District: **District 8**

PROJECT: **Dale Evans Parkway at Waalew Road**

EA:
PPNO:

1A PROJECT DATA

Type of Project	Remember to run model for both roads	
Select project type from list	Intersection	
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)	4	hours

1B HIGHWAY DESIGN AND TRAFFIC DATA

Highway Design		No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)		C	C
Number of General Traffic Lanes		2	2
Number of HOV/HOT Lanes		0	0
HOV Restriction (2 or 3)		0	
Exclusive ROW for Buses (y/n)		N	
Highway Free-Flow Speed		55	55
Ramp Design Speed (if aux. lane/off-ramp proj.)		0	0
Length (in miles)	Highway Segment	0.2	0.2
	Impacted Length	0.2	0.0

Average Daily Traffic			
	Current	3,186	
		No Build	Build
	Base (Year 1)	3,375	3,375
	Forecast (Year 20)	5,175	5,175
Average Hourly HOV/HOT Lane Traffic		0	0
Percent of Induced Trips in HOV (if HOT or 2-to-3		0	0%
Percent Traffic in Weave		0.0%	0.0%
Percent Trucks (include RVs, if applicable)		5%	5%
Truck Speed		0	

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.)	0	

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	1.30	1.30
	Peak	1.15	1.15
High Occupancy Vehicle (if HOV/HOT lanes)		2.15	2.15

1C HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)	Count (No.)	Rate
Total Accidents (Tot)	3	0.86
Fatal Accidents (Fat)	1	0.287
Injury Accidents (Inj)	0	0.00
Property Damage Only (PDO) Accidents	2	0.57

Statewide Basic Average Accident Rate	No Build	Build
Rate Group	I 22	I 09
Accident Rate (per million vehicle-miles)	0.14	0.43
Percent Fatal Accidents (Pct Fat)	1.2%	0.4%
Percent Injury Accidents (Pct Inj)	38.2%	36.1%

1D RAIL AND TRANSIT DATA

Annual Person-Trips		No Build	Build
	Base (Year 1)		
	Forecast (Year 20)		
Percent Trips during Peak Period		33%	
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					
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
Construction Period									
1	$100							$100,000	$100,000
2		100	1,260					1,360,000	1,307,692
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
Project Open									
1								$0	$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
9								0	0
10								0	0
11								0	0
12								0	0
13								0	0
14								0	0
15								0	0
16								0	0
17								0	0
18								0	0
19								0	0
20								0	0
Total	$100	$100	$1,260	$0	$0	$0	$0	$1,460,000	$1,407,692

Present Value = Future Value (in Constant Dollars) / (1 + Real Discount Rate) ^ Year

District: District 8

PROJECT: Dale Evans Parkway at Waalew Road

EA:
PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$1.4
Life-Cycle Benefits (mil. $)	$2.6
Net Present Value (mil. $)	$1.1
Benefit / Cost Ratio:	1.8
Rate of Return on Investment:	11.2%
Payback Period:	9 years

ITEMIZED BENEFITS (mil. $)	Passenger Benefits	Freight Benefits	Total Over 20 Years	Average Annual
Travel Time Savings	$1.2	$1.2	$2.4	$0.1
Veh. Op. Cost Savings	$1.5	$0.2	$1.6	$0.1
Accident Cost Savings	-$1.6	-$0.1	-$1.7	-$0.1
Emission Cost Savings	$0.1	$0.1	$0.2	$0.0
TOTAL BENEFITS	$1.1	$1.5	$2.6	$0.1

Person-Hours of Time Saved	197,271	9,864

Should benefit-cost results include:

1) Induced Travel? (y/n)	Y (Default = Y)
2) Vehicle Operating Costs? (y/n)	Y (Default = Y)
3) Accident Costs? (y/n)	Y (Default = Y)
4) Vehicle Emissions? (y/n) includes value for CO_2e	Y (Default = Y)

	Tons		Value (mil. $)	
EMISSIONS REDUCTION	Total Over 20 Years	Average Annual	Total Over 20 Years	Average Annual
CO Emissions Saved	5	0	$0.0	$0.0
CO_2 Emissions Saved	2,340	117	$0.1	$0.0
NO_X Emissions Saved	3	0	$0.1	$0.0
PM_{10} Emissions Saved	0	0	$0.0	$0.0
$PM_{2.5}$ Emissions Saved	0	0		
SO_X Emissions Saved	0	0	$0.0	$0.0
VOC Emissions Saved	0	0	$0.0	$0.0

C

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	$20,261	$0	$23,463	$0	$0	$46,924	$0	$48,071
20	$0	$14,743	$0	$17,074	$0	$0	$34,146	$0	$34,981
2	$0	$20,028	$0	$23,194	$0	$0	$46,385	$0	$47,519
3	$0	$19,783	$0	$22,911	$0	$0	$45,818	$0	$46,939
4	$0	$19,528	$0	$22,615	$0	$0	$45,226	$0	$46,332
5	$0	$19,263	$0	$22,308	$0	$0	$44,612	$0	$45,703
6	$0	$18,989	$0	$21,991	$0	$0	$43,979	$0	$45,054
7	$0	$18,708	$0	$21,665	$0	$0	$43,328	$0	$44,387
8	$0	$18,420	$0	$21,332	$0	$0	$42,662	$0	$43,705
9	$0	$18,127	$0	$20,993	$0	$0	$41,983	$0	$43,010
10	$0	$17,830	$0	$20,648	$0	$0	$41,294	$0	$42,303
11	$0	$17,528	$0	$20,299	$0	$0	$40,595	$0	$41,588
12	$0	$17,223	$0	$19,946	$0	$0	$39,889	$0	$40,864
13	$0	$16,916	$0	$19,590	$0	$0	$39,177	$0	$40,135
14	$0	$16,607	$0	$19,232	$0	$0	$38,461	$0	$39,402
15	$0	$16,296	$0	$18,872	$0	$0	$37,742	$0	$38,665
16	$0	$15,985	$0	$18,512	$0	$0	$37,022	$0	$37,927
17	$0	$15,674	$0	$18,151	$0	$0	$36,301	$0	$37,188
18	$0	$15,363	$0	$17,791	$0	$0	$35,580	$0	$36,450
19	$0	$15,053	$0	$17,432	$0	$0	$34,862	$0	$35,714
Total	**$0**	**$352,323**	**$0**	**$408,018**	**$0**	**$0**	**$815,985**	**$0**	**$835,940**

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	$138,718	$150,038	7,788
20	$0	$0	$0	$0	$100,944	$230,029	11,939
2	$0	$0	$0	$0	$137,126	$154,248	8,006
3	$0	$0	$0	$0	$135,451	$158,458	8,225
4	$0	$0	$0	$0	$133,701	$162,668	8,443
5	$0	$0	$0	$0	$131,886	$166,878	8,662
6	$0	$0	$0	$0	$130,013	$171,088	8,880
7	$0	$0	$0	$0	$128,089	$175,298	9,099
8	$0	$0	$0	$0	$126,120	$179,508	9,317
9	$0	$0	$0	$0	$124,114	$183,718	9,536
10	$0	$0	$0	$0	$122,075	$187,928	9,754
11	$0	$0	$0	$0	$120,009	$192,138	9,973
12	$0	$0	$0	$0	$117,922	$196,348	10,191
13	$0	$0	$0	$0	$115,818	$200,559	10,410
14	$0	$0	$0	$0	$113,701	$204,769	10,628
15	$0	$0	$0	$0	$111,575	$208,979	10,847
16	$0	$0	$0	$0	$109,445	$213,189	11,065
17	$0	$0	$0	$0	$107,314	$217,399	11,284
18	$0	$0	$0	$0	$105,185	$221,609	11,502
19	$0	$0	$0	$0	$103,061	$225,819	11,721
Total	**$0**	**$0**	**$0**	**$0**	**$2,412,267**	**$3,800,668**	**197,271**

C

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	$27,392	$0	$3,497	$0	$56,121	$0	$7,164	-	-	$94,174	$101,858
20	$0	$19,933	$0	$2,544	$0	$40,839	$0	$5,213	-	-	$68,529	$156,163
2	$0	$27,078	$0	$3,456	$0	$55,477	$0	$7,082	-	-	$93,092	$104,716
3	$0	$26,747	$0	$3,414	$0	$54,799	$0	$6,995	-	-	$91,955	$107,575
4	$0	$26,402	$0	$3,370	$0	$54,091	$0	$6,905	-	-	$90,768	$110,433
5	$0	$26,043	$0	$3,324	$0	$53,357	$0	$6,811	-	-	$89,535	$113,291
6	$0	$25,673	$0	$3,277	$0	$52,599	$0	$6,714	-	-	$88,264	$116,149
7	$0	$25,293	$0	$3,229	$0	$51,820	$0	$6,615	-	-	$86,957	$119,007
8	$0	$24,905	$0	$3,179	$0	$51,024	$0	$6,513	-	-	$85,621	$121,865
9	$0	$24,508	$0	$3,128	$0	$50,212	$0	$6,410	-	-	$84,259	$124,723
10	$0	$24,106	$0	$3,077	$0	$49,387	$0	$6,304	-	-	$82,874	$127,581
11	$0	$23,698	$0	$3,025	$0	$48,552	$0	$6,198	-	-	$81,472	$130,440
12	$0	$23,286	$0	$2,972	$0	$47,707	$0	$6,090	-	-	$80,055	$133,298
13	$0	$22,870	$0	$2,919	$0	$46,856	$0	$5,981	-	-	$78,627	$136,156
14	$0	$22,452	$0	$2,866	$0	$46,000	$0	$5,872	-	-	$77,190	$139,014
15	$0	$22,032	$0	$2,812	$0	$45,140	$0	$5,762	-	-	$75,747	$141,872
16	$0	$21,612	$0	$2,759	$0	$44,278	$0	$5,652	-	-	$74,301	$144,730
17	$0	$21,191	$0	$2,705	$0	$43,416	$0	$5,542	-	-	$72,854	$147,588
18	$0	$20,771	$0	$2,651	$0	$42,554	$0	$5,432	-	-	$71,408	$150,447
19	$0	$20,351	$0	$2,598	$0	$41,695	$0	$5,322	-	-	$69,966	$153,305
Total	**$0**	**$476,343**	**$0**	**$60,805**	**$0**	**$975,923**	**$0**	**$124,576**	**-**	**-**	**$1,637,648**	**$2,580,211**

C

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	($30,548)	$0	($1,608)	$0	($62,586)	$0	($3,294)	$0	($98,036)	($106,036)
20	$0	($22,230)	$0	($1,170)	$0	($45,543)	$0	($2,397)	$0	($71,340)	($162,567)
2	$0	($30,197)	$0	($1,589)	$0	($61,868)	$0	($3,256)	$0	($96,910)	($109,011)
3	$0	($29,828)	$0	($1,570)	$0	($61,112)	$0	($3,216)	$0	($95,726)	($111,986)
4	$0	($29,443)	$0	($1,550)	$0	($60,322)	$0	($3,175)	$0	($94,490)	($114,962)
5	$0	($29,043)	$0	($1,529)	$0	($59,504)	$0	($3,132)	$0	($93,207)	($117,937)
6	$0	($28,631)	$0	($1,507)	$0	($58,658)	$0	($3,087)	$0	($91,883)	($120,912)
7	$0	($28,207)	$0	($1,485)	$0	($57,790)	$0	($3,042)	$0	($90,523)	($123,888)
8	$0	($27,774)	$0	($1,462)	$0	($56,902)	$0	($2,995)	$0	($89,132)	($126,863)
9	$0	($27,332)	$0	($1,439)	$0	($55,997)	$0	($2,947)	$0	($87,714)	($129,838)
10	$0	($26,883)	$0	($1,415)	$0	($55,077)	$0	($2,899)	$0	($86,273)	($132,814)
11	$0	($26,428)	$0	($1,391)	$0	($54,145)	$0	($2,850)	$0	($84,813)	($135,789)
12	$0	($25,968)	$0	($1,367)	$0	($53,203)	$0	($2,800)	$0	($83,338)	($138,764)
13	$0	($25,505)	$0	($1,342)	$0	($52,254)	$0	($2,750)	$0	($81,851)	($141,740)
14	$0	($25,039)	$0	($1,318)	$0	($51,299)	$0	($2,700)	$0	($80,355)	($144,715)
15	$0	($24,571)	$0	($1,293)	$0	($50,340)	$0	($2,649)	$0	($78,853)	($147,690)
16	$0	($24,102)	$0	($1,269)	$0	($49,379)	$0	($2,599)	$0	($77,348)	($150,666)
17	$0	($23,632)	$0	($1,244)	$0	($48,417)	$0	($2,548)	$0	($75,842)	($153,641)
18	$0	($23,163)	$0	($1,219)	$0	($47,457)	$0	($2,498)	$0	($74,337)	($156,616)
19	$0	($22,696)	$0	($1,195)	$0	($46,498)	$0	($2,447)	$0	($72,836)	($159,592)
Total	**$0**	**($531,218)**	**$0**	**($27,959)**	**$0**	**($1,088,350)**	**$0**	**($57,282)**	**$0**	**($1,704,809)**	**($2,686,027)**

C

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	$1,542	$0	$3,099	$0	$0	$3,159	$0	$6,349
20	$0	$808	$0	$1,897	$0	$0	$1,656	$0	$3,887
2	$0	$1,543	$0	$3,072	$0	$0	$3,162	$0	$6,293
3	$0	$1,544	$0	$3,043	$0	$0	$3,162	$0	$6,234
4	$0	$1,543	$0	$3,012	$0	$0	$3,161	$0	$6,171
5	$0	$1,541	$0	$2,980	$0	$0	$3,158	$0	$6,105
6	$0	$1,539	$0	$2,946	$0	$0	$3,153	$0	$6,036
7	$0	$1,536	$0	$2,911	$0	$0	$3,146	$0	$5,964
8	$0	$831	$0	$2,273	$0	$0	$1,702	$0	$4,657
9	$0	$830	$0	$2,244	$0	$0	$1,701	$0	$4,598
10	$0	$830	$0	$2,214	$0	$0	$1,700	$0	$4,537
11	$0	$829	$0	$2,184	$0	$0	$1,699	$0	$4,475
12	$0	$828	$0	$2,153	$0	$0	$1,696	$0	$4,412
13	$0	$827	$0	$2,122	$0	$0	$1,693	$0	$4,348
14	$0	$825	$0	$2,091	$0	$0	$1,690	$0	$4,283
15	$0	$823	$0	$2,059	$0	$0	$1,685	$0	$4,218
16	$0	$820	$0	$2,027	$0	$0	$1,680	$0	$4,152
17	$0	$818	$0	$1,994	$0	$0	$1,675	$0	$4,086
18	$0	$815	$0	$1,962	$0	$0	$1,669	$0	$4,020
19	$0	$812	$0	$1,930	$0	$0	$1,663	$0	$3,954
Total	**$0**	**$21,482**	**$0**	**$48,213**	**$0**	**$0**	**$44,011**	**$0**	**$98,777**

C

SUMMARY OF EMISSION REDUCTION BENEFITS (continued)

Year	TRANSIT				Present Value of Emission Benefits	Constant Dollars
	Peak Bus	Non-Peak Bus	Passenger Rail	Light Rail		
1	$0	$0	$0	$0	$14,148	$15,303
20	$0	$0	$0	$0	$8,248	$18,796
2	$0	$0	$0	$0	$14,070	$15,826
3	$0	$0	$0	$0	$13,982	$16,357
4	$0	$0	$0	$0	$13,887	$16,895
5	$0	$0	$0	$0	$13,783	$17,441
6	$0	$0	$0	$0	$13,674	$17,994
7	$0	$0	$0	$0	$13,558	$18,555
8	$0	$0	$0	$0	$9,462	$13,468
9	$0	$0	$0	$0	$9,374	$13,875
10	$0	$0	$0	$0	$9,282	$14,289
11	$0	$0	$0	$0	$9,187	$14,709
12	$0	$0	$0	$0	$9,090	$15,135
13	$0	$0	$0	$0	$8,990	$15,567
14	$0	$0	$0	$0	$8,888	$16,007
15	$0	$0	$0	$0	$8,785	$16,453
16	$0	$0	$0	$0	$8,680	$16,907
17	$0	$0	$0	$0	$8,573	$17,368
18	$0	$0	$0	$0	$8,466	$17,836
19	$0	$0	$0	$0	$8,357	$18,312
Total	**$0**	**$0**	**$0**	**$0**	**$212,482**	**$327,092**

C

SUMMARY OF EMISSION REDUCTION BENEFITS (continued)

Year	TONS EMISSIONS SAVED (tons/yr)						
	CO	CO_2	NO_X	PM_{10}	SO_X	VOC	$PM_{2.5}$
1	0	116	0	0	0	0	0
20	0	126	0	0	0	0	0
2	0	119	0	0	0	0	0
3	0	122	0	0	0	0	0
4	0	126	0	0	0	0	0
5	0	129	0	0	0	0	0
6	0	132	0	0	0	0	0
7	0	135	0	0	0	0	0
8	0	99	0	0	0	0	0
9	0	101	0	0	0	0	0
10	0	103	0	0	0	0	0
11	0	105	0	0	0	0	0
12	0	108	0	0	0	0	0
13	0	110	0	0	0	0	0
14	0	112	0	0	0	0	0
15	0	115	0	0	0	0	0
16	0	117	0	0	0	0	0
17	0	119	0	0	0	0	0
18	0	122	0	0	0	0	0
19	0	124	0	0	0	0	0
Total	**5**	**2,340**	**3**	**0**	**0**	**0**	**0**

C

SUMMARY OF EMISSION REDUCTION BENEFITS (continued)

Year	DOLLARS EMISSIONS SAVED (PV $/yr)					
	CO	CO_2	NO_X	PM_{10}	SO_X	VOC
1	$45	$4,236	$8,561	$1,020	$206	$81
20	$15	$3,191	$4,830	$95	$104	$14
2	$44	$4,271	$8,463	$1,008	$204	$80
3	$44	$4,303	$8,359	$996	$201	$79
4	$43	$4,333	$8,252	$983	$199	$78
5	$43	$4,359	$8,140	$970	$196	$77
6	$42	$4,383	$8,024	$956	$193	$76
7	$41	$4,405	$7,905	$942	$190	$74
8	$19	$3,143	$6,034	$119	$129	$17
9	$19	$3,155	$5,938	$117	$127	$17
10	$18	$3,165	$5,841	$115	$125	$17
11	$18	$3,174	$5,742	$113	$123	$17
12	$18	$3,181	$5,642	$111	$121	$16
13	$17	$3,187	$5,541	$109	$119	$16
14	$17	$3,191	$5,440	$107	$117	$16
15	$17	$3,194	$5,339	$105	$115	$15
16	$16	$3,196	$5,237	$103	$112	$15
17	$16	$3,196	$5,135	$101	$110	$15
18	$16	$3,195	$5,033	$99	$108	$15
19	$16	$3,194	$4,931	$97	$106	$14
Total	**$525**	**$71,651**	**$128,387**	**$8,266**	**$2,906**	**$747**

A

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
Construction Period								
1								
2								
3								
4								
5								
6								
7								
8								
Project Open								
1	$138,718	$94,174	($98,036)	$14,148				
2	$137,126	$93,092	($96,910)	$14,070				
3	$135,451	$91,955	($95,726)	$13,982				
4	$133,701	$90,768	($94,490)	$13,887				
5	$131,886	$89,535	($93,207)	$13,783				
6	$130,013	$88,264	($91,883)	$13,674				
7	$128,089	$86,957	($90,523)	$13,558				
8	$126,120	$85,621	($89,132)	$9,462				
9	$124,114	$84,259	($87,714)	$9,374				
10	$122,075	$82,874	($86,273)	$9,282				
11	$120,009	$81,472	($84,813)	$9,187				
12	$117,922	$80,055	($83,338)	$9,090				
13	$115,818	$78,627	($81,851)	$8,990				
14	$113,701	$77,190	($80,355)	$8,888				
15	$111,575	$75,747	($78,853)	$8,785				
16	$109,445	$74,301	($77,348)	$8,680				
17	$107,314	$72,854	($75,842)	$8,573				
18	$105,185	$71,408	($74,337)	$8,466				
19	$103,061	$69,966	($72,836)	$8,357				
20	$100,944	$68,529	($71,340)	$8,248				
Total	$2,412,267	$1,637,648	($1,704,809)	$212,482	$0	$0	$0	$0

197,271	Person-Hours of Time Saved		Person-Hours of Time Saved

tons	$ PV		tons	$ PV	
5	$525	CO Saved			CO Saved
2,340	$71,651	CO_2 Saved			CO_2 Saved
3	$128,387	NO_X Saved			NO_X Saved
0	$8,266	PM_{10} Saved			PM_{10} Saved
0		$PM_{2.5}$ Saved			$PM_{2.5}$ Saved
0	$2,906	SO_X Saved			SO_X Saved
0	$747	VOC Saved			VOC Saved

$1,243,958	$185,381	($85,240)	$146,990				

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	$100,000	($100,000)
				$0	$1,307,692	($1,307,692)
				$0	$0	$0
				$0	$0	$0
				$0	$0	$0
				$0	$0	$0
				$0	$0	$0
				$0	$0	$0
				$149,005	$0	$149,005
				$147,378	$0	$147,378
				$145,662	$0	$145,662
				$143,865	$0	$143,865
				$141,998	$0	$141,998
				$140,067	$0	$140,067
				$138,080	$0	$138,080
				$132,071	$0	$132,071
				$130,032	$0	$130,032
				$127,958	$0	$127,958
				$125,855	$0	$125,855
				$123,728	$0	$123,728
				$121,583	$0	$121,583
				$119,423	$0	$119,423
				$117,254	$0	$117,254
				$115,078	$0	$115,078
				$112,900	$0	$112,900
				$110,722	$0	$110,722
				$108,549	$0	$108,549
				$106,382	$0	$106,382
$0	$0	$0	$0	**$2,557,588**	**$1,407,692**	**$1,149,896**

Person-Hours of Time Saved

tons	$ PV	
		CO Saved
		CO_2 Saved
		NO_X Saved
		PM_{10} Saved
		$PM_{2.5}$ Saved
		SO_X Saved
		VOC Saved

Freight Benefits Only

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
Construction Period								
1								
2								
3								
4								
5								
6								
7								
8								
Project Open								
1	$150,038	$101,858	($106,036)	$15,303				
2	$154,248	$104,716	($109,011)	$15,826				
3	$158,458	$107,575	($111,986)	$16,357				
4	$162,668	$110,433	($114,962)	$16,895				
5	$166,878	$113,291	($117,937)	$17,441				
6	$171,088	$116,149	($120,912)	$17,994				
7	$175,298	$119,007	($123,888)	$18,555				
8	$179,508	$121,865	($126,863)	$13,468				
9	$183,718	$124,723	($129,838)	$13,875				
10	$187,928	$127,581	($132,814)	$14,289				
11	$192,138	$130,440	($135,789)	$14,709				
12	$196,348	$133,298	($138,764)	$15,135				
13	$200,559	$136,156	($141,740)	$15,567				
14	$204,769	$139,014	($144,715)	$16,007				
15	$208,979	$141,872	($147,690)	$16,453				
16	$213,189	$144,730	($150,666)	$16,907				
17	$217,399	$147,588	($153,641)	$17,368				
18	$221,609	$150,447	($156,616)	$17,836				
19	$225,819	$153,305	($159,592)	$18,312				
20	$230,029	$156,163	($162,567)	$18,796				
Total	$3,800,668	$2,580,211	($2,686,027)	$327,092	$0	$0	$0	$0

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	$100,000	($100,000)	
				$0	$1,360,000	($1,360,000)	
				$0	$0	$0	
				$0	$0	$0	
				$0	$0	$0	
				$0	$0	$0	
				$0	$0	$0	
				$0	$0	$0	
				$161,164	$0	$161,164	$161,164
				$165,780	$0	$165,780	$326,943
				$170,403	$0	$170,403	$497,347
				$175,034	$0	$175,034	$672,381
				$179,673	$0	$179,673	$852,054
				$184,318	$0	$184,318	$1,036,372
				$188,972	$0	$188,972	$1,225,344
				$187,978	$0	$187,978	$1,413,323
				$192,479	$0	$192,479	$1,605,801
				$196,985	$0	$196,985	$1,802,786
				$201,498	$0	$201,498	$2,004,284
				$206,017	$0	$206,017	$2,210,301
				$210,542	$0	$210,542	$2,420,843
				$215,074	$0	$215,074	$2,635,917
				$219,614	$0	$219,614	$2,855,531
				$224,160	$0	$224,160	$3,079,691
				$228,714	$0	$228,714	$3,308,405
				$233,275	$0	$233,275	$3,541,680
				$237,844	$0	$237,844	$3,779,523
				$242,421	$0	$242,421	$4,021,944
$0	$0	$0	$0	**$4,021,944**	**$1,460,000**	**$2,561,944**	

Total Construction Costs **$1,460,000**

Years After Construction Begins	ANNUAL RETURNS ON INVESTMENT
1	($100,000)
2	($1,360,000)
3	$161,164
4	$165,780
5	$170,403
6	$175,034
7	$179,673
8	$184,318
9	$188,972
10	$187,978
11	$192,479
12	$196,985
13	$201,498
14	$206,017
15	$210,542
16	$215,074
17	$219,614
18	$224,160
19	$228,714
20	$233,275
21	$237,844
22	$242,421
23	$0
24	$0
25	$0
26	$0
27	$0
28	$0

Internal Rate of Return **11.22%**

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

Payback Period **9 years**

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

2A

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	1,052		1,052	
Weaving Volume	0		0	
Truck Volume	55		55	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Non-Peak Period				
Non-HOV Volume	2,155		2,155	
Weaving Volume	0		0	
Truck Volume	113		113	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Year 20				
Peak Period				
HOV Volume	0		0	
Non-HOV Volume	1,613		1,613	
Weaving Volume	0		0	
Truck Volume	85		85	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Non-Peak Period				
Non-HOV Volume	3,304		3,304	
Weaving Volume	0		0	
Truck Volume	174		174	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Build				
Year 1				
Peak Period				
HOV Volume	0		0	
Non-HOV Volume	1,052		1,052	
Weaving Volume	0		0	
Truck Volume	55		55	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Non-Peak Period				
Non-HOV Volume	2,155		2,155	
Weaving Volume	0		0	
Truck Volume	113		113	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Year 20				
Peak Period				
HOV Volume	0		0	
Non-HOV Volume	1,613		1,613	
Weaving Volume	0		0	
Truck Volume	85		85	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	
Non-Peak Period				
Non-HOV Volume	3,304		3,304	
Weaving Volume	0		0	
Truck Volume	174		174	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	0.0		5.0	

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
No Build				
Fatal Accidents	0.287		0.287	
Injury Accidents	0.00		0.00	
PDO Accidents	0.57		0.57	
Total Accidents	0.857			

Hwy Safety or Weaving Improvement 0% collision reduction factor (per HSIP Guidelines)

Adjustment Factor (Actual/Statewide Avg. Existing)				
Fatal Accidents	170.8333		170.8333	
Injury Accidents	0.0000		0.0000	
PDO Accidents	6.7185		6.7185	

Build				
Fatal Accidents	0.294		0.294	
Injury Accidents	0.00		0.00	
PDO Accidents	1.83		1.83	
Total Accidents	2.128			

2C

RAMP AND ARTERIAL INPUTS

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

Detailed Information Available? (y/n) N

Aggregate Segment Length (estimate as VMT/total volume)

All Ramps		miles
Arterials		miles

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

Build (Peak Period Only)			
Year 1			
Aggregate Ramp Volume		0	
Aggregate Arterial Volume		0	
Average Ramp Speed		5.0	
Average Arterial Speed		5.0	
Year 20			
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
Year 1			
Peak Period			
HOV Trips	0	0	
Non-HOV Trips	441,486	441,486	0
Truck Trips	20,205	20,205	0
Non-Peak Period			
Non-HOV Trips	1,022,488	1,022,488	0
Truck Trips	41,396	41,396	0
Total Trips	1,525,575	1,525,575	0
Year 20			
Peak Period			
HOV Trips	0	0	
Non-HOV Trips	676,859	676,859	0
Truck Trips	30,978	30,978	0
Non-Peak Period			
Non-HOV Trips	1,567,615	1,567,615	0
Truck Trips	63,466	63,466	0
Total Trips	2,338,918	2,338,918	0

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	2016	
Economic Update Factor (Using GDP Deflator)	1.00	1
Real Discount Rate	4.0%	2

Travel Time Parameters

	Value	Units	
Statewide Average Hourly Wage	$ 27.34	$/hr	3
Heavy and Light Truck Drivers			
Average Hourly Wage	$ 20.44	$/hr	3
Benefits and Costs	$ 10.97	$/hr	4
Value of Time			
Automobile	$ 13.65	$/hr/per	5
Truck	$ 31.40	$/hr/veh	5
Auto & Truck Composite	$ 18.95	$/hr/veh	6
Transit	$ 13.65	$/hr/per	5
Out-of-Vehicle Travel	2	times	5
Incident-Related Travel	3	times	7
Travel Time Uprater	0.0%	annual incr	

Vehicle Operating Cost Parameters

Average Fuel Price			
Automobile (regular unleaded)	$ 3.18	$/gal	8
Truck (diesel)	$ 3.00	$/gal	8
Sales and Fuel Taxes			
State Sales Tax (gasoline)	2.25%	%	9
State Sales Tax (diesel)	7.50%	%	9
Average Local Sales Tax	0.50%	%	9
Federal Fuel Excise Tax (gasoline)	$ 0.184	$/gal	9
Federal Fuel Excise Tax (diesel)	$ 0.244	$/gal	9
State Fuel Excise Tax (gasoline)	$ 0.278	$/gal	9
State Fuel Excise Tax (diesel)	$ 0.160	$/gal	9
Fuel Cost Per Gallon (Exclude Taxes)			
Automobile	$ 2.65	$/gal	
Truck	$ 2.40	$/gal	
Non-Fuel Cost Per Mile			
Automobile	$ 0.313	$/mi	10
Truck	$ 0.429	$/mi	11
Idling Speed for Op. Costs and Emissions	5	mph	

Accident Cost Parameters

Cost of a Fatality	$ 9,800,000	$/event	12
Cost of an Injury			
Level A (Severe)	$ 466,400	$/event	12
Level B (Moderate)	$ 127,000	$/event	12
Level C (Minor)	$ 64,900	$/event	12
Cost of Property Damage	$ 2,700	$/event	13
Cost of Highway Accident			
Fatal Accident	$ 10,800,000	$/accident	
Injury Accident	$ 148,800	$/accident	
PDO Accident	$ 9,700	$/accident	
Average Cost	$ 185,600	$/accident	
Statewide Highway Accident Rates			
Fatal Accident	0.006	per mil veh-mi	14
Injury Accident	0.29	per mil veh-mi	14
PDO Accident	0.55	per mil veh-mi	14
Non-Freeway	1.05	per mil veh-mi	15

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

Highway Operations Parameters

	Value	Units	
Maximum V/C Ratio	1.56	-	16
Percent ADT in Peak Period	32.8%	%	
Percent ADT in Average Peak Hour	8.2%	%	
Annualization Factor	365	days/yr	

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

Non-HOV Lanes	Alpha	Beta	Capacity (vphpl)
No Build	0.05	10	800
Build	0.05	10	800

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

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

Active Transportation Parameters

General Travel Activity Characteristics Parameters	Value	Units	
Cycling Days per Year	365	days	
Walking Days per Year	365	days	
School Days per Year	180	days	
Vehicle Statistics			
Average Vehicle Speed	25	mph	
Average Vehicle Occupancy	1.25	persons / veh	*19*
Active Transportation User Characteristics			
Average Cycling Speed	11.80	mph	*20*
Average Walking Speed	3.00	mph	*21*
Number of Unlinked Cycling Trips per Day	1.93	trips	*19*
Number of Unlinked Pedestrian Trips per Day	2.38	trips	*19*
Diversion of Cyclists from Personal Vehicles	50%	assumption	
Diversion of Pedestrians from Personal Vehicles	50%	assumption	
Value of Travel Time			
Adults	$ 13.65	$/hr/per	
Children	$ 13.65	$/hr/per	
Cycling Journey Quality - Facility Preference Factors as Function of Distance by Facility Class			
Class I	0.57	-	*20*
Class II	0.49	-	*20*
Class III	0.92	-	*20*
Class IV	0.49	-	*20*
Note: Class IV assumed to be the same as Class II			
Walking Journey Quality Values per Mile by Amentity			
Street Lighting	$0.110	$/mi	*22*
Curb Level	$0.078	$/mi	*22*
Crowding	$0.055	$/mi	*22*
Pavement Evenness	$0.026	$/mi	*22*
Information Panels	$0.026	$/mi	*22*
Benches	$0.017	$/mi	*22*
Directional Signage	$0.017	$/mi	*22*
Health (Absenteeism Reduction)			
Average Absence of Employees	3.60	days/yr	*23*
Percentage Covered by Short-Term Sick Leave	95%	%	*24*
Percentage of Sick Days Reduced When Active at Least 30 Minutes per Day	6%	%	*25*
Health (Mortality Reduction)			
Percentage of Cyclists Aged 16-64	70.5%	%	*26*
Percentage of Pedestrians Aged 16-74	76.2%	%	*26*
Percentage Reduction in Mortality per 365 Annual Cycling Miles	4.5%	%	*27*
Percentage Reduction in Mortality per 365 Annual Walking Miles	9.0%	%	*27*
Morality Rate - All Causes (Aged 20-64)	266	#/100,000 people	*28*
Morality Rate - All Causes (Aged 20-74)	395	#/100,000 people	*28*

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

Travel Demand Tables

Project Types

Highway Capacity Expansion			Please select a type of highway project
General Highway	FALSE	GenHwy	
HOV Lane Addition	FALSE	HOV	Enter HOV restriction in section 1B
HOT Lane Addition	FALSE	HOT	Include toll payers as HOVs & check AVOs
Passing Lane	FALSE	Passing	Enter a truck speed in section 1B
Intersection	TRUE	Intersect	Remember to run model for both roads
Truck Only Lane	FALSE	TruckLane	Remember to run macro for truck lane
Bypass	FALSE	Bypass	Remember to run model for both roads
Queuing	FALSE	Queuing	Add arrival rate & check departure rate in 1B
Pavement	FALSE	Pavement	Enter pavement condition in section 1B
Rail or Transit Cap Expansion			Please select a type of rail or transit project
Passenger Rail	FALSE	PassRail	Enter data in both sections 1B & 1E
Light-Rail (LRT)	FALSE	LRT	Enter data in both sections 1B & 1E
Bus	FALSE	Bus	Enter data in both sections 1B & 1E
Hwy-Rail Grade Crossing	FALSE	HwyRail	Put hwy design in 1B, safety in 1C & crossing in 1D
Hwy Operational Improvement			Please select a type of op. improvement
Auxiliary Lane	FALSE	AuxLane	Enter ramp design speed & on-ramp volume
Freeway Connector	FALSE	FreeConn	Check percent traffic in weave in section 1B
HOV Connector	FALSE	HOVConn	Check percent traffic in weave in section 1B
HOV Drop Ramp	FALSE	HOVDrop	Check percent traffic in weave in section 1B
Off-Ramp Widening	FALSE	OffRamp	Check percent traffic in weave in section 1B
On-Ramp Widening	FALSE	OnRamp	Enter on-ramp volume & metering strategy
HOV-2 to HOV-3 Conv	FALSE	HOV2to3	Check AVOs & trips in sections 1B & 2D
HOT Lane Conversion	FALSE	HOTConv	Check AVOs & trips in sections 1B & 2D
Transp Mgmt Systems (TMS)			Please select a type of TMS project
Ramp Metering	FALSE	RM	Enter model data, if avail, in sections 2A & 2C
Ramp Metering Signal Coord	FALSE	AM	Enter model data, if avail, in sections 2A & 2C
Incident Management	FALSE	IM	Enter model data, if avail, in sections 2A & 2C
Traveler Information	FALSE	TI	Enter model data, if avail, in sections 2A & 2C
Arterial Signal Management	FALSE	ASM	Complete only sections 1A, 1E & 2C
Transit Vehicle Location (AVL)	FALSE	AVL	Enter transit agency costs in section 1D
Transit Vehicle Signal Priority	FALSE	SigPriority	Check travel time in section 1D
Bus Rapid Transit (BRT)	FALSE	BRT	Enter free-flow bus lane speed in section 1B
TMS Lookup Code	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	Fwy/Exp	Other	Fwy/Exp	Other
1	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%
2	16.8%	16.8%	16.8%	16.8%	16.8%	16.8%
3	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
4	32.8%	32.8%	32.8%	32.8%	32.8%	32.8%
5	40.3%	40.3%	40.3%	40.3%	40.3%	40.3%
6	47.4%	47.4%	47.4%	47.4%	47.4%	47.4%
7	54.2%	54.2%	54.2%	54.2%	54.2%	54.2%
8	60.8%	60.8%	60.8%	60.8%	60.8%	60.8%
9	67.1%	67.1%	67.1%	67.1%	67.1%	67.1%
10	73.4%	73.4%	73.4%	73.4%	73.4%	73.4%
11	79.0%	79.0%	79.0%	79.0%	79.0%	79.0%
12	84.3%	84.3%	84.3%	84.3%	84.3%	84.3%
13	88.6%	88.6%	88.6%	88.6%	88.6%	88.6%
14	91.6%	91.6%	91.6%	91.6%	91.6%	91.6%
15	94.3%	94.3%	94.3%	94.3%	94.3%	94.3%
16	96.4%	96.4%	96.4%	96.4%	96.4%	96.4%
17	97.6%	97.6%	97.6%	97.6%	97.6%	97.6%
18	98.5%	98.5%	98.5%	98.5%	98.5%	98.5%
19	99.1%	99.1%	99.1%	99.1%	99.1%	99.1%
20	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%
21	99.7%	99.7%	99.7%	99.7%	99.7%	99.7%
22	99.8%	99.8%	99.8%	99.8%	99.8%	99.8%
23	99.9%	99.9%	99.9%	99.9%	99.9%	99.9%
24	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

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

AGE COHORTS FOR MORTALITY RISK REDUCTION

(percent of population)

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

AVERAGE DISTANCE PER ACTIVE TRANSPORTATION TRIP

(miles/trip)

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

TRIP PURPOSE FOR ACTIVE TRANSPORTATION TRIPS

(percent of trips)

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

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

Operating Cost Tables

FUEL CONSUMPTION RATES

(gal/veh-mi)

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

** Includes motorcycles & motorhomes*

Note: Five mph is best estimate for idling

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

Accident Tables

HIGHWAY INJURY SEVERITY FREQUENCY
(percent of injuries)

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

Source: 2013 SWITRS Annual Report, Table 8C

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

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

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

NUMBER OF FATALITIES
(events/accident)

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

NUMBER OF INJURIES
(events/accident)

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

NUMBER OF VEHICLES INVOLVED
(events/accident)

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

DISTRIBUTION OF ACCIDENT TYPES
(percent of accidents)

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

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

COST OF NON-HIGHWAY ACCIDENT EVENTS
($/event)

Event	Pass Train	Light Rail	Bus	Freight Rail
Fatality	$9,800,000	$9,800,000	$9,800,000	$9,800,000
Injury	$180,500	$180,500	$180,500	$180,500
Prop Damage	$78,800	$12,400	$3,800	$147,600

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

COSTS OF NON-HIGHWAY ACCIDENTS
($/million veh-mi)

Value	Pass Train	Light Rail	Bus	Freight Rail
Cost	$611,200	$3,209,500	$1,011,600	$13,122,900

Source: Combination of above two tables

HIGHWAY-RAIL GRADE CROSSING INCIDENTS
(units in table)

Value	Incident	Fatality	Injury
Total Events	799	94	515
Avg per Incident		0.1176	0.6446
Cost per Event		$9,800,000	$180,500

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

COST OF HIGHWAY ACCIDENTS
($/accident)

Accident Type	Urban	Suburban	Rural	Average
Fatal Accident	$10,800,000	$10,700,000	$11,300,000	$11,000,000
Injury Accident	$148,800	$148,600	$154,200	$149,300
PDO Accident	$9,700	$11,000	$8,600	$10,600
All Types	$185,600	$104,600	$281,100	$135,800

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

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2020

Mode	Speed	CO	CO2	NOX	PM10	SOX	VOC	PM2.5
Auto	0	2.7812	66.6818	0.2922	0.0022	0.0007	0.3837	0.0020
	5	2.4569	766.8891	0.1849	0.0119	0.0076	0.2149	0.0110
	6	2.3624	736.4937	0.1767	0.0110	0.0073	0.1979	0.0102
	7	2.2679	706.0983	0.1684	0.0101	0.0070	0.1809	0.0093
	8	2.1734	675.7028	0.1602	0.0092	0.0067	0.1639	0.0085
	9	2.0789	645.3074	0.1519	0.0084	0.0064	0.1469	0.0077
	10	1.9844	614.9120	0.1436	0.0075	0.0061	0.1299	0.0069
	11	1.9452	593.4537	0.1408	0.0070	0.0059	0.1221	0.0064
	12	1.9060	571.9954	0.1380	0.0065	0.0057	0.1142	0.0060
	13	1.8667	550.5371	0.1352	0.0060	0.0054	0.1064	0.0055
	14	1.8275	529.0788	0.1323	0.0055	0.0052	0.0986	0.0051
	15	1.7883	507.6205	0.1295	0.0050	0.0050	0.0908	0.0046
	16	1.7449	490.1154	0.1262	0.0047	0.0048	0.0853	0.0044
	17	1.7015	472.6104	0.1230	0.0044	0.0047	0.0797	0.0041
	18	1.6580	455.1053	0.1197	0.0041	0.0045	0.0742	0.0038
	19	1.6146	437.6003	0.1165	0.0038	0.0043	0.0687	0.0035
	20	1.5712	420.0952	0.1132	0.0036	0.0042	0.0632	0.0033
	21	1.5324	407.5672	0.1102	0.0034	0.0040	0.0598	0.0031
	22	1.4935	395.0392	0.1073	0.0032	0.0039	0.0563	0.0029
	23	1.4547	382.5112	0.1043	0.0030	0.0038	0.0529	0.0028
	24	1.4159	369.9831	0.1013	0.0028	0.0037	0.0495	0.0026
	25	1.3770	357.4551	0.0984	0.0026	0.0035	0.0461	0.0024
	26	1.3526	349.3782	0.0970	0.0025	0.0035	0.0442	0.0023
	27	1.3282	341.3012	0.0957	0.0024	0.0034	0.0424	0.0022
	28	1.3037	333.2243	0.0943	0.0023	0.0033	0.0405	0.0021
	29	1.2793	325.1474	0.0929	0.0022	0.0032	0.0387	0.0020
	30	1.2549	317.0704	0.0916	0.0020	0.0031	0.0369	0.0019
	31	1.2403	312.8750	0.0911	0.0020	0.0031	0.0358	0.0018
	32	1.2258	308.6796	0.0907	0.0019	0.0031	0.0348	0.0018
	33	1.2112	304.4842	0.0903	0.0018	0.0030	0.0337	0.0017
	34	1.1966	300.2888	0.0898	0.0018	0.0030	0.0327	0.0016
	35	1.1821	296.0934	0.0894	0.0017	0.0029	0.0316	0.0016
	36	1.1699	294.5019	0.0892	0.0017	0.0029	0.0310	0.0015
	37	1.1576	292.9105	0.0890	0.0016	0.0029	0.0303	0.0015
	38	1.1454	291.3191	0.0889	0.0016	0.0029	0.0297	0.0014
	39	1.1332	289.7276	0.0887	0.0015	0.0029	0.0291	0.0014
	40	1.1209	288.1362	0.0885	0.0015	0.0029	0.0284	0.0014
	41	1.1115	288.4709	0.0887	0.0015	0.0029	0.0282	0.0013
	42	1.1021	288.8057	0.0889	0.0014	0.0029	0.0280	0.0013
	43	1.0927	289.1404	0.0890	0.0014	0.0029	0.0278	0.0013
	44	1.0833	289.4751	0.0892	0.0014	0.0029	0.0275	0.0013
	45	1.0739	289.8098	0.0893	0.0014	0.0029	0.0273	0.0013
	46	1.0644	291.6375	0.0895	0.0014	0.0029	0.0272	0.0013
	47	1.0549	293.4651	0.0897	0.0014	0.0029	0.0271	0.0012
	48	1.0454	295.2927	0.0898	0.0013	0.0029	0.0270	0.0012
	49	1.0359	297.1204	0.0900	0.0013	0.0029	0.0269	0.0012
	50	1.0264	298.9480	0.0901	0.0013	0.0030	0.0268	0.0012
	51	1.0176	301.2656	0.0905	0.0013	0.0030	0.0269	0.0012
	52	1.0088	303.5831	0.0908	0.0013	0.0030	0.0271	0.0012
	53	0.9999	305.9006	0.0912	0.0013	0.0030	0.0272	0.0012
	54	0.9911	308.2182	0.0915	0.0013	0.0030	0.0273	0.0012
	55	0.9822	310.5357	0.0919	0.0013	0.0031	0.0274	0.0012
	56	0.9679	312.2601	0.0915	0.0014	0.0031	0.0275	0.0013
	57	0.9535	313.9844	0.0912	0.0014	0.0031	0.0276	0.0013
	58	0.9391	315.7088	0.0908	0.0014	0.0031	0.0277	0.0013
	59	0.9248	317.4331	0.0904	0.0014	0.0031	0.0278	0.0013
	60	0.9104	319.1575	0.0901	0.0014	0.0032	0.0279	0.0013
	61	0.9102	321.1627	0.0908	0.0015	0.0032	0.0288	0.0013
	62	0.9099	323.1679	0.0915	0.0015	0.0032	0.0298	0.0014
	63	0.9096	325.1730	0.0922	0.0015	0.0032	0.0307	0.0014
	64	0.9093	327.1782	0.0929	0.0016	0.0032	0.0316	0.0014
	65	0.9090	329.1834	0.0936	0.0016	0.0033	0.0326	0.0015
	66	0.9328	332.1274	0.0961	0.0016	0.0033	0.0340	0.0015
	67	0.9566	335.0713	0.0986	0.0016	0.0033	0.0355	0.0015
	68	0.9804	338.0152	0.1011	0.0017	0.0033	0.0370	0.0015
	69	1.0041	340.9592	0.1036	0.0017	0.0034	0.0384	0.0016
	70	1.0279	343.9031	0.1062	0.0017	0.0034	0.0399	0.0016

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2040

Mode	Speed	CO	CO2	NOX	PM10	SOX	VOC	PM2.5
Auto	0	1.6243	41.5134	0.1182	0.0008	0.0004	0.1038	0.0007
	5	1.0375	512.1914	0.0448	0.0042	0.0051	0.0871	0.0038
	6	1.0103	492.7973	0.0435	0.0039	0.0049	0.0810	0.0035
	7	0.9831	473.4032	0.0422	0.0035	0.0047	0.0749	0.0033
	8	0.9559	454.0092	0.0409	0.0032	0.0045	0.0688	0.0030
	9	0.9286	434.6151	0.0396	0.0029	0.0043	0.0627	0.0027
	10	0.9014	415.2211	0.0383	0.0026	0.0041	0.0566	0.0024
	11	0.8807	400.2645	0.0375	0.0024	0.0040	0.0531	0.0022
	12	0.8600	385.3079	0.0366	0.0023	0.0038	0.0495	0.0021
	13	0.8392	370.3513	0.0358	0.0021	0.0037	0.0460	0.0019
	14	0.8185	355.3947	0.0349	0.0019	0.0035	0.0424	0.0018
	15	0.7977	340.4381	0.0341	0.0017	0.0034	0.0389	0.0016
	16	0.7797	328.9303	0.0333	0.0016	0.0033	0.0365	0.0015
	17	0.7616	317.4224	0.0326	0.0015	0.0031	0.0342	0.0014
	18	0.7435	305.9146	0.0318	0.0014	0.0030	0.0318	0.0013
	19	0.7254	294.4067	0.0311	0.0013	0.0029	0.0295	0.0012
	20	0.7073	282.8989	0.0303	0.0012	0.0028	0.0272	0.0011
	21	0.6937	274.6096	0.0298	0.0012	0.0027	0.0258	0.0011
	22	0.6802	266.3204	0.0293	0.0011	0.0026	0.0245	0.0010
	23	0.6666	258.0312	0.0287	0.0010	0.0026	0.0231	0.0010
	24	0.6530	249.7419	0.0282	0.0010	0.0025	0.0218	0.0009
	25	0.6394	241.4527	0.0276	0.0009	0.0024	0.0204	0.0008
	26	0.6287	235.9199	0.0273	0.0009	0.0023	0.0196	0.0008
	27	0.6180	230.3871	0.0270	0.0008	0.0023	0.0188	0.0008
	28	0.6072	224.8543	0.0266	0.0008	0.0022	0.0180	0.0007
	29	0.5965	219.3215	0.0263	0.0007	0.0022	0.0172	0.0007
	30	0.5858	213.7887	0.0260	0.0007	0.0021	0.0164	0.0007
	31	0.5769	210.7272	0.0257	0.0007	0.0021	0.0158	0.0006
	32	0.5681	207.6656	0.0254	0.0007	0.0021	0.0152	0.0006
	33	0.5592	204.6041	0.0252	0.0006	0.0020	0.0147	0.0006
	34	0.5504	201.5426	0.0249	0.0006	0.0020	0.0141	0.0006
	35	0.5415	198.4811	0.0246	0.0006	0.0020	0.0135	0.0005
	36	0.5339	197.2354	0.0244	0.0006	0.0020	0.0131	0.0005
	37	0.5263	195.9898	0.0243	0.0006	0.0019	0.0128	0.0005
	38	0.5188	194.7441	0.0241	0.0005	0.0019	0.0124	0.0005
	39	0.5112	193.4985	0.0239	0.0005	0.0019	0.0120	0.0005
	40	0.5036	192.2529	0.0237	0.0005	0.0019	0.0117	0.0005
	41	0.4983	192.4698	0.0237	0.0005	0.0019	0.0116	0.0005
	42	0.4930	192.6867	0.0237	0.0005	0.0019	0.0115	0.0005
	43	0.4876	192.9036	0.0236	0.0005	0.0019	0.0114	0.0004
	44	0.4823	193.1206	0.0236	0.0005	0.0019	0.0113	0.0004
	45	0.4770	193.3375	0.0235	0.0005	0.0019	0.0112	0.0004
	46	0.4717	194.4847	0.0235	0.0005	0.0019	0.0112	0.0004
	47	0.4664	195.6319	0.0235	0.0005	0.0019	0.0111	0.0004
	48	0.4611	196.7791	0.0234	0.0005	0.0019	0.0110	0.0004
	49	0.4558	197.9263	0.0234	0.0005	0.0020	0.0109	0.0004
	50	0.4506	199.0735	0.0234	0.0005	0.0020	0.0109	0.0004
	51	0.4463	200.6160	0.0234	0.0005	0.0020	0.0110	0.0004
	52	0.4420	202.1586	0.0235	0.0005	0.0020	0.0110	0.0004
	53	0.4377	203.7011	0.0235	0.0005	0.0020	0.0111	0.0004
	54	0.4334	205.2437	0.0236	0.0005	0.0020	0.0112	0.0004
	55	0.4291	206.7862	0.0237	0.0005	0.0020	0.0113	0.0004
	56	0.4253	208.1718	0.0238	0.0005	0.0021	0.0115	0.0004
	57	0.4216	209.5573	0.0238	0.0005	0.0021	0.0116	0.0004
	58	0.4179	210.9429	0.0239	0.0005	0.0021	0.0118	0.0004
	59	0.4142	212.3284	0.0240	0.0005	0.0021	0.0120	0.0004
	60	0.4105	213.7139	0.0241	0.0005	0.0021	0.0122	0.0005
	61	0.4105	214.9073	0.0243	0.0005	0.0021	0.0127	0.0005
	62	0.4104	216.1006	0.0245	0.0005	0.0021	0.0131	0.0005
	63	0.4104	217.2939	0.0247	0.0005	0.0021	0.0135	0.0005
	64	0.4103	218.4873	0.0249	0.0005	0.0022	0.0140	0.0005
	65	0.4103	219.6806	0.0251	0.0006	0.0022	0.0144	0.0005
	66	0.4137	220.9470	0.0254	0.0006	0.0022	0.0147	0.0005
	67	0.4171	222.2134	0.0256	0.0006	0.0022	0.0149	0.0005
	68	0.4205	223.4798	0.0258	0.0006	0.0022	0.0152	0.0005
	69	0.4238	224.7463	0.0260	0.0006	0.0022	0.0155	0.0005
	70	0.4272	226.0127	0.0262	0.0006	0.0022	0.0157	0.0006

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2020

Mode	Speed	CO	CO2	NOX	PM10	SOX	VOC	PM2.5
Auto	0	2.7812	66.6818	0.2922	0.0022	0.0007	0.3837	0.0020
	5	2.4569	766.8891	0.1849	0.0119	0.0076	0.2149	0.0110
	6	2.3624	736.4937	0.1767	0.0110	0.0073	0.1979	0.0102
	7	2.2679	706.0983	0.1684	0.0101	0.0070	0.1809	0.0093
	8	2.1734	675.7028	0.1602	0.0092	0.0067	0.1639	0.0085
Truck	0	0.9305	9.0247	0.6741	0.0002	0.0002	0.0657	0.0002
	5	3.6942	2632.6795	8.9241	0.1305	0.0246	1.0958	0.1248
	6	3.5195	2514.9122	8.2937	0.1206	0.0235	1.0078	0.1153
	7	3.3449	2397.1449	7.6633	0.1107	0.0223	0.9199	0.1059
	8	3.1702	2279.3775	7.0329	0.1009	0.0212	0.8319	0.0965
	9	2.9956	2161.6102	6.4026	0.0910	0.0201	0.7440	0.0870
	10	2.8209	2043.8428	5.7722	0.0812	0.0190	0.6560	0.0776
	11	2.6205	1905.7080	5.2310	0.0737	0.0178	0.5864	0.0705
	12	2.4202	1767.5732	4.6898	0.0663	0.0165	0.5169	0.0633
	13	2.2198	1629.4383	4.1485	0.0588	0.0153	0.4474	0.0562
	14	2.0195	1491.3035	3.6073	0.0514	0.0141	0.3778	0.0491
	15	1.8191	1353.1687	3.0661	0.0440	0.0129	0.3083	0.0420
	16	1.7210	1328.7488	3.0671	0.0432	0.0126	0.2863	0.0413
	17	1.6228	1304.3289	3.0681	0.0424	0.0124	0.2644	0.0405
	18	1.5246	1279.9090	3.0692	0.0416	0.0122	0.2424	0.0398
	19	1.4265	1255.4891	3.0702	0.0409	0.0120	0.2205	0.0391
	20	1.3283	1231.0692	3.0712	0.0401	0.0117	0.1986	0.0383
	21	1.2704	1198.9333	3.0121	0.0388	0.0114	0.1880	0.0371
	22	1.2124	1166.7975	2.9531	0.0376	0.0111	0.1775	0.0359
	23	1.1545	1134.6616	2.8940	0.0363	0.0108	0.1669	0.0347
	24	1.0965	1102.5258	2.8350	0.0350	0.0105	0.1564	0.0335
	25	1.0386	1070.3899	2.7759	0.0338	0.0102	0.1458	0.0323
	26	1.0089	1057.3247	2.7566	0.0337	0.0100	0.1414	0.0322
	27	0.9792	1044.2595	2.7373	0.0336	0.0099	0.1371	0.0321
	28	0.9495	1031.1942	2.7180	0.0335	0.0098	0.1327	0.0320
	29	0.9198	1018.1290	2.6988	0.0334	0.0097	0.1283	0.0319
	30	0.8902	1005.0638	2.6795	0.0333	0.0095	0.1239	0.0318
	31	0.8697	1009.5733	2.6973	0.0337	0.0095	0.1210	0.0322
	32	0.8493	1014.0828	2.7152	0.0341	0.0095	0.1181	0.0326
	33	0.8289	1018.5923	2.7331	0.0345	0.0096	0.1152	0.0330
	34	0.8084	1023.1018	2.7509	0.0349	0.0096	0.1123	0.0333
	35	0.7880	1027.6114	2.7688	0.0353	0.0096	0.1094	0.0337
	36	0.7707	1026.1846	2.7470	0.0355	0.0096	0.1065	0.0340
	37	0.7534	1024.7579	2.7253	0.0358	0.0096	0.1035	0.0342
	38	0.7362	1023.3312	2.7036	0.0360	0.0095	0.1006	0.0345
	39	0.7189	1021.9044	2.6818	0.0363	0.0095	0.0977	0.0347
	40	0.7016	1020.4777	2.6601	0.0366	0.0095	0.0947	0.0350
	41	0.6870	1013.9423	2.6305	0.0369	0.0095	0.0923	0.0353
	42	0.6725	1007.4069	2.6010	0.0372	0.0094	0.0898	0.0356
	43	0.6579	1000.8716	2.5715	0.0376	0.0094	0.0873	0.0359
	44	0.6434	994.3362	2.5419	0.0379	0.0093	0.0849	0.0363
	45	0.6288	987.8008	2.5124	0.0382	0.0093	0.0824	0.0366
	46	0.6314	964.3856	2.4771	0.0378	0.0091	0.0810	0.0362
	47	0.6340	940.9704	2.4418	0.0374	0.0089	0.0795	0.0358
	48	0.6366	917.5552	2.4065	0.0370	0.0087	0.0781	0.0354
	49	0.6392	894.1400	2.3712	0.0366	0.0085	0.0766	0.0350
	50	0.6419	870.7248	2.3359	0.0362	0.0083	0.0752	0.0346
	51	0.6220	892.7249	2.4040	0.0401	0.0085	0.0765	0.0384
	52	0.6022	914.7250	2.4722	0.0441	0.0087	0.0779	0.0422
	53	0.5824	936.7252	2.5404	0.0480	0.0089	0.0792	0.0459
	54	0.5626	958.7253	2.6086	0.0520	0.0091	0.0805	0.0497
	55	0.5428	980.7255	2.6768	0.0559	0.0093	0.0819	0.0535
	56	0.5271	1009.3233	2.7048	0.0580	0.0096	0.0817	0.0555
	57	0.5115	1037.9211	2.7329	0.0600	0.0098	0.0816	0.0574
	58	0.4958	1066.5189	2.7610	0.0621	0.0101	0.0814	0.0594
	59	0.4802	1095.1167	2.7891	0.0641	0.0104	0.0813	0.0613
	60	0.4645	1123.7146	2.8172	0.0661	0.0106	0.0811	0.0633
	61	0.4591	1143.6798	2.8456	0.0659	0.0108	0.0798	0.0631
	62	0.4537	1163.6450	2.8741	0.0657	0.0110	0.0785	0.0629
	63	0.4483	1183.6103	2.9025	0.0655	0.0112	0.0772	0.0627
	64	0.4429	1203.5755	2.9309	0.0653	0.0114	0.0759	0.0625
	65	0.4374	1223.5407	2.9594	0.0651	0.0116	0.0745	0.0623
	66	0.4579	1221.1740	2.9982	0.0648	0.0116	0.0762	0.0620
	67	0.4784	1218.8073	3.0370	0.0646	0.0115	0.0778	0.0618
	68	0.4989	1216.4406	3.0758	0.0643	0.0115	0.0795	0.0615
	69	0.5193	1214.0739	3.1146	0.0641	0.0115	0.0811	0.0613
	70	0.5398	1211.7072	3.1534	0.0638	0.0115	0.0828	0.0610

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2040

Mode	Speed	CO	CO2	NOX	PM10	SOX	VOC	PM2.5
Auto	0	1.6243	41.5134	0.1182	0.0008	0.0004	0.1038	0.0007
	5	1.0375	512.1914	0.0448	0.0042	0.0051	0.0871	0.0038
	6	1.0103	492.7973	0.0435	0.0039	0.0049	0.0810	0.0035
	7	0.9831	473.4032	0.0422	0.0035	0.0047	0.0749	0.0033
	8	0.9559	454.0092	0.0409	0.0032	0.0045	0.0688	0.0030
Truck	0	0.5426	6.2184	0.8784	0.0001	0.0001	0.0216	0.0001
	5	2.2343	2133.8128	7.8220	0.0104	0.0197	0.1694	0.0099
	6	2.1544	2037.2309	7.2086	0.0103	0.0188	0.1668	0.0098
	7	2.0745	1940.6489	6.5953	0.0101	0.0178	0.1643	0.0096
	8	1.9946	1844.0670	5.9819	0.0100	0.0169	0.1617	0.0095
	9	1.9147	1747.4850	5.3685	0.0099	0.0160	0.1591	0.0094
	10	1.8348	1650.9031	4.7551	0.0097	0.0150	0.1566	0.0093
	11	1.6377	1541.7983	4.2323	0.0095	0.0141	0.1456	0.0090
	12	1.4405	1432.6935	3.7096	0.0092	0.0132	0.1347	0.0088
	13	1.2434	1323.5888	3.1868	0.0090	0.0123	0.1237	0.0086
	14	1.0462	1214.4840	2.6640	0.0087	0.0113	0.1128	0.0083
	15	0.8490	1105.3793	2.1412	0.0085	0.0104	0.1018	0.0081
	16	0.7673	1083.3925	2.1164	0.0081	0.0102	0.0899	0.0077
	17	0.6856	1061.4058	2.0917	0.0077	0.0100	0.0780	0.0073
	18	0.6039	1039.4190	2.0669	0.0073	0.0098	0.0661	0.0070
	19	0.5221	1017.4323	2.0422	0.0069	0.0096	0.0542	0.0066
	20	0.4404	995.4456	2.0174	0.0065	0.0094	0.0423	0.0062
	21	0.4190	964.9603	1.9304	0.0064	0.0091	0.0397	0.0061
	22	0.3975	934.4750	1.8433	0.0062	0.0088	0.0370	0.0059
	23	0.3761	903.9897	1.7562	0.0061	0.0085	0.0344	0.0058
	24	0.3546	873.5044	1.6692	0.0059	0.0082	0.0317	0.0057
	25	0.3332	843.0192	1.5821	0.0058	0.0079	0.0290	0.0055
	26	0.3186	829.3296	1.5318	0.0057	0.0078	0.0275	0.0054
	27	0.3039	815.6399	1.4814	0.0056	0.0077	0.0259	0.0054
	28	0.2893	801.9503	1.4311	0.0055	0.0075	0.0244	0.0053
	29	0.2747	788.2607	1.3808	0.0054	0.0074	0.0228	0.0052
	30	0.2601	774.5711	1.3305	0.0053	0.0073	0.0213	0.0051
	31	0.2617	772.3339	1.2970	0.0054	0.0072	0.0204	0.0052
	32	0.2634	770.0966	1.2636	0.0055	0.0072	0.0195	0.0052
	33	0.2650	767.8594	1.2302	0.0056	0.0071	0.0186	0.0053
	34	0.2667	765.6222	1.1968	0.0056	0.0070	0.0177	0.0054
	35	0.2683	763.3850	1.1634	0.0057	0.0070	0.0168	0.0054
	36	0.2556	758.7409	1.1196	0.0059	0.0070	0.0162	0.0057
	37	0.2429	754.0968	1.0759	0.0062	0.0069	0.0156	0.0059
	38	0.2301	749.4527	1.0322	0.0064	0.0069	0.0150	0.0061
	39	0.2174	744.8086	0.9885	0.0066	0.0068	0.0143	0.0063
	40	0.2047	740.1645	0.9447	0.0068	0.0068	0.0137	0.0065
	41	0.1954	734.5862	0.9025	0.0072	0.0068	0.0134	0.0069
	42	0.1861	729.0080	0.8603	0.0075	0.0067	0.0131	0.0072
	43	0.1768	723.4298	0.8182	0.0078	0.0067	0.0128	0.0075
	44	0.1675	717.8516	0.7760	0.0082	0.0066	0.0125	0.0078
	45	0.1582	712.2733	0.7338	0.0085	0.0066	0.0122	0.0081
	46	0.1501	701.7716	0.6947	0.0087	0.0065	0.0123	0.0083
	47	0.1420	691.2700	0.6557	0.0089	0.0064	0.0123	0.0085
	48	0.1339	680.7683	0.6166	0.0091	0.0064	0.0124	0.0087
	49	0.1258	670.2666	0.5776	0.0093	0.0063	0.0124	0.0089
	50	0.1177	659.7649	0.5385	0.0095	0.0062	0.0125	0.0091
	51	0.1134	670.7116	0.5630	0.0104	0.0063	0.0124	0.0099
	52	0.1091	681.6584	0.5874	0.0113	0.0064	0.0123	0.0108
	53	0.1048	692.6052	0.6119	0.0122	0.0066	0.0122	0.0117
	54	0.1005	703.5520	0.6364	0.0131	0.0067	0.0121	0.0125
	55	0.0962	714.4987	0.6609	0.0140	0.0068	0.0120	0.0134
	56	0.0964	730.3835	0.7136	0.0153	0.0069	0.0124	0.0146
	57	0.0966	746.2682	0.7663	0.0166	0.0071	0.0127	0.0158
	58	0.0969	762.1530	0.8191	0.0178	0.0072	0.0130	0.0171
	59	0.0971	778.0378	0.8718	0.0191	0.0074	0.0134	0.0183
	60	0.0973	793.9225	0.9245	0.0204	0.0075	0.0137	0.0195
	61	0.1018	810.7058	1.0126	0.0218	0.0077	0.0144	0.0209
	62	0.1064	827.4890	1.1007	0.0233	0.0078	0.0151	0.0222
	63	0.1109	844.2722	1.1888	0.0247	0.0080	0.0157	0.0236
	64	0.1154	861.0555	1.2769	0.0261	0.0081	0.0164	0.0250
	65	0.1200	877.8387	1.3650	0.0275	0.0083	0.0171	0.0263
	66	0.1280	880.4223	1.3757	0.0277	0.0083	0.0180	0.0265
	67	0.1361	883.0060	1.3865	0.0279	0.0084	0.0189	0.0267
	68	0.1442	885.5896	1.3972	0.0281	0.0084	0.0198	0.0269
	69	0.1522	888.1732	1.4080	0.0283	0.0084	0.0207	0.0271
	70	0.1603	890.7569	1.4187	0.0285	0.0084	0.0216	0.0272

Emissions Tables

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2020

Mode	Speed	CO	CO2	NOX	PM10	SOX	VOC	PM2.5
Auto	0	2.7812	66.6818	0.2922	0.0022	0.0007	0.3837	0.0020
	5	2.4569	766.8891	0.1849	0.0119	0.0076	0.2149	0.0110
	6	2.3624	736.4937	0.1767	0.0110	0.0073	0.1979	0.0102
	7	2.2679	706.0983	0.1684	0.0101	0.0070	0.1809	0.0093
	8	2.1734	675.7028	0.1602	0.0092	0.0067	0.1639	0.0085
Bus	0	1.7052	12.7834	0.6062	0.0001	0.0001	0.0807	0.0001
	5	20.7553	2860.2247	6.9105	0.0597	0.0186	0.4993	0.0570
	6	20.2836	2782.8803	6.5264	0.0560	0.0182	0.4690	0.0535
	7	19.8120	2705.5358	6.1422	0.0523	0.0177	0.4387	0.0500
	8	19.3403	2628.1913	5.7580	0.0486	0.0172	0.4084	0.0465
	9	18.8686	2550.8469	5.3739	0.0449	0.0167	0.3781	0.0429
	10	18.3970	2473.5024	4.9897	0.0412	0.0162	0.3478	0.0394
	11	18.2626	2387.8333	4.6778	0.0381	0.0155	0.3189	0.0364
	12	18.1282	2302.1641	4.3659	0.0349	0.0147	0.2901	0.0334
	13	17.9938	2216.4950	4.0539	0.0318	0.0140	0.2612	0.0304
	14	17.8595	2130.8259	3.7420	0.0286	0.0132	0.2324	0.0274
	15	17.7251	2045.1567	3.4300	0.0255	0.0125	0.2035	0.0243
	16	19.5028	2013.8706	3.1042	0.0219	0.0114	0.1854	0.0209
	17	21.2804	1982.5846	2.7783	0.0184	0.0103	0.1672	0.0175
	18	23.0581	1951.2985	2.4524	0.0148	0.0092	0.1490	0.0141
	19	24.8358	1920.0124	2.1265	0.0112	0.0081	0.1308	0.0108
	20	26.6134	1888.7263	1.8007	0.0077	0.0070	0.1126	0.0074
	21	22.0537	1802.6822	2.1964	0.0114	0.0082	0.1152	0.0109
	22	17.4940	1716.6380	2.5921	0.0151	0.0095	0.1178	0.0144
	23	12.9342	1630.5938	2.9878	0.0188	0.0107	0.1203	0.0180
	24	8.3745	1544.5496	3.3835	0.0225	0.0119	0.1229	0.0215
	25	3.8147	1458.5055	3.7792	0.0262	0.0131	0.1255	0.0251
	26	3.7714	1430.8138	3.7304	0.0255	0.0128	0.1204	0.0243
	27	3.7280	1403.1221	3.6817	0.0247	0.0126	0.1153	0.0236
	28	3.6846	1375.4304	3.6330	0.0239	0.0123	0.1102	0.0229
	29	3.6413	1347.7387	3.5842	0.0232	0.0120	0.1051	0.0222
	30	3.5979	1320.0470	3.5355	0.0224	0.0118	0.1000	0.0214
	31	3.5389	1302.9919	3.4890	0.0218	0.0116	0.0965	0.0209
	32	3.4800	1285.9368	3.4425	0.0212	0.0115	0.0930	0.0203
	33	3.4210	1268.8817	3.3960	0.0206	0.0114	0.0894	0.0197
	34	3.3621	1251.8266	3.3495	0.0200	0.0112	0.0859	0.0192
	35	3.3031	1234.7715	3.3030	0.0194	0.0111	0.0824	0.0186
	36	3.3885	1237.8678	3.1905	0.0188	0.0111	0.0802	0.0180
	37	3.4738	1240.9642	3.0780	0.0181	0.0111	0.0780	0.0173
	38	3.5592	1244.0606	2.9655	0.0175	0.0111	0.0757	0.0167
	39	3.6446	1247.1569	2.8529	0.0168	0.0111	0.0735	0.0161
	40	3.7300	1250.2533	2.7404	0.0162	0.0111	0.0713	0.0155
	41	3.7750	1258.8091	2.6699	0.0161	0.0112	0.0702	0.0154
	42	3.8200	1267.3650	2.5995	0.0161	0.0113	0.0691	0.0154
	43	3.8651	1275.9208	2.5290	0.0160	0.0113	0.0680	0.0153
	44	3.9101	1284.4766	2.4585	0.0160	0.0114	0.0669	0.0153
	45	3.9551	1293.0324	2.3880	0.0159	0.0115	0.0658	0.0152
	46	3.8713	1292.4992	2.4237	0.0165	0.0115	0.0648	0.0158
	47	3.7875	1291.9659	2.4595	0.0171	0.0115	0.0639	0.0164
	48	3.7037	1291.4326	2.4952	0.0177	0.0115	0.0629	0.0170
	49	3.6199	1290.8994	2.5309	0.0184	0.0115	0.0620	0.0175
	50	3.5361	1290.3661	2.5666	0.0190	0.0115	0.0610	0.0181
	51	3.3966	1282.7008	2.7690	0.0208	0.0115	0.0615	0.0198
	52	3.2572	1275.0355	2.9713	0.0226	0.0114	0.0620	0.0216
	53	3.1177	1267.3703	3.1736	0.0244	0.0114	0.0625	0.0233
	54	2.9782	1259.7050	3.3759	0.0261	0.0114	0.0629	0.0250
	55	2.8388	1252.0397	3.5783	0.0279	0.0113	0.0634	0.0267
	56	2.9208	1268.5531	3.5566	0.0303	0.0114	0.0664	0.0290
	57	3.0029	1285.0664	3.5349	0.0326	0.0116	0.0693	0.0312
	58	3.0850	1301.5798	3.5132	0.0349	0.0117	0.0723	0.0334
	59	3.1671	1318.0932	3.4915	0.0372	0.0118	0.0753	0.0356
	60	3.2492	1334.6065	3.4698	0.0396	0.0119	0.0782	0.0378
	61	3.1376	1357.3126	3.5254	0.0452	0.0122	0.0847	0.0432
	62	3.0260	1380.0187	3.5809	0.0508	0.0124	0.0911	0.0486
	63	2.9145	1402.7247	3.6365	0.0564	0.0126	0.0976	0.0539
	64	2.8029	1425.4308	3.6920	0.0620	0.0129	0.1040	0.0593
	65	2.6914	1448.1369	3.7475	0.0676	0.0131	0.1105	0.0646
	66	2.7330	1459.9054	3.4083	0.0593	0.0132	0.1036	0.0567
	67	2.7747	1471.6740	3.0692	0.0510	0.0133	0.0968	0.0487
	68	2.8163	1483.4425	2.7300	0.0427	0.0135	0.0899	0.0408
	69	2.8579	1495.2110	2.3908	0.0344	0.0136	0.0831	0.0329
	70	2.8996	1506.9796	2.0516	0.0261	0.0137	0.0762	0.0249

HIGHWAY EMISSIONS FACTORS (g/mi)

Model Year 2040

Mode	Speed	CO	CO2	NOX	PM10	SOX	VOC	PM2.5
Auto	0	1.6243	41.5134	0.1182	0.0008	0.0004	0.1038	0.0007
	5	1.0375	512.1914	0.0448	0.0042	0.0051	0.0871	0.0038
	6	1.0103	492.7973	0.0435	0.0039	0.0049	0.0810	0.0035
	7	0.9831	473.4032	0.0422	0.0035	0.0047	0.0749	0.0033
	8	0.9559	454.0092	0.0409	0.0032	0.0045	0.0688	0.0030
Bus	0	1.3037	10.4247	1.2376	0.0001	0.0001	0.0639	0.0001
	5	23.9976	2501.4118	2.6218	0.0074	0.0141	0.1044	0.0070
	6	23.4637	2424.4382	2.4492	0.0071	0.0136	0.0990	0.0067
	7	22.9297	2347.4646	2.2765	0.0068	0.0131	0.0936	0.0064
	8	22.3957	2270.4910	2.1038	0.0064	0.0127	0.0881	0.0061
	9	21.8617	2193.5175	1.9311	0.0061	0.0122	0.0827	0.0058
	10	21.3278	2116.5439	1.7584	0.0058	0.0118	0.0773	0.0055
	11	21.1073	2047.5775	1.6420	0.0055	0.0112	0.0736	0.0052
	12	20.8868	1978.6110	1.5255	0.0052	0.0107	0.0699	0.0050
	13	20.6662	1909.6446	1.4091	0.0050	0.0101	0.0662	0.0047
	14	20.4457	1840.6782	1.2926	0.0047	0.0096	0.0625	0.0045
	15	20.2252	1771.7118	1.1762	0.0045	0.0090	0.0588	0.0042
	16	22.3237	1775.9215	1.0665	0.0043	0.0083	0.0594	0.0040
	17	24.4222	1780.1312	0.9569	0.0041	0.0075	0.0601	0.0039
	18	26.5207	1784.3409	0.8473	0.0039	0.0067	0.0607	0.0037
	19	28.6192	1788.5505	0.7377	0.0037	0.0060	0.0613	0.0035
	20	30.7177	1792.7602	0.6280	0.0035	0.0052	0.0620	0.0033
	21	25.2049	1655.9515	0.7462	0.0034	0.0061	0.0542	0.0033
	22	19.6922	1519.1428	0.8643	0.0034	0.0070	0.0465	0.0032
	23	14.1794	1382.3341	0.9825	0.0033	0.0078	0.0388	0.0032
	24	8.6666	1245.5254	1.1006	0.0033	0.0087	0.0311	0.0031
	25	3.1538	1108.7167	1.2188	0.0032	0.0096	0.0234	0.0031
	26	3.1149	1084.9049	1.1651	0.0032	0.0094	0.0225	0.0030
	27	3.0759	1061.0931	1.1114	0.0032	0.0092	0.0216	0.0030
	28	3.0370	1037.2814	1.0577	0.0031	0.0089	0.0207	0.0030
	29	2.9981	1013.4696	1.0040	0.0031	0.0087	0.0199	0.0029
	30	2.9591	989.6578	0.9503	0.0031	0.0085	0.0190	0.0029
	31	2.9189	974.6062	0.9043	0.0031	0.0084	0.0184	0.0029
	32	2.8788	959.5545	0.8584	0.0031	0.0083	0.0177	0.0029
	33	2.8386	944.5029	0.8125	0.0031	0.0081	0.0171	0.0029
	34	2.7984	929.4513	0.7666	0.0031	0.0080	0.0164	0.0029
	35	2.7582	914.3996	0.7207	0.0031	0.0079	0.0158	0.0030
	36	2.8909	917.8025	0.6824	0.0032	0.0079	0.0156	0.0030
	37	3.0237	921.2055	0.6441	0.0032	0.0079	0.0155	0.0030
	38	3.1565	924.6084	0.6058	0.0033	0.0078	0.0153	0.0031
	39	3.2892	928.0113	0.5676	0.0033	0.0078	0.0152	0.0031
	40	3.4220	931.4142	0.5293	0.0033	0.0078	0.0150	0.0032
	41	3.5398	941.3220	0.5092	0.0035	0.0079	0.0150	0.0033
	42	3.6575	951.2298	0.4890	0.0036	0.0079	0.0150	0.0034
	43	3.7753	961.1377	0.4689	0.0037	0.0080	0.0150	0.0035
	44	3.8931	971.0455	0.4488	0.0038	0.0081	0.0150	0.0036
	45	4.0108	980.9533	0.4287	0.0039	0.0081	0.0150	0.0038
	46	3.9266	980.8062	0.4258	0.0042	0.0081	0.0148	0.0040
	47	3.8424	980.6590	0.4230	0.0045	0.0082	0.0146	0.0043
	48	3.7582	980.5119	0.4202	0.0047	0.0082	0.0144	0.0045
	49	3.6739	980.3647	0.4173	0.0050	0.0082	0.0142	0.0048
	50	3.5897	980.2176	0.4145	0.0053	0.0082	0.0140	0.0050
	51	3.5005	975.8673	0.4381	0.0059	0.0082	0.0139	0.0056
	52	3.4112	971.5171	0.4617	0.0065	0.0082	0.0138	0.0062
	53	3.3220	967.1668	0.4852	0.0070	0.0082	0.0138	0.0067
	54	3.2327	962.8166	0.5088	0.0076	0.0082	0.0137	0.0073
	55	3.1435	958.4663	0.5324	0.0082	0.0082	0.0137	0.0078
	56	3.2439	976.2456	0.5594	0.0089	0.0083	0.0141	0.0085
	57	3.3442	994.0250	0.5864	0.0096	0.0084	0.0144	0.0092
	58	3.4446	1011.8043	0.6133	0.0104	0.0086	0.0148	0.0099
	59	3.5449	1029.5836	0.6403	0.0111	0.0087	0.0152	0.0106
	60	3.6453	1047.3629	0.6673	0.0118	0.0088	0.0156	0.0113
	61	3.3385	1067.0328	0.7561	0.0135	0.0091	0.0159	0.0129
	62	3.0317	1086.7026	0.8449	0.0152	0.0094	0.0163	0.0145
	63	2.7248	1106.3724	0.9338	0.0169	0.0097	0.0166	0.0162
	64	2.4180	1126.0422	1.0226	0.0186	0.0099	0.0169	0.0178
	65	2.1112	1145.7121	1.1114	0.0203	0.0102	0.0173	0.0194
	66	2.0966	1149.4634	1.0159	0.0184	0.0103	0.0172	0.0176
	67	2.0819	1153.2148	0.9203	0.0164	0.0103	0.0170	0.0157
	68	2.0673	1156.9661	0.8248	0.0145	0.0104	0.0169	0.0139
	69	2.0527	1160.7175	0.7292	0.0126	0.0104	0.0168	0.0120
	70	2.0380	1164.4688	0.6337	0.0107	0.0105	0.0167	0.0102

Source: California Air Resources Board, EMFAC 2017

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

HEALTH COST OF TRANSPORTATION EMISSIONS

($/ton)

Area	Proj Loc	CO	CO_2e	NO_X	PM_{10}	SO_X	VOC
LA/South Coast	1	$160	$38	$63,900	$523,300	$196,600	$3,970
CA Urban Area	2	$80	$38	$18,700	$151,100	$75,500	$1,305
CA Rural Area	3	$75	$38	$13,900	$107,700	$54,400	$1,025

CO_2e Uprater 2.0% increase in value per year

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

PASSENGER TRAIN EMISSIONS FACTORS

(g/train-mile)

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

LIGHT RAIL EMISSIONS FACTORS

(g/veh-mile)

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

FREIGHT LOCOMOTIVE EMISSIONS FACTORS

(g/gal)

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

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

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

Pavement Adjustments (used only for pavement projects)

PAVEMENT DETERIORATION

(IRI in inches/mile)

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

Source: Paterson, 1987

VEHICLE OPERATING SPEED

(percent adjustment)

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

Source: Botterill, 1996 and 1997

FUEL CONSUMPTION

(percent adjustment)

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

Source: Texas Transportation Institute, 1994

NON-FUEL COSTS

(percent adjustment)

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

Source: ARRB Research Board TR VOC Model

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

VEHICLE OPERATING SPEED
(percent adjustment)

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

Source: Fitzpatrick, Brewer, and Venglar, 2003

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

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

TMS 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
TIoth	1.00	1.00	1.02	0.97	-0.11	-0.12	-0.35	1.00
TIsev	1.00	1.00	1.01	0.97	-0.39	-0.39	-0.35	1.00

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

TRANSIT TRAVEL TIME AND AGENCY COST SAVINGS
(percent savings)

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

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