

1. Benefit-Cost Analysis

County of Santa Cruz - Aptos Village Improvements Project Benefit-Cost Analysis

Project Title:	County of Santa Cruz		
Project Corridors:	Roadway Improvements in the vicinity of Aptos Village Project		
Project Stakeholders:	County of Santa Cruz		
Total # of Project Signals:	2	# of Project Roadways:	7
Local Agency Contact:	R. Rivas, R. Adams, County of Santa Cruz		
Consultant Contact:	V. Gandluru, R. Haygood - TJKM; M. Gourlay - Barry Swenson Builder		

Construction Costs for Project Roadways	
Soquel Drive	\$3,651,512
Trout Gulch Road	\$152,646
Aptos Creek Road	\$105,430
Granite Way	\$511,953
Cathedral Drive	\$105,639
Valencia Street	\$647,899
Parade Street	\$222,191
Total Costs	\$5,397,270

Benefits from the Roadway Improvements				
Measures	Annual Average		Lifetime (20 Years) ⁷	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings (hrs)	18,544	\$322,076	459,903	\$7,987,479
Fuel Consumption Savings (gal)	76,557	\$301,838	1,898,616	\$7,485,594
ROG Emissions Reduction (tons)	1.6	\$1,995	41	\$49,486
NOx Emissions Reduction (tons)	2.4	\$41,236	59	\$1,022,662
PM10x Emissions Reduction (tons)	0.3	\$36,347	6	\$901,399
CO Emissions Reduction (tons)	6.1	\$455	152	\$11,279
Benefits from the Mixed-use VMT Reduction				
Measures	Annual Average		Lifetime (20 Years) ⁷	
	Savings	Monetized Savings	Savings	Monetized Savings
Travel Time Savings (hrs)	16,765	\$291,174	415,778	\$7,221,121
Fuel Consumption Savings (gal)	19,772	\$77,953	490,338	\$1,933,236
ROG Emissions Reduction (tons)	0.2	\$235	5	\$5,818
NOx Emissions Reduction (tons)	0.6	\$11,058	16	\$274,247
PM10x Emissions Reduction (tons)	0.0	\$5,876	1	\$145,722
CO Emissions Reduction (tons)	2.5	\$185	62	\$4,578
Benefits from the Collision Safety				
	Crash Costs/Year			Lifetime Annual Collision Costs
	Before	After	% Change	
Collision Costs	\$5,020,500	\$2,212,424	56%	
Total Lifetime Benefits				\$29,850,698

Overall Project Benefits	Auto
Average Decrease in Travel Time	46%
Average Speed Increase	111%
Average Fuel Savings	29%

Benefit/Cost Ratio	6 : 1
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Notes:

- General methodology, fuel consumption factors, and health costs of motor vehicle emissions based on California Department of Transportation, Office of Transportation Economics. California Life-Cycle Benefit/Cost Analysis Model and Technical Supplement to the User's Guide, 2009.
- Benefits claimed include travel time savings, fuel consumption savings, and health cost savings associated with emissions reductions for the entire week. Yearly savings calculated based on 365 days in a year.
- Value of time assumed to be 50 percent of the wage rate for off-the-clock travel or \$17.37 in 2010 constant dollars. Bay Area average wage rate is \$20.82 per hour in 1990 constant dollars, based on Travel Demand Models for the San Francisco Bay Area [BAYCAST-90] Technical Summary, Table 4, p. 28, June 1997. Adjusted for inflation using CPI, from US Dept of Labor, Bureau of Labor Statistics, CPI - All Urban Consumers, San Francisco-Oakland-San Jose, CA area, All Items, Not Seasonally Adjusted (Series Id:CUURA422SA0). Vehicle fleet assumed to be 100 percent automobiles.
- Average vehicle occupancy assumed to be 1.118 persons per vehicle and is used in calculating travel-time savings in autos only. This is based on the San Francisco Bay Area Baycast Travel Model run for the RTP 2009 (using the 2010 network) developed by the Metropolitan Transportation Commission.
- Average fuel cost is from US Dept of Labor Bureau of Labor Statistics, CPI - Average Price Data, San Francisco-Oakland-San Jose, CA area, Gasoline unleaded regular per gallon. Average of monthly prices in the Bay Area from January 2011 - October 2011 is \$3.94.
- Health cost of ROG Emissions (\$1,210 per ton), NOx Emissions (\$17,298 per ton), PM10x Emissions (\$139,867 per ton), and CO Emissions (\$74 per ton) are based on the California Department of Transportation, Office of Transportation Economics from Exhibit III-41, p. III-64 of the year 2007.
- Project life assumed to be twenty years. The traffic volume growth rate is at 1.011 per year over the 20-year study period.

2. Auto

AUTO																														
USER INPUTS							CALCULATIONS																							
Corridor (From-To)	Distance (feet)	Period (AM, MD, or PM)	Average Peak Period Traffic Volume (vph)	ADT Factor	Travel Time Before Project (sec)	Travel Time After Project (sec)	Distance (mi)	Annual Affected VMT	Speed Before Project (mph)	Speed After Project (mph)	Speed Increase (percent diff.)	Travel Time Before Project (hrs)	Travel Time Savings (hrs)	Fuel Consumption Before Project (gal)	Fuel Consumption Savings (gal)	ROG Emission Before Project (lbs)	ROG Emission Reduction (lbs)	NOx Emission Before Project (lbs)	NOx Emission Reduction (lbs)	PM10 Ex Emission Before Project (lbs)	PM10 Ex Emission Reduction (lbs)	CO Emission Before Project (lbs)	CO Emission Reduction (lbs)							
Aptos Creek Road	618 AM	230	5	84.08	28.03	0.12	49,130	5	15	200%	1343	895	7,463	3,154	111	68.9	238.4	99.1	19.8	10.7	791.8	250.2								
	618 PM	230	5	84.08	28.03	0.12	49,130	5	15	200%	1343	895	7,463	3,154	111	68.9	238.4	99.1	19.8	10.7	791.8	250.2								
Trout Gulch Road	1,125 AM	870	5	69.57	58.87	0.21	338,299	11	13	18%	4203	647	36,638	3,484	435	72.2	1,170.5	105.6	86.7	11.8	4,298.3	284.6								
	1,125 PM	870	5	69.57	58.87	0.21	338,299	11	13	18%	4203	647	36,638	3,484	435	72.2	1,170.5	105.6	86.7	11.8	4,298.3	284.6								
Soquel Drive	1,660 AM	1,130	5	161.32	75.28	0.31	648,359	7	15	114%	12659	6,752	88,501	31,640	1,241	683.6	2,825.8	987.2	228.2	107.4	9,673.4	2,526.3								
	1,660 PM	1,130	5	161.32	75.28	0.31	648,359	7	15	114%	12659	6,752	88,501	31,640	1,241	683.6	2,825.8	987.2	228.2	107.4	9,673.4	2,526.3								
TOTAL												36,411	16,587	265,203	76,557	3,576	1,649	8,469	2,384	670	260	29,527	6,122							
Total with Occupancy (Person hours travelled)												40,708	18,544																	

3. Emission factors

Table 4 Emission Factors by Speed

Project Life 1-5 years (2008-2012)

Grams per Mile				
Speed				
(mph)	ROG	NOx	PM10 Ex	CO
5	1.0269	2.2034	0.1834	7.3166
6	0.9481	2.091	0.1716	7.0451
7	0.8692	1.9787	0.1598	6.7736
8	0.7903	1.8663	0.148	6.5022
9	0.7114	1.754	0.1362	6.2307
10	0.6326	1.6416	0.1244	5.9592
11	0.5842	1.5708	0.1164	5.7683
12	0.5357	1.4999	0.1085	5.5774
13	0.4873	1.4291	0.1005	5.3864
14	0.4389	1.3582	0.0926	5.1955
15	0.3905	1.2874	0.0846	5.0046
16	0.3655	1.2559	0.0799	4.8691
17	0.3404	1.2244	0.0752	4.7336
18	0.3154	1.193	0.0706	4.5982
19	0.2903	1.1615	0.0659	4.4627
20	0.2653	1.13	0.0612	4.3272
21	0.2541	1.1176	0.0588	4.2319
22	0.2429	1.1053	0.0565	4.1366
23	0.2318	1.0929	0.0541	4.0412
24	0.2206	1.0806	0.0518	3.9459
25	0.2094	1.0682	0.0494	3.8506
26	0.202	1.0598	0.0478	3.7786
27	0.1945	1.0513	0.0463	3.7065
28	0.187	1.0429	0.0447	3.6345
29	0.1795	1.0344	0.0432	3.5624
30	0.1721	1.026	0.0416	3.4904
31	0.1672	1.0209	0.0406	3.4367
32	0.1623	1.0158	0.0395	3.383
33	0.1574	1.0108	0.0385	3.3292
34	0.1526	1.0057	0.0374	3.2755
35	0.1477	1.0006	0.0364	3.2218
36	0.1448	0.9988	0.0358	3.1839
37	0.1419	0.997	0.0352	3.146
38	0.139	0.9952	0.0346	3.108
39	0.136	0.9934	0.034	3.0701
40	0.1331	0.9916	0.0334	3.0322
41	0.1319	0.9931	0.0333	3.0092
42	0.1307	0.9946	0.0332	2.9862
43	0.1294	0.996	0.033	2.9632
44	0.1282	0.9975	0.0329	2.9402
45	0.127	0.999	0.0328	2.9172
46	0.1273	1.0041	0.033	2.9102
47	0.1276	1.0092	0.0332	2.9032
48	0.1279	1.0144	0.0334	2.8962
49	0.1282	1.0195	0.0336	2.8892
50	0.1285	1.0246	0.0338	2.8822
51	0.1303	1.0337	0.0344	2.8942
52	0.1321	1.0428	0.0349	2.9063
53	0.1339	1.0518	0.0355	2.9183
54	0.1357	1.0609	0.036	2.9304
55	0.1375	1.07	0.0366	2.9424
56	0.1412	1.0841	0.0376	2.9802
57	0.1449	1.0982	0.0386	3.018
58	0.1486	1.1122	0.0396	3.0558
59	0.1523	1.1263	0.0406	3.0936
60	0.156	1.1404	0.0416	3.1314
61	0.1621	1.1611	0.043	3.2069
62	0.1681	1.1818	0.0444	3.2824
63	0.1741	1.2024	0.0458	3.358
64	0.1801	1.2231	0.0472	3.4335
65	0.1862	1.2438	0.0486	3.509

Source: CARB March 2010

EMFAC2007 Versions 2.3 (Nov1, 2006), average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F.

ROS includes running exhaust and running evaporative emissions. PM10 Ex includes running exhaust emissions only.

4. Fuel consumption

Fuel Consumption Rates
(gal/veh-mile)

Speed	Auto
5	0.1519
6	0.1442
7	0.1365
8	0.1288
9	0.1212
10	0.1135
11	0.1083
12	0.1032
13	0.0980
14	0.0928
15	0.0877
16	0.0842
17	0.0808
18	0.0773
19	0.0739
20	0.0704
21	0.0681
22	0.0658
23	0.0634
24	0.0611
25	0.0588
26	0.0572
27	0.0556
28	0.0541
29	0.0525
30	0.0509
31	0.0499
32	0.0489
33	0.0478
34	0.0468
35	0.0458
36	0.0451
37	0.0445
38	0.0439
39	0.0433
40	0.0426
41	0.0423
42	0.0420
43	0.0417
44	0.0415
45	0.0412
46	0.0412
47	0.0412
48	0.0412
49	0.0411
50	0.0411
51	0.0414
52	0.0417
53	0.042
54	0.0423
55	0.0426
56	0.0432
57	0.0438
58	0.0444
59	0.045
60	0.0457
61	0.0467
62	0.0477
63	0.0487
64	0.0497
65	0.0507
66	0.0514
67	0.0521
68	0.0528
69	0.0535
70	0.0542
71	0.0542
72	0.0543
73	0.0543
74	0.0544
75	0.0544
76	0.0545
77	0.0545
78	0.0546
79	0.0547
80	0.0547

Source: CARB
EMFAC2002, V2.2, 2003 & 2023 average
Cal-B/C Parameters 6/28/2010

5. Monetary values

		2010	2011	2012
Value of Time	<i>per hour</i>	\$17.37		
Fuel Cost	<i>per gallon</i>	\$3.07	\$3.94	
Occupancy	<i>persons per vehicle</i>	1.118		
ROG	<i>per ton</i>	\$1,210		
Nox	<i>per ton</i>	\$17,298		
PM10x	<i>per ton</i>	\$139,867		
CO	<i>per ton</i>	\$74		

Source: Energy Almanac, State of California

http://energyalmanac.ca.gov/gasoline/retail_gasoline_prices2.html

The weekly California statewide average prices are compiled by the U.S. Department of Energy's Energy Information Administration (EIA) from a telephone survey that includes a sample of 38 California gasoline stations. These stations were sampled with a likelihood equal to the company's proportional size to the total annual volume of gasoline, by grade, sold in California.

2011

Value of Time				
	1990	2010	2011	2012
CPI	130.7	218.056		
\$	\$20.82	\$34.74		
50%	\$10.41	\$17.37		

Fuel Costs				
	Month	2010	2011	2012
1	January	\$2.990		
2	February	\$2.902		
3	March	\$3.028		
4	April	\$3.064		
5	May	\$3.075		
6	June	\$3.058		
7	July	\$3.125		
8	August	\$3.136		
9	September	\$3.006		
10	October	\$3.076		
11	November	\$3.147		
12	December	\$3.205		
	Average	\$3.068		

Health Cost of Transportation Emissions (\$/TON)				
CA URBAN	2007	2010	2011	2012
ROG	\$1,140	\$1,210		
NOX	\$16,300	\$17,298		
PM	\$131,800	\$139,867		
CO	\$70	\$74		

*Use 2% per annum increase from 2007 to calculate values for future years

Unleaded Gasoline Statewide Averages			
Date	Regular	Midgrade	Premium
10/10/2011	\$3.82	\$3.92	\$4.03
10/3/2011	\$3.84	\$3.94	\$4.04
9/26/2011	\$3.89	\$3.99	\$4.10
9/19/2011	\$3.92	\$4.03	\$4.13
9/12/2011	\$3.94	\$4.05	\$4.15
9/5/2011	\$3.94	\$4.05	\$4.15
8/29/2011	\$3.81	\$3.91	\$4.02
8/22/2011	\$3.73	\$3.84	\$3.94
8/15/2011	\$3.73	\$3.84	\$3.94
8/8/2011	\$3.80	\$3.90	\$4.00
8/1/2011	\$3.81	\$3.92	\$4.02
7/25/2011	\$3.82	\$3.93	\$4.03
7/18/2011	\$3.80	\$3.90	\$4.01
7/11/2011	\$3.78	\$3.89	\$3.99
7/4/2011	\$3.79	\$3.90	\$4.00
6/27/2011	\$3.84	\$3.95	\$4.05
6/20/2011	\$3.90	\$4.01	\$4.11
6/13/2011	\$3.94	\$4.05	\$4.15
6/6/2011	\$3.99	\$4.10	\$4.20
5/30/2011	\$4.06	\$4.17	\$4.27
5/23/2011	\$4.12	\$4.23	\$4.34
5/16/2011	\$4.22	\$4.33	\$4.43
5/9/2011	\$4.25	\$4.36	\$4.47
5/2/2011	\$4.26	\$4.36	\$4.46
4/25/2011	\$4.22	\$4.32	\$4.42
4/18/2011	\$4.21	\$4.31	\$4.41
4/11/2011	\$4.16	\$4.27	\$4.37
4/4/2011	\$4.06	\$4.16	\$4.27
3/28/2011	\$4.03	\$4.13	\$4.23
3/21/2011	\$3.97	\$4.07	\$4.17
3/14/2011	\$3.95	\$4.06	\$4.16
3/7/2011	\$3.87	\$3.98	\$4.08
2/28/2011	\$3.72	\$3.82	\$3.92
2/21/2011	\$3.56	\$3.66	\$3.76
2/14/2011	\$3.45	\$3.55	\$3.65
2/7/2011	\$3.40	\$3.50	\$3.60
1/31/2011	\$3.36	\$3.47	\$3.57
1/24/2011	\$3.36	\$3.46	\$3.56
1/17/2011	\$3.35	\$3.46	\$3.56
1/10/2011	\$3.33	\$3.44	\$3.54
1/3/2011	\$3.31	\$3.42	\$3.52
Average	\$3.84	\$3.94	\$4.04

6. Safety benefits

Year	Average Daily Traffic (Vehicles)	Crash Costs Per Year Before Improvements	Crash Costs per Year After Improvements	Change in Annual Crash Costs
2010	16,600	\$217,120	-	-
2011	16,791	\$219,617	-	-
2012	16,984	\$222,142	-	-
2013	17,179	\$224,697	\$99,019	\$125,678
2014	17,377	\$227,281	\$100,158	\$127,123
2015	17,577	\$229,895	\$101,310	\$128,585
2016	17,779	\$232,539	\$102,475	\$130,064
2017	17,983	\$235,213	\$103,653	\$131,560
2018	18,190	\$237,918	\$104,845	\$133,073
2019	18,399	\$240,654	\$106,051	\$134,603
2020	18,611	\$243,421	\$107,270	\$136,151
2021	18,825	\$246,221	\$108,504	\$137,717
2022	19,041	\$249,052	\$109,752	\$139,300
2023	19,260	\$251,916	\$111,014	\$140,902
2024	19,482	\$254,813	\$112,291	\$142,523
2025	19,706	\$257,744	\$113,582	\$144,162
2026	19,933	\$260,708	\$114,888	\$145,820
2027	20,162	\$263,706	\$116,209	\$147,497
2028	20,394	\$266,739	\$117,546	\$149,193
2029	20,628	\$269,806	\$118,898	\$150,908
2030	20,865	\$272,909	\$120,265	\$152,644
2031	21,105	\$276,047	\$121,648	\$154,399
2032	21,348	\$279,222	\$123,047	\$156,175
20-year Totals		\$5,020,500	\$2,212,424	\$2,808,076

Year	Average Daily Traffic (Vehicles)	Million vehicle miles travelled (in a year)	No. of Collisions (in a year)	Accident Rate	Above Statewide Average (2.95)? (Yes/No)
2010	16,600	1.88	4.6	2.45	No
2011	16,791	1.90	5	2.45	-
2012	16,984	1.92	5	2.45	-
2013	17,179	1.94	5	2.45	-
2014	17,377	1.97	5	2.45	-
2015	17,577	1.99	5	2.45	-
2016	17,779	2.01	5	2.45	-
2017	17,983	2.03	5	2.45	-
2018	18,190	2.06	5	2.45	-
2019	18,399	2.08	5	2.45	-
2020	18,611	2.11	5	2.45	-
2021	18,825	2.13	5	2.45	-
2022	19,041	2.15	5	2.45	-
2023	19,260	2.18	5	2.45	-
2024	19,482	2.20	5	2.45	-
2025	19,706	2.23	5	2.45	-
2026	19,933	2.26	6	2.45	-
2027	20,162	2.28	6	2.45	-
2028	20,394	2.31	6	2.45	-
2029	20,628	2.33	6	2.45	-
2030	20,865	2.36	6	2.45	-
2031	21,105	2.39	6	2.45	-
2032	21,348	2.42	6	2.45	-