Attachment 9: Benefit Cost Analysis Memo

East Bay Greenway Multimodal Project: Implementing a Community Vision

2023 RCN Grant Benefit Cost Analysis Memo

ALAMEDA County Transportation Commission

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1 Cost-Effectiveness Analysis

A Benefit-Cost Analysis (BCA) was conducted in conformance with United States Department of Transportation (USDOT) guidance to assess the impacts of the East Bay Greenway Multimodal Project (EBGW). The project will construct approximately 10.6 miles of a major north-south bicycle and multimodal corridor on local streets and a state conventional highway adding Class I, buffered Class II, neighborhood Class III, and Class IV facilities connecting five Bay Area Rapid Transit (BART) stations, beginning at the Lake Merritt Station in Oakland to the Bay Fair Station in San Leandro. The EBGW project also includes signalized and unsignalized intersection upgrades, pedestrian and transit boarding islands, and transit signal priority to increase transit reliability. The project comprises a major segment of a larger 16-mile project planned from Lake Merritt to South Hayward, and it has independent utility. Placemaking improvements, such as parklets, public art, and streetscape enhancements, will support anticipated growth in transit and active transportation along the corridor and reflect local community heritages. The BCA conducted for the EBGW project indicated a favorable benefit/cost (B/C) ratio with the monetized benefits of the project exceeding the estimated project-related costs. In the summary discussion to follow, individual analysis inputs and results are presented.

The analysis was performed using the California Department of Transportation (Caltrans) 2022 Cal-B/C Active Transit Model (Cal-B/C Model), version 8.1. This model incorporates project costs by category and benefits related to travel options and conditions for bicyclists and pedestrians, and it is considered the most appropriate model to address the project description and needs. The model incorporated the Real Discount Rate update to reflect USDOT guidance. All other data inputs remained specific to the State of California because the data provided is more conservative than the USDOT BCA guidance.

The Cal-B/C Model Inputs section discusses Cal-B/C inputs used in the analysis of the EBGW project, and the CAL-B/C Model Results section provides details regarding the BCA results. All monetary values presented in this appendix are expressed in 2021 dollars. A 7% discount rate was used to compute the net present value of benefits and costs.

2 Benefit-Cost Analysis Summary

The Cal B/C model calculates the B/C ratio based on inputs (i.e., type of project, improvement characteristics, existing and future trip data, and crash rates). The B/C analysis includes benefits in the following categories:

- Journey Quality
- Additional Delay Savings
- Additional Safety Benefits
- Health Benefits
- Emission Reductions

Table 1 provides a summary of the Cal B/C results for the EBGW project.

Table 1. EBGW CAL-B/C Results

Life-Cycle Costs (mil. $)	$103.6
Life-Cycle Benefits (mil. $)	$295.3
Net Present Value (mil. $)	$191.7
Benefit / Cost Ratio:	2.8
Rate of Return on Investment:	134.3%
Payback Period:	6 years

3 Cal-B/C Model Inputs

The Cal-B/C model includes several default parameters, such as travel time, vehicle operating cost, crash cost, active transportation, and highway operations. Sources for these default values include the Office of Management and Budget (OMB), Bureau of Labor Statistics (BLS), USDOT Department Guidance, ITS[1] Deployment Analysis System (IDAS) model, American Transportation Research Institute, AAA, Caltrans, and California Board of Equalization. The default values were used in this BCA unless otherwise stated.

The model was fitted to the EBGW project using project-specific crash, traffic, and bicyclist and pedestrian usage data. These inputs are discussed in the following subsections. The model identifies the required project specific data inputs with green cells.

[1] intelligent transportation systems

3.1 Project and Site Characteristics

The 2022 Cal-B/C model, version 8.1 requires users to select the project type from a given list. The EBGW project was identified as an "Existing facility upgrade and new facility extension" project, which is categorized as a Type 3 project. Users must also input the project length for the existing and the new facility. Other characteristics required for the model included project location, if the project was included in a Safe Routes to School (SRTS) program, if the project had programmatic initiatives, and the expected length of the construction period. Table 2 provides the project inputs that were entered into the model.

Table 2. Project and Site Characteristics

Type of Project		
Existing facility upgrade only = 1 New facility only, no existing facility work = 2 Existing facility upgrade and new facility extension = 3	3	
Total Project Length		Project Type Data Check
Total Existing Facility Length (miles)	4.97	OK
Total New Facility Length (miles)	4.13	OK
Characteristics		
Project Location (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural)	2	
Safe Route to School? (enter 1 for Yes, 0 for No)	0	
Programmatic Initiatives? (enter 1 for Yes, 0 for No)	0	
Construction		Constr. Years Data Check
Length of Construction Period (years)	2	OK

3.2 Existing Segment Improvements and Trip Volume

The Cal-B/C model requires project specific data for improvement characteristics based on cycling and pedestrian usage, along with existing trip data in the base year and future year scenarios. Data inputs were based on the geometric configurations from the project concept drawings, dated September 28, 2022; historic bicycle and pedestrian counts; and future year model data (traffic volumes and bicycle/pedestrian usage forecasts) obtained from the Alameda County Transportation Commission (CTC) Transportation Demand Model by Kittelson and Associates; and crash data[2] from the draft *Transportation Impact Study* prepared for the EBGW project by CHS Consulting. Projected annual growth rates were calculated based on bicycle and pedestrian data. The Cal-B/C model calculated the daily trips in the base year and in Year 20 (20 years

[2] Crash data was collected for the most recent pre-pandemic, full five-year period between January 1, 2015, and December 31, 2019, using the UC Berkeley Transportation Injury Mapping System (TIMS). The data includes collisions between pedestrians, bicyclists, and automobiles. The data set focused on collisions that occurred within a 500-foot radius of the proposed East Bay Greenway Project corridor.

post-construction) based off the current daily trip data. This was done for both the bicycle and pedestrian trips, as shown in Table 3.

Table 3. Existing Segment Improvements and Trip Volume

Improvement Characteristics				
Existing Facility Length, if Applicable	Class	No Build	Build	Project Length Data Check
Bike Paths (miles)	I	0.5	0.92	OK
Bike Lanes (miles)	II	4.27	0	
Bike Route (miles)	III	0.2	0.12	
Separated Bikeways, Cycle Tracks (miles)	IV	0	3.93	
Total		4.97	4.97	
Pedestrian Improvements		Yes =1 or No=0	Yes =1 or No=0	
Street Lighting		1	1	
Curb Level		0	1	
Crowding		0	1	
Pavement Evenness		0	1	
Information Panels		0	0	
Benches		0	1	
Directional Signage		0	1	
Trip Data - Adults				
Cycling		No Build	Build	
Daily Trips - Current		493		
Projected Annual Growth Rates from Year 1 (%)		2.3%	11.1%	
Daily Trips - Year 1 (post-construction)		516	609	
Daily Trips - Year 20 (post-construction)		805	4,961	
Pedestrian				
Daily Trips - Current		1,123		
Projected Annual Growth Rates from Year 1 (%)		2.3%	2.3%	
Daily Trips - Year 1 (post-construction)		1,174	1,174	
Daily Trips - Year 20 (post-construction)		1,832	1,832	

3.3 New Facility Improvements and Trip Volume

The Cal-B/C model also required project-specific data for improvement characteristics based on bicycle and pedestrian usage along with new facility trip data in the base year and future year scenarios. The No Build (base year) was assumed to have identical ridership to the existing scenario. The Cal-B/C model calculated the daily trips in the base year and in Year 20 (20 years post-construction). This was done for the bicycle and pedestrian trips using identical growth rates. To be conservative, no initial bump in demand is assumed when the new facility opens. New facility data is included in Table 4.

Table 4. New Facility Improvements and Trip Volume

Improvement Characteristics				
New Facility Length	Class	No Build	Build	Project Length Data Check
No Facility	0	4.13		OK
Bike Paths (miles)	I		1.16	
Bike Lanes (miles)	II		0	
Bike Route (miles)	III		0.13	
Separated Bikeways, Cycle Tracks (miles)	IV		2.84	
Total		4.13	4.13	
Pedestrian Improvements			Yes =1	
Street Lighting			1	
Curb Level			1	
Crowding			1	
Pavement Evenness			1	
Information Panels			0	
Benches			1	
Directional Signage			1	
Trip Data - Adults				
Cycling		No Build	Build	
Daily Trips - Current		493		
Projected Annual Growth Rates from Year 1 (%)		2.3%	11.1%	
Daily Trips - Year 1 (post-construction)		516	609	
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Daily Trips - Current		1,123		
Projected Annual Growth Rates from Year 1 (%)		2.3%	2.3%	
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Daily Trips - Year 20 (post-construction)		1,832	1,832	

3.4 Intersection Improvements – Time Savings and Crash Data

The EBGW project plans to improve 13 intersections along the corridor. The Cal-B/C model considers intersection improvements and the associated travel time and crash data. The number of improved intersections is based on new or major signal modifications and new Pedestrian Hybrid Beacon or Rapid Rectangular Flashing Beacon controls. To be conservative, no time savings were assumed at the improved intersections in the corridor. Bicyclist and pedestrian crash rates were provided from the draft *Transportation Impact Study* by CHS Consulting. To be conservative, the BCA assumed the existing trend of declining bicycling crashes (about 1.5% fewer each year) continues after the project is implemented. Values were calculated using the least squares method for bicycle crashes per year as provided by the Alameda CTC. Specific benefits or costs related to SRTS initiatives or any non-infrastructure initiatives, such as education and outreach programs, were not quantified. The breakdown of intersection and accident data is in Table 5.

Table 5. Intersection Improvements

Reduced Delay Due to Intersection Improvements			
Time Savings Parameters			
Number of Improved Intersections			13
Time Savings per Improved Intersection (min.)			
Intersection improvements on SRTS? (enter 1 for Yes, 0 for No)			
Accident Rate - Current Conditions			
Cyclists		Count (No.)	Rate per Year
Number of Years of Data		5.00	
Existing Conditions			
Total Number of Accidents (Tot)		200	40.0
Number of Fatal Accidents (Fat)		1	0.2
Number of Injury Accidents (Inj)		99	19.8
Number of \Property Damage Only (PDO) Accidents		100	20.0
Annual Growth Rate in Accidents (%/year)		-1.5%	-0.003
Pedestrians		Count (No.)	Rate per Year
Number of Years of Data		5.00	
Existing Conditions			
Total Number of Accidents (Tot)		312	62.4
Number of Fatal Accidents (Fat)		5	1.0
Number of Injury Accidents (Inj)		157	31.4
Number of \Property Damage Only (PDO) Accidents		150	30.0
Annual Growth Rate in Accidents (%/year)		2.7%	0.0054

4 Project Costs

Project costs and the length of the construction period were entered into the Cal B/C model. Project costs were included in the following categories, as appropriate: Project Support, Right-of-Way (ROW) Acquisition, Construction, and Maintenance/Operations.

The initial design and construction costs for the EBGW project are approximately $120.9 million. The construction period is assumed to be two years, beginning in 2024. Annual construction expenditures were assumed to be allocated proportionally over the 14 months of construction. The total project cost is $103.6 million in present value terms, including maintenance/operations. The breakdown of project costs, as reflected in the Cal B/C analysis, is indicated in Table 6.

Table 6. Project Costs

Year	Construction Years	DIRECT PROJECT COSTS						TOTAL COSTS (in dollars)	
		INITIAL COSTS			SUBSEQUENT COSTS				
		Project Support	R / W	Construction	Maint./ Op.	Rehab.		Constant Dollars	Present Value
Infrastructure Program Costs									
1	0	$4,719.0	$403.0		<-- Must enter a cost			$5,122,000	$5,122,000
2	0	$3,875.0						3,875,000	3,621,495
3	1			$55,975.0				55,975,000	48,890,733
4	1			$55,975.0				55,975,000	45,692,274
5	0							0	0
6	0							0	0
7	0							0	0
8	0							0	0
Annual Infrastructure O&M Costs									
1								$0	$0
2								0	0
3								0	0
4					$39			39,350	28,056
5					$40			40,190	26,780
6					$39			39,350	24,505
7					$40			40,190	23,391
8					$39			39,350	21,404
9					$40			40,190	20,431
10					$39			39,350	18,695
11					$40			40,190	17,845
12					$39			39,350	16,329
13					$40			40,190	15,586
14					$39			39,350	14,262
15					$40			40,190	13,614
16					$39			39,350	12,457
17					$40			40,190	11,891
18					$39			39,350	10,881
19					$40			40,190	10,386
20					$39			39,350	9,504
Total		$8,594	$403	$111,950	$676	$0		$121,622,670	$103,622,518

Note: Initial and subsequent costs are entered in thousands of dollars.

5 CAL-B/C Model Results

The Cal-B/C model evaluated benefits related to journey quality, intersection safety, auto crash costs, health for absenteeism and reduced mortality, and emissions reduction. **Figures 1** and **2** graphically depict the share by category of total project life cycle benefits and total project life cycle costs associated with the EBGW project, as discussed in more detail in the following subsections. Additional safety benefits are the combination of intersection safety and reduced auto crash costs. Health benefits are the combination of absenteeism and reduced mortality benefits.

Figure 1. EBGW Itemized Benefits, Present Value

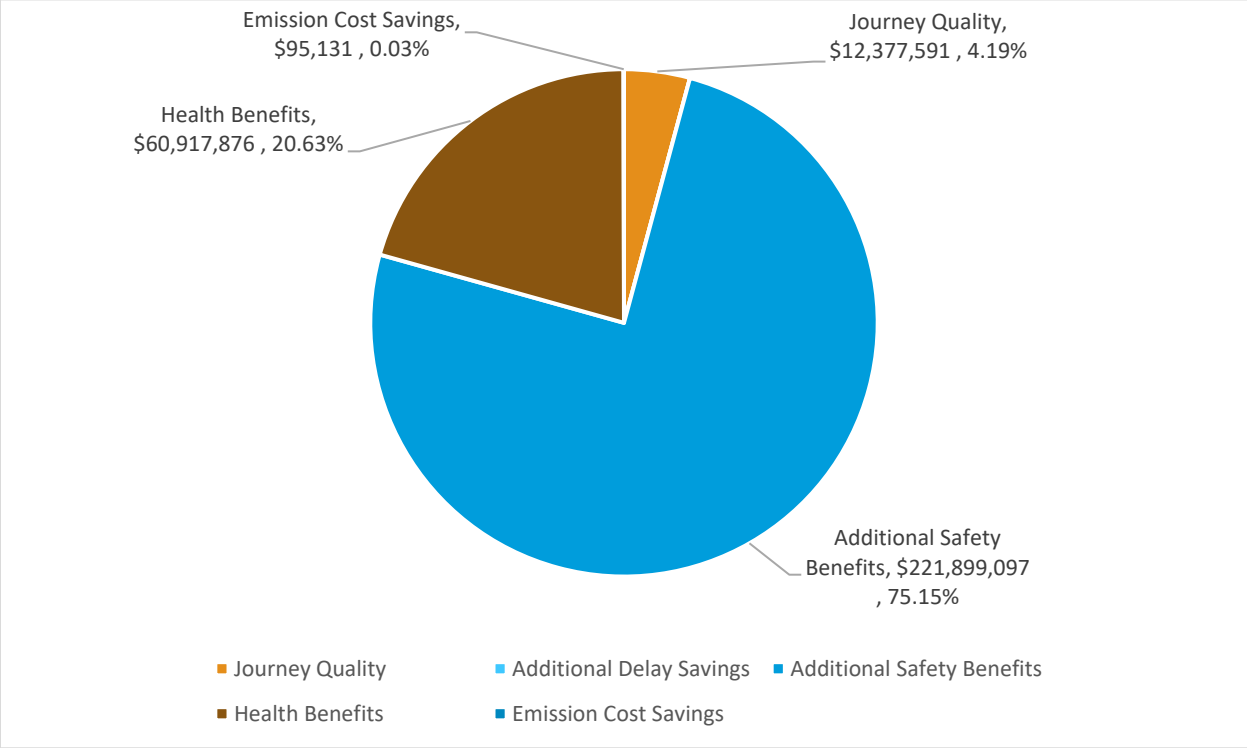
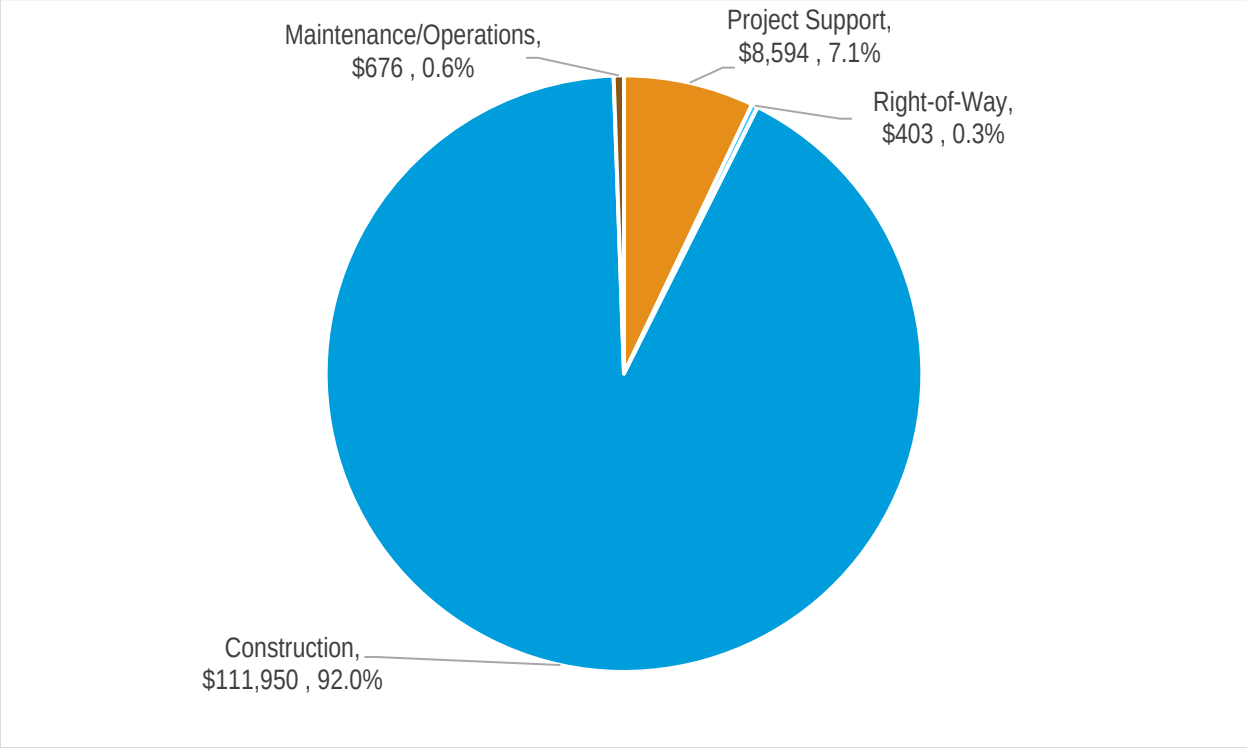


Figure 2. EBGW Project Costs, Present Value



5.1 Journey Quality Savings

The Cal-B/C model calculated journey quality benefits for bicyclists and pedestrians who travel to a destination. The journey quality benefit looks at improvements in the quality of the trip for pedestrians and cyclists that arise from a greater feeling of safety, comfort, aesthetics, and other types of improvements. Improvements to existing and new facilities can generate benefits for current trips and induced trips. Recreational users are not included. The model interpolated the year-to-year data between Year 1 and Year 20 benefits. Refer to the formulas for more information about each calculation.

Average Annual Trips = Average Daily Trips x Annual Days in Year, by purpose

Time-Value of Improved Facility = (1 - Facility Preference Factor) x Distance per Trip (miles) / Travel Speed (mph)

Value of Journey Quality = Time-Value of Improvement x Average Value of Time

Tables 7 and 8 provide total journey quality benefits by year for the existing and new facility, respectively. Both tables are the combined calculations of bicyclist and pedestrian benefits. Note that Value of Journey Quality for Induced Trips applies the rule of half[3].

Table 7. Journey Quality Savings – Existing Facility

Year	AVERAGE ANNUAL VOLUME (trips/yr.)				JOURNEY QUALITY VALUE ($)			Constant Dollars	Present Value
	Total Trips, Existing Facility (Baseline)	Total Trips, Improved Facility	Existing Trips, Improved Facility	Induced Trips, Improved Facility	Existing Trip-Miles, Existing Facility	Existing Trip-Miles, Improved Facility	Induced Trip-Miles, Improved Facility		
1	616,835	650,685	616,835	33,849	421,229	477,597	12	$56,380	$49,244
20	962,577	2,479,340	962,577	1,516,763	657,331	745,295	521	$88,483	$21,370
1	616,835	650,685	616,835	33,849	421,229	477,597	12	$56,380	$49,244
2	635,033	746,930	635,033	111,897	433,656	491,687	38	$58,069	$47,402
3	653,229	843,175	653,229	189,945	446,081	505,775	65	$59,759	$45,590
4	671,427	939,420	671,427	267,993	458,508	519,865	92	$61,449	$43,812
5	689,624	1,035,666	689,624	346,042	470,935	533,955	119	$63,138	$42,071
6	707,821	1,131,910	707,821	424,090	483,361	548,043	146	$64,828	$40,372
7	726,018	1,228,156	726,018	502,138	495,788	562,133	172	$66,517	$38,714
8	744,214	1,324,400	744,214	580,186	508,214	576,223	199	$68,207	$37,100
9	762,412	1,420,646	762,412	658,234	520,641	590,311	226	$69,897	$35,532
10	780,608	1,516,890	780,608	736,282	533,068	604,401	253	$71,587	$34,011
11	798,806	1,613,136	798,806	814,330	545,493	618,491	279	$73,277	$32,535
12	817,002	1,709,380	817,002	892,378	557,920	632,579	306	$74,966	$31,108
13	835,199	1,805,626	835,199	970,426	570,346	646,669	333	$76,656	$29,728
14	853,396	1,901,870	853,396	1,048,474	582,773	660,759	360	$78,346	$28,396
15	871,593	1,998,116	871,593	1,126,522	595,199	674,848	387	$80,035	$27,111
16	889,790	2,094,360	889,790	1,204,570	607,626	688,937	413	$81,725	$25,872
17	907,987	2,190,606	907,987	1,282,618	620,053	703,027	440	$83,414	$24,680
18	926,184	2,286,850	926,184	1,360,666	632,478	717,116	467	$85,104	$23,532
19	944,381	2,383,096	944,381	1,438,715	644,905	731,205	494	$86,794	$22,429
20	962,577	2,479,340	962,577	1,516,763	657,331	745,295	521	$88,483	$21,370
Total									$680,609

[3] The Rule of Half assumes the value of benefit accrued for new users is one half that of existing users.

Table 8. Journey Quality Savings - New Facility

Year	ANNUAL PERSON-TRIPS (trips/yr.) Total Trips, No Facility (Baseline)	Total Trips, New Facility	Existing Trips, New Facility	Induced Trips, New Facility	JOURNEY QUALITY VALUE ($)	Existing Trips, New Facility	Induced Trips, New Facility	Constant Dollars	Present Value
1	616,835	650,685	616,835	33,849	0	468,913	34,208	$503,121	$439,446
20	962,577	2,479,340	962,577	1,516,763	0	731,744	1,532,826	$2,264,570	$546,923
1	616,835	650,685	616,835	33,849	0	468,913	34,208	$503,121	$439,446
2	635,033	746,930	635,033	111,897	0	482,747	113,082	$595,829	$486,374
3	653,229	843,175	653,229	189,945	0	496,580	191,957	$688,536	$525,282
4	671,427	939,420	671,427	267,993	0	510,413	270,832	$781,245	$557,016
5	689,624	1,035,666	689,624	346,042	0	524,247	349,706	$873,953	$582,351
6	707,821	1,131,910	707,821	424,090	0	538,079	428,581	$966,660	$601,987
7	726,018	1,228,156	726,018	502,138	0	551,913	507,455	$1,059,368	$616,561
8	744,214	1,324,400	744,214	580,186	0	565,746	586,330	$1,152,076	$626,653
9	762,412	1,420,646	762,412	658,234	0	579,579	665,205	$1,244,783	$632,785
10	780,608	1,516,890	780,608	736,282	0	593,412	744,079	$1,337,492	$635,433
11	798,806	1,613,136	798,806	814,330	0	607,246	822,954	$1,430,200	$635,026
12	817,002	1,709,380	817,002	892,378	0	621,078	901,829	$1,522,907	$631,952
13	835,199	1,805,626	835,199	970,426	0	634,912	980,703	$1,615,615	$626,564
14	853,396	1,901,870	853,396	1,048,474	0	648,745	1,059,578	$1,708,323	$619,175
15	871,593	1,998,116	871,593	1,126,522	0	662,578	1,138,453	$1,801,030	$610,072
16	889,790	2,094,360	889,790	1,204,570	0	676,411	1,217,327	$1,893,738	$599,510
17	907,987	2,190,606	907,987	1,282,618	0	690,245	1,296,202	$1,986,447	$587,717
18	926,184	2,286,850	926,184	1,360,666	0	704,077	1,375,076	$2,079,154	$574,903
19	944,381	2,383,096	944,381	1,438,715	0	717,911	1,453,951	$2,171,862	$561,250
20	962,577	2,479,340	962,577	1,516,763	0	731,744	1,532,826	$2,264,570	$546,923
Total									$11,696,980

5.2 Intersection Safety Savings

The Cal-B/C model evaluated safety savings by calculating the safety benefits associated with intersection improvements along a bicycle/pedestrian facility. Improvements to existing intersections (e.g., lights, bridges, etc.) can lead to reduced accidents at intersections. Benefits can arise for existing and induced pedestrians and cyclists at each intersection crossed. The number of intersections crossed per trip is determined by the total length of the existing facility, the average distance traveled per user type, and the number of intersections with improvements. The magnitude of impacts is determined by the percent reduction in existing accidents due to specific safety measures. The model interpolated the year-to-year data between Year 1 and Year 20 benefits. Refer to the formulas for more information about each calculation.

Baseline Average Annual Crashes by Type = Sum of Total Crashes by Type / Years of Crash Data

Reduction in Crashes by Type = Crash Modification Factor(s) x Baseline Average Annual Crash by Type

Value of Crash Reduction by Type = Reduced Number of Crashes by Type x Value of Crash by Type

Value of Crash Reduction All Types = Sum of Value of Crash by Type

Table 9 provides total intersection safety benefits by year for the EBGW project for bicyclists and pedestrians.

Table 9. Intersection Safety Savings

Year	EXISTING ACCIDENT RATE AT AFFECTED INTERSECTIONS (events/yr.)				NEW ACCIDENT RATE AT AFFECTED INTERSECTIONS (events/yr.)				ACCIDENT REDUCTION AT AFFECTED INTERSECTIONS (events/yr.)				SAFETY VALUE ($)		
	Fatalities	Injuries	Property Damage Only	Total	Fatalities	Injuries	Property Damage Only	Total	Fatalities	Injuries	Property Damage Only	Total	Total	Constant Dollars	Present Value
1	1.2	51.2	50	102.4	0.2	11.2	11	22.5	1	40	39	79.9	$19,498,139	$19,498,139	$17,030,429
20	1.9	67	64.8	133.5	0.4	14.7	14.2	29.3	1.4	52.3	50.6	104.2	$27,925,730	$27,925,730	$6,744,430
1	1.2	51.2	50	102.4	0.24	11.24	10.99	22.48	0.96	39.96	39.01	79.93	$19,498,139	$19,498,139	$17,030,429
2	1.2	51.7	50.5	103.5	0.24	11.38	11.12	22.74	0.95	40.42	39.48	80.76	$19,820,219	$19,820,219	$16,179,203
3	1.29	52.31	51	104.61	0.24	11.51	11.16	22.91	0.95	40.9	39.85	81.7	$20,154,060	$20,154,060	$15,375,436
4	1.29	52.92	51.61	105.83	0.24	11.65	11.29	23.19	0.95	41.37	40.32	82.64	$20,499,935	$20,499,935	$14,616,171
5	1.29	53.54	52.23	107.05	0.24	11.79	11.43	23.46	1.05	41.85	40.8	83.59	$20,858,124	$20,858,124	$13,898,648
6	1.29	54.26	52.84	108.39	0.34	11.93	11.57	23.74	1.04	42.33	41.28	84.65	$21,228,912	$21,228,912	$13,220,299
7	1.38	54.88	53.47	109.73	0.34	12.07	11.71	24.11	1.04	42.92	41.76	85.72	$21,612,597	$21,612,597	$12,578,729
8	1.38	55.61	54.19	111.18	0.34	12.21	11.85	24.39	1.04	43.4	42.25	86.79	$22,009,485	$22,009,485	$11,971,701
9	1.38	56.45	54.82	112.64	0.34	12.35	11.99	24.68	1.14	44	42.83	87.97	$22,419,888	$22,419,888	$11,397,134
10	1.47	57.18	55.56	114.21	0.34	12.59	12.23	25.06	1.14	44.69	43.43	89.15	$22,844,130	$22,844,130	$10,853,081
11	1.47	58.02	56.39	115.79	0.34	12.73	12.37	25.44	1.13	45.29	44.02	90.45	$23,282,544	$23,282,544	$10,337,727
12	1.47	58.87	57.14	117.47	0.34	12.88	12.52	25.83	1.13	45.99	44.62	91.74	$23,735,468	$23,735,468	$9,849,375
13	1.57	59.72	57.98	119.27	0.34	13.12	12.76	26.12	1.23	46.59	45.22	93.15	$24,203,259	$24,203,259	$9,386,441
14	1.56	60.67	58.83	121.06	0.34	13.27	12.9	26.61	1.23	47.4	45.93	94.56	$24,686,276	$24,686,276	$8,947,443
15	1.66	61.62	59.79	122.97	0.34	13.52	13.15	27	1.23	48.11	46.64	95.97	$25,184,891	$25,184,891	$8,530,994
16	1.66	62.58	60.64	124.99	0.33	13.76	13.3	27.4	1.32	48.92	47.35	97.49	$25,699,487	$25,699,487	$8,135,800
17	1.66	63.65	61.6	127.01	0.33	13.91	13.55	27.89	1.32	49.64	48.16	99.12	$26,230,459	$26,230,459	$7,760,646
18	1.75	64.71	62.67	129.04	0.33	14.16	13.79	28.29	1.32	50.55	48.88	100.75	$26,778,210	$26,778,210	$7,404,399
19	1.75	65.78	63.74	131.27	0.43	14.41	13.94	28.78	1.42	51.37	49.69	102.49	$27,343,158	$27,343,158	$7,065,992
20	1.85	66.96	64.81	133.52	0.43	14.66	14.19	29.28	1.42	52.3	50.62	104.23	$27,925,730	$27,925,730	$6,744,430
Total															$221,284,079

5.3 Crash Reduction

The Cal-B/C model evaluated the accident-cost benefits by calculating the benefits of avoided crashes on. Some of the induced pedestrian and cycling trips entail diversions from auto use. Benefits from reduced auto use include reduced frequency of accidents and level of auto emissions. Crash costs were calculated by crash type. The model interpolated the year-to-year data between Year 1 and Year 20 benefits. Refer to the formulas for more information about each calculation.

Vehicle-Miles Traveled = Affected Length x Average Volume / Vehicle Occupancy

Highway Accident Cost = (VMT[4] x Rate x Cost/Mile) by Crash Type

Transit Crash Cost = Vehicle-Miles x Crash Cost/Mile

Transit Crash Cost/Mile from Parameters

Table 10 provides the total crash cost savings benefit and crash cost savings benefit by year for the EBGW project.

[4] vehicle miles traveled

Table 10. Crash Reduction Benefits

Year	AVERAGE ANNUAL VOLUME (trip-miles/yr.) Induced Trips, Cycling	Induced Trips, Pedestrians	REDUCED VMT (veh-miles/yr.) Induced Trips, Cyclists, Pedestrians	ACCIDENT BENEFITS ($/yr.) Induced Trips	Constant Dollars	Present Value
1	83,561	0	27,669	$3,476	$3,476	$3,036
20	3,744,311	0	1,239,838	$155,763	$155,763	$37,619
1	83,561	0	27,669	$3,476	$3,476	$3,036
2	276,232	0	91,468	$11,491	$11,491	$9,380
3	468,903	0	155,266	$19,506	$19,506	$14,881
4	661,574	0	219,064	$27,521	$27,521	$19,622
5	854,245	0	282,863	$35,537	$35,537	$23,680
6	1,046,916	0	346,661	$43,552	$43,552	$27,122
7	1,239,587	0	410,459	$51,567	$51,567	$30,012
8	1,432,258	0	474,258	$59,582	$59,582	$32,409
9	1,624,929	0	538,056	$67,597	$67,597	$34,363
10	1,817,600	0	601,854	$75,612	$75,612	$35,923
11	2,010,271	0	665,653	$83,627	$83,627	$37,132
12	2,202,942	0	729,451	$91,642	$91,642	$38,028
13	2,395,613	0	793,249	$99,658	$99,658	$38,649
14	2,588,284	0	857,048	$107,673	$107,673	$39,026
15	2,780,955	0	920,846	$115,688	$115,688	$39,187
16	2,973,626	0	984,645	$123,703	$123,703	$39,161
17	3,166,297	0	1,048,443	$131,718	$131,718	$38,971
18	3,358,969	0	1,112,241	$139,733	$139,733	$38,637
19	3,551,640	0	1,176,040	$147,748	$147,748	$38,181
20	3,744,311	0	1,239,838	$155,763	$155,763	$37,619
Total						$615,019

5.4 Health – Absenteeism

The Cal-B/C model calculated the benefits to employers of improved health of employees who use active transportation modes. Benefits were based on the value of reduced work absences. The model interpolated the year-to-year data between Year 1 and Year 20 benefits. Refer to the formulas for more information about each calculation. The average value of time per day is based on the state average wage rate for an 8-hour day.

Average Annual Commuters = Average Daily Trips / Roundtrip Factor x Commuting Purpose (%) x Annual Days

Reduced Days of Work Absences = Average Annual Commuters x Short-term Sick Leave Coverage x Reduction in Sick Days

Value of Short-term Health = Reduced Days of Work Absences x Average Value of Time per Day

Table 11 provides total absenteeism health benefits by year for the EBGW project. This health benefit was only calculated for induced (i.e., new to the system) bicycle users.

Table 11. Health Benefits - Absenteeism

Year	COMMUTER TRIPS (trips/yr.) Total Commuters, Existing + New Facility (Baseline)	COMMUTER TRIPS (trips/yr.) Total Commuters, Improved + New Facility	COMMUTER TRIPS (trips/yr.) Induced Commuters, Existing Facility	REDUCTION IN ABSENTEEISM (days) Induced Commuters	VALUE OF REDUCED ABSENTEEISM ($/day) Induced Commuters	Constant Dollars	Present Value
1	86	102	15	2	$259.54	$556	$486
20	134	828	693	96	$259.54	$24,936	$6,022
1	86	102	15	2	$259.54	$556	$486
2	89	140	51	7	$259.54	$1,840	$1,502
3	91	178	87	12	$259.54	$3,123	$2,382
4	94	216	122	17	$259.54	$4,406	$3,141
5	96	254	158	22	$259.54	$5,689	$3,791
6	99	293	194	27	$259.54	$6,972	$4,342
7	101	331	229	32	$259.54	$8,255	$4,805
8	104	369	265	37	$259.54	$9,538	$5,188
9	106	407	301	42	$259.54	$10,822	$5,501
10	109	445	337	47	$259.54	$12,105	$5,751
11	111	484	372	52	$259.54	$13,388	$5,944
12	114	522	408	57	$259.54	$14,671	$6,088
13	117	560	444	61	$259.54	$15,954	$6,187
14	119	598	479	66	$259.54	$17,237	$6,248
15	122	636	515	71	$259.54	$18,520	$6,274
16	124	675	551	76	$259.54	$19,804	$6,269
17	127	713	586	81	$259.54	$21,087	$6,239
18	129	751	622	86	$259.54	$22,370	$6,185
19	132	789	658	91	$259.54	$23,653	$6,112
20	134	828	693	96	$259.54	$24,936	$6,022
Total							$98,458

5.5 Health – Reduced Mortality

The Cal-B/C model calculated the benefits to bicyclists and pedestrians for improved long-term health based on a reduced risk of mortality. Reduced mortality costs were calculated by user type. The model interpolated the year-to-year data between Year 1 and Year 20 benefits. Refer to the formulas for more information about each calculation.

Number of Induced Users = Users with Project (Improved or New Facility) - Baseline Users (Existing and/or no Facility)

Number of Users in Risk-reducing Age Group = Number of Induced Users x Percent of Users (by Mode) in Risk-reducing Age Group

Number of Expected Deaths in Age Group (Baseline) = Number of Users in Risk-Reducing Age Group x Death Rate (Group)

Reduced Mortality Risk = Expected Deaths in Age Group x Mortality Risk Reduction (%), as function of annual trip miles

Value of Reduced Mortality = Reduced Number of Annual Deaths x Value of Life

Table 12 provides total reduced mortality health benefits by year for the EBGW project. This health benefit was only calculated for induced cycle users.

Table 12. Health Benefits – Reduced Mortality

Year	AVERAGE ANNUAL USERS (Users/yr.) Total Users, Existing Facility (Baseline)	Total Users, Improved Facility	Induced Users, Improved Facility	REDUCED MORTALITY RISK (# of persons) Users in Risk-Reducing Age Group (Ages 20-64)	Expected # of Deaths Among Users	Reduced Mortality Risk (Induced User Trips)	VALUE OF REDUCED MORTALITY ($) Induced Users	Constant Dollars	Present Value
1	231	273	42	22.8	0.1	0.0	$171,878	$171,878	$150,125
20	361	2,225	1,863	1,023.0	2.6	0.6	$7,701,742	$7,701,742	$1,860,072
1	231	273	42	22.8	0.1	0.0	$171,878	$171,878	$150,125
2	238	376	137	75.5	0.2	0.0	$568,187	$568,187	$463,809
3	245	478	233	128.1	0.3	0.1	$964,495	$964,495	$735,809
4	252	581	329	180.8	0.5	0.1	$1,360,804	$1,360,804	$970,234
5	259	684	425	233.4	0.6	0.1	$1,757,113	$1,757,113	$1,170,838
6	265	787	521	286.0	0.7	0.2	$2,153,421	$2,153,421	$1,341,042
7	272	889	617	338.7	0.9	0.2	$2,549,730	$2,549,730	$1,483,366
8	279	992	713	391.3	1.0	0.2	$2,946,039	$2,946,039	$1,602,450
9	286	1,095	809	444.0	1.1	0.3	$3,342,347	$3,342,347	$1,699,080
10	293	1,197	905	496.6	1.3	0.3	$3,738,656	$3,738,656	$1,776,208
11	300	1,300	1,000	549.3	1.4	0.3	$4,134,965	$4,134,965	$1,835,974
12	306	1,403	1,096	601.9	1.5	0.3	$4,531,273	$4,531,273	$1,880,317
13	313	1,506	1,192	654.5	1.6	0.4	$4,927,582	$4,927,582	$1,911,001
14	320	1,608	1,288	707.2	1.8	0.4	$5,323,890	$5,323,890	$1,929,623
15	327	1,711	1,384	759.8	1.9	0.4	$5,720,199	$5,720,199	$1,937,629
16	334	1,814	1,480	812.5	2.0	0.5	$6,116,508	$6,116,508	$1,936,330
17	341	1,916	1,576	865.1	2.2	0.5	$6,512,816	$6,512,816	$1,926,907
18	347	2,019	1,672	917.8	2.3	0.5	$6,909,125	$6,909,125	$1,910,431
19	354	2,122	1,768	970.4	2.4	0.6	$7,305,434	$7,305,434	$1,887,863
20	361	2,225	1,863	1,023.0	2.6	0.6	$7,701,742	$7,701,742	$1,860,072
Total									$30,409,709

5.6 Emissions Reduction

The Cal-B/C model determined an emissions reduction benefit by calculating VMT and highway emissions costs. Emissions costs were calculated by emissions type. The model interpolated the year-to-year data between Year 1 and Year 20 benefits. Refer to the formulas for more information about each calculation.

Vehicle-Miles Traveled = Affected Length x Avg. Annual Volume

Highway Emissions Cost = (VMT x Rate x Cost/Mile) by Emissions Type

Vehicle Emissions Cost = (Vehicle-Miles x Rate x Cost/Mile) by Emissions Type

Table 13 provides the total emissions benefit and the emissions benefit by year for the EBGW project.

Table 13. Emissions Reduction

Year	AVERAGE ANNUAL VOLUME (trip-miles/yr.) Induced Trips, Cycling	Induced Trips, Pedestrians	REDUCED VMT (veh-miles/yr.) Induced Trips	AVERAGE SPEED (mph) Induced Trips	RUNNING EMISSIONS ($/yr.) Induced Trips	Constant Dollars	Present Value
1	83,561	0	27,669	25	$573	$573	$500
20	3,744,311	0	1,239,838	25	$25,842	$25,842	$6,241
1	83,561	0	27,669	25	$573	$573	$500
2	276,232	0	91,468	25	$1,926	$1,926	$1,572
3	468,903	0	155,266	25	$3,327	$3,327	$2,538
4	661,574	0	219,064	25	$4,778	$4,778	$3,406
5	854,245	0	282,863	25	$6,279	$6,279	$4,184
6	1,046,916	0	346,661	25	$7,832	$7,832	$4,877
7	1,239,587	0	410,459	25	$9,439	$9,439	$5,494
8	1,432,258	0	474,258	25	$7,886	$7,886	$4,289
9	1,624,929	0	538,056	25	$9,116	$9,116	$4,634
10	1,817,600	0	601,854	25	$10,389	$10,389	$4,936
11	2,010,271	0	665,653	25	$11,708	$11,708	$5,199
12	2,202,942	0	729,451	25	$13,074	$13,074	$5,425
13	2,395,613	0	793,249	25	$14,487	$14,487	$5,618
14	2,588,284	0	857,048	25	$15,950	$15,950	$5,781
15	2,780,955	0	920,846	25	$17,463	$17,463	$5,915
16	2,973,626	0	984,645	25	$19,028	$19,028	$6,024
17	3,166,297	0	1,048,443	25	$20,647	$20,647	$6,109
18	3,358,969	0	1,112,241	25	$22,321	$22,321	$6,172
19	3,551,640	0	1,176,040	25	$24,052	$24,052	$6,216
20	3,744,311	0	1,239,838	25	$25,842	$25,842	$6,241
Total							$95,131

6 Other Benefits

The Cal-B/C model quantifies the key benefits from implementation of the active transportation project. The model reflects a conservative representation of the benefits the project will provide: non-quantifiable benefits are considered outside of the BCA analysis, but should be recognized when considering the overal beneficial impact of the project. Other benefits to aknowledge from the EBGW project include, but are not limited to, the following:

- State of Good Repair: The EBGW project includes roadway pavement rehabilitation and resurfacing which will prolong the useful life of the roadway and reduce wear and tear on vehicles –which result in reduced maintenance costs for both the owner and users.
- Multimodal Access: The new facility will encourage a mode shift from motorized to non-motorized trips for first- and last-mile trips; therefore, reducing vehicle usage harmful emissions in the community.
- Improved Connectivity: The facility will allow improved connectivity within the community. Individuals will have better access to jobs, resources, services, and various community centers.
- Addition of Green Infrastructure: The project will provide opportunities to incorporate green and sustainable infrastructure such as stormwater infrastructure to capture run-off from the street into planters or pervious areas to improve the water quality and provide irrigation for plants; water-efficient or drought-resistant plantings to conserve water and reduce maintenance; addition of street trees to enhance the urban fores, reduce the heat-island effect and provide natural shading along the EBGW; new and enhanced urban open space; and energy-efficient lighting to reduce energy use and contribution to light pollution.

These benefits, in addition to those analyzed in the Cal-B/C model, work to improve the quality of life and the accessibility for the surrounding community. Please see the RCN narrative for additional discussion on the beneficial aspects of the project.