

District: **TxDOT Houston**

PROJECT: **BU 90-U from IH 610 to E of Mesa Rd (old FM 527)**

EA:	Arterial
PPNO:	0028-01-067

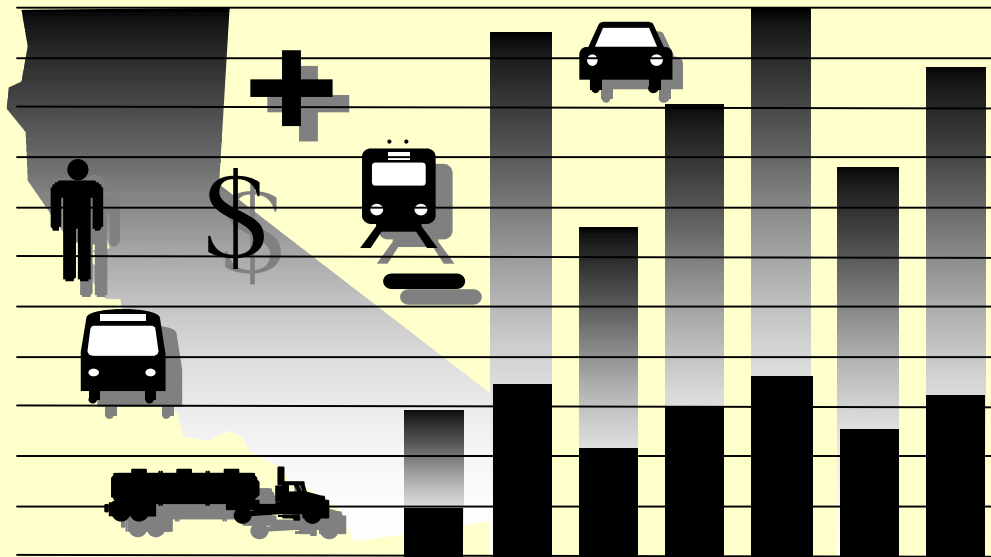
3	<b>INVESTMENT ANALYSIS</b> <b>SUMMARY RESULTS</b>																																									
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**Should benefit-cost results include:**

<b>1) Induced Travel? (y/n)</b>	<input type="text" value="Y"/> Default = Y
<b>2) Vehicle Operating Costs? (y/n)</b>	<input type="text" value="Y"/> Default = Y
<b>3) Accident Costs? (y/n)</b>	<input type="text" value="Y"/> Default = Y
<b>4) Vehicle Emissions? (y/n)</b> includes value for CO <sub>2</sub> e	<input type="text" value="Y"/> Default = Y



# California Life-Cycle Benefit/Cost Analysis Model (Version 5.0) TIGER Benefit-Cost Analysis



Office of Transportation Economics  
Division of Transportation Planning  
2014 TIGER Grant Applications

For questions and comments, please contact:

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District: **TxDOT Houston**

PROJECT: **BU 90-U from IH 610 to E of Mesa Rd (old FM 527)**

Facility Type: **Arterial**  
 CSJ #: **0028-01-067**

**1A PROJECT DATA**

**Type of Project**  
 Select project type from list: **General Highway**

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

Length of Construction Period: **2** years  
 One- or Two-Way Data: **2** enter 1 or 2  
 Current

**Length of Peak Period(s)** (up to 24 hrs): **7** hours

**1C HIGHWAY ACCIDENT DATA**

**Actual 3-Year Accident Data (from Table B)**

	Count (No.)	Rate
Total Accidents (Tot)	110	3.93
Fatal Accidents (Fat)	0	0.000
Injury Accidents (Inj)	35	1.25
Property Damage Only (PDO) Accidents	75	2.68

**Statewide Basic Average Accident Rate**

Rate Group	No Build	Build
Accident Rate (per million vehicle-miles)	0.64	0.29
Percent Fatal Accidents (Pct Fat)	1.0%	0.6%
Percent Injury Accidents (Pct Inj)	48.0%	26.4%

**1B HIGHWAY DESIGN AND TRAFFIC DATA**

**Highway Design**

	No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)	C	C
Number of General Traffic Lanes	4	6
Number of HOV/HOT Lanes		
HOV Restriction (2 or 3)		
Exclusive ROW for Buses (y/n)	N	
Highway Free-Flow Speed	45	55
Ramp Design Speed (if aux. lane/off-ramp proj.)	35	35
Length (in miles) Highway Segment	1.2	1.2
Impacted Length	1.2	1.2

**Average Daily Traffic**

	No Build	Build
Current	29,941	
Base (Year 1)	32,553	32,553
Forecast (Year 20)	57,370	57,370

**Average Hourly HOV/HOT Lane Traffic**

	No Build	Build
Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)		100%

**Percent Traffic in Weave**: 0.0%

**Percent Trucks** (include RVs, if applicable): 10%

**Truck Speed**

**On-Ramp Volume**

	Peak	Non-Peak
Hourly Ramp Volume (if aux. lane/on-ramp proj.)	0	0
Metering Strategy (1, 2, 3, or D, if on-ramp proj.)		

**Queue Formation** (if queuing or grade crossing project)

	Year 1	Year 20
Arrival Rate (in vehicles per hour)	0	0
Departure Rate (in vehicles per hour)	0	0

**Pavement Condition** (if pavement project)

	No Build	Build
IRI (inches/mile) Base (Year 1)		
Forecast (Year 20)		

**Average Vehicle Occupancy (AVO)**

	No Build	Build
General Traffic Non-Peak	1.32	1.32
Peak	1.25	1.25
High Occupancy Vehicle (if HOV/HOT lanes)	2.15	2.15

**1D RAIL AND TRANSIT DATA**

**Annual Person-Trips**

	No Build	Build
Base (Year 1)		
Forecast (Year 20)		

**Percent Trips during Peak Period**: 54%

**Percent New Trips from Parallel Highway**: 100%

**Annual Vehicle-Miles**

	No Build	Build
Base (Year 1)		
Forecast (Year 20)		

**Average Vehicles/Train** (if rail project)

**Reduction in Transit Accidents**

Percent Reduction (if safety project)

**Average Transit Travel Time**

	No Build	Build
In-Vehicle Non-Peak (in minutes)		0.0
Peak (in minutes)		0.0
Out-of-Vehicle Non-Peak (in minutes)	0.0	0.0
Peak (in minutes)	0.0	0.0

**Highway Grade Crossing**

	Current	Year 1	Year 20
Annual Number of Trains		0	
Avg. Gate Down Time (in min.)		0.0	

**Transit Agency Costs** (if TMS project)

	No Build	Build
Annual Capital Expenditure		\$0
Annual Ops. and Maintenance Expenditure		\$0

Model should be run for both roads for intersection or bypass highway projects, and may be run twice for connectors. Press button below to prepare model to enter data for second road. After data are entered, results reflect total project benefits.

Prepare Model for Second Road

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.

1E PROJECT COSTS (enter costs in thousands of dollars)									
Col. no.	(1)	(2)	(3)	(4)	(5)	(6)	(7)		
Year	DIRECT PROJECT COSTS					Mitigation	Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	INITIAL COSTS		SUBSEQUENT COSTS					Constant Dollars	Present Value
	Project Support	R / W	Construction	Maint./ Op.	Rehab.				
<b>Construction Period</b>									
1			\$7,500					\$7,500,000	\$7,500,000
2			7,500					7,500,000	7,281,553
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
<b>Project Open</b>									
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
<b>Total</b>	\$0	\$0	\$15,000	\$0	\$0	\$0	\$0	\$15,000,000	\$14,781,553

$$\text{Present Value} = \frac{\text{Future Value (in Constant Dollars)}}{(1 + \text{Real Discount Rate})^{\text{Year}}}$$

### HIGHWAY SPEED AND VOLUME INPUTS

Calculated by Model      Changed by User      Used for Proj. Eval.      Reason for Change

**No Build**

**Year 1**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	15,674		15,674	
Weaving Volume	0		0	
Truck Volume	1,742		1,742	
HOV Speed	55.0		55.0	
Non-HOV Speed	44.8		44.8	
Weaving Speed	55.0		55.0	
Truck Speed	44.8		44.8	

Non-Peak Period

Non-HOV Volume	13,624		13,624	
Weaving Volume	0		0	
Truck Volume	1,514		1,514	
Non-HOV Speed	45.0		45.0	
Weaving Speed	55.0		55.0	
Truck Speed	45.0		45.0	

**Year 20**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	27,624		27,624	
Weaving Volume	0		0	
Truck Volume	3,069		3,069	
HOV Speed	55.0		55.0	
Non-HOV Speed	20.8		20.8	
Weaving Speed	55.0		55.0	
Truck Speed	20.8		20.8	

Non-Peak Period

Non-HOV Volume	24,009		24,009	
Weaving Volume	0		0	
Truck Volume	2,668		2,668	
Non-HOV Speed	45.0		45.0	
Weaving Speed	55.0		55.0	
Truck Speed	45.0		45.0	

**Build**

**Year 1**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	15,674		15,674	
Weaving Volume	0		0	
Truck Volume	1,742		1,742	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

Non-Peak Period

Non-HOV Volume	13,624		13,624	
Weaving Volume	0		0	
Truck Volume	1,514		1,514	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

**Year 20**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	27,624		27,624	
Weaving Volume	0		0	
Truck Volume	3,069		3,069	
HOV Speed	55.0		55.0	
Non-HOV Speed	53.9		53.9	
Weaving Speed	55.0		55.0	
Truck Speed	53.9		53.9	

Non-Peak Period

Non-HOV Volume	24,009		24,009	
Weaving Volume	0		0	
Truck Volume	2,668		2,668	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

Model speed estimates based on Highway Capacity Manual, pavement research, and research on weaving impacts

2B

### HIGHWAY ACCIDENT RATES

	Calculated by Model	Changed by User	Used for Proj. Eval.	Reason for Change
<b>No Build</b>				
Fatal Accidents	0.000		0.000	
Injury Accidents	1.25		1.25	
PDO Accidents	2.68		2.68	
<b>Total Accidents</b>	<b>3.930</b>			
<b>Hwy Safety or Weaving Improvement</b> <input type="text" value="0%"/> collision reduction factor (per HSIP Guidelines)				
<b>Adjustment Factor (Actual/Statewide Avg. Existing)</b>				
Fatal Accidents	0.0000		0.0000	
Injury Accidents	4.0809		4.0809	
PDO Accidents	8.2301		8.2301	
<b>Build</b>				
Fatal Accidents	0.000		0.000	
Injury Accidents	0.31		0.31	
PDO Accidents	1.71		1.71	
<b>Total Accidents</b>	<b>2.020</b>			

2C

### RAMP AND ARTERIAL INPUTS

(if detailed information is available for a TMS or an arterial signal management project)

Detailed Information Available? (y/n)

Aggregate Segment Length (estimate as VMT/total volume)

All Ramps  miles

Arterials  miles

	Entered by User	Used for Proj. Eval.	Source/Notes
<b>No Build (Peak Period Only)</b>			
<b>Year 1</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
<b>Year 20</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
<b>Build (Peak Period Only)</b>			
<b>Year 1</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
<b>Year 20</b>			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	

2D

### ANNUAL PERSON-TRIPS

(for HOV and HOT lane projects that affect average vehicle occupancy)

**No Build      Build      Induced**

<b>Year 1</b>			
<b>Peak Period</b>			
HOV Trips	0	0	
Non-HOV Trips	5,094,182	5,094,182	0
Truck Trips	452,816	452,816	0
<b>Non-Peak Period</b>			
Non-HOV Trips	4,675,602	4,675,602	0
Truck Trips	393,569	393,569	0
<b>Total Trips</b>	<b>10,616,170</b>	<b>10,616,170</b>	<b>0</b>

<b>Year 20</b>			
<b>Peak Period</b>			
HOV Trips	0	0	
Non-HOV Trips	8,977,688	8,977,688	0
Truck Trips	798,017	798,017	0
<b>Non-Peak Period</b>			
Non-HOV Trips	8,240,007	8,240,007	0
Truck Trips	693,603	693,603	0
<b>Total Trips</b>	<b>18,709,315</b>	<b>18,709,315</b>	<b>0</b>

## SUMMARY OF TRAVEL TIME BENEFITS

Year	HIGHWAY								
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Ramp	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck
1	\$0	\$369,607	\$0	\$57,261	\$0	\$0	\$331,108	\$0	\$48,576
20	\$0	\$3,323,301	\$0	\$514,859	\$0	\$0	\$417,428	\$0	\$61,240
2	\$0	\$435,063	\$0	\$67,402	\$0	\$0	\$338,374	\$0	\$49,642
3	\$0	\$506,065	\$0	\$78,402	\$0	\$0	\$345,286	\$0	\$50,656
4	\$0	\$582,994	\$0	\$90,320	\$0	\$0	\$351,852	\$0	\$51,620
5	\$0	\$666,283	\$0	\$103,223	\$0	\$0	\$358,084	\$0	\$52,534
6	\$0	\$756,429	\$0	\$117,189	\$0	\$0	\$363,990	\$0	\$53,400
7	\$0	\$854,001	\$0	\$132,305	\$0	\$0	\$369,581	\$0	\$54,221
8	\$0	\$959,653	\$0	\$148,673	\$0	\$0	\$374,865	\$0	\$54,996
9	\$0	\$1,074,137	\$0	\$166,410	\$0	\$0	\$379,851	\$0	\$55,727
10	\$0	\$1,198,329	\$0	\$185,650	\$0	\$0	\$384,549	\$0	\$56,417
11	\$0	\$1,333,242	\$0	\$206,551	\$0	\$0	\$388,966	\$0	\$57,065
12	\$0	\$1,480,064	\$0	\$229,297	\$0	\$0	\$393,112	\$0	\$57,673
13	\$0	\$1,640,189	\$0	\$254,105	\$0	\$0	\$396,994	\$0	\$58,242
14	\$0	\$1,815,265	\$0	\$281,228	\$0	\$0	\$400,620	\$0	\$58,774
15	\$0	\$2,007,253	\$0	\$310,972	\$0	\$0	\$403,999	\$0	\$59,270
16	\$0	\$2,218,502	\$0	\$343,699	\$0	\$0	\$407,136	\$0	\$59,730
17	\$0	\$2,451,849	\$0	\$379,850	\$0	\$0	\$410,041	\$0	\$60,156
18	\$0	\$2,710,754	\$0	\$419,961	\$0	\$0	\$412,720	\$0	\$60,549
19	\$0	\$2,999,473	\$0	\$464,690	\$0	\$0	\$415,180	\$0	\$60,910
<b>Total</b>	<b>\$0</b>	<b>\$29,382,452</b>	<b>\$0</b>	<b>\$4,552,047</b>	<b>\$0</b>	<b>\$0</b>	<b>\$7,643,736</b>	<b>\$0</b>	<b>\$1,121,400</b>



C

**SUMMARY OF TRAVEL TIME BENEFITS (continued)**

Year	TRANSIT				Present Value of Travel Time Benefits	Constant Dollars	Total Per-Hrs of Time Saved
	Peak In-Vehicle	Peak Out-of-Veh	Non-Peak In-Vehicle	Non-Peak Out-of-Veh			
1	\$0	\$0	\$0	\$0	\$806,552	\$855,671	52,133
20	\$0	\$0	\$0	\$0	\$4,316,828	\$8,030,571	389,657
2	\$0	\$0	\$0	\$0	\$890,481	\$973,053	58,576
3	\$0	\$0	\$0	\$0	\$980,409	\$1,103,459	65,632
4	\$0	\$0	\$0	\$0	\$1,076,785	\$1,248,289	73,360
5	\$0	\$0	\$0	\$0	\$1,180,124	\$1,409,130	81,824
6	\$0	\$0	\$0	\$0	\$1,291,009	\$1,587,778	91,098
7	\$0	\$0	\$0	\$0	\$1,410,108	\$1,786,283	101,266
8	\$0	\$0	\$0	\$0	\$1,538,186	\$2,006,984	112,422
9	\$0	\$0	\$0	\$0	\$1,676,126	\$2,252,573	124,676
10	\$0	\$0	\$0	\$0	\$1,824,944	\$2,526,149	138,153
11	\$0	\$0	\$0	\$0	\$1,985,824	\$2,831,310	152,998
12	\$0	\$0	\$0	\$0	\$2,160,146	\$3,172,247	169,381
13	\$0	\$0	\$0	\$0	\$2,349,530	\$3,553,874	187,500
14	\$0	\$0	\$0	\$0	\$2,555,887	\$3,981,989	207,588
15	\$0	\$0	\$0	\$0	\$2,781,493	\$4,463,479	229,921
16	\$0	\$0	\$0	\$0	\$3,029,067	\$5,006,587	254,831
17	\$0	\$0	\$0	\$0	\$3,301,897	\$5,621,259	282,715
18	\$0	\$0	\$0	\$0	\$3,603,985	\$6,319,609	314,059
19	\$0	\$0	\$0	\$0	\$3,940,253	\$7,116,536	349,459
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$42,699,635</b>	<b>\$65,846,831</b>	<b>3,437,250</b>

**SUMMARY OF VEHICLE OPERATING COST BENEFITS**

Year	HIGHWAY						TRANSIT		Present Value of Veh Op Cost Benefits	Constant Dollars		
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck			Peak Period	Non-Peak Period
1	\$0	(\$13,829)	\$0	(\$2,873)	\$0	(\$15,626)	\$0	(\$3,085)	-	-	(\$35,413)	(\$37,570)
20	\$0	\$376,656	\$0	\$72,026	\$0	(\$15,704)	\$0	(\$3,101)	-	-	\$429,877	\$799,698
2	\$0	(\$5,586)	\$0	(\$1,365)	\$0	(\$15,779)	\$0	(\$3,115)	-	-	(\$25,846)	(\$28,243)
3	\$0	(\$1,408)	\$0	(\$516)	\$0	(\$15,910)	\$0	(\$3,141)	-	-	(\$20,976)	(\$23,609)
4	\$0	\$1,418	\$0	\$173	\$0	(\$16,021)	\$0	(\$3,163)	-	-	(\$17,593)	(\$20,395)
5	\$0	\$14,259	\$0	\$2,440	\$0	(\$16,111)	\$0	(\$3,181)	-	-	(\$2,593)	(\$3,097)
6	\$0	\$22,916	\$0	\$4,026	\$0	(\$16,183)	\$0	(\$3,195)	-	-	\$7,564	\$9,303
7	\$0	\$31,613	\$0	\$5,796	\$0	(\$16,236)	\$0	(\$3,206)	-	-	\$17,967	\$22,760
8	\$0	\$48,968	\$0	\$8,977	\$0	(\$16,273)	\$0	(\$3,213)	-	-	\$38,459	\$50,181
9	\$0	\$63,452	\$0	\$11,633	\$0	(\$16,294)	\$0	(\$3,217)	-	-	\$55,574	\$74,686
10	\$0	\$77,901	\$0	\$14,282	\$0	(\$16,300)	\$0	(\$3,218)	-	-	\$72,665	\$100,585
11	\$0	\$92,281	\$0	\$16,918	\$0	(\$16,292)	\$0	(\$3,217)	-	-	\$89,690	\$127,877
12	\$0	\$120,958	\$0	\$22,176	\$0	(\$16,270)	\$0	(\$3,212)	-	-	\$123,651	\$181,585
13	\$0	\$142,258	\$0	\$26,344	\$0	(\$16,236)	\$0	(\$3,206)	-	-	\$149,160	\$225,618
14	\$0	\$163,348	\$0	\$30,297	\$0	(\$16,190)	\$0	(\$3,197)	-	-	\$174,259	\$271,490
15	\$0	\$182,762	\$0	\$34,379	\$0	(\$16,133)	\$0	(\$3,185)	-	-	\$197,823	\$317,447
16	\$0	\$224,653	\$0	\$42,403	\$0	(\$16,066)	\$0	(\$3,172)	-	-	\$247,819	\$409,606
17	\$0	\$254,704	\$0	\$48,252	\$0	(\$15,988)	\$0	(\$3,157)	-	-	\$283,811	\$483,169
18	\$0	\$284,290	\$0	\$54,012	\$0	(\$15,902)	\$0	(\$3,140)	-	-	\$319,260	\$559,825
19	\$0	\$317,568	\$0	\$60,529	\$0	(\$15,807)	\$0	(\$3,121)	-	-	\$359,169	\$648,699
<b>Total</b>	<b>\$0</b>	<b>\$2,399,181</b>	<b>\$0</b>	<b>\$449,909</b>	<b>\$0</b>	<b>(\$321,324)</b>	<b>\$0</b>	<b>(\$63,441)</b>	<b>-</b>	<b>-</b>	<b>\$2,464,325</b>	<b>\$4,169,616</b>

## SUMMARY OF ACCIDENT REDUCTION BENEFITS

Year	HIGHWAY								TRANSIT	Present Value of Accident Benefits	Constant Dollars
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck	All Periods		
1	\$0	\$1,205,769	\$0	\$133,974	\$0	\$1,048,005	\$0	\$116,445	\$0	\$2,504,194	\$2,656,700
20	\$0	\$1,211,845	\$0	\$134,649	\$0	\$1,053,286	\$0	\$117,032	\$0	\$2,516,812	\$4,682,011
2	\$0	\$1,217,620	\$0	\$135,291	\$0	\$1,058,305	\$0	\$117,589	\$0	\$2,528,806	\$2,763,295
3	\$0	\$1,227,758	\$0	\$136,418	\$0	\$1,067,117	\$0	\$118,569	\$0	\$2,549,860	\$2,869,890
4	\$0	\$1,236,272	\$0	\$137,364	\$0	\$1,074,517	\$0	\$119,391	\$0	\$2,567,543	\$2,976,486
5	\$0	\$1,243,248	\$0	\$138,139	\$0	\$1,080,580	\$0	\$120,064	\$0	\$2,582,032	\$3,083,081
6	\$0	\$1,248,770	\$0	\$138,752	\$0	\$1,085,379	\$0	\$120,598	\$0	\$2,593,499	\$3,189,676
7	\$0	\$1,252,915	\$0	\$139,213	\$0	\$1,088,982	\$0	\$120,998	\$0	\$2,602,107	\$3,296,272
8	\$0	\$1,255,759	\$0	\$139,529	\$0	\$1,091,454	\$0	\$121,273	\$0	\$2,608,014	\$3,402,867
9	\$0	\$1,257,374	\$0	\$139,708	\$0	\$1,092,858	\$0	\$121,429	\$0	\$2,611,370	\$3,509,462
10	\$0	\$1,257,831	\$0	\$139,759	\$0	\$1,093,255	\$0	\$121,473	\$0	\$2,612,317	\$3,616,058
11	\$0	\$1,257,194	\$0	\$139,688	\$0	\$1,092,701	\$0	\$121,411	\$0	\$2,610,994	\$3,722,653
12	\$0	\$1,255,527	\$0	\$139,503	\$0	\$1,091,252	\$0	\$121,250	\$0	\$2,607,532	\$3,829,249
13	\$0	\$1,252,890	\$0	\$139,210	\$0	\$1,088,961	\$0	\$120,996	\$0	\$2,602,056	\$3,935,844
14	\$0	\$1,249,342	\$0	\$138,816	\$0	\$1,085,877	\$0	\$120,653	\$0	\$2,594,688	\$4,042,439
15	\$0	\$1,244,938	\$0	\$138,326	\$0	\$1,082,049	\$0	\$120,228	\$0	\$2,585,541	\$4,149,035
16	\$0	\$1,239,731	\$0	\$137,748	\$0	\$1,077,523	\$0	\$119,725	\$0	\$2,574,726	\$4,255,630
17	\$0	\$1,233,770	\$0	\$137,086	\$0	\$1,072,342	\$0	\$119,149	\$0	\$2,562,348	\$4,362,225
18	\$0	\$1,227,106	\$0	\$136,345	\$0	\$1,066,550	\$0	\$118,506	\$0	\$2,548,506	\$4,468,821
19	\$0	\$1,219,782	\$0	\$135,531	\$0	\$1,060,185	\$0	\$117,798	\$0	\$2,533,297	\$4,575,416
<b>Total</b>	<b>\$0</b>	<b>\$24,795,441</b>	<b>\$0</b>	<b>\$2,755,049</b>	<b>\$0</b>	<b>\$21,551,178</b>	<b>\$0</b>	<b>\$2,394,575</b>	<b>\$0</b>	<b>\$51,496,243</b>	<b>\$73,387,110</b>

## SUMMARY OF EMISSION REDUCTION BENEFITS

Year	HIGHWAY								
	Peak HOV	Peak Non-HOV	Peak Weaving	Peak Truck	Peak Ramp	Peak Arterial	Non-Peak Non-HOV	Non-Peak Weaving	Non-Peak Truck
1	\$0	(\$1,292)	\$0	(\$624)	\$0	\$0	(\$1,433)	\$0	(\$590)
20	\$0	\$48,944	\$0	\$8,426	\$0	\$0	(\$1,762)	\$0	(\$387)
2	\$0	(\$440)	\$0	(\$475)	\$0	\$0	(\$1,472)	\$0	(\$600)
3	\$0	(\$102)	\$0	(\$423)	\$0	\$0	(\$1,510)	\$0	(\$610)
4	\$0	\$440	\$0	(\$347)	\$0	\$0	(\$1,546)	\$0	(\$619)
5	\$0	\$1,821	\$0	(\$136)	\$0	\$0	(\$1,582)	\$0	(\$627)
6	\$0	\$2,873	\$0	\$39	\$0	\$0	(\$1,616)	\$0	(\$635)
7	\$0	\$3,751	\$0	\$222	\$0	\$0	(\$1,650)	\$0	(\$642)
8	\$0	\$5,503	\$0	\$797	\$0	\$0	(\$1,422)	\$0	(\$329)
9	\$0	\$6,961	\$0	\$1,066	\$0	\$0	(\$1,454)	\$0	(\$335)
10	\$0	\$8,659	\$0	\$1,344	\$0	\$0	(\$1,486)	\$0	(\$340)
11	\$0	\$10,380	\$0	\$1,631	\$0	\$0	(\$1,516)	\$0	(\$346)
12	\$0	\$13,797	\$0	\$2,216	\$0	\$0	(\$1,546)	\$0	(\$351)
13	\$0	\$16,397	\$0	\$2,683	\$0	\$0	(\$1,575)	\$0	(\$356)
14	\$0	\$19,088	\$0	\$3,141	\$0	\$0	(\$1,604)	\$0	(\$361)
15	\$0	\$21,814	\$0	\$3,630	\$0	\$0	(\$1,632)	\$0	(\$366)
16	\$0	\$27,318	\$0	\$4,583	\$0	\$0	(\$1,659)	\$0	(\$370)
17	\$0	\$31,479	\$0	\$5,331	\$0	\$0	(\$1,686)	\$0	(\$375)
18	\$0	\$35,749	\$0	\$6,073	\$0	\$0	(\$1,712)	\$0	(\$379)
19	\$0	\$40,534	\$0	\$6,943	\$0	\$0	(\$1,737)	\$0	(\$383)
<b>Total</b>	<b>\$0</b>	<b>\$293,672</b>	<b>\$0</b>	<b>\$46,121</b>	<b>\$0</b>	<b>\$0</b>	<b>(\$31,601)</b>	<b>\$0</b>	<b>(\$8,998)</b>

C

**SUMMARY OF EMISSION REDUCTION BENEFITS (continued)**

Year	TRANSIT				Present Value of Emission Benefits	Constant Dollars	CO <sub>2</sub> EMISSIONS SAVED	
	Peak Bus	Non-Peak Bus	Passenger Rail	Light Rail			tons/yr	PV \$/yr
1	\$0	\$0	\$0	\$0	(\$3,939)	(\$4,179)	(117)	(\$2,753)
20	\$0	\$0	\$0	\$0	\$55,220	\$102,726	2,457	\$48,035
2	\$0	\$0	\$0	\$0	(\$2,987)	(\$3,264)	(91)	(\$2,115)
3	\$0	\$0	\$0	\$0	(\$2,645)	(\$2,977)	(78)	(\$1,795)
4	\$0	\$0	\$0	\$0	(\$2,072)	(\$2,402)	(64)	(\$1,454)
5	\$0	\$0	\$0	\$0	(\$524)	(\$626)	(11)	(\$253)
6	\$0	\$0	\$0	\$0	\$661	\$813	27	\$600
7	\$0	\$0	\$0	\$0	\$1,681	\$2,130	67	\$1,494
8	\$0	\$0	\$0	\$0	\$4,549	\$5,936	149	\$3,276
9	\$0	\$0	\$0	\$0	\$6,239	\$8,384	223	\$4,865
10	\$0	\$0	\$0	\$0	\$8,177	\$11,319	302	\$6,515
11	\$0	\$0	\$0	\$0	\$10,149	\$14,470	385	\$8,222
12	\$0	\$0	\$0	\$0	\$14,116	\$20,730	548	\$11,595
13	\$0	\$0	\$0	\$0	\$17,149	\$25,940	683	\$14,297
14	\$0	\$0	\$0	\$0	\$20,263	\$31,570	824	\$17,080
15	\$0	\$0	\$0	\$0	\$23,446	\$37,625	971	\$19,939
16	\$0	\$0	\$0	\$0	\$29,872	\$49,373	1,254	\$25,492
17	\$0	\$0	\$0	\$0	\$34,749	\$59,158	1,481	\$29,821
18	\$0	\$0	\$0	\$0	\$39,732	\$69,670	1,718	\$34,254
19	\$0	\$0	\$0	\$0	\$45,356	\$81,919	1,990	\$39,289
<b>Total</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$299,194</b>	<b>\$508,314</b>	<b>12,719</b>	<b>\$256,405</b>

## NET PRESENT VALUE CALCULATION

Year	PRESENT VALUE OF USER BENEFITS				PRESENT VALUE OF USER BENEFITS (road 2)			
	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions
<b>Construction Period</b>								
1								
2								
3								
4								
5								
6								
7								
8								
<b>Project Open</b>								
1	\$806,552	(\$35,413)	\$2,504,194	(\$3,939)				
2	\$890,481	(\$25,846)	\$2,528,806	(\$2,987)				
3	\$980,409	(\$20,976)	\$2,549,860	(\$2,645)				
4	\$1,076,785	(\$17,593)	\$2,567,543	(\$2,072)				
5	\$1,180,124	(\$2,593)	\$2,582,032	(\$524)				
6	\$1,291,009	\$7,564	\$2,593,499	\$661				
7	\$1,410,108	\$17,967	\$2,602,107	\$1,681				
8	\$1,538,186	\$38,459	\$2,608,014	\$4,549				
9	\$1,676,126	\$55,574	\$2,611,370	\$6,239				
10	\$1,824,944	\$72,665	\$2,612,317	\$8,177				
11	\$1,985,824	\$89,690	\$2,610,994	\$10,149				
12	\$2,160,146	\$123,651	\$2,607,532	\$14,116				
13	\$2,349,530	\$149,160	\$2,602,056	\$17,149				
14	\$2,555,887	\$174,259	\$2,594,688	\$20,263				
15	\$2,781,493	\$197,823	\$2,585,541	\$23,446				
16	\$3,029,067	\$247,819	\$2,574,726	\$29,872				
17	\$3,301,897	\$283,811	\$2,562,348	\$34,749				
18	\$3,603,985	\$319,260	\$2,548,506	\$39,732				
19	\$3,940,253	\$359,169	\$2,533,297	\$45,356				
20	\$4,316,828	\$429,877	\$2,516,812	\$55,220				
<b>Total</b>	\$42,699,635	\$2,464,325	\$51,496,243	\$299,194	\$0	\$0	\$0	\$0

3,437,250	Person-Hours of Time Saved
12,719	CO <sub>2</sub> Emissions Saved (tons)
\$256,405	CO <sub>2</sub> Emissions Saved (\$ PV)

	Person-Hours of Time Saved
	CO <sub>2</sub> Emissions Saved (tons)
	CO <sub>2</sub> Emissions Saved (\$ PV)

PRESENT VALUE OF USER BENEFITS (road 3)				Present Value of Total User Benefits	Present Value of Total Project Costs	NET PRESENT VALUE
Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions			
				\$0	\$7,500,000	(\$7,500,000)
				\$0	\$7,281,553	(\$7,281,553)
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$3,271,394	\$0	\$3,271,394
				\$3,390,455	\$0	\$3,390,455
				\$3,506,648	\$0	\$3,506,648
				\$3,624,663	\$0	\$3,624,663
				\$3,759,038	\$0	\$3,759,038
				\$3,892,733	\$0	\$3,892,733
				\$4,031,864	\$0	\$4,031,864
				\$4,189,209	\$0	\$4,189,209
				\$4,349,308	\$0	\$4,349,308
				\$4,518,103	\$0	\$4,518,103
				\$4,696,657	\$0	\$4,696,657
				\$4,905,445	\$0	\$4,905,445
				\$5,117,896	\$0	\$5,117,896
				\$5,345,098	\$0	\$5,345,098
				\$5,588,303	\$0	\$5,588,303
				\$5,881,484	\$0	\$5,881,484
				\$6,182,805	\$0	\$6,182,805
				\$6,511,483	\$0	\$6,511,483
				\$6,878,076	\$0	\$6,878,076
				\$7,318,737	\$0	\$7,318,737
				<b>\$96,959,397</b>	<b>\$14,781,553</b>	<b>\$82,177,843</b>

	Person-Hours of Time Saved
	CO <sub>2</sub> Emissions Saved (tons)
	CO <sub>2</sub> Emissions Saved (\$ PV)

B

## INTERNAL RATE OF RETURN ON INVESTMENT AND PAYBACK PERIOD

Year	USER BENEFITS IN CONSTANT DOLLARS				USER BENEFITS IN CONSTANT DOLLARS (road 2)			
	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions
<b>Construction Period</b>								
1								
2								
3								
4								
5								
6								
7								
8								
<b>Project Open</b>								
1	\$855,671	(\$37,570)	\$2,656,700	(\$4,179)				
2	\$973,053	(\$28,243)	\$2,763,295	(\$3,264)				
3	\$1,103,459	(\$23,609)	\$2,869,890	(\$2,977)				
4	\$1,248,289	(\$20,395)	\$2,976,486	(\$2,402)				
5	\$1,409,130	(\$3,097)	\$3,083,081	(\$626)				
6	\$1,587,778	\$9,303	\$3,189,676	\$813				
7	\$1,786,283	\$22,760	\$3,296,272	\$2,130				
8	\$2,006,984	\$50,181	\$3,402,867	\$5,936				
9	\$2,252,573	\$74,686	\$3,509,462	\$8,384				
10	\$2,526,149	\$100,585	\$3,616,058	\$11,319				
11	\$2,831,310	\$127,877	\$3,722,653	\$14,470				
12	\$3,172,247	\$181,585	\$3,829,249	\$20,730				
13	\$3,553,874	\$225,618	\$3,935,844	\$25,940				
14	\$3,981,989	\$271,490	\$4,042,439	\$31,570				
15	\$4,463,479	\$317,447	\$4,149,035	\$37,625				
16	\$5,006,587	\$409,606	\$4,255,630	\$49,373				
17	\$5,621,259	\$483,169	\$4,362,225	\$59,158				
18	\$6,319,609	\$559,825	\$4,468,821	\$69,670				
19	\$7,116,536	\$648,699	\$4,575,416	\$81,919				
20	\$8,030,571	\$799,698	\$4,682,011	\$102,726				
<b>Total</b>	<b>\$65,846,831</b>	<b>\$4,169,616</b>	<b>\$73,387,110</b>	<b>\$508,314</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>



USER BENEFITS IN CONSTANT DOLLARS (road 3)				Total User Benefits in Constant Dollars	Total Project Costs in Constant Dollars	ANNUAL RETURNS ON INVESTMENT	CUMULATIVE RETURNS AFTER PROJ OPENS
Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions				
				\$0	\$7,500,000	(\$7,500,000)	
				\$0	\$7,500,000	(\$7,500,000)	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$3,470,622	\$0	\$3,470,622	\$3,470,622
				\$3,704,842	\$0	\$3,704,842	\$7,175,464
				\$3,946,763	\$0	\$3,946,763	\$11,122,227
				\$4,201,978	\$0	\$4,201,978	\$15,324,205
				\$4,488,488	\$0	\$4,488,488	\$19,812,693
				\$4,787,570	\$0	\$4,787,570	\$24,600,264
				\$5,107,444	\$0	\$5,107,444	\$29,707,708
				\$5,465,968	\$0	\$5,465,968	\$35,173,676
				\$5,845,106	\$0	\$5,845,106	\$41,018,782
				\$6,254,111	\$0	\$6,254,111	\$47,272,893
				\$6,696,310	\$0	\$6,696,310	\$53,969,202
				\$7,203,811	\$0	\$7,203,811	\$61,173,014
				\$7,741,277	\$0	\$7,741,277	\$68,914,290
				\$8,327,488	\$0	\$8,327,488	\$77,241,778
				\$8,967,586	\$0	\$8,967,586	\$86,209,364
				\$9,721,196	\$0	\$9,721,196	\$95,930,560
				\$10,525,811	\$0	\$10,525,811	\$106,456,372
				\$11,417,924	\$0	\$11,417,924	\$117,874,296
				\$12,422,570	\$0	\$12,422,570	\$130,296,865
				\$13,615,007	\$0	\$13,615,007	\$143,911,872
\$0	\$0	\$0	\$0	<b>\$143,911,872</b>	<b>\$15,000,000</b>	<b>\$128,911,872</b>	

Total Construction Costs

**\$15,000,000**

Years After Construction Begins	ANNUAL RETURNS ON INVESTMENT
1	(\$7,500,000)
2	(\$7,500,000)
3	\$3,470,622
4	\$3,704,842
5	\$3,946,763
6	\$4,201,978
7	\$4,488,488
8	\$4,787,570
9	\$5,107,444
10	\$5,465,968
11	\$5,845,106
12	\$6,254,111
13	\$6,696,310
14	\$7,203,811
15	\$7,741,277
16	\$8,327,488
17	\$8,967,586
18	\$9,721,196
19	\$10,525,811
20	\$11,417,924
21	\$12,422,570
22	\$13,615,007
23	\$0
24	\$0
25	\$0
26	\$0
27	\$0
28	\$0

**Internal Rate of Return** 26.57%

**Payback Period** 4 years

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.

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	2015
Economic Update Factor (Using GDP Deflator)	1.02
Real Discount Rate	3.0%

Travel Time Parameters		
	Value	Units
Statewide Average Hourly Wage	\$ 30.26	\$/hr
<b>Heavy and Light Truck Drivers</b>		
Average Hourly Wage	\$ 17.69	\$/hr
Benefits and Costs	\$ 8.68	\$/hr
<b>Value of Time</b>		
Automobile	\$ 15.13	\$/hr/per
Truck	\$ 26.37	\$/hr/veh
Auto & Truck Composite	\$ 20.27	\$/hr/veh
Transit	\$ 15.13	\$/hr/per
Out-of-Vehicle Travel	2	times
Incident-Related Travel	3	times
Travel Time Updater	1.2%	annual incr
<b>Vehicle Operating Cost Parameters</b>		
<b>Average Fuel Price</b>		
Automobile (regular unleaded)	\$ 3.37	\$/gal
Truck (diesel)	\$ 3.74	\$/gal
<b>Sales and Fuel Taxes</b>		
State Sales Tax (gasoline)	0.00%	%
State Sales Tax (diesel)	0.00%	%
Average Local Sales Tax	0.00%	%
Federal Fuel Excise Tax (gasoline)	\$ 0.184	\$/gal
Federal Fuel Excise Tax (diesel)	\$ 0.244	\$/gal
State Fuel Excise Tax (gasoline)	\$ 0.200	\$/gal
State Fuel Excise Tax (diesel)	\$ 0.200	\$/gal
<b>Fuel Cost Per Gallon (Exclude Taxes)</b>		
Automobile	\$ 3.00	\$/gal
Truck	\$ 3.30	\$/gal
<b>Non-Fuel Cost Per Mile</b>		
Automobile	\$ 0.324	\$/mi
Truck	\$ 0.447	\$/mi
Idling Speed for Op. Costs and Emissions	5	mph
<b>Accident Cost Parameters</b>		
Cost of a Fatality	\$ 9,200,000	\$/event
<b>Cost of an Injury</b>		
Level A (Severe)	\$ 966,000	\$/event
Level B (Moderate)	\$ 432,400	\$/event
Level C (Minor)	\$ 27,600	\$/event
Cost of Property Damage	\$ 3,927	\$/event
<b>Cost of Highway Accident</b>		
Fatal Accident	\$ 10,200,000	\$/accident
Injury Accident	\$ 261,100	\$/accident
PDO Accident	\$ 15,900	\$/accident
Average Cost	\$ 145,400	\$/accident
<b>Statewide Highway Accident Rates</b>		
Fatal Accident	0.007	per mil veh-mi
Injury Accident	0.27	per mil veh-mi
PDO Accident	0.53	per mil veh-mi
Non-Freeway	1.05	per mil veh-mi

Highway Operations Parameters				
	Value	Units		
Maximum V/C Ratio	1.56	-		
Percent ADT in Peak Period	53.5%	%		
Percent ADT in Average Peak Hour	7.6%	%		
Annualization Factor	260	days/yr		
<b>Freeway</b>				
	Alpha	Beta	Capacity (vp/hpl)	Dep. Rate (vp/hpl)
Freeway	0.20	10	2,000	1,800
Expressway	0.20	10	2,000	1,800
Conventional Highway	0.05	10	800	1,400
HOV Lanes	0.55	8	1,600	
<b>Non-HOV Lanes</b>				
	Alpha	Beta	Capacity (vp/hpl)	
No Build	0.05	10	800	
Build	0.05	10	800	

Sources: 15) Highway Capacity Manual, 16) NCHRP 387, 17) PeMS data

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) National Safety Council, 13) TASAS summary 2009

TIGER Sources: 1) OMB GDP and Deflators Used in Historical Tables 1940-2019 (Table 10.1), 2) TIC

**Travel Demand Tables**

**Project Types**

**Highway Capacity Expansion**  
 Please select a type of highway project

General Highway	<input type="checkbox"/> TRUE	GenHwy	
HOV Lane Addition	<input type="checkbox"/> FALSE	HOV	Enter HOV restriction in section 1B
HOT Lane Addition	<input type="checkbox"/> FALSE	HOT	Include toll payers as HOVs & check AVOs
Passing Lane	<input type="checkbox"/> FALSE	Passing	Enter a truck speed in section 1B
Intersection	<input type="checkbox"/> FALSE	Intersect	Remember to run model for both roads
Bypass	<input type="checkbox"/> FALSE	Bypass	Remember to run model for both roads
Queuing	<input type="checkbox"/> FALSE	Queuing	Add arrival rate & check departure rate in 1B
Pavement	<input type="checkbox"/> FALSE	Pavement	Enter pavement condition in section 1B

**Rail or Transit Cap Expansion**  
 Please select a type of rail or transit project

Passenger Rail	<input type="checkbox"/> FALSE	PassRail	Enter data in both sections 1B & 1E
Light-Rail (LRT)	<input type="checkbox"/> FALSE	LRT	Enter data in both sections 1B & 1E
Bus	<input type="checkbox"/> FALSE	Bus	Enter data in both sections 1B & 1E
Hwy-Rail Grade Crossing	<input type="checkbox"/> 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	<input type="checkbox"/> FALSE	AuxLane	Enter ramp design speed & on-ramp volume
Freeway Connector	<input type="checkbox"/> FALSE	FreeConn	Check percent traffic in weave in section 1B
HOV Connector	<input type="checkbox"/> FALSE	HOVConn	Check percent traffic in weave in section 1B
HOV Drop Ramp	<input type="checkbox"/> FALSE	HOVDrop	Check percent traffic in weave in section 1B
Off-Ramp Widening	<input type="checkbox"/> FALSE	OffRamp	Check percent traffic in weave in section 1B
On-Ramp Widening	<input type="checkbox"/> FALSE	OnRamp	Enter on-ramp volume & metering strategy
HOV-2 to HOV-3 Conv	<input type="checkbox"/> FALSE	HOV2to3	Check AVOs & trips in sections 1B & 2D
HOT Lane Conversion	<input type="checkbox"/> FALSE	HOTConv	Check AVOs & trips in sections 1B & 2D

**Transp Mgmt Systems (TMS)**  
 Please select a type of TMS project

Ramp Metering	<input type="checkbox"/> FALSE	RM	Enter model data, if avail, in sections 2A & 2C
Ramp Metering Signal Coord	<input type="checkbox"/> FALSE	AM	Enter model data, if avail, in sections 2A & 2C
Incident Management	<input type="checkbox"/> FALSE	IM	Enter model data, if avail, in sections 2A & 2C
Traveler Information	<input type="checkbox"/> FALSE	TI	Enter model data, if avail, in sections 2A & 2C
Arterial Signal Management	<input type="checkbox"/> FALSE	ASM	Complete only sections 1A, 1E & 2C
Transit Vehicle Location (AVL)	<input type="checkbox"/> FALSE	AVL	Enter transit agency costs in section 1D
Transit Vehicle Signal Priority	<input type="checkbox"/> FALSE	SigPriority	Check travel time in section 1D
Bus Rapid Transit (BRT)	<input type="checkbox"/> FALSE	BRT	Enter free-flow bus lane speed in section 1B

TMS Lookup Code  NoAdj TMSLookup  
 User Modified Inputs  FALSE 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
1	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%
2	17.2%	17.2%	17.2%	17.2%	17.2%	17.2%
3	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%
4	34.1%	34.1%	34.1%	34.1%	34.1%	34.1%
5	41.0%	41.0%	41.0%	41.0%	41.0%	41.0%
6	47.3%	47.3%	47.3%	47.3%	47.3%	47.3%
7	53.5%	53.5%	53.5%	53.5%	53.5%	53.5%
8	59.6%	59.6%	59.6%	59.6%	59.6%	59.6%
9	65.6%	65.6%	65.6%	65.6%	65.6%	65.6%
10	71.1%	71.1%	71.1%	71.1%	71.1%	71.1%
11	76.5%	76.5%	76.5%	76.5%	76.5%	76.5%
12	81.7%	81.7%	81.7%	81.7%	81.7%	81.7%
13	86.9%	86.9%	86.9%	86.9%	86.9%	86.9%
14	89.9%	89.9%	89.9%	89.9%	89.9%	89.9%
15	92.7%	92.7%	92.7%	92.7%	92.7%	92.7%
16	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%
17	96.7%	96.7%	96.7%	96.7%	96.7%	96.7%
18	97.9%	97.9%	97.9%	97.9%	97.9%	97.9%
19	98.9%	98.9%	98.9%	98.9%	98.9%	98.9%
20	99.5%	99.5%	99.5%	99.5%	99.5%	99.5%
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, 2000-2001 California Statewide Travel Survey  
 Weekday Travel Report, June 2003

**Operating Cost Tables**

<b>FUEL CONSUMPTION RATES</b>		
<i>(gal/veh-mi)</i>		
<b>Speed</b>	<b>Auto*</b>	<b>Truck</b>
5	0.1439	0.2234
6	0.1366	0.2130
7	0.1293	0.2026
8	0.1220	0.1922
9	0.1147	0.1818
10	0.1074	0.1714
11	0.1025	0.1631
12	0.0977	0.1548
13	0.0929	0.1466
14	0.0880	0.1383
15	0.0832	0.1300
16	0.0800	0.1247
17	0.0767	0.1193
18	0.0735	0.1139
19	0.0702	0.1086
20	0.0670	0.1032
21	0.0648	0.0997
22	0.0626	0.0962
23	0.0603	0.0926
24	0.0581	0.0891
25	0.0559	0.0856
26	0.0544	0.0832
27	0.0529	0.0809
28	0.0515	0.0785
29	0.0500	0.0762
30	0.0485	0.0738
31	0.0475	0.0723
32	0.0465	0.0708
33	0.0455	0.0693
34	0.0445	0.0678
35	0.0435	0.0663
36	0.0429	0.0654
37	0.0423	0.0645
38	0.0417	0.0635
39	0.0411	0.0626
40	0.0405	0.0617
41	0.0402	0.0613
42	0.0400	0.0609
43	0.0397	0.0604
44	0.0394	0.0600
45	0.0391	0.0596
46	0.0391	0.0596
47	0.0391	0.0596
48	0.0391	0.0596
49	0.0391	0.0596
50	0.0390	0.0596
51	0.0393	0.0600
52	0.0396	0.0604
53	0.0399	0.0608
54	0.0401	0.0612
55	0.0404	0.0617
56	0.0410	0.0626
57	0.0416	0.0635
58	0.0422	0.0644
59	0.0428	0.0653
60	0.0433	0.0662
61	0.0443	0.0677
62	0.0453	0.0692
63	0.0462	0.0708
64	0.0472	0.0723
65	0.0482	0.0738
66	0.0488	0.0752
67	0.0495	0.0767
68	0.0502	0.0781
69	0.0509	0.0796
70	0.0515	0.0810
71	0.0516	0.0821
72	0.0516	0.0831
73	0.0516	0.0842
74	0.0517	0.0854
75	0.0517	0.0865
76	0.0518	0.0882
77	0.0518	0.0900
78	0.0519	0.0918
79	0.0519	0.0936
80	0.0520	0.0953

\*Includes motorcycles & motorhomes  
 Note: Five mph is best estimate for idling

Source: California Air Resources Board,  
 EMFAC2011, 2011 & 2031 average

**Accident Tables**

**HIGHWAY INJURY SEVERITY FREQUENCY**  
(percent of injuries)

Event	Urban	Suburban	Rural	Average
Severe Injury (A)	4.70%	4.70%	4.70%	4.70%
Other Visible Injury (B)	26.28%	26.28%	26.28%	26.28%
Complaint of Pain (C)	69.02%	69.02%	69.02%	69.02%

Source: 2009 SWITRS Annual Report, Table 8C

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

Event	Pass Train	Light Rail	Bus
Fatality	0.0428	0.1897	0.0351
Injury	0.2517	3.6283	3.8909
All Accidents	0.2519	7.4952	3.8924

Source: USDOT, Transportation Statistics Annual Report, Table 2-33, 2002 to 2008 average

**NUMBER OF FATALITIES**  
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.09	1.11	1.16	1.13

**NUMBER OF INJURIES**  
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	0.84	1.02	1.26	1.06
Injury Accident	1.42	1.43	1.51	1.44

**NUMBER OF VEHICLES INVOLVED**  
(events/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	1.69	1.63	1.61	1.65
Injury Accident	2.08	1.97	1.58	1.96
PDO Accident	2.03	1.94	1.62	1.95

**DISTRIBUTION OF ACCIDENT TYPES**  
(percent of accidents)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	0.50%	0.74%	2.11%	0.83%
Injury Accident	32.08%	32.90%	37.91%	33.27%
PDO Accident	67.42%	66.37%	59.98%	65.90%

Source: California Department of Transportation, TASAS Unit, 2007 to 2009 average

**COST OF TRANSIT ACCIDENT EVENTS**  
(\$/event)

Event	Pass Train	Light Rail	Bus
Fatality	\$9,200,000	\$9,200,000	\$9,200,000
Injury	\$513,400	\$513,400	\$513,400
Prop Damage	\$82,000	\$5,800	\$2,800

Source: FTA, Transit Safety & Security Statistics, 2002 to 2007 average

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

Value	Pass Train	Light Rail	Bus
Cost	\$543,600	\$3,651,500	\$2,331,400

Source: Combination of above two tables

**HIGHWAY-RAIL GRADE CROSSING INCIDENTS**  
(units in table)

Value	Incident	Fatality	Injury
Total Events	1,500	332	608
Avg per Incident		0.2213	0.4053
Cost per Event		\$9,200,000	\$513,400

Source: FRA, Office of Safety Analysis, 5.11 - Hwy/Rail Incidents Summary Tables, California, Jan 2001 to Dec 2010

**COST OF HIGHWAY ACCIDENTS**  
(\$/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	\$10,200,000	\$10,400,000	\$10,900,000	\$10,600,000
Injury Accident	\$261,100	\$262,400	\$275,100	\$264,100
PDO Accident	\$15,900	\$15,200	\$12,700	\$15,300
All Types	\$145,400	\$172,900	\$342,100	\$185,700

Source: Combination of above four tables

**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









**HEALTH COST OF TRANSPORTATION EMISSIONS**  
(\$/ton)

Area	Proj Loc	CO	CO <sub>2</sub> e	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	VOC
LA/South Coast	1	\$0	\$24	\$8,209	\$360,383	\$46,561	\$2,083
CA Urban Area	2	\$0	\$24	\$7,877	\$360,383	\$46,561	\$1,999
CA Rural Area	3	\$0	\$24	\$7,877	\$360,383	\$46,561	\$1,999

CO<sub>2</sub>e Uprater  increase in value per year

Sources: McCubbin and Delucchi, 1996 for emissions other than CO<sub>2</sub>e  
Interagency Working Group on Social Cost of Carbon, United States Government, 2010 for CO<sub>2</sub>e

**PASSENGER TRAIN EMISSIONS FACTORS**  
(g/train-mile)

Mode	Year	CO	CO <sub>2</sub>	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	VOC
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 <sub>2</sub>	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	VOC
Light Rail	2002	0.14		1.13	0.17		0.06
	2022	0.14		1.14	0.17		0.06

Source: California Air Resources Board

**Pavement Adjustments** (used only for pavement projects)

**PAVEMENT DETERIORATION**  
(IRI in inches/mile)

Year 0	Year 20, By Loading		
	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	1.00	1.02
25	1.00	1.02
50	1.00	1.02
75	1.00	1.02
100	1.00	1.02
125	1.00	1.02
150	1.00	1.01
175	1.00	1.00
200	1.00	0.98
225	1.00	0.95
250	1.00	0.92
275	0.99	0.89
300	0.98	0.86
325	0.97	0.83
350	0.96	0.81
375	0.95	0.78
400	0.94	0.76
425	0.93	0.73
450	0.92	0.71

Source: Botterill, 1996 and 1997

**FUEL CONSUMPTION**  
(percent adjustment)

IRI	Auto	Truck
0	0.97	0.96
25	0.98	0.97
50	0.98	0.97
75	0.98	0.98
100	0.98	0.98
125	0.99	0.99
150	1.00	0.99
175	1.00	1.00
200	1.01	1.01
225	1.01	1.02
250	1.02	1.03
275	1.03	1.04
300	1.03	1.05
325	1.04	1.06
350	1.05	1.07
375	1.06	1.08
400	1.07	1.10
425	1.08	1.11
450	1.09	1.13

Source: Texas Transportation Institute, 1994

**NON-FUEL COSTS**  
(percent adjustment)

IRI	Auto	Truck
0	1.00	1.00
25	1.00	1.00
50	1.00	1.00
75	1.00	1.00
100	1.00	1.00
125	1.00	1.00
150	1.02	1.02
175	1.03	1.04
200	1.05	1.06
225	1.07	1.08
250	1.09	1.10
275	1.11	1.12
300	1.12	1.14
325	1.14	1.16
350	1.16	1.18
375	1.18	1.20
400	1.19	1.22
425	1.21	1.24
450	1.23	1.26

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	1.00	1.00
0.002	0.98	0.99
0.004	0.96	0.98
0.006	0.95	0.96
0.008	0.93	0.95
0.010	0.91	0.94
0.012	0.89	0.93
0.014	0.87	0.92
0.016	0.85	0.90
0.018	0.84	0.89
0.020	0.79	0.88
0.022	0.75	0.87
0.024	0.71	0.85
0.026	0.66	0.84
0.028	0.62	0.82
0.030	0.58	0.79
0.032	0.54	0.76
0.034	0.50	0.73
0.036	0.48	0.71
0.038	0.47	0.68
0.040	0.47	0.65
0.042	0.47	0.62
0.044	0.47	0.60
0.046	0.46	0.57
0.048	0.46	0.54
0.050	0.46	0.51
0.052	0.46	0.48
0.054	0.45	0.48
0.056	0.45	0.47
0.058	0.45	0.47
0.060	0.45	0.47
0.062	0.45	0.47
0.064	0.45	0.47
0.066	0.45	0.47
0.068	0.45	0.46
0.070	0.45	0.46
0.072	0.45	0.46
0.074	0.45	0.46
0.076	0.45	0.46
0.078	0.45	0.46
0.080	0.45	0.45

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 Strategy	Without		With		Non-Highway Benefits			Total Benefit
	Speed	Volume	Speed	Volume	TT	VOC	Em	
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	0.00
ORsev	0.95	1.03	1.00	1.00	0.00	0.00	5.67	0.00
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
Tloth	1.00	1.00	1.02	0.97	-0.11	-0.12	-0.35	1.00
Tlsev	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  
18) 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