

District: **TxDOT Houston**

PROJECT: **US 90A from at Western City limits of Richmond to Santa Fe RR**

EA:	Arterial
PPNO:	0027-07-032

3

INVESTMENT ANALYSIS SUMMARY RESULTS

Life-Cycle Costs (mil. \$)	\$20.7
Life-Cycle Benefits (mil. \$)	\$190.7
Net Present Value (mil. \$)	\$170.0
Benefit / Cost Ratio:	9.2
Rate of Return on Investment:	36.1%
Payback Period:	3 years

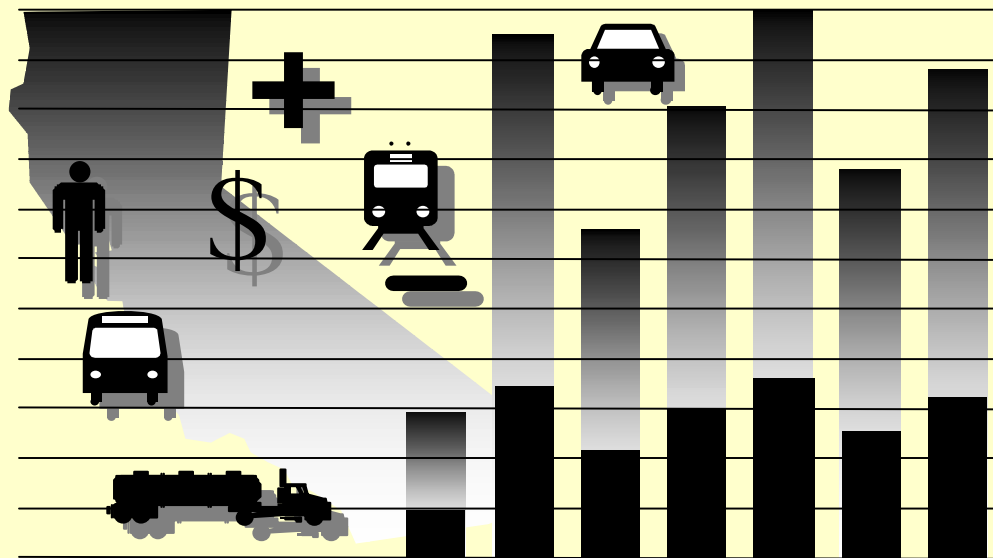
ITEMIZED BENEFITS (mil. \$)	Average Annual	Total Over 20 Years
Travel Time Savings	\$8.5	\$169.8
Veh. Op. Cost Savings	\$0.7	\$14.4
Accident Cost Savings	\$0.2	\$4.7
Emission Cost Savings	\$0.1	\$1.7
TOTAL BENEFITS	\$9.5	\$190.7
Person-Hours of Time Saved	692,863	13,857,258
CO₂ Emissions Saved (tons)	3,261	65,226
CO₂ Emissions Saved (mil. \$)	\$0.1	\$1.4

Should benefit-cost results include:

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



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: **US 90A from at Western City limits of Richmond to Santa Fe RR**

Facility Type: **Arterial**
 CSJ #: **0027-07-032**

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
 Current

1C HIGHWAY ACCIDENT DATA

Actual 3-Year Accident Data (from Table B)

	Count (No.)	Rate
Total Accidents (Tot)	16	0.60
Fatal Accidents (Fat)	0	0.000
Injury Accidents (Inj)	3	0.11
Property Damage Only (PDO) Accidents	13	0.49

Statewide Basic Average Accident Rate

	No Build	Build
Rate Group		
Accident Rate (per million vehicle-miles)	0.46	0.21
Percent Fatal Accidents (Pct Fat)	1.0%	0.4%
Percent Injury Accidents (Pct Inj)	49.2%	22.1%

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		
HOV Restriction (2 or 3)		
Exclusive ROW for Buses (y/n)	N	
Highway Free-Flow Speed	35	55
Ramp Design Speed (if aux. lane/off-ramp proj.)	35	35
Length (in miles) Highway Segment	0.6	0.6
Impacted Length	0.6	0.6

Average Daily Traffic

	No Build	Build
Current	56,864	
Base (Year 1)	61,825	61,825
Forecast (Year 20)	108,958	108,958

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): 3%

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)	
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
Construction Period									
1			\$10,500					\$10,500,000	\$10,500,000
2			10,500					10,500,000	10,194,175
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	\$0	\$0	\$21,000	\$0	\$0	\$0	\$0	\$21,000,000	\$20,694,175

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

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	32,084		32,084	
Weaving Volume	0		0	
Truck Volume	992		992	
HOV Speed	55.0		55.0	
Non-HOV Speed	6.6		6.6	
Weaving Speed	55.0		55.0	
Truck Speed	6.6		6.6	

Non-Peak Period

Non-HOV Volume	27,886		27,886	
Weaving Volume	0		0	
Truck Volume	862		862	
Non-HOV Speed	32.2		32.2	
Weaving Speed	55.0		55.0	
Truck Speed	32.2		32.2	

Year 20

Peak Period

HOV Volume	0		0	
Non-HOV Volume	56,544		56,544	
Weaving Volume	0		0	
Truck Volume	1,749		1,749	
HOV Speed	55.0		55.0	
Non-HOV Speed	6.6		6.6	
Weaving Speed	55.0		55.0	
Truck Speed	6.6		6.6	

Non-Peak Period

Non-HOV Volume	49,146		49,146	
Weaving Volume	0		0	
Truck Volume	1,520		1,520	
Non-HOV Speed	6.6		6.6	
Weaving Speed	55.0		55.0	
Truck Speed	6.6		6.6	

Build

Year 1

Peak Period

HOV Volume	0		0	
Non-HOV Volume	32,084		32,084	
Weaving Volume	0		0	
Truck Volume	992		992	
HOV Speed	55.0		55.0	
Non-HOV Speed	10.4		10.4	
Weaving Speed	55.0		55.0	
Truck Speed	10.4		10.4	

Non-Peak Period

Non-HOV Volume	27,886		27,886	
Weaving Volume	0		0	
Truck Volume	862		862	
Non-HOV Speed	50.6		50.6	
Weaving Speed	55.0		55.0	
Truck Speed	50.6		50.6	

Year 20

Peak Period

HOV Volume	0		0	
Non-HOV Volume	56,544		56,544	
Weaving Volume	0		0	
Truck Volume	1,749		1,749	
HOV Speed	55.0		55.0	
Non-HOV Speed	10.4		10.4	
Weaving Speed	55.0		55.0	
Truck Speed	10.4		10.4	

Non-Peak Period

Non-HOV Volume	49,146		49,146	
Weaving Volume	0		0	
Truck Volume	1,520		1,520	
Non-HOV Speed	10.4		10.4	
Weaving Speed	55.0		55.0	
Truck Speed	10.4		10.4	

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	0.000		0.000	
Injury Accidents	0.11		0.11	
PDO Accidents	0.49		0.49	
Total Accidents	0.600			
Hwy Safety or Weaving Improvement <input type="text" value="0%"/> collision reduction factor (per HSIP Guidelines)				
Adjustment Factor (Actual/Statewide Avg. Existing)				
Fatal Accidents	0.0000		0.0000	
Injury Accidents	0.4907		0.4907	
PDO Accidents	2.1544		2.1544	
Build				
Fatal Accidents	0.000		0.000	
Injury Accidents	0.02		0.02	
PDO Accidents	0.34		0.34	
Total Accidents	0.365			

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
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	10,427,383	10,427,383	0
Truck Trips	257,997	257,997	0
Non-Peak Period			
Non-HOV Trips	9,570,584	9,570,584	0
Truck Trips	224,240	224,240	0
Total Trips	20,480,205	20,480,205	0

Year 20			
Peak Period			
HOV Trips	0	0	
Non-HOV Trips	18,376,720	18,376,720	0
Truck Trips	454,682	454,682	0
Non-Peak Period			
Non-HOV Trips	16,866,738	16,866,738	0
Truck Trips	395,191	395,191	0
Total Trips	36,093,330	36,093,330	0

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	\$5,058,927	\$0	\$218,157	\$0	\$0	\$947,167	\$0	\$38,679
20	\$0	\$6,377,839	\$0	\$275,033	\$0	\$0	\$5,853,783	\$0	\$239,047
2	\$0	\$5,169,955	\$0	\$222,945	\$0	\$0	\$1,010,281	\$0	\$41,256
3	\$0	\$5,275,557	\$0	\$227,499	\$0	\$0	\$1,078,058	\$0	\$44,024
4	\$0	\$5,375,889	\$0	\$231,825	\$0	\$0	\$1,151,202	\$0	\$47,011
5	\$0	\$5,471,103	\$0	\$235,931	\$0	\$0	\$1,230,558	\$0	\$50,251
6	\$0	\$5,561,348	\$0	\$239,823	\$0	\$0	\$1,317,148	\$0	\$53,788
7	\$0	\$5,646,767	\$0	\$243,507	\$0	\$0	\$1,412,223	\$0	\$57,670
8	\$0	\$5,727,503	\$0	\$246,988	\$0	\$0	\$1,517,330	\$0	\$61,962
9	\$0	\$5,803,692	\$0	\$250,274	\$0	\$0	\$1,634,403	\$0	\$66,743
10	\$0	\$5,875,469	\$0	\$253,369	\$0	\$0	\$1,765,897	\$0	\$72,113
11	\$0	\$5,942,965	\$0	\$256,280	\$0	\$0	\$1,914,974	\$0	\$78,201
12	\$0	\$6,006,307	\$0	\$259,011	\$0	\$0	\$2,085,778	\$0	\$85,176
13	\$0	\$6,065,621	\$0	\$261,569	\$0	\$0	\$2,283,845	\$0	\$93,264
14	\$0	\$6,121,027	\$0	\$263,958	\$0	\$0	\$2,516,753	\$0	\$102,775
15	\$0	\$6,172,644	\$0	\$266,184	\$0	\$0	\$2,795,145	\$0	\$114,143
16	\$0	\$6,220,588	\$0	\$268,251	\$0	\$0	\$3,134,464	\$0	\$128,000
17	\$0	\$6,264,971	\$0	\$270,165	\$0	\$0	\$3,558,001	\$0	\$145,296
18	\$0	\$6,305,903	\$0	\$271,931	\$0	\$0	\$4,102,609	\$0	\$167,536
19	\$0	\$6,343,491	\$0	\$273,551	\$0	\$0	\$4,830,250	\$0	\$197,250
Total	\$0	\$116,787,565	\$0	\$5,036,250	\$0	\$0	\$46,139,869	\$0	\$1,884,183

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	\$6,262,930	\$6,644,342	421,302
20	\$0	\$0	\$0	\$0	\$12,745,702	\$23,710,760	1,198,904
2	\$0	\$0	\$0	\$0	\$6,444,437	\$7,042,010	441,225
3	\$0	\$0	\$0	\$0	\$6,625,138	\$7,456,651	461,667
4	\$0	\$0	\$0	\$0	\$6,805,927	\$7,889,935	482,704
5	\$0	\$0	\$0	\$0	\$6,987,844	\$8,343,851	504,425
6	\$0	\$0	\$0	\$0	\$7,172,106	\$8,820,786	526,938
7	\$0	\$0	\$0	\$0	\$7,360,167	\$9,323,639	550,378
8	\$0	\$0	\$0	\$0	\$7,553,783	\$9,855,973	574,908
9	\$0	\$0	\$0	\$0	\$7,755,111	\$10,422,221	600,734
10	\$0	\$0	\$0	\$0	\$7,966,848	\$11,027,980	628,119
11	\$0	\$0	\$0	\$0	\$8,192,419	\$11,680,431	657,400
12	\$0	\$0	\$0	\$0	\$8,436,271	\$12,388,949	689,017
13	\$0	\$0	\$0	\$0	\$8,704,299	\$13,166,033	723,563
14	\$0	\$0	\$0	\$0	\$9,004,513	\$14,028,739	761,845
15	\$0	\$0	\$0	\$0	\$9,348,117	\$15,000,983	804,999
16	\$0	\$0	\$0	\$0	\$9,751,303	\$16,117,419	854,672
17	\$0	\$0	\$0	\$0	\$10,238,433	\$17,430,247	913,352
18	\$0	\$0	\$0	\$0	\$10,847,977	\$19,021,994	984,969
19	\$0	\$0	\$0	\$0	\$11,644,542	\$21,031,337	1,076,138
Total	\$0	\$0	\$0	\$0	\$169,847,868	\$250,404,282	13,857,258

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	\$413,282	\$0	\$20,031	\$0	\$92,262	\$0	\$4,687	-	-	\$530,262	\$562,555
20	\$0	\$415,367	\$0	\$20,132	\$0	\$361,020	\$0	\$17,498	-	-	\$814,016	\$1,514,309
2	\$0	\$417,344	\$0	\$20,228	\$0	\$116,772	\$0	\$6,001	-	-	\$560,345	\$612,304
3	\$0	\$420,819	\$0	\$20,396	\$0	\$136,533	\$0	\$7,074	-	-	\$584,822	\$658,222
4	\$0	\$423,737	\$0	\$20,538	\$0	\$152,615	\$0	\$7,938	-	-	\$604,828	\$701,162
5	\$0	\$426,129	\$0	\$20,653	\$0	\$182,650	\$0	\$9,623	-	-	\$639,055	\$763,065
6	\$0	\$428,021	\$0	\$20,745	\$0	\$196,202	\$0	\$10,359	-	-	\$655,327	\$805,970
7	\$0	\$429,442	\$0	\$20,814	\$0	\$201,966	\$0	\$10,698	-	-	\$662,920	\$839,767
8	\$0	\$430,417	\$0	\$20,861	\$0	\$244,703	\$0	\$13,032	-	-	\$709,014	\$925,102
9	\$0	\$430,971	\$0	\$20,888	\$0	\$247,584	\$0	\$13,267	-	-	\$712,710	\$957,823
10	\$0	\$431,128	\$0	\$20,896	\$0	\$250,240	\$0	\$13,490	-	-	\$715,754	\$990,770
11	\$0	\$430,909	\$0	\$20,885	\$0	\$301,419	\$0	\$16,451	-	-	\$769,664	\$1,097,357
12	\$0	\$430,338	\$0	\$20,858	\$0	\$304,862	\$0	\$16,734	-	-	\$772,791	\$1,134,870
13	\$0	\$429,435	\$0	\$20,814	\$0	\$308,056	\$0	\$17,003	-	-	\$775,308	\$1,172,723
14	\$0	\$428,219	\$0	\$20,755	\$0	\$353,071	\$0	\$19,817	-	-	\$821,861	\$1,280,433
15	\$0	\$426,709	\$0	\$20,682	\$0	\$328,964	\$0	\$18,753	-	-	\$795,108	\$1,275,915
16	\$0	\$424,924	\$0	\$20,595	\$0	\$366,797	\$0	\$21,171	-	-	\$833,487	\$1,377,627
17	\$0	\$422,881	\$0	\$20,496	\$0	\$344,894	\$0	\$19,998	-	-	\$808,270	\$1,376,025
18	\$0	\$420,597	\$0	\$20,385	\$0	\$334,267	\$0	\$18,527	-	-	\$793,777	\$1,391,893
19	\$0	\$418,087	\$0	\$20,264	\$0	\$393,251	\$0	\$20,237	-	-	\$851,840	\$1,538,517
Total	\$0	\$8,498,755	\$0	\$411,915	\$0	\$5,218,127	\$0	\$282,361	-	-	\$14,411,158	\$20,976,409

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	\$119,133	\$0	\$3,685	\$0	\$103,546	\$0	\$3,202	\$0	\$229,566	\$243,547	
20	\$0	\$119,734	\$0	\$3,703	\$0	\$104,068	\$0	\$3,219	\$0	\$230,724	\$429,215	
2	\$0	\$120,304	\$0	\$3,721	\$0	\$104,563	\$0	\$3,234	\$0	\$231,822	\$253,319	
3	\$0	\$121,306	\$0	\$3,752	\$0	\$105,434	\$0	\$3,261	\$0	\$233,753	\$263,091	
4	\$0	\$122,147	\$0	\$3,778	\$0	\$106,165	\$0	\$3,283	\$0	\$235,374	\$272,863	
5	\$0	\$122,837	\$0	\$3,799	\$0	\$106,764	\$0	\$3,302	\$0	\$236,702	\$282,635	
6	\$0	\$123,382	\$0	\$3,816	\$0	\$107,239	\$0	\$3,317	\$0	\$237,753	\$292,407	
7	\$0	\$123,792	\$0	\$3,829	\$0	\$107,595	\$0	\$3,328	\$0	\$238,543	\$302,179	
8	\$0	\$124,073	\$0	\$3,837	\$0	\$107,839	\$0	\$3,335	\$0	\$239,084	\$311,951	
9	\$0	\$124,232	\$0	\$3,842	\$0	\$107,978	\$0	\$3,340	\$0	\$239,392	\$321,723	
10	\$0	\$124,278	\$0	\$3,844	\$0	\$108,017	\$0	\$3,341	\$0	\$239,479	\$331,495	
11	\$0	\$124,215	\$0	\$3,842	\$0	\$107,962	\$0	\$3,339	\$0	\$239,358	\$341,267	
12	\$0	\$124,050	\$0	\$3,837	\$0	\$107,819	\$0	\$3,335	\$0	\$239,040	\$351,039	
13	\$0	\$123,790	\$0	\$3,829	\$0	\$107,593	\$0	\$3,328	\$0	\$238,538	\$360,811	
14	\$0	\$123,439	\$0	\$3,818	\$0	\$107,288	\$0	\$3,318	\$0	\$237,863	\$370,583	
15	\$0	\$123,004	\$0	\$3,804	\$0	\$106,910	\$0	\$3,306	\$0	\$237,025	\$380,355	
16	\$0	\$122,489	\$0	\$3,788	\$0	\$106,463	\$0	\$3,293	\$0	\$236,033	\$390,127	
17	\$0	\$121,901	\$0	\$3,770	\$0	\$105,951	\$0	\$3,277	\$0	\$234,898	\$399,899	
18	\$0	\$121,242	\$0	\$3,750	\$0	\$105,379	\$0	\$3,259	\$0	\$233,630	\$409,671	
19	\$0	\$120,519	\$0	\$3,727	\$0	\$104,750	\$0	\$3,240	\$0	\$232,235	\$419,443	
Total	\$0	\$2,449,865	\$0	\$75,769	\$0	\$2,129,322	\$0	\$65,855	\$0	\$4,720,812	\$6,727,614	

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	\$45,966	\$0	\$1,954	\$0	\$0	\$9,702	\$0	\$417
20	\$0	\$56,342	\$0	\$2,367	\$0	\$0	\$48,971	\$0	\$2,058
2	\$0	\$47,066	\$0	\$2,002	\$0	\$0	\$12,461	\$0	\$570
3	\$0	\$48,124	\$0	\$2,048	\$0	\$0	\$14,657	\$0	\$701
4	\$0	\$49,143	\$0	\$2,093	\$0	\$0	\$16,725	\$0	\$817
5	\$0	\$50,122	\$0	\$2,135	\$0	\$0	\$20,494	\$0	\$1,017
6	\$0	\$51,064	\$0	\$2,176	\$0	\$0	\$22,239	\$0	\$1,114
7	\$0	\$51,970	\$0	\$2,216	\$0	\$0	\$23,330	\$0	\$1,175
8	\$0	\$48,020	\$0	\$1,996	\$0	\$0	\$25,573	\$0	\$1,246
9	\$0	\$48,856	\$0	\$2,032	\$0	\$0	\$26,496	\$0	\$1,290
10	\$0	\$49,663	\$0	\$2,068	\$0	\$0	\$27,273	\$0	\$1,339
11	\$0	\$50,443	\$0	\$2,102	\$0	\$0	\$33,676	\$0	\$1,657
12	\$0	\$51,196	\$0	\$2,136	\$0	\$0	\$34,871	\$0	\$1,716
13	\$0	\$51,923	\$0	\$2,168	\$0	\$0	\$35,720	\$0	\$1,770
14	\$0	\$52,624	\$0	\$2,199	\$0	\$0	\$41,988	\$0	\$2,096
15	\$0	\$53,302	\$0	\$2,230	\$0	\$0	\$40,096	\$0	\$2,020
16	\$0	\$53,955	\$0	\$2,259	\$0	\$0	\$45,636	\$0	\$2,318
17	\$0	\$54,585	\$0	\$2,288	\$0	\$0	\$43,664	\$0	\$2,233
18	\$0	\$55,193	\$0	\$2,315	\$0	\$0	\$43,199	\$0	\$2,104
19	\$0	\$55,778	\$0	\$2,342	\$0	\$0	\$52,060	\$0	\$2,334
Total	\$0	\$1,025,334	\$0	\$43,126	\$0	\$0	\$618,829	\$0	\$29,992

C

SUMMARY OF EMISSION REDUCTION BENEFITS (continued)

Year	TRANSIT				Present Value of Emission Benefits	Constant Dollars	CO ₂ EMISSIONS SAVED	
	Peak Bus	Non-Peak Bus	Passenger Rail	Light Rail			tons/yr	PV \$/yr
1	\$0	\$0	\$0	\$0	\$58,039	\$61,574	1,738	\$40,908
20	\$0	\$0	\$0	\$0	\$109,738	\$204,145	4,720	\$92,288
2	\$0	\$0	\$0	\$0	\$62,099	\$67,857	1,894	\$44,145
3	\$0	\$0	\$0	\$0	\$65,530	\$73,755	2,035	\$46,968
4	\$0	\$0	\$0	\$0	\$68,777	\$79,731	2,168	\$49,544
5	\$0	\$0	\$0	\$0	\$73,768	\$88,083	2,364	\$53,514
6	\$0	\$0	\$0	\$0	\$76,593	\$94,200	2,493	\$55,879
7	\$0	\$0	\$0	\$0	\$78,691	\$99,683	2,598	\$57,668
8	\$0	\$0	\$0	\$0	\$76,835	\$100,252	2,877	\$63,234
9	\$0	\$0	\$0	\$0	\$78,674	\$105,731	2,980	\$64,883
10	\$0	\$0	\$0	\$0	\$80,342	\$111,212	3,085	\$66,511
11	\$0	\$0	\$0	\$0	\$87,878	\$125,293	3,419	\$72,984
12	\$0	\$0	\$0	\$0	\$89,918	\$132,048	3,533	\$74,702
13	\$0	\$0	\$0	\$0	\$91,581	\$138,524	3,649	\$76,400
14	\$0	\$0	\$0	\$0	\$98,908	\$154,095	3,989	\$82,701
15	\$0	\$0	\$0	\$0	\$97,648	\$156,696	3,976	\$81,630
16	\$0	\$0	\$0	\$0	\$104,167	\$172,173	4,297	\$87,366
17	\$0	\$0	\$0	\$0	\$102,770	\$174,959	4,288	\$86,333
18	\$0	\$0	\$0	\$0	\$102,810	\$180,279	4,332	\$86,377
19	\$0	\$0	\$0	\$0	\$112,514	\$203,213	4,792	\$94,619
Total	\$0	\$0	\$0	\$0	\$1,717,281	\$2,523,504	65,226	\$1,378,655

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	\$6,262,930	\$530,262	\$229,566	\$58,039				
2	\$6,444,437	\$560,345	\$231,822	\$62,099				
3	\$6,625,138	\$584,822	\$233,753	\$65,530				
4	\$6,805,927	\$604,828	\$235,374	\$68,777				
5	\$6,987,844	\$639,055	\$236,702	\$73,768				
6	\$7,172,106	\$655,327	\$237,753	\$76,593				
7	\$7,360,167	\$662,920	\$238,543	\$78,691				
8	\$7,553,783	\$709,014	\$239,084	\$76,835				
9	\$7,755,111	\$712,710	\$239,392	\$78,674				
10	\$7,966,848	\$715,754	\$239,479	\$80,342				
11	\$8,192,419	\$769,664	\$239,358	\$87,878				
12	\$8,436,271	\$772,791	\$239,040	\$89,918				
13	\$8,704,299	\$775,308	\$238,538	\$91,581				
14	\$9,004,513	\$821,861	\$237,863	\$98,908				
15	\$9,348,117	\$795,108	\$237,025	\$97,648				
16	\$9,751,303	\$833,487	\$236,033	\$104,167				
17	\$10,238,433	\$808,270	\$234,898	\$102,770				
18	\$10,847,977	\$793,777	\$233,630	\$102,810				
19	\$11,644,542	\$851,840	\$232,235	\$112,514				
20	\$12,745,702	\$814,016	\$230,724	\$109,738				
Total	\$169,847,868	\$14,411,158	\$4,720,812	\$1,717,281	\$0	\$0	\$0	\$0

13,857,258	Person-Hours of Time Saved
65,226	CO ₂ Emissions Saved (tons)
\$1,378,655	CO ₂ Emissions Saved (\$ PV)

	Person-Hours of Time Saved
	CO ₂ Emissions Saved (tons)
	CO ₂ 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	\$10,500,000	(\$10,500,000)
				\$0	\$10,194,175	(\$10,194,175)
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$0	\$0	\$0
				\$7,080,797	\$0	\$7,080,797
				\$7,298,703	\$0	\$7,298,703
				\$7,509,242	\$0	\$7,509,242
				\$7,714,906	\$0	\$7,714,906
				\$7,937,369	\$0	\$7,937,369
				\$8,141,780	\$0	\$8,141,780
				\$8,340,320	\$0	\$8,340,320
				\$8,578,716	\$0	\$8,578,716
				\$8,785,887	\$0	\$8,785,887
				\$9,002,422	\$0	\$9,002,422
				\$9,289,318	\$0	\$9,289,318
				\$9,538,021	\$0	\$9,538,021
				\$9,809,726	\$0	\$9,809,726
				\$10,163,145	\$0	\$10,163,145
				\$10,477,897	\$0	\$10,477,897
				\$10,924,991	\$0	\$10,924,991
				\$11,384,372	\$0	\$11,384,372
				\$11,978,195	\$0	\$11,978,195
				\$12,841,131	\$0	\$12,841,131
				\$13,900,180	\$0	\$13,900,180
				\$190,697,119	\$20,694,175	\$170,002,944

	Person-Hours of Time Saved
	CO ₂ Emissions Saved (tons)
	CO ₂ 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
Construction Period								
1								
2								
3								
4								
5								
6								
7								
8								
Project Open								
1	\$6,644,342	\$562,555	\$243,547	\$61,574				
2	\$7,042,010	\$612,304	\$253,319	\$67,857				
3	\$7,456,651	\$658,222	\$263,091	\$73,755				
4	\$7,889,935	\$701,162	\$272,863	\$79,731				
5	\$8,343,851	\$763,065	\$282,635	\$88,083				
6	\$8,820,786	\$805,970	\$292,407	\$94,200				
7	\$9,323,639	\$839,767	\$302,179	\$99,683				
8	\$9,855,973	\$925,102	\$311,951	\$100,252				
9	\$10,422,221	\$957,823	\$321,723	\$105,731				
10	\$11,027,980	\$990,770	\$331,495	\$111,212				
11	\$11,680,431	\$1,097,357	\$341,267	\$125,293				
12	\$12,388,949	\$1,134,870	\$351,039	\$132,048				
13	\$13,166,033	\$1,172,723	\$360,811	\$138,524				
14	\$14,028,739	\$1,280,433	\$370,583	\$154,095				
15	\$15,000,983	\$1,275,915	\$380,355	\$156,696				
16	\$16,117,419	\$1,377,627	\$390,127	\$172,173				
17	\$17,430,247	\$1,376,025	\$399,899	\$174,959				
18	\$19,021,994	\$1,391,893	\$409,671	\$180,279				
19	\$21,031,337	\$1,538,517	\$419,443	\$203,213				
20	\$23,710,760	\$1,514,309	\$429,215	\$204,145				
Total	\$250,404,282	\$20,976,409	\$6,727,614	\$2,523,504	\$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	\$10,500,000	(\$10,500,000)	
				\$0	\$10,500,000	(\$10,500,000)	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$0	\$0	\$0	
				\$7,512,018	\$0	\$7,512,018	\$7,512,018
				\$7,975,489	\$0	\$7,975,489	\$15,487,507
				\$8,451,719	\$0	\$8,451,719	\$23,939,226
				\$8,943,691	\$0	\$8,943,691	\$32,882,917
				\$9,477,633	\$0	\$9,477,633	\$42,360,550
				\$10,013,363	\$0	\$10,013,363	\$52,373,913
				\$10,565,268	\$0	\$10,565,268	\$62,939,181
				\$11,193,278	\$0	\$11,193,278	\$74,132,459
				\$11,807,498	\$0	\$11,807,498	\$85,939,957
				\$12,461,458	\$0	\$12,461,458	\$98,401,415
				\$13,244,347	\$0	\$13,244,347	\$111,645,761
				\$14,006,906	\$0	\$14,006,906	\$125,652,667
				\$14,838,091	\$0	\$14,838,091	\$140,490,758
				\$15,833,849	\$0	\$15,833,849	\$156,324,608
				\$16,813,949	\$0	\$16,813,949	\$173,138,556
				\$18,057,346	\$0	\$18,057,346	\$191,195,902
				\$19,381,131	\$0	\$19,381,131	\$210,577,033
				\$21,003,837	\$0	\$21,003,837	\$231,580,870
				\$23,192,510	\$0	\$23,192,510	\$254,773,380
				\$25,858,429	\$0	\$25,858,429	\$280,631,809
\$0	\$0	\$0	\$0	\$280,631,809	\$21,000,000	\$259,631,809	

Total Construction Costs

\$21,000,000

Years After Construction Begins	ANNUAL RETURNS ON INVESTMENT
1	(\$10,500,000)
2	(\$10,500,000)
3	\$7,512,018
4	\$7,975,489
5	\$8,451,719
6	\$8,943,691
7	\$9,477,633
8	\$10,013,363
9	\$10,565,268
10	\$11,193,278
11	\$11,807,498
12	\$12,461,458
13	\$13,244,347
14	\$14,006,906
15	\$14,838,091
16	\$15,833,849
17	\$16,813,949
18	\$18,057,346
19	\$19,381,131
20	\$21,003,837
21	\$23,192,510
22	\$25,858,429
23	\$0
24	\$0
25	\$0
26	\$0
27	\$0
28	\$0

Internal Rate of Return 36.05%

Payback Period 3 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
Heavy and Light Truck Drivers		
Average Hourly Wage	\$ 17.69	\$/hr
Benefits and Costs	\$ 8.68	\$/hr
Value of Time		
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 Uprater	1.2%	annual incr
Vehicle Operating Cost Parameters		
Average Fuel Price		
Automobile (regular unleaded)	\$ 3.37	\$/gal
Truck (diesel)	\$ 3.74	\$/gal
Sales and Fuel Taxes		
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
Fuel Cost Per Gallon (Exclude Taxes)		
Automobile	\$ 3.00	\$/gal
Truck	\$ 3.30	\$/gal
Non-Fuel Cost Per Mile		
Automobile	\$ 0.324	\$/mi
Truck	\$ 0.447	\$/mi
Idling Speed for Op. Costs and Emissions	5	mph
Accident Cost Parameters		
Cost of a Fatality	\$ 9,200,000	\$/event
Cost of an Injury		
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
Cost of Highway Accident		
Fatal Accident	\$ 10,200,000	\$/accident
Injury Accident	\$ 261,100	\$/accident
PDO Accident	\$ 15,900	\$/accident
Average Cost	\$ 145,400	\$/accident
Statewide Highway Accident Rates		
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

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

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		
Freeway				
	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	
Non-HOV Lanes				
	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

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
HOT Lane Addition	<input type="checkbox"/> FALSE	HOT
Passing Lane	<input type="checkbox"/> FALSE	Passing
Intersection	<input type="checkbox"/> FALSE	Intersect
Bypass	<input type="checkbox"/> FALSE	Bypass
Queueing	<input type="checkbox"/> FALSE	Queueing
Pavement	<input type="checkbox"/> FALSE	Pavement
Rail or Transit Cap Expansion		
Please select a type of rail or transit project		
Passenger Rail	<input type="checkbox"/> FALSE	PassRail
Light-Rail (LRT)	<input type="checkbox"/> FALSE	LRT
Bus	<input type="checkbox"/> FALSE	Bus
Hwy-Rail Grade Crossing	<input type="checkbox"/> FALSE	HwyRail
Hwy Operational Improvement		
Please select a type of op. improvement		
Auxiliary Lane	<input type="checkbox"/> FALSE	AuxLane
Freeway Connector	<input type="checkbox"/> FALSE	FreeConn
HOV Connector	<input type="checkbox"/> FALSE	HOVConn
HOV Drop Ramp	<input type="checkbox"/> FALSE	HOVDrop
Off-Ramp Widening	<input type="checkbox"/> FALSE	OffRamp
On-Ramp Widening	<input type="checkbox"/> FALSE	OnRamp
HOV-2 to HOV-3 Conv	<input type="checkbox"/> FALSE	HOV2to3
HOT Lane Conversion	<input type="checkbox"/> FALSE	HOTConv
Transp Mgmt Systems (TMS)		
Please select a type of TMS project		
Ramp Metering	<input type="checkbox"/> FALSE	RM
Ramp Metering Signal Coord	<input type="checkbox"/> FALSE	AM
Incident Management	<input type="checkbox"/> FALSE	IM
Traveler Information	<input type="checkbox"/> FALSE	TI
Arterial Signal Management	<input type="checkbox"/> FALSE	ASM
Transit Vehicle Location (AVL)	<input type="checkbox"/> FALSE	AVL
Transit Vehicle Signal Priority	<input type="checkbox"/> FALSE	SigPriority
Bus Rapid Transit (BRT)	<input type="checkbox"/> FALSE	BRT
TMS Lookup Code	<input type="checkbox"/> NoAdj	TMSLookup
User Modified Inputs	<input type="checkbox"/> 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	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

FUEL CONSUMPTION RATES
(gal/veh-mi)

Speed	Auto*	Truck
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

Emissions Tables

Bus	0	16.2307	31.60	1.9169	0.0000	0.0000	1.1480
	5	28.2802	2573.44	19.0484	0.9433	0.0248	3.0451
	6	27.1830	2530.41	18.5778	0.9295	0.0243	2.9403
	7	26.0858	2487.38	18.1073	0.9157	0.0237	2.8355
	8	24.9885	2444.35	17.6367	0.9019	0.0232	2.7307
	9	23.8913	2401.32	17.1662	0.8882	0.0226	2.6258
	10	22.7941	2358.29	16.6956	0.8744	0.0221	2.5210
	11	21.3267	2300.37	16.0232	0.8534	0.0215	2.3743
	12	19.8593	2242.45	15.3507	0.8324	0.0210	2.2276
	13	18.3919	2184.53	14.6782	0.8115	0.0204	2.0808
	14	16.9246	2126.60	14.0058	0.7905	0.0199	1.9341
	15	15.4572	2068.68	13.3333	0.7695	0.0193	1.7873
	16	14.5867	2033.37	12.9075	0.7558	0.0188	1.6952
	17	13.7162	1998.07	12.4816	0.7420	0.0182	1.6031
	18	12.8457	1962.76	12.0557	0.7282	0.0177	1.5110
	19	11.9752	1927.46	11.6298	0.7144	0.0171	1.4188
	20	11.1047	1892.15	11.2040	0.7006	0.0165	1.3267
	21	10.5723	1870.09	10.9408	0.6918	0.0165	1.2671
	22	10.0400	1848.02	10.6777	0.6829	0.0165	1.2076
	23	9.5076	1825.95	10.4146	0.6741	0.0165	1.1480
	24	8.9753	1803.89	10.1514	0.6653	0.0165	1.0884
	25	8.4430	1781.82	9.8883	0.6565	0.0165	1.0288
	26	8.1131	1768.58	9.7399	0.6504	0.0165	0.9897
	27	7.7832	1755.34	9.5915	0.6443	0.0165	0.9505
	28	7.4533	1742.10	9.4431	0.6383	0.0165	0.9113
	29	7.1234	1728.86	9.2947	0.6322	0.0165	0.8722
	30	6.7935	1715.62	9.1463	0.6261	0.0165	0.8330
	31	6.5905	1707.35	9.0884	0.6217	0.0165	0.8071
	32	6.3875	1699.08	9.0305	0.6173	0.0165	0.7811
	33	6.1845	1690.80	8.9726	0.6129	0.0165	0.7552
	34	5.9815	1682.53	8.9146	0.6085	0.0165	0.7293
	35	5.7785	1674.25	8.8567	0.6041	0.0165	0.7034
	36	5.6621	1669.29	8.8760	0.6013	0.0165	0.6857
	37	5.5457	1664.32	8.8953	0.5985	0.0165	0.6680
	38	5.4293	1659.36	8.9146	0.5958	0.0165	0.6504
	39	5.3129	1654.39	8.9339	0.5930	0.0165	0.6327
	40	5.1965	1649.43	8.9532	0.5903	0.0165	0.6151
	41	5.1430	1647.77	9.0531	0.5886	0.0160	0.6041
	42	5.0895	1646.12	9.1529	0.5870	0.0154	0.5930
	43	5.0360	1644.46	9.2528	0.5853	0.0149	0.5820
	44	4.9825	1642.81	9.3526	0.5836	0.0143	0.5710
	45	4.9290	1641.15	9.4525	0.5820	0.0138	0.5599
	46	4.9306	1641.15	9.6478	0.5809	0.0143	0.5528
	47	4.9323	1641.15	9.8431	0.5798	0.0149	0.5456
	48	4.9339	1641.15	10.0383	0.5787	0.0154	0.5384
	49	4.9356	1641.15	10.2336	0.5776	0.0160	0.5312
	50	4.9372	1641.15	10.4289	0.5765	0.0165	0.5241
	51	4.9395	1643.91	10.7489	0.5759	0.0165	0.5202
	52	5.0498	1646.67	11.0688	0.5754	0.0165	0.5163
	53	5.1061	1649.43	11.3888	0.5748	0.0165	0.5125
	54	5.1623	1652.19	11.7087	0.5743	0.0165	0.5086
	55	5.2186	1654.94	12.0287	0.5737	0.0165	0.5048
	56	5.3400	1660.46	12.5312	0.5737	0.0165	0.5048
	57	5.4613	1665.98	13.0338	0.5737	0.0165	0.5048
	58	5.5827	1671.49	13.5363	0.5737	0.0165	0.5048
	59	5.7040	1677.01	14.0389	0.5737	0.0165	0.5048
	60	5.8254	1682.53	14.5414	0.5737	0.0165	0.5048
	61	6.0334	1691.35	15.3237	0.5748	0.0165	0.5070
	62	6.2413	1700.18	16.1059	0.5759	0.0165	0.5092
	63	6.4493	1709.00	16.8881	0.5770	0.0165	0.5114
	64	6.6573	1717.83	17.6704	0.5781	0.0165	0.5136
	65	6.8653	1726.66	18.4526	0.5792	0.0165	0.5158
	66	7.2029	1741.55	19.6861	0.5809	0.0165	0.5213
	67	7.5405	1756.45	20.9196	0.5825	0.0165	0.5268
	68	7.8781	1771.34	22.1531	0.5842	0.0165	0.5323
	69	8.2157	1786.24	23.3866	0.5858	0.0165	0.5379
	70	8.5533	1801.13	24.6200	0.5875	0.0165	0.5434
	71	9.0967	1824.30	26.6181	0.5897	0.0165	0.5533
	72	9.6400	1847.47	28.6162	0.5919	0.0165	0.5632
	73	10.1834	1870.64	30.6142	0.5941	0.0165	0.5732
	74	10.7268	1893.81	32.6123	0.5963	0.0165	0.5831
	75	11.2702	1916.98	34.6104	0.5985	0.0165	0.5930
	76	12.1600	1955.59	37.9467	0.6024	0.0171	0.6074
	77	13.0498	1994.21	41.2831	0.6063	0.0177	0.6217
	78	13.9396	2032.82	44.6195	0.6101	0.0182	0.6360
	79	14.8294	2071.44	47.9558	0.6140	0.0188	0.6504
	80	15.7192	2110.05	51.2922	0.6178	0.0193	0.6647

Bus	0	6.7367	35.88	0.9329	0.0000	0.0000	0.4575
	5	8.5199	2438.77	9.8329	0.7659	0.0243	1.0942
	6	8.1853	2395.98	9.5863	0.7576	0.0238	1.0616
	7	7.8508	2353.19	9.3398	0.7494	0.0233	1.0290
	8	7.5162	2310.39	9.0932	0.7411	0.0229	0.9964
	9	7.1816	2267.60	8.8467	0.7328	0.0224	0.9638
	10	6.8470	2224.80	8.6001	0.7246	0.0219	0.9313
	11	6.4035	2168.39	8.2490	0.7124	0.0209	0.8846
	12	5.9600	2111.98	7.8979	0.7003	0.0199	0.8379
	13	5.5165	2055.57	7.5468	0.6881	0.0190	0.7912
	14	5.0730	1999.16	7.1957	0.6760	0.0180	0.7445
	15	4.6295	1942.75	6.8446	0.6638	0.0170	0.6978
	16	4.3689	1908.71	6.6219	0.6555	0.0170	0.6677
	17	4.1082	1874.67	6.3992	0.6473	0.0170	0.6375
	18	3.8476	1840.63	6.1764	0.6390	0.0170	0.6074
	19	3.5869	1806.59	5.9537	0.6307	0.0170	0.5772
	20	3.3263	1772.55	5.7310	0.6225	0.0170	0.5471
	21	3.1687	1751.15	5.5929	0.6171	0.0170	0.5271
	22	3.0111	1729.75	5.4548	0.6118	0.0170	0.5072
	23	2.8536	1708.36	5.3167	0.6064	0.0170	0.4873
	24	2.6960	1686.96	5.1786	0.6011	0.0170	0.4673
	25	2.5385	1665.56	5.0405	0.5957	0.0170	0.4474
	26	2.4412	1652.92	4.9617	0.5923	0.0170	0.4343
	27	2.3439	1640.28	4.8829	0.5889	0.0170	0.4211
	28	2.2467	1627.63	4.8041	0.5855	0.0170	0.4080
	29	2.1494	1614.99	4.7253	0.5821	0.0170	0.3949
	30	2.0522	1602.34	4.6466	0.5787	0.0170	0.3817
	31	1.9919	1593.59	4.6149	0.5758	0.0170	0.3730
	32	1.9316	1584.84	4.5833	0.5729	0.0170	0.3642
	33	1.8713	1576.08	4.5517	0.5699	0.0170	0.3555
	34	1.8110	1567.33	4.5201	0.5670	0.0170	0.3467
	35	1.7507	1558.58	4.4885	0.5641	0.0170	0.3380
	36	1.7166	1554.20	4.4977	0.5626	0.0165	0.3321
	37	1.6826	1549.82	4.5070	0.5612	0.0160	0.3263
	38	1.6485	1545.45	4.5162	0.5597	0.0156	0.3205
	39	1.6145	1541.07	4.5255	0.5583	0.0151	0.3146
	40	1.5805	1536.69	4.5347	0.5568	0.0146	0.3088
	41	1.5639	1534.75	4.5863	0.5558	0.0141	0.3049
	42	1.5474	1532.80	4.6378	0.5549	0.0136	0.3010
	43	1.5309	1530.86	4.6894	0.5539	0.0131	0.2971
	44	1.5143	1528.91	4.7409	0.5529	0.0126	0.2932
	45	1.4978	1526.97	4.7924	0.5519	0.0122	0.2893
	46	1.4973	1526.97	4.8926	0.5510	0.0122	0.2869
	47	1.4968	1526.97	4.9928	0.5500	0.0122	0.2845
	48	1.4963	1526.97	5.0930	0.5490	0.0122	0.2821
	49	1.4958	1526.97	5.1932	0.5481	0.0122	0.2796
	50	1.4954	1526.97	5.2933	0.5471	0.0122	0.2772
	51	1.5099	1529.40	5.4592	0.5471	0.0126	0.2762
	52	1.5245	1531.83	5.6250	0.5471	0.0131	0.2752
	53	1.5391	1534.26	5.7908	0.5471	0.0136	0.2743
	54	1.5537	1536.69	5.9566	0.5471	0.0141	0.2733
	55	1.5683	1539.13	6.1225	0.5471	0.0146	0.2723
	56	1.6019	1544.48	6.3836	0.5471	0.0151	0.2723
	57	1.6354	1549.82	6.6447	0.5471	0.0156	0.2723
	58	1.6690	1555.17	6.9059	0.5471	0.0160	0.2723
	59	1.7025	1560.52	7.1670	0.5471	0.0165	0.2723
	60	1.7361	1565.87	7.4282	0.5471	0.0170	0.2723
	61	1.7930	1574.63	7.8347	0.5476	0.0170	0.2738
	62	1.8499	1583.38	8.2413	0.5481	0.0170	0.2752
	63	1.9068	1592.13	8.6478	0.5485	0.0170	0.2767
	64	1.9637	1600.89	9.0543	0.5490	0.0170	0.2782
	65	2.0206	1609.64	9.4609	0.5495	0.0170	0.2796
	66	2.1144	1624.23	10.1038	0.5505	0.0170	0.2821
	67	2.2083	1638.82	10.7467	0.5515	0.0170	0.2845
	68	2.3021	1653.41	11.3895	0.5524	0.0170	0.2869
	69	2.3960	1667.99	12.0324	0.5534	0.0170	0.2893
	70	2.4898	1682.58	12.6753	0.5544	0.0170	0.2918
	71	2.6401	1705.44	13.7155	0.5558	0.0170	0.2957
	72	2.7904	1728.30	14.7557	0.5573	0.0170	0.2996
	73	2.9406	1751.15	15.7959	0.5588	0.0170	0.

HEALTH COST OF TRANSPORTATION EMISSIONS
(\$/ton)

Area	Proj Loc	CO	CO ₂ e	NO _x	PM ₁₀	SO _x	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

CO₂e Uprater 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, 2010 for CO₂e

PASSENGER TRAIN EMISSIONS FACTORS
(g/train-mile)

Mode	Year	CO	CO ₂	NO _x	PM ₁₀	SO _x	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 ₂	NO _x	PM ₁₀	SO _x	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