [Forecast Year]	AD10		

## Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item (cont.)

Section Title	Data Input Item	To Find, Look at Cell	Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)
2C & 2D) Model Data	Number of Trips	F24 (Base Year), V24 (Future Year)	Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor); Project Initiation Document (PID)/Project Study Report (PSR)/Project Report (PR) or other source may also have transit trips
	Vehicle Miles Traveled (VMT)	G23 (Base Year), W23 (Future Year)	Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor)
	Vehicle Hours Traveled (VHT) (Highway modes only)	H23 (Base Year), X23 (Future Year)	
	Passenger Miles Traveled (PMT) (Transit modes only)	I23 (Base Year), Y23 (Future Year)	
	Passenger Hours Traveled (PHT) (Transit modes only)	J23 (Base Year), Z23 (Future Year)	
	Out-of-Pocket Cost (\$ per trip) (for tolls)	K23 (Base Year), AA23 (Future Year)	
	Speed (Calculated by Cal-B/C)	L26 (Base Year), AB26 (Future Year)	
	Average Vehicle Occupancy (AVO)	M23 (Base Year), AC23 (Future Year)	Regional Travel Demand Model, Managed Lane Annual Report, American Community Survey, Field Data Collection
	Percent Trucks	N25 (Base Year), AD25 (Future Year)	Regional Travel Demand Model, Caltrans Traffic Census, Field Data Collection



## Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item (cont.)

Section Title	Data Input Item	To Find, Look at Cell	Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)
2E) Definitions of Safety Groups and Years	Select Mode	AL10	Depends on proposed project
	Name	AM10	Depends on proposed project
	Description	AN10	Depends on proposed project
	Fatal Reduction Factor	AQ10	Crash Modification Factors Clearinghouse
	Injury Reduction Factor	AR10	
	PDO Reduction Factor	AS10	
2F) & 2G) Safety Data	Vehicle Miles Traveled (VMT)	AM23	Regional Travel Demand Model (Total VMT must equal total VMT in Sections 2C and 2D for build and no build scenarios)
	Fatal Accident Rate Per MVM	AN23	TASAS (Table B)/SWITRS
	Injury Accident Rate Per MVM	AO23	
	PDO Accident Rate Per MVM	AP23	

03

## **Model Data**

## TDM Output

# Travel Demand Model (TDM)

- There are multiple travel demand models, microsimulation models and HCM tools
- Main outputs needed from all tools include:
  - VMT
  - VHT
- Ideally, outputs are organized for input into Cal-B/C
- Can be organized by:
  - Facility type
  - Speed bin
  - Vehicle type
  - Time of Day
- Want Cal-B/C inputs to be reasonably refined to accurately reflect benefits
  - Especially emissions and vehicle operating cost benefits

Scenario	Hour/TimePeriod	VehicleType	Dir	BottleneckArea	FacilityType	TravelTime(min)	Speed(mph)	TotalDelay(veh-hrs)	Volume	VHT(Hrs)	VMT(Miles)	Q-ratio	AvgOcc	PercentTrucks	
PM_S1	15	SOV	NB	1	Freeway	5.59	41.12	116.06	3450.2	285.26	11085.47	38.86	1	0%	
PM_S1	15	HOV	NB	1	Freeway	5.69	40.8	15.29	761.2	45.31	1461.98	32.26	2.38	0%	
PM_S1	15	Truck	NB	1	Freeway	6.8	33.96	1.25	34.8	3.6	116.34	32.3	1	100%	
PM_S1	15	SOV	NB	2	Freeway	3.06	8.96	102.12	2374.6	119.76	1060.47	8.85	1	0%	
PM_S1	15	HOV	NB	2	Freeway	0.85	32.32	4.25	690.6	9.75	308.41	31.63	2.38	0%	
PM_S1	15	Truck	NB	2	Freeway	2.84	10.38	1.02	22.6	1.12	10.09	8.99	1	100%	
PM_S1	15	SOV	NB	3	Freeway	6.95	10.86	382.73	4898.4	470.7	5297.41	11.25	1	0%	
PM_S1	15	HOV	NB	3	Freeway	3.74	20.16	24.05	1373.6	42.31	1212.52	28.66	2.38	0%	
PM_S1	15	Truck	NB	3	Freeway	6.95	10.96	4.2	51	4.77	53.78	11.28	1	100%	
PM_S1	15	SOV	NB	4	Freeway	3.12	17.04	198.36	5753.8	277.07	4731.06	17.08	1	0%	
PM_S1	15	HOV	NB	4	Freeway	1.67	31.8	13.12	1513.8	34.77	1320.51	37.98	2.38	0%	
PM_S1	15	Truck	NB	4	Freeway	2.76	19.34	1.8	58.6	2.53	48.71	19.24	1	100%	
PM_S1	15	SOV	NB	5	Freeway	4.2	27.84	252.64	8168.6	474.81	13515.62	28.47	1	0%	
PM_S1	15	HOV	NB	5	Freeway	2.42	48.5	9.27	1161.4	64.58	3263.37	50.53	2.38	0%	
PM_S1	15	Truck	NB	5	Freeway	4.11	28.5	2.62	84.6	5.01	143.63	28.69	1	100%	
PM_S1	15	SOV	NB	6	Freeway	1.55	43.12	49.47	6940.6	143.32	5920.2	41.31	1	0%	
PM_S1	15	HOV	NB	6	Freeway	1.04	62.76	0.26	1070.2	13.93	856.39	61.46	2.38	0%	
PM_S1	15	Truck	NB	6	Freeway	1.72	38.98	0.44	70.8	1.6	59.05	36.95	1	100%	
PM_S1	15	SOV	NB	7	Freeway	7.33	53.14	143.18	4027.6	858.15	45190.63	52.66	1	0%	
PM_S1	15	HOV	NB	7	Freeway										
PM_S1	15	Truck	NB	7	Freeway										
PM_S1	15	SOV	NB	1	OffRamp										

TDM output organized and formatted for input

Input to Cal-B/C

MODEL DATA - YEAR 2020									
REQUIRED FOR TRANSIT									
	Number of Trips (Trips) * **	Vehicle Miles Traveled (VMT) *	Vehicle Hours Traveled (VHT)	Passenger Miles Traveled (PMT)	Passenger Hours Traveled (PHT)	Out-of-Pocket Cost (\$ per trip)	Speed	Average Vehicle Occupancy (AVO)	Percent Trucks
No Build									
1	Bottleneck1_Hour15_HOV	4,164	94				44.1	2.38	0.0%
2	Bottleneck1_Hour15_SOV	43,043	839				51.3	1.00	0.0%
3	Bottleneck1_Hour15_Truck	432	10				44.7	1.00	100.0%
4	Bottleneck1_Hour16_HOV	5,321	137				38.7	2.38	0.0%
5	Bottleneck1_Hour16_SOV	45,670	1,007				45.4	1.00	0.0%
6	Bottleneck1_Hour16_Truck	476	12				40.9	1.00	100.0%
7	Bottleneck1_Hour17_HOV	5,224	131				39.8	2.38	0.0%
8	Bottleneck1_Hour17_SOV	46,564	1,035				45.0	1.00	0.0%
9	Bottleneck1_Hour17_Truck	455	12				39.0	1.00	100.0%
10	Bottleneck1_Hour18_HOV	4,339	87				50.1	2.38	0.0%
11	Bottleneck1_Hour18_SOV	39,352	737				53.4	1.00	0.0%
12	Bottleneck1_Hour18_Truck	405	9				45.4	1.00	100.0%
13	Bottleneck2_Hour15_HOV	1,264	25				51.1	2.38	0.0%
14	Bottleneck2_Hour15_SOV	11,563	302				38.3	1.00	0.0%
15	Bottleneck2_Hour15_Truck	113	3				35.4	1.00	100.0%
16	Bottleneck2_Hour16_HOV	1,443	29				50.4	2.38	0.0%
17	Bottleneck2_Hour16_SOV	12,991	344				37.7	1.00	0.0%
18	Bottleneck2_Hour16_Truck	132	4				34.6	1.00	100.0%
19	Bottleneck2_Hour17_HOV	2,006	37				54.5	2.38	0.0%
20	Bottleneck2_Hour17_SOV	13,070	365				35.8	1.00	0.0%
21	Bottleneck2_Hour17_Truck	125	4				34.2	1.00	100.0%
22	Bottleneck2_Hour18_HOV	1,339	23				59.5	2.38	0.0%
23	Bottleneck2_Hour18_SOV	11,185	245				45.6	1.00	0.0%
24	Bottleneck2_Hour18_Truck	120	3				41.5	1.00	100.0%

# Highway Capacity Manual (HCM) Tool

- There are multiple HCM tools, including HCS and FREEVAL
- Primary outputs needed same as for TDM/micro-simulation:
  - VMT
  - VHT
- Organized by segment

The screenshot shows the FREEVAL software interface. The main window displays a table with columns for segments (Seg. 1 to Seg. 11) and a 'Facility Total' column. The rows include various performance metrics such as Length (mi), Average Travel Time (min), VMTD (veh-miles / interval), VMTV (veh-miles / interval), PMTD (p-miles / interval), PMTV (p-miles / interval), VHT (travel / interval (hrs)), VHD (delay / interval (hrs)), Space Mean Speed (mph), Reported Density (pc/mi/ln), Max D/C, Max V/C, User Delay Cost (\$), Vehicle Operating Cost (\$), and Total User Cost (\$).

Copy to Excel

	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7	Seg. 8	Seg. 9	Seg. 10	Seg. 11	Facility Total
Length (mi)	0.38	0.28	0.57	0.17	0.28	0.38	0.28	0.19	0.28	0.23	0.38	3.43
Average Travel Time (min)	0.34	0.32	0.63	0.23	0.39	0.61	0.34	0.18	0.34	0.20	0.33	3.90
VMTD (veh-miles / interval)	5492	4306	9150	2410	4305	5740	4588	3059	4588	3392	5653	52684
VMTV (veh-miles / interval)	5492	4306	9151	2410	4306	5741	4590	3060	4590	3393	5655	52695
PMTD (p-miles / interval)	5492	4306	9150	2410	4305	5740	4588	3059	4588	3392	5653	52684
PMTV (p-miles / interval)	5492	4306	9151	2410	4306	5741	4590	3060	4590	3393	5655	52695
VHT (travel / interval (hrs))	82	80	168	53	98	155	93	47	92	51	81	1000
VHD (delay / interval (hrs))	3	18	38	19	36	73	27	4	27	3	0	247
Space Mean Speed (mph)	67	54	54	45	44	37	50	64	50	67	70	53
Reported Density (pc/mi/ln)	25	27	26	36	37	48	29	29	30	26	19	29
Max D/C	0.73	0.93	0.73	0.73	0.94	0.79	1.01	0.85	1.01	0.77	0.58	1.01
Max V/C	0.73	0.93	0.73	0.72	0.93	0.77	1.00	0.83	1.00	0.76	0.57	1.00
User Delay Cost (\$)	73.11	392.74	803.32	399.46	777.58	1547.04	575.42	80.03	567.77	53.53	6.36	5275.80
Vehicle Operating Cost (\$)	101.68	546.28	1117.34	555.67	1081.63	2152.03	800.40	111.31	789.79	74.46	8.85	7324.50
Total User Cost (\$)	174.79	939.02	1920.66	955.12	1859.20	3699.07	1375.82	191.35	1357.57	127.99	15.22	12600.31

The screenshot shows an Excel spreadsheet titled 'MODEL DATA - YEAR 2020'. It has columns for 'REQUIRED FOR TRANSIT' (Number of Trips, Vehicle Miles Traveled, Vehicle Hours Traveled, Passenger Miles Traveled, Passenger Hours Traveled, Out-of-Pocket Cost, Speed, Average Vehicle Occupancy, Percent Trucks) and 'No Build' (1 Seg. 1 to 11 Seg. 11, TOTAL). The data is organized by segment, with the total row showing 0 trips, 52,695 VMT, 1,000 VHT, 0 PMT, 0 PHT, 0 cost, 69.7 speed, 1.32 occupancy, and 6.0% trucks.

Input to Cal-B/C

	VMT	VHT
Seg. 1	5492	82
Seg. 2	4306	80
Seg. 3	9151	168
Seg. 4	2410	53
Seg. 5	4306	98
Seg. 6	5741	155
Seg. 7	4590	93
Seg. 8	3060	47
Seg. 9	4590	92
Seg. 10	3393	51
Seg. 11	5655	81

Transposed/  
reorganized

# Percent Truck Volume – Caltrans Traffic Census

- Model outputs sometimes may not have percent trucks
- Truck Traffic on California State Highways System
- Truck Traffic is classified by number of axles by location
- Locations remain fairly consistent over the years
- Data that can be used in Cal-B/C includes:
  - Truck Percent Total of Vehicles
- <https://dot.ca.gov/programs/traffic-operations/census>


The screenshot shows the Caltrans Traffic Census Program interface. The Excel spreadsheet displays the following data for route 010 on BANNING, SUNSET AVE:

ROUTE	DIST	CNTY	MILE	DESCRIPTION	VEHICLE AADT	TRUCK AADT	TRUCK % TOT	TRUCK AADT By Axle	TRUCK AADT By Axle	TRUCK AADT By Axle	TOTAL AADT	%	TRUCK AADT By Axle	TRUCK AADT By Axle	TRUCK AADT By Axle	EAL	YEAR
010	08	RIV	R105.08	JCT. RTE. 177 NORTH	27300	9648	35.34	1,232	220	104	8,092	12.77	2.28	1.08	83.87	2,870	15E
010	08	RIV	R105.08	JCT. RTE. 177 NORTH	26400	9715	36.80	1,256	188	107	8,163	12.93	1.94	1.10	84.02	2,893	15E
010	08	RIV	11.333	BANNING, SUNSET AVE	135000	19305	14.30	5,023	1,583	888	10,811	31.20	8.20	4.60	56.00	4,185	85V
010	08	RIV	R14.76	EAST RAMSEY ST	125000	22875	18.30	3,203	1,830	1,373	16,470	14.00	8.00	6.00	72.00	6,115	86V
010	08	RIV	R14.76	EAST RAMSEY ST	122000	19520	16.00	3,709	1,542	976	13,293	19.00	7.90	5.00	68.10	4,960	86E
010	08	RIV	R149.15	JCT. RTE. 78 SOUTH	29000	9541	32.90	1,261	212	116	7,951	13.22	2.22	1.22	83.33	2,824	15E
010	08	RIV	R149.15	JCT. RTE. 78 SOUTH	28000	9660	34.50	1,165	196	147	8,153	12.06	2.03	1.52	84.40	2,893	15E
010	08	RIV	R154.16	JCT. RTE. 95 NORTH	30000	10845	36.15	1,471	243	137	8,995	13.56	2.24	1.26	82.94	3,197	04E
010	08	RIV	R154.16	JCT. RTE. 95 NORTH	29000	10275	35.43	1,358	228	125	8,562	13.22	2.22	1.22	83.33	3,041	04E
010	08	RIV	R156.49	ARIZONA STATE LINE	30000	10824	36.08	1,468	242	136	8,977	13.56	2.24	1.26	82.94	3,297	04E


# Average Vehicle Occupancy (AVO) – Data Sources

- Models may not have AVO included in the outputs. Other sources include:
  - Caltrans Managed Lane Annual Report
    - Caltrans district offices prepare annual reports with statistics on managed facilities
      - » Covers express lanes and high occupancy vehicle (HOV) lanes
    - Provides vehicle classification and occupancy counts during peak travel periods for managed lanes and adjacent general purpose lanes
      - » Managed lane peak period and peak hour volumes
      - » Average vehicle occupancy (AVO) statistics for managed lane and adjacent general purpose lane
  - American Community Survey
  - Field Data Collection

## 2016 MANAGED LANE ANNUAL REPORT



www.dot.ca.gov/dist07



STATE OF CALIFORNIA  
DEPARTMENT OF TRANSPORTATION

District 7  
Los Angeles and Ventura Counties

Division of Traffic Operations  
Office of System Performance  
Managed Lanes Branch

May 2017

**CALTRANS - DISTRICT 7**  
HOV Lane Operation on Route 134

Co. Rte. Dir.	LA 134 WB		LA 134 EB	
	LA 134 WB	LA 134 WB	LA 134 EB	LA 134 EB
Location	JACKSON		JACKSON	
Post Mile	7.41		7.41	
Date	11/02/16		11/02/16	
Occupancy Requirement	2 <sup>+</sup>		2 <sup>+</sup>	
	AM HOV Peak 1-Hour 7:30 - 8:30	AM HOV Peak 2-Hour 6:30-8:30	PM HOV Peak 1-Hour 15:45 - 16:45	PM HOV Peak 2-Hour 16:00-18:00
<b>High Occupancy Vehicle (HOV) Lane Vehicle Summary</b>				
Carpools (Vehicles with 2-5 occupants only)	1051	1831	972	1769
Vanpools	13	28	7	32
Buses	3	3	5	4
Motorcycles (MC's)	23	58	29	53
Single Occupant Vehicles	7	11	94	144
White Decal Vehicles (Electric Veh. & Compressed Natural Gas)	80	126	35	86
Green Decal Vehicles (Plug-in Hybrids)	86	140	29	80
<b>Total Vehicles in HOV Lane</b>	<b>1263</b>	<b>2297</b>	<b>1171</b>	<b>2168</b>
2 person carpool volume in HOV lane (vehicles)	959	1765	892	1638
2 or more (2+) person carpool volume in HOV Lane (veh.)*	1064	1959	979	1801
3 person carpool volume in HOV lane (vehicles)	85	155	65	108
3 or more (3+) person carpool volume in HOV Lane (veh.)*	105	194	87	163
<b>HOV Lane People Summary</b>				
People in Carpools (Vehicles with 2-5 occupants only)	2203	4041	2046	3702
People in Vanpools	78	168	42	192
People in Buses	70	70	110	100
People in CNG/EV/Plug-in Hybrid, Single Occ. Veh. and MC's	196	335	187	363
<b>Total HOV Lane People</b>	<b>2547</b>	<b>4614</b>	<b>2385</b>	<b>4357</b>
<b>General Purpose (GP) Lane Summary*</b>				
Number of General Purpose Lanes	4		4	
General Purpose Lane Vehicles**	7800	15241	6841	13619
General Purpose Vehicles per Lane**	1950	3810	1710	3405
General Purpose Lane People**	8394	16334	7548	15035
General Purpose People per Lane**	2096	4083	1887	3759
<b>Freeway Summary</b>				
Total Freeway Vehicles	9063	17538	8012	15787
Total Freeway People	10931	20948	9933	19392
Percent of Total Freeway Vehicles in HOV Lane	13.94%	13.10%	14.62%	13.73%
Percent of Total Freeway Vehicles per General Purpose Lane	21.52%	21.73%	21.35%	21.57%
Percent of Total Freeway People in HOV Lane	23.30%	22.03%	24.01%	22.47%
Percent of Total Freeway People per General Purpose Lane	19.17%	19.49%	19.00%	19.38%
<b>GP Lane Carpool Summary*</b>				
2+ Carpool volume in GP Lanes (vehicles)*	480	913	490	1044
2+ Percent Carpools in GP Lanes	6.15%	5.99%	7.16%	7.66%
3+ Carpool Volume in GP Lanes (vehicles)*	35	73	55	99
3+ Percent Carpools in GP Lanes	0.45%	0.48%	0.80%	0.73%
<b>Average Occupancy</b>				
HOV Lane Average Occupancy (people)	2.02	2.01	2.04	2.01
General Purpose Lane Average Occupancy (people)	1.07	1.07	1.10	1.10
<b>HOV Lane Violation</b>				
HOV Lane Violation (percentage)	0.55%	0.48%	0.03%	0.64%
<b>Equivalent Number of GP Lanes</b>				
Equivalent number of GP Lanes needed to carry HOV people	1.22	1.13	1.26	1.16

Peak 1-hour & peak 2-hour totals are based on the highest volume during the following peak period courts: 6:30-8:30 & 15:30-18:00.  
 \*The peak hour of the general purpose lane may vary from the peak hour of the HOV lane.  
 \* Carpools and vanpools only.  
 \*\* Single occupant vehicles, carpools, vanpools, buses, motorcycles, CNG/EV/Plug-in Hybrids and trucks.

04

## **Traffic Collision Data**

# Traffic Accident Surveillance and Analysis System (TASAS) - Transportation Systems Network (TSN) Reports

- Highway inventory database which contains the current and historical collisions on the SHS
- Preferred source for SHS collision data
- Data/Reports only accessible through Caltrans Staff
- Data that can be used in Cal-B/C includes:
  - Total Accidents (Tot)
  - Fatal Accidents (Fat)
  - Injury Accidents (Inj)
  - Property Damage Only (PDO) Accidents (Tot – (Fat+Inj))
  - Accident Rate (per million vehicle-miles)
  - Percent Fatal Accidents (Pct Fat)
- <https://dot.ca.gov/programs/research-innovation-system-information/office-of-highway-system-information-performance>

OTM22130  
01/14/2020  
02:30 PM

California Department of Transportation  
Table B - Selective Accident Rate Calculation

Page# 1  
Event ID: 4185099

Location Description	Rate Group (RUS)	No. of Accidents / Significance							Pers Kd Inj	ADT Man X-St	Total MV+ or MVM	Accident Rates					
		Tot	Fat	Inj	F+I	Multi Veh	Wet	Dark				Actual Fat	Actual F+I	Average Tot	Average Fat	Average F+I	Tot
	8,293 MI H U	627	5	243	248	488	64	221	5	131.2	794.27	0.006	.31	.79	0.003	.24	.77
	43,789 MI H NA	10598	31	2854	2885	9474	465	3609	34	226.8	7249.88	0.004	.40	1.46	0.004	.34	1.09
	16,763 MI H NA	13269	24	3676	3700	11844	654	4626	25	237.3	8100.70	0.003	.46	1.64	0.004	.34	1.08
	11,506 MI H NA	1475	3	394	397	1255	76	478	3	177.1	1487.53	0.002	.27	.99	0.004	.27	.85



# Statewide Integrated Traffic Records System (SWITRS)

- Collects and processes detailed data gathered from a collision scene by CHP and local law enforcement
- Account required to access detailed reports and data
- California collision data by location, date/time and type
- Used for collision data off the State Highway System (SHS) – TASAS should be used for SHS projects
- Downloadable but requires extensive data manipulation
- Data that can be used in Cal-B/C includes:
  - Total Accidents (Tot)
  - Fatal Accidents (Fat)
  - Injury Accidents (Inj)
  - Property Damage Only (PDO) Accidents
- <https://iswitrs.chp.ca.gov/Reports/jsp/index.jsp>



	A	B	C	D	E	F	G	H	I	J	K	L
1	CASE_ID	ACCIDENT PROC	DA JURIS	COLLISION_DATE	COLLISION_TIME	OFFICER	REPORTING_DISTRICT	DAY_OF_WEEK	CHP_SHIFT	POPULATION	CNTY	CITY_LO
2	6980428	2015	20151112	1941	20150621	1247	10658		7	5	7	194
3	8371443	2017	20170609	1941	20170506	2500	10861	333	6	5	7	194
4	8068295	2016	20160621	1941	20160610	500	6311		5	5	7	194
5	8347200	2017	20170417	1941	20170405	333	10911		3	5	7	194
6	8064659	2016	20160624	1941	20160603	556	10805	231	5	5	7	194
7	8513141	2017	20180119	1931	20171213	837	5304	1931	3	5	5	193
8	6244413	2013	20140421	1941	20131007	1748	6287		1	5	7	194
9	8422238	2017	20170803	1941	20170721	520	11007	341	5	5	7	194
10	8151848	2016	20161026	1941	20161009	1244	10042		7	5	7	194
11	8041984	2016	20160527	1909	20160514	1245	560	1909	6	5	4	190
12	8486588	2017	20180109	1931	20171011	912	5304	1931	3	5	5	193
13	8440707	2017	20170911	1931	20170817	1631	5304	1931	4	5	5	193
14	8399963	2017	20170705	1907	20170619	1015	238	2	1	5	4	190
15	6941724	2015	20151019	1941	20150525	2254	10545	221	1	5	7	194
16	6446622	2014	20150305	1941	20140407	503	6287	244	1	5	7	194
17	8283016	2016	20170125	1941	20161227	2140	6042		2	5	7	194
18	8085729	2016	20160727	1948	20160626	235	450	1948	7	5	5	194
19	6693006	2014	20141202	1973	20140924	1900	607	1973	3	5	1	197

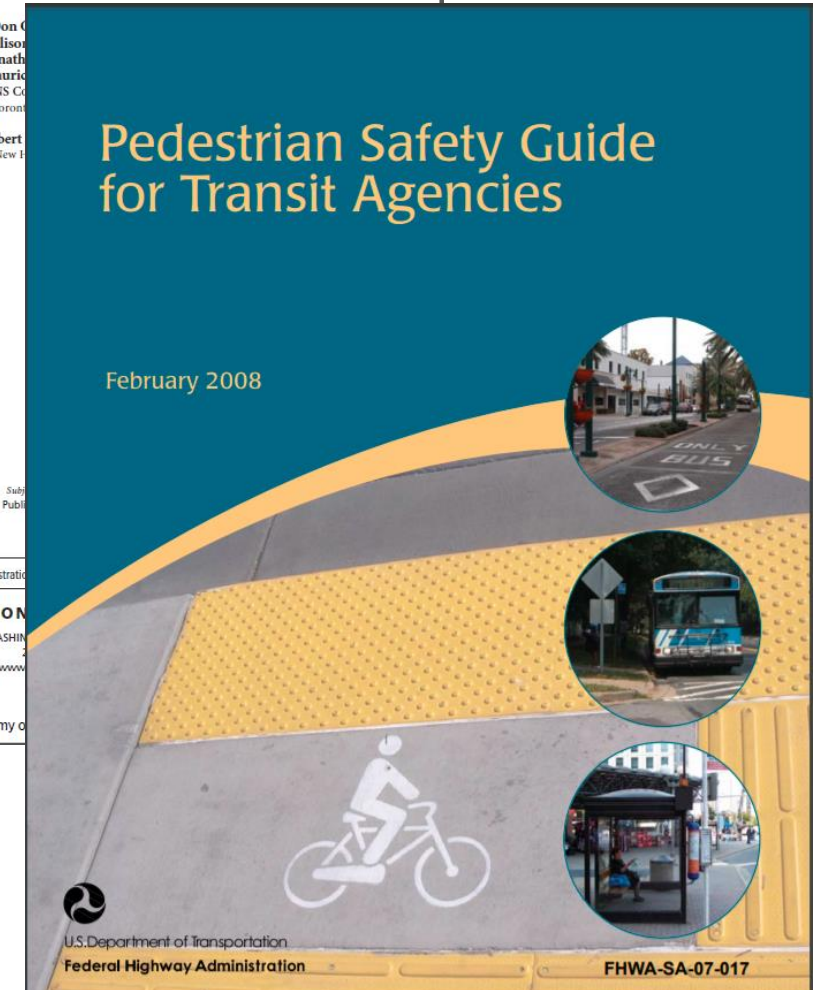
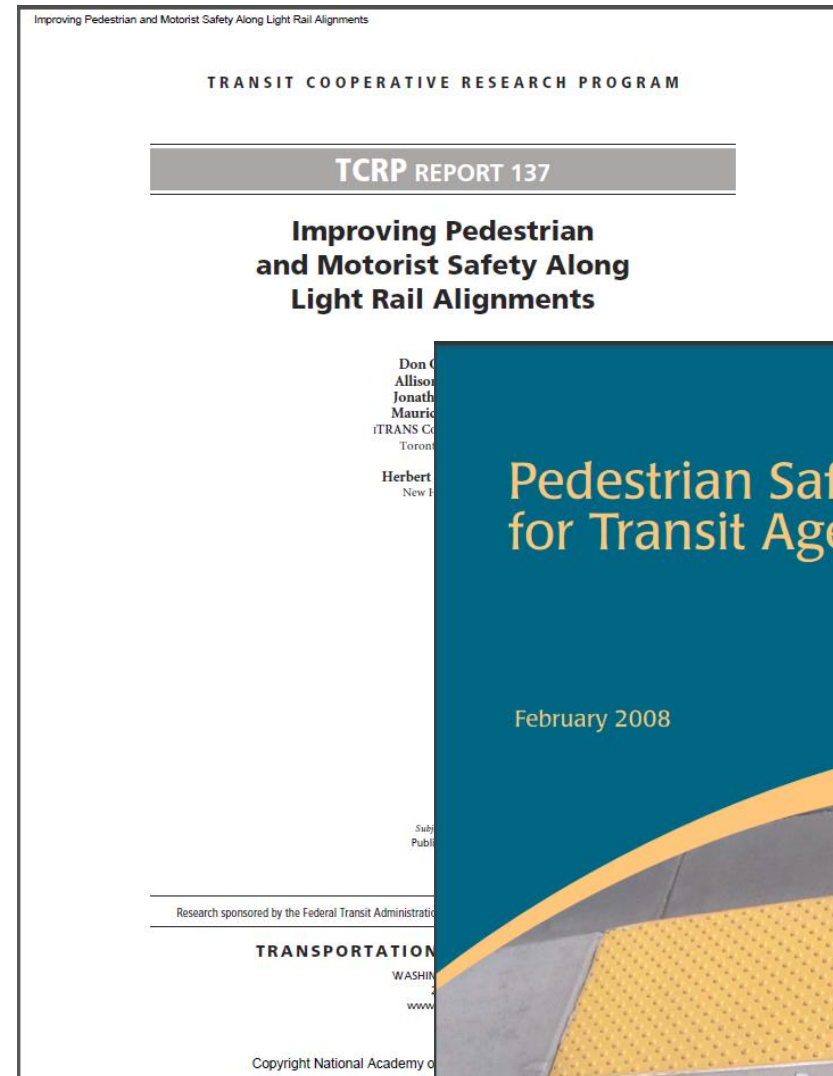
# Crash Modifications Factors (CMF) Clearinghouse

- A searchable database of CMFs
- A CMF is used to compute the expected number of crashes after implementing a countermeasure
- Find appropriate countermeasures and CMFs
  - Collision type
  - Roadway type
  - Location
  - Severity
  - Time of Day
  - Roadway Condition

The screenshot shows the homepage of the Crash Modification Factors Clearinghouse. At the top, there is a dark blue header with the 'CMF' logo and the text 'CRASH MODIFICATION FACTORS CLEARINGHOUSE'. Below the header is a navigation bar with links for 'ABOUT THE CLEARINGHOUSE', 'USING CMFs', 'DEVELOPING CMFs', and 'ADDITIONAL RESOURCES'. The main content area features a search bar with the placeholder text 'ENTER SEARCH TERMS...'. To the right of the search bar is a dropdown menu labeled 'Countermeasure Name' and a 'SEARCH' button. Below the search bar, there are 'FREQUENT SEARCHES' for 'ROUNDBOUT', 'SIGNAL', 'PEDESTRIAN', 'SHOULDER', 'TSMO', and 'BROWSE ALL'. The main content is divided into three columns, each with a header image and a text box. The first column is titled 'WHAT ARE CMFs?' and includes a brief description of CMFs and a 'LEARN MORE' link. The second column is titled 'GETTING STARTED' and includes a link to the 'USER GUIDE'. The third column is titled 'CHANGE AHEAD' and includes information about the transition to the NCHRP 17-72 project and a 'LEARN MORE' link. At the bottom, there is a dark blue footer with the text 'RECEIVE THE QUARTERLY EMAIL NEWSLETTER' and a form with fields for 'EMAIL ADDRESS', 'FIRST NAME', 'LAST NAME', 'ORGANIZATION', and a 'SIGN UP' button.

## Other Sources for Safety Data

- For percent reduction in transit accidents, other documentation and research can be utilized



05

## **Project Costing Data**

## Project Costs – Direct Initial Costs

- The level of detail for cost estimates depends on where the project is in the development process
  - Plans, Specifications and Estimate (PS&E), Project Report (PR), and Project Study Reports (PSR) provide detailed cost estimates
    - These costs typically include support costs (e.g., design), right of way (ROW or R/W), and construction costs (including contingency)
  - Regional Transportation Improvement Programs (RTIP)
  - Caltrans State Highway Operation and Protection Program (SHOPP)

Enter all project costs (in today's dollars) in columns 1 to 7. Costs during construction should be entered in the first eight rows. Project costs (including maintenance and operating costs) should be net of costs without project.

PROJECT COSTS (enter costs in thousands of dollars)

Year	INITIAL COSTS			SUBSEQUENT COSTS		Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	Project Support	R / W	Construction	Maint./ Op.	Rehab.		Constant Dollars	Present Value
<b>Construction Period</b>								
2019				Enter Construction Cost			\$0	\$0
2020							0	0
2021							0	0
2022							0	0
2023							0	0
2024							0	0
2025							0	0
2026							0	0
<b>Project Open</b>								
2020							\$0	\$0
2021							0	0
2022							0	0
2023							0	0
2024							0	0
2025							0	0
2026							0	0
2027							0	0
2028							0	0
2029							0	0
2030							0	0
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2052							0	0
2053							0	0
2054							0	0
2055							0	0

1) Project Information    2) Model Inputs    3) Results    Travel Time    Const

Note: Remember to enter costs in thousands of dollars (1000\$). Otherwise, you will not get a correct Benefit/Cost Ratio

## Project Costs – Direct Initial Costs (cont.)

- Pre-planning stages are more difficult
  - Caltrans project cost database with rule-of-thumb cost guides
  - Cost-per-mile estimates are available
    - Costs per mile vary significantly depending on the location, region, and project type
    - Look for a similar completed project in the same region with known costs, then estimate the cost per mile for the similar type of improvements
    - If ROW impacts are likely, then a reserve amount should be included. Caltrans has rule-of-thumb ROW estimates available

Enter all project costs (in today's dollars) in columns 1 to 7. Costs during construction should be entered in the first eight rows. Project costs (including maintenance and operating costs) should be net of costs without project.

PROJECT COSTS (enter costs in thousands of dollars)

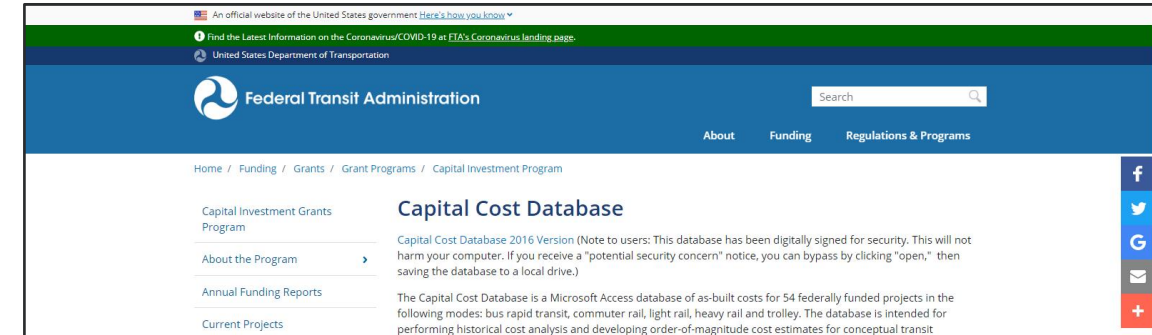
Year	INITIAL COSTS			SUBSEQUENT COSTS			Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	Project Support	R / W	Construction	Maint./ Op.	Rehab.	Mitigation		Constant Dollars	Present Value
<b>Construction Period</b>									
2019				Enter Construction Cost				\$0	\$0
2020								0	0
2021								0	0
2022								0	0
2023								0	0
2024								0	0
2025								0	0
2026								0	0
<b>Project Open</b>									
2020								\$0	\$0
2021								0	0
2022								0	0
2023								0	0
2024								0	0
2025								0	0
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2052								0	0
2053								0	0
2054								0	0
2055								0	0

Navigation: Title | Instructions | 1) Project Information | 2) Model Inputs | 3) Results | Travel Time | Const

Note: Remember to enter costs in thousands of dollars (1000\$). Otherwise, you will not get a correct Benefit/Cost Ratio

# Project Costs – Federal Transit Administration (FTA) Capital Costs Database

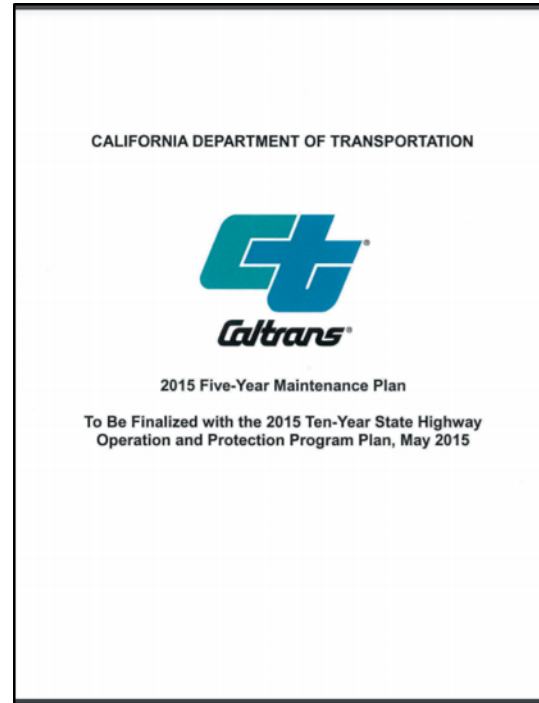
- Microsoft Access database that can be used to estimate order-of-magnitude cost for conceptual transit projects
- Uses the FTA Standard Cost Category (SCC) codes for comparisons among transit operators
- Contains “as-built” costs for 54 federally funded projects:
  - Bus rapid transit
  - Commuter rail
  - Light rail
  - Heavy rail
  - Trolley



Cost Category and Element	Units	Quantity	Mid-Point of Construction	Total Element Cost at Mid-Point of Construction (\$X'000)	Unit Cost at Mid-Point of Construction	National Average, User Selected Base Year 2016
<b>Total Project Costs (excluding finance charges): \$177,100,001</b>						
Cost Category	Unit Measure	Units	Unit Cost	Total Cost at Mid-Point of Construction (\$X'000)	Total National Average, User Selected Base Year (\$X'000) 2016	Percent of Total Cost
10 Guideway & Track Elements	LF Guideway	44687	\$2,109	\$40,300	\$94,234	23%
20 Stations, Stops, Terminals, Intermodels	Stations	5	\$8,885,590	\$19,000	\$44,428	11%
30 Support Facilities: Yards, Shops, Admin. Bldgs	Vehicles	18	\$51,963	\$400	\$935	0%
40 Sitework & Special Conditions	LF Guideway	44687	\$73	\$1,400	\$3,274	1%
50 Systems	Track Feet	92546	\$293	\$11,600	\$27,124	7%
60 Row, Land, Existing Improvements	LF Guideway	44687	\$2,020	\$38,600	\$90,259	22%
70 Vehicles	Vehicles	18	\$4,247,936	\$32,700	\$76,463	18%
<b>Total Hard Costs</b>	<b>LF Guideway</b>	<b>44687</b>	<b>\$7,535</b>	<b>\$144,000</b>	<b>\$336,717</b>	<b>81%</b>

# Project Costs – Subsequent Costs

- Caltrans and regional agencies have estimates for maintenance and operating costs for various facilities
- Transit annual operating expenses can be estimated from NTD data tables
- Subsequent costs should be entered as a **net** increase or decrease from the No Build case
  - May be positive (e.g., increased cost due to a new lane being constructed)
  - May be negative (e.g., avoided maintenance or rehabilitation)



Operating Expenses,2 (1) - Excel

	A	B	C	O	Q	S	W	AA
	Agency	City	State	Vehicle Maintenance	Facility Maintenance	General Administration	Total	Vehicle Revenue Hours
12	New Jersey Transit Corporation	Newark	NJ	\$12,433,673	\$6,441,459	\$31,530,936	\$98,086,952	126,422
14	New Jersey Transit Corporation	Newark	NJ	\$3,405,044	\$5,926,489	\$3,979,417	\$22,345,248	50,262
17	Los Angeles County Metropolitan Transportation Authority	Los Angeles	CA	\$74,608,014	\$37,603,979	\$79,906,659	\$377,416,763	866,272
30	King County Department of Metro Transit, dba: King	Seattle	WA	\$0	\$0	\$0	\$0	0
45	Metropolitan Transit Authority of Harris County, Texas	Houston	TX	\$15,117,378	\$15,199,854	\$18,482,675	\$79,277,412	300,133
50	Massachusetts Bay Transportation Authority	Boston	MA	\$58,667,899	\$17,184,275	\$36,258,468	\$213,658,148	706,032
67	Maryland Transit Administration	Baltimore	MD	\$10,014,619	\$12,324,396	\$6,509,505	\$43,950,196	151,280
86	Denver Regional Transportation District	Denver	CO	\$24,666,970	\$22,846,002	\$34,042,000	\$122,305,271	720,150
103	Utah Transit Authority	Salt Lake City	UT	\$25,371,102	\$9,594,202	\$15,292,108	\$71,414,293	362,257
117	Dallas Area Rapid Transit	Dallas	TX	\$37,319,388	\$41,659,119	\$34,853,739	\$191,495,581	458,345
127	City and County of San Francisco, dba: San Francisco	San Francisco	CA	\$72,417,984	\$29,665,742	\$38,309,599	\$221,060,950	556,545
133	Tri-County Metropolitan Transportation District of Oregon	Portland	OR	\$41,331,691	\$25,560,017	\$28,740,425	\$150,694,667	626,091
139	Port Authority of Allegheny County	Pittsburgh	PA	\$21,480,512	\$20,589,688	\$5,929,802	\$66,793,023	478,175
142	Metro Transit	Minneapolis	MN	\$12,549,095	\$11,699,847	\$28,195,729	\$73,006,195	125,583
163	San Diego Metropolitan Transit System	San Diego	CA	\$20,209,080	\$12,502,824	\$25,618,230	\$90,313,010	478,175
185	Santa Clara Valley Transportation Authority	San Jose	CA	\$41,087,099	\$27,318,635	\$18,755,072	\$128,622,203	220,589
216	Bi-State Development Agency of the Missouri-Illinois	St. Louis	MO	\$13,673,749	\$19,671,573	\$19,095,764	\$80,216,036	264,761
222	The Greater Cleveland Regional Transit Authority	Cleveland	OH	\$2,618,219	\$3,666,216	\$1,636,300	\$12,119,266	48,997
239	City of Charlotte North Carolina, dba: Charlotte Area	Charlotte	NC	\$5,167,065	\$2,854,055	\$7,450,065	\$21,366,867	89,679
249	Transportation District Commission of Hampton Roads	Hampton	VA	\$1,518,483	\$334,916	\$3,360,439	\$10,619,844	29,571
253	Central Puget Sound Regional Transit Authority, dba: Seattle	Seattle	WA	\$12,209,055	\$28,789,445	\$31,408,199	\$115,567,317	264,385
262	Niagara Frontier Transportation Authority	Buffalo	NY	\$2,786,355	\$9,560,643	\$3,991,370	\$25,551,007	82,671
412	Sacramento Regional Transit District	Sacramento	CA	\$16,037,374	\$10,526,891	\$15,624,192	\$70,866,915	248,656
1190	Valley Metro Rail, Inc.	Phoenix	AZ	\$7,870,743	\$9,243,589	\$7,366,444	\$43,021,498	217,912



# Project Costs – Mitigation Costs

- Mitigation costs (in thousands of dollars) include costs to protect communities and the environment from negative impacts
  - Include wetland and community preservation as well as sound walls to reduce highway or rail transit noise
- Plans, PS&E, PR, and PSR will provide mitigation cost estimates (with details found in the appendices)
- Often these costs can be included in the “construction” costs for a project and may not need to be entered into Cal-B/C as a separate costs
  - Soundwalls and environmental mitigations are examples of mitigations that are built into the cost of projects presented in PRs
- On-going mitigation costs that continue after the project construction is completed will be included in PRs

PROJECT COST ESTIMATE  
EA: 31450 PID: D01234567

**SECTION 5: ENVIRONMENTAL**

5A - ENVIRONMENTAL MITIGATION				
Item code	Unit	Quantity	Unit Price (\$)	Cost
Biological Mitigation				
Total of Section 1-4				
130670	Temporary Reinforced Silt Fence	LF	\$ 144,076,600 x 3.0%	\$ 4,322,300
141000	Temporary Fence (Type ESA)	LF	x	- \$
				Subtotal Environmental Mitigation \$ 4,322,300
5B - LANDSCAPE AND IRRIGATION				
Item code	Unit	Quantity	Unit Price (\$)	Cost
Highway Planting				
Total of Section 1-4				
20XXXX	Highway Planting (Landscaped Status)	ACRE	\$ 144,076,600 x 3.0%	\$ 4,322,300
20XXXX	Irrigation System	LS	x 97,000.00	\$ 3,482,300
204099	Plant Establishment Work	LS	x	- \$
204101	Extend Plant Establishment Work	LS	x	- \$
20XXXX	Follow-up Landscape Project	LS	x	- \$
150685	Remove Irrigation Facility	LS	x	- \$
20XXXX	Maintain Existing (Irrigation or Planted Areas)	LS	x	- \$
206400	Check and Test Existing Irrigation Facilities	LS	x	- \$
21011X	Imported Topsoil (X)	CY/TON	x	- \$
20XXXX	Rock Blanket, Rock Mulch, DG, Gravel Mulch	QFT/SQYD	x	- \$
200122	Weed Germination	SQYD	x	- \$
208304	Water Meter	EA	x	- \$
2087XX	XX" Conduit (Use for Irrigation x-overs)	LF	x	- \$
20890X	Extended A. Utilization (Use for Extension of Irrigation)	LF	x	- \$
				Subtotal Landscape and Irrigation \$ 7,804,600
5C - EROSION CONTROL				
Item code	Unit	Quantity	Unit Price (\$)	Cost
Move In/Move Out (Erosion Control)				
210010	Fiber Rolls	EA	x	- \$
210350	Compost Sock	LF	x	- \$
2102XX	Roller Erosion Control Product (X)	SQFT	x	- \$
21025X	Bonded Fiber Matrix	QFT/ACRE	x	- \$
210300	Hydromulch	SQFT	x	- \$
210420	Straw	SQFT	x	- \$
210430	Hydroseed	SQFT	x	- \$
210600	Compost	SQFT	x	- \$
210630	Incorporate Materials	SQFT	x	- \$
Total of Section 1-4				
				\$ 144,076,600 x 10.0% = \$ 14,407,700
				Subtotal Erosion Control \$ 14,407,700
5D - NPDES				
Item code	Unit	Quantity	Unit Price (\$)	Cost
130300	Prepare SWPPP	LS	1 x 10,000.00	\$ 10,000
130200	Prepare WPCP	LS	x	- \$
130100	Job Site Management	LS	x	- \$
130330	Storm Water Annual Report	EA	x	- \$
130310	Rain Event Action Plan (REAP)	EA	x	- \$
130320	Storm Water Sampling and Analysis Day	EA	x	- \$
130520	Temporary Hydraulic Mulch	SQYD	x	- \$
130550	Temporary Hydroseed	SQYD	x	- \$
130505	Move-In/Move-Out (Temporary Erosion Control)	EA	x	- \$
130640	Temporary Fiber Roll	LF	x	- \$
130900	Temporary Concrete Washout	LS	x	- \$
130710	Temporary Construction Entrance	EA	x	- \$
130610	Temporary Check Dam	LF	x	- \$
130620	Temporary Drainage Inlet Protection	EA	x	- \$
130730	Street Sweeping	LS	x	- \$
Total of Section 1-4				
				\$ 144,076,600 x 10.0% = \$ 14,407,700
				Subtotal NPDES \$ 14,417,700
Supplemental Work for NPDES				
065595	Water Pollution Control Maintenance Sharing*	LS	x	- \$
065596	Additional Water Pollution Control**	LS	x	- \$
065597	Storm Water Sampling and Analysis***	LS	x	- \$
XXXXXX	Storm Water BMPs	LS	1 x 12,930,000.00	\$ 12,930,000
				Subtotal Supplemental Work for NPDES \$ 12,930,000
				<b>TOTAL ENVIRONMENTAL \$ 40,952,300</b>

\*Applies to all SWPPPs and those WPCPs with sediment control or soil stabilization BMPs.  
 \*\*Applies to both SWPPPs and WPCP projects.  
 \*\*\*Applies only to project with SWPPPs.

06

**Conclusion**

## **In this module, you learned...**

- About potential data sources for data input and project costing for Cal-B/C Corridor
- How to get data from these sources

## What's Next?

- **Module 9b** walks through an example project BCA analysis
- **Module 10** closes out the training and will summarize other resources to learn more about BCA