

# ATTACHMENT C SR-138 BENEFIT-COST ANALYSIS



## California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C) Version 3.2



Office of Transportation Economics  
Division of Transportation Planning  
June 2010

District:

PROJECT:

EA:   
 PPNO:

**1A PROJECT DATA**

**Type of Project**  
 Select project type from list

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

**Length of Construction Period**  years

**Length of Peak Period(s)** (up to 8 hrs)  hours

**1C HIGHWAY ACCIDENT DATA**

**Actual 3-Year Accident Data for Facility**

	Count (No.)	Rate
Fatal Accidents	21	0.07
Injury Accidents	159	0.50
Property Damage Only (PDO) Accidents	169	0.53

**Statewide Average for Highway Classification**

	Existing	New
Accident Rate (per million vehicle-miles)	0.81	0.48
Percent Fatal Accidents	0.049%	0.025%
Percent Injury Accidents	37%	22%

**1B HIGHWAY DESIGN AND TRAFFIC DATA**

**Highway Design**

	Existing	New
Number of General Traffic Lanes	2	4
Number of HOV Lanes	0	0
HOV Restriction (2 or 3)	2	
Exclusive ROW for Buses (y/n)	N	
Highway Free-Flow Speed	55	55
Ramp Design Speed (if aux. lane/off-ramp proj.)	35	35
Length (in miles) Highway Segment	18.0	18.0
Affected Area	18.0	18.0

**Average Daily Traffic**

	w/o Project	w/ Project
Current	16,200	
Base (Year 1)	18,426	26,051
Forecast (Year 20)	29,000	41,000

**Average Hourly HOV Traffic** (if HOV lanes)

**Percent Traffic in Weave** (if oper. improvement)

**Percent Trucks** (include RVs, if applicable)

**Truck Speed** (if passing lane project)

**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.)		

**Pavement Condition** (if pavement project)

	w/o Project	w/ Project
IRI (inches/mile) Base (Year 1)		
Forecast (Year 20)		

**Average Vehicle Occupancy**

	Existing	New
General Traffic Non-Peak	1.15	1.15
Peak	1.10	1.10
High Occupancy Vehicle (if HOV lanes)	2.05	2.05

**1D TRANSIT DATA**

**Annual Person-Trips**

	w/o Project	w/ Project
Base (Year 1)		
Forecast (Year 20)		
Percent Trips during Peak Period	39%	
Percent New Trips from Parallel Highway		100%

**Annual Vehicle-Miles**

	w/o Project	w/ Project
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**

	Existing	New
In-Vehicle	Non-Peak (in minutes)	0.0
	Peak (in minutes)	0.0
Out-of-Vehicle	Non-Peak (in minutes)	0.0
	Peak (in minutes)	0.0

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

	Existing	New
Annual Capital Expenditure		\$0
Annual Ops. and Maintenance Expenditure		\$0

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**PROJECT COSTS**

Col. no. (1) (2) (3) (4) (5) (6) (7)

Year	DIRECT PROJECT COSTS						Transit Agency Cost Savings	TOTAL COSTS	
	INITIAL COSTS			SUBSEQUENT COSTS				Constant Dollars	Present Value
	Project Support	R / W	Construction	Maint./ Op.	Rehab.	Mitigation			
<b>Construction Begins</b>									
0	\$29,705,000	\$18,355,000	\$38,338,250					\$86,398,250	\$86,398,250
1			\$38,338,250					38,338,250	35,830,140
2			\$38,338,500					38,338,500	33,486,331
3			\$38,338,500					38,338,500	31,295,636
4								0	0
5								0	0
6								0	0
7								0	0
<b>Project Opens</b>									
1								\$0	\$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
9								0	0
10								0	0
11								0	0
12								0	0
13								0	0
14								0	0
15								0	0
16								0	0
17								0	0
18								0	0
19								0	0
20								0	0
<b>Total</b>	\$29,705,000	\$18,355,000	\$153,353,500	\$0	\$0	\$0	\$0	\$201,413,500	\$187,010,357

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

**HIGHWAY SPEED AND VOLUME INPUTS**

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

**Without Project**

**Year 1**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	6,468		6,468	
Weaving Volume	0		0	
Truck Volume	719		719	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

Non-Peak Period

Non-HOV Volume	10,116		10,116	
Weaving Volume	0		0	
Truck Volume	1,124		1,124	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

**Year 20**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	10,179		10,179	
Weaving Volume	0		0	
Truck Volume	1,131		1,131	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

Non-Peak Period

Non-HOV Volume	15,921		15,921	
Weaving Volume	0		0	
Truck Volume	1,769		1,769	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

**With Project**

**Year 1**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	9,144		9,144	
Weaving Volume	0		0	
Truck Volume	1,016		1,016	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

Non-Peak Period

Non-HOV Volume	14,302		14,302	
Weaving Volume	0		0	
Truck Volume	1,589		1,589	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

**Year 20**

Peak Period

HOV Volume	0		0	
Non-HOV Volume	14,391		14,391	
Weaving Volume	0		0	
Truck Volume	1,599		1,599	
HOV Speed	55.0		55.0	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

Non-Peak Period

Non-HOV Volume	22,509		22,509	
Weaving Volume	0		0	
Truck Volume	2,501		2,501	
Non-HOV Speed	55.0		55.0	
Weaving Speed	55.0		55.0	
Truck Speed	55.0		55.0	

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

## INVESTMENT ANALYSIS SUMMARY RESULTS

<b>Life-Cycle Costs (mil. \$)</b>	\$187.0
<b>Life-Cycle Benefits (mil. \$)</b>	\$270.9
<b>Net Present Value (mil. \$)</b>	\$83.9
<b>Benefit / Cost Ratio:</b>	1.4
<b>Rate of Return on Investment:</b>	10.0%
<b>Payback Period:</b>	8 years

<b>ITEMIZED BENEFITS (mil. \$)</b>	Average Annual	Total Over 20 Years
<b>Travel Time Savings</b>	\$0.0	\$0.0
<b>Veh. Op. Cost Savings</b>	\$0.0	\$0.0
<b>Accident Cost Savings</b>	\$13.5	\$270.9
<b>Emission Cost Savings</b>	\$0.0	\$0.0
<b>TOTAL BENEFITS</b>	\$13.5	\$270.9
<b>Person Hours of Delay Saved</b>	0	0

Accident Reduction Benefits

This sheet calculates accident benefits for highway and transit.

Formulas:

Vehicle-Miles Traveled = Affected Length x Avg Volume
veh-miles/yr = miles x vehicles/yr
Transit Acc Cost = Veh-Miles x Acc Cost/Mile
New Acc Cost = (VMT x Rate x Cost/Mile) by Acc. Type
Transit Acc. Cost/Mile from PARAMETERS

HIGHWAY BENEFITS

Peak Period Non-HOV

Table with columns: Year, Existing Facility, New Facility, Existing Facility, New Facility, Existing Facility, New Facility, Constant Dollars, Present Value. Rows 1-20.

Peak Period Truck

Table with columns: Year, Existing Facility, New Facility, Existing Facility, New Facility, Existing Facility, New Facility, Constant Dollars, Present Value. Rows 1-20.

Non-Peak Period Non-HOV

Table with columns: Year, Existing Facility, New Facility, Existing Facility, New Facility, Existing Facility, New Facility, Constant Dollars, Present Value. Rows 1-20.

Non-Peak Period Truck

Table with columns: Year, Existing Facility, New Facility, Existing Facility, New Facility, Existing Facility, New Facility, Constant Dollars, Present Value. Rows 1-20.

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

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NET PRESENT VALUE CALCULATION

Year	PRESENT VALUE OF USER BENEFITS				PRESENT VALUE OF USER BENEFITS (on other road)				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	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions			
<b>Construction Begins</b>											
0									\$0	\$86,398,250	(\$86,398,250)
1									\$0	\$35,830,140	(\$35,830,140)
2									\$0	\$33,486,331	(\$33,486,331)
3									\$0	\$31,295,636	(\$31,295,636)
4									\$0	\$0	\$0
5									\$0	\$0	\$0
6									\$0	\$0	\$0
7									\$0	\$0	\$0
<b>Project Opens</b>											
1	\$0		\$13,310,913	\$0			\$4,679,687		\$17,990,600	\$0	\$17,990,600
2	\$0		\$12,815,833	\$0			\$4,691,117		\$17,506,950	\$0	\$17,506,950
3	\$0		\$12,328,562	\$0			\$4,690,847		\$17,019,409	\$0	\$17,019,409
4	\$0		\$11,850,195	\$0			\$4,679,965		\$16,530,161	\$0	\$16,530,161
5	\$0		\$11,381,654	\$0			\$4,659,483		\$16,041,138	\$0	\$16,041,138
6	\$0		\$10,923,701	\$0			\$4,630,340		\$15,554,041	\$0	\$15,554,041
7	\$0		\$10,476,955	\$0			\$4,593,406		\$15,070,361	\$0	\$15,070,361
8	\$0		\$10,041,910	\$0			\$4,549,490		\$14,591,400	\$0	\$14,591,400
9	\$0		\$9,618,947	\$0			\$4,499,341		\$14,118,287	\$0	\$14,118,287
10	\$0		\$9,208,347	\$0			\$4,443,651		\$13,651,998	\$0	\$13,651,998
11	\$0		\$8,810,302	\$0			\$4,383,063		\$13,193,365	\$0	\$13,193,365
12	\$0		\$8,424,928	\$0			\$4,318,169		\$12,743,097	\$0	\$12,743,097
13	\$0		\$8,052,270	\$0			\$4,249,516		\$12,301,786	\$0	\$12,301,786
14	\$0		\$7,692,314	\$0			\$4,177,609		\$11,869,923	\$0	\$11,869,923
15	\$0		\$7,344,992	\$0			\$4,102,915		\$11,447,907	\$0	\$11,447,907
16	\$0		\$7,010,192	\$0			\$4,025,862		\$11,036,054	\$0	\$11,036,054
17	\$0		\$6,687,762	\$0			\$3,946,843		\$10,634,606	\$0	\$10,634,606
18	\$0		\$6,377,517	\$0			\$3,866,221		\$10,243,738	\$0	\$10,243,738
19	\$0		\$6,079,242	\$0			\$3,784,328		\$9,863,570	\$0	\$9,863,570
20	\$0		\$5,792,699	\$0			\$3,701,467		\$9,494,166	\$0	\$9,494,166
<b>Total</b>	\$0	\$0	\$184,229,236	\$0	\$0	\$0	\$86,673,319	\$0	\$270,902,556	\$187,010,357	\$83,892,199

INTERNAL RATE OF RETURN ON INVESTMENT AND PAYBACK PERIOD

Year	USER BENEFITS IN CONSTANT DOLLARS				USER BENEFITS IN CONSTANT DOLLARS (on other road)				Total User Benefits	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	Travel Time Savings	Vehicle Op. Cost Savings	Accident Reductions	Vehicle Emission Reductions				
<b>Construction Begins</b>												
0									\$0	\$86,398,250	(\$86,398,250)	
1									\$0	\$38,338,250	(\$38,338,250)	
2									\$0	\$38,338,500	(\$38,338,500)	
3									\$0	\$38,338,500	(\$38,338,500)	
4									\$0	\$0	\$0	
5									\$0	\$0	\$0	
6									\$0	\$0	\$0	
7									\$0	\$0	\$0	
<b>Project Opens</b>												
1	\$0	\$17,447,802	\$0	\$0	\$5,688,188	\$0	\$0	\$23,136,080	\$0	\$23,136,080	\$23,136,080	
2	\$0	\$17,974,869	\$0	\$0	\$5,987,186	\$0	\$0	\$23,962,055	\$0	\$23,962,055	\$47,098,136	
3	\$0	\$18,501,847	\$0	\$0	\$6,286,184	\$0	\$0	\$24,788,030	\$0	\$24,788,030	\$71,886,166	
4	\$0	\$19,028,824	\$0	\$0	\$6,585,181	\$0	\$0	\$25,614,005	\$0	\$25,614,005	\$97,500,171	
5	\$0	\$19,555,801	\$0	\$0	\$6,884,179	\$0	\$0	\$26,439,980	\$0	\$26,439,980	\$123,940,151	
6	\$0	\$20,082,779	\$0	\$0	\$7,183,177	\$0	\$0	\$27,265,955	\$0	\$27,265,955	\$151,206,107	
7	\$0	\$20,609,756	\$0	\$0	\$7,482,174	\$0	\$0	\$28,091,930	\$0	\$28,091,930	\$179,298,037	
8	\$0	\$21,136,734	\$0	\$0	\$7,781,172	\$0	\$0	\$28,917,905	\$0	\$28,917,905	\$208,215,942	
9	\$0	\$21,663,711	\$0	\$0	\$8,080,169	\$0	\$0	\$29,743,880	\$0	\$29,743,880	\$237,959,823	
10	\$0	\$22,190,688	\$0	\$0	\$8,379,167	\$0	\$0	\$30,569,855	\$0	\$30,569,855	\$268,529,678	
11	\$0	\$22,717,666	\$0	\$0	\$8,678,165	\$0	\$0	\$31,395,830	\$0	\$31,395,830	\$299,925,508	
12	\$0	\$23,244,643	\$0	\$0	\$8,977,162	\$0	\$0	\$32,221,805	\$0	\$32,221,805	\$332,147,313	
13	\$0	\$23,771,620	\$0	\$0	\$9,276,160	\$0	\$0	\$33,047,780	\$0	\$33,047,780	\$365,195,094	
14	\$0	\$24,298,598	\$0	\$0	\$9,575,157	\$0	\$0	\$33,873,755	\$0	\$33,873,755	\$399,068,849	
15	\$0	\$24,825,575	\$0	\$0	\$9,874,155	\$0	\$0	\$34,699,730	\$0	\$34,699,730	\$433,768,579	
16	\$0	\$25,352,553	\$0	\$0	\$10,173,153	\$0	\$0	\$35,525,705	\$0	\$35,525,705	\$469,294,284	
17	\$0	\$25,879,530	\$0	\$0	\$10,472,150	\$0	\$0	\$36,351,680	\$0	\$36,351,680	\$505,645,965	
18	\$0	\$26,406,507	\$0	\$0	\$10,771,148	\$0	\$0	\$37,177,655	\$0	\$37,177,655	\$542,823,620	
19	\$0	\$26,933,485	\$0	\$0	\$11,070,145	\$0	\$0	\$38,003,630	\$0	\$38,003,630	\$580,827,250	
20	\$0	\$27,460,462	\$0	\$0	\$11,369,143	\$0	\$0	\$38,829,605	\$0	\$38,829,605	\$619,656,855	
<b>Total</b>	\$0	\$0	\$449,083,540	\$0	\$0	\$0	\$170,573,315	\$0	\$619,656,855	\$201,413,500	\$418,243,355	

Years After Construction Begins	ANNUAL RETURNS ON INVESTMENT
0	(\$86,398,250)
1	(\$38,338,250)
2	(\$38,338,500)
3	(\$38,338,500)
4	\$23,136,080
5	\$24,788,030
6	\$24,788,030
7	\$25,614,005
8	\$26,439,980
9	\$27,265,955
10	\$28,091,930
11	\$28,917,905
12	\$29,743,880
13	\$30,569,855
14	\$31,395,830
15	\$32,221,805
16	\$33,047,780
17	\$33,873,755
18	\$34,699,730
19	\$35,525,705
20	\$36,351,680
21	\$37,177,655
22	\$38,003,630
23	\$38,829,605
24	\$0
25	\$0
26	\$0
27	\$0

Internal Rate of Return **10.04%**

Total Construction Costs **\$201,413,500**

Payback Period **8 years**



## Parameters

<b>General Economic Parameters</b>	
Year of Current Dollars for Model	2003
Economic Update Factor (Using GDP Deflator)	1.00
Real Discount Rate	7.0%

<b>Highway Operations Parameters</b>		
	Value	Units
Maximum V/C Ratio	1.4	-
Percent ADT in Average Peak Hour	7.8%	%
Capacity per Lane (general)	2000	veh/hr
Capacity per HOV Lane	1500	veh/hr
<b>Travel Time Parameters</b>		
Average Hourly Wage		
Transportation and Warehousing	\$ 18.74	\$/hr
Statewide	\$ 20.92	\$/hr
Value of Time		
Automobile	\$ 10.46	\$/hr/person
Truck	\$ 27.83	\$/hr
Transit	\$ 10.46	\$/hr/person
Out-of-Vehicle Travel	2	times
Incident-Related Travel	3	times
<b>Operating Cost Parameters</b>		
Fuel Cost Per Gallon (Exclude Taxes)	\$ 2.55	\$/gal
Non-Fuel Cost Per Mile		
Automobile	\$ 0.173	\$/mi
Truck	\$ 0.299	\$/mi
<b>Accident Cost Parameters</b>		
Cost of a Fatality	\$ 2,847,668	\$/event
Cost of an Injury		
Level A (Severe)	\$ 157,357	\$/event
Level B (Moderate)	\$ 42,505	\$/event
Level C (Minor)	\$ 22,960	\$/event
Cost of Highway Accident		
Fatal Accident	\$ 3,262,459	\$/accident
Injury Accident	\$ 85,716	\$/accident
PDO Accident	\$ 7,198	\$/accident
Average Cost	\$ 61,509	\$/accident
Statewide Highway Accident Rates		
Fatal Accident	0.009	per million veh-mi
Injury Accident	0.343	per million veh-mi
PDO Accident	0.690	per million veh-mi
Non-Freeway	1.49	per million veh-mi

Sources: 1) Highway Capacity Manual, 2) Statewide Travel Survey 1991, 3) Bureau of Labor Statistics (BLS) Covered Wages and Employment Program, 4) AAA Daily Fuel Gauge Report, 5) OPIS Energy Group and Wright Express, 6) Jack Faucett Associates, 7) Paccar, Inc. 8) National Safety Council, 9) Urban Institute, 10) TASAS summary for 2000