



# Mercer Corridor West Project

## TIGER GRANT BENEFIT COST ANALYSIS (BCA) TECHNICAL DOCUMENTATION

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This document outlines the methods and assumptions utilized in the calculation of some key benefits for the cost-benefit analysis to be included in a City of Seattle TIGER Grant application. The elements of the benefits relate to those determinable by anticipated transportation operations with and without the project, as well as benefits related construction, operations and maintenance.

### 1. Purpose of Benefit Cost Analysis (BCA)

The formal benefit-cost analysis (BCA) was conducted for this project using best practices for BCA in transportation planning, and reflecting all TIGER IV grant application guidelines. As noted in the application, it is important to note that a formal BCA is not a comprehensive measure of a project's total economic impact, as many benefits cannot be readily quantified or occur under conditions of uncertainty. This broader set of economic benefits and impacts on local and regional economic well-being and competitiveness are described in other sections of the application, particularly as it related to Economic Competitiveness.

To the maximum extent possible given available data, the formal BCA prepared in connection with this TIGER grant application reflects quantifiable economic benefits.

**Livability and Economic Competitiveness:** By improving both travel time and reliability for vehicles traveling through a key crosstown bottleneck in the City's arterial system, the project will improve the quality of life for many City residents, as well as improve access, property values and reinforce ongoing redevelopment efforts. Travel time benefits will also extend to freight that uses the Mercer Corridor.

**Safety:** The project is anticipated to reduce vehicle-related accidents of varying severity compared with recent accident history along the corridor.

**Environmental Sustainability:** The project will result in a significant reduction in delay in the corridor, greatly reducing the amount of fuel consumed, and the related emissions in the corridor.

**State of Good Repair:** The benefit is from the reduction in maintenance costs from the wear and tear on the existing concrete pavement compared to the new concrete pavement and the maintenance costs for the bridge. Additionally, there is a cost benefit to replace existing utilities with the Mercer West project.



## 2. Analysis Years and Other Baseline Assumptions

### Length of Benefit

The operational benefit calculations for the Mercer West project assumed that they would continue for at least 25 years. The specific years used in the technical analysis are as follows:

- Year of Opening: 2015
- First Year of Operation: 2016
- Horizon Year of Benefit Period: 2040

There is an accompanying cost reduction required in Years 2013 to 2015 that reflects the added delay resulting from reduced capacity during construction.

The number of days per year that demonstrate benefit vary depending on whether or not the estimate is related to congestion or not. For measures that are congestion related, 250 days a year is assumed. For non-related congestion measures, 300 days a year is assumed.

### Monetized Value Assumptions

As specified in the TIGER Benefit Cost Analysis (BCA) Resource Guide, the benefits were estimated utilizing fixed values. These include the value of injuries (determined by the severity of the injury), value of property damage without injury, the value of travel time for general purpose traveler (noting that the traffic volumes needed to be adjusted for auto occupancy) with an additional calculation for truck drivers. Emissions values were also specified in the document for carbon dioxide, volatile organic compounds, nitrogen oxides, particulate matter and sulfur dioxide.

The project costs were estimated using a thirty-year straight-line benefit calculation, as well as one that demonstrates a life cycle price deflator that utilizes a 3 percent and 7 percent discount rate to determine the aggregate present value.

A discount at present value will reduce the benefit of replacing the utilities before the end of the life cycle is reached. There is also inflation associated with replacing the utilities in the future.

## 3. Project Benefits Assumptions and Results

All project benefits calculations are provided in the Excel File **BCAcalcs.xls**. Specific worksheets, or tabs, are associated with each of the summary tables provided in this document. The worksheet names are provided with each of the tables in this section.

**Livability Benefit Assumptions** – To determine livability, the travel time savings at the AM and PM peak hours was determined using intersection operations analysis software and summing travel time savings in the corridor. For the previous and following hours adjacent to the peak hour (attributed to the peak period), delays were assumed to be 85 percent of the peak hour delays. The remaining hours of the day assumed no increase in congestion.

The classification of vehicle types was used to estimate the costs associated with the loss of time by different types of travelers. The City's travel model used for a wider variety of Federally-reviewed



studies provides vehicle occupancy classes for cars. The typical vehicle occupancy over an average weekday determined from this tool is 1.30. The typical percent of trucks – light-, medium- and heavy-duty classifications – is determined as 9 percent.

**Modeling and Traffic Forecast/Travel Time Assumptions** – The primary scenarios used for this analysis are the scenarios submitted for the Mercer West Environmental and Final Design submittals. The travel model forecasts originated from the analysis of the Alaskan Way Viaduct Replacement project.

To be conservative on the benefits, only the Year 2015 scenarios were used. 2015 is the year of opening. All scenarios included the replacement of the AWV (SR 99 Bored Tunnel) and associated street network improvements, such as the closure of Broad Street, the opening of east-west streets across Aurora (former SR 99 roadway) and Broad Street (at John, Thomas and Harrison streets), and the new access ramps at Republican Street. The Broad Street closure is a necessary part of the SR 99 Bored Tunnel, because the new highway connection from the tunnel to the SR 99 mainline will be constructed through the existing Broad Street roadway.

In addition to the Alaskan Way Viaduct replacement, the scenarios assumed the completion of the Mercer Corridor East project.

The traffic analysis compared projected conditions under the proposed project, Mercer West, to a no build scenario that would leave Mercer Street as a one-way eastbound street from Fifth Ave N to Eighth Ave N. A second no build scenario was developed for a sensitivity analysis. This second no build scenario assumes that the existing Mercer Street roadway would be converted to two-way operation with two lanes in each direction from Fifth Ave N to Dexter Ave N and widened out to three lanes in each direction from Dexter Ave N to Eighth Ave N. Mercer Street would not be widened between Fifth Ave N, and the SR 99 bridge over Mercer Street would not be replaced in the second no action scenario. This second no build scenario is considered not acceptable by a broad range of stakeholders, due to the traffic and travel time impacts and lack of pedestrian and bicycle improvements. None of the bicycle or pedestrian improvements in the Underpass section of the project (Dexter Ave N to Fifth Ave N) would be included in either of the no build assumptions.

The estimates of travel delay were then derived from the available intersection analysis tool developed for the project, using pivoted traffic volumes from the model. In the baseline instance, the model volumes were adjusted to reflect the two possible configurations for the existing underpass (no action) – as a one-way, four-lane operation in the eastbound direction and a two-way, two-lane operation in each direction.

**Travel Time Savings Analysis Results** – Total travel time savings and annual related cost savings for auto travel under the Project and No Build scenarios are summarized in Table 1. The annual costs were reduced to year 2015 dollars (consistent with the project completion date, and similar to the project cost (mid-2014) estimate.) Year 2015 value of travel time savings for auto travel are summarized in Table 2. Total travel time savings and annual related cost savings for truck travel under the Project and No Build scenarios are summarized in Table 3. The total twenty-five year value of travel time savings, discounted by 3% and 7% to 2015 values for truck travel are summarized in Table 4.



Table 1			
Auto Travel Time Savings of Project Compared to:			
	No-Build 1 one-way EB Mercer	No Build 1 with Adjusted WB Volume	No-Build 2 Two-Way Underpass
AM WB Travel Time (min)	32.99	25.39	7.73
AM WB Volume	1092	1092	1092
AM EB Travel Time (min)	1.27	2.97	1.95
AM EB Volume	1547	1547	1547
Total Travel Time Per AM Hour (min)	37990	32320	11458
AM Peak Period Factor	2.70	2.70	2.70
Total AM Period Travel Time (Min)	102572	87265	30936
Cost Savings - AM Travel Time (\$)	29,062	24,725	8,765
PM WB Travel Time (min)	36.46	27.66	11.18
PM WB Volume	1183	1183	1183
PM EB Travel Time (min)	11.50	6.19	2.60
PM EB Volume	1911	1911	1911
Total Travel Time Per PM Hour (min)	65109	44551	18195
PM Peak Period Factor	2.70	2.70	2.70
Total PM Period Travel Time (Min)	175793	120287	49125
Cost Savings - PM Travel Time (\$)	49,808	34,081	13,919
Cost Savings - Daily Travel Time (\$)	78,870	58,807	22,684
No. of Day Per Year	250	250	250
Annual Cost Savings	19,717,579	14,701,644	5,671,012

Worksheets for Table 1 in **BCAcalcs.xls: Table 1&2**



Table 2

2015 Value of Net Auto Travel Time Savings Discounted at 3% and 7%. Project compared to:

Year	No-Build 1 one-way EB Mercer		No Build 1 with Adjusted WB Volume		No-Build 2 Four-Lane, Two-Way Underpass	
	3%	7%	3%	7%	3%	7%
2016	19,143,280	18,427,644	14,273,441	13,739,854	5,505,837	5,300,011
2017	18,585,709	17,222,097	13,857,709	12,840,985	5,345,473	4,953,281
2018	18,044,378	16,095,418	13,454,087	12,000,921	5,189,779	4,629,235
2019	17,518,813	15,042,446	13,062,220	11,215,814	5,038,621	4,326,388
2020	17,008,556	14,058,361	12,681,767	10,482,069	4,891,865	4,043,353
2021	16,513,162	13,138,655	12,312,395	9,796,326	4,749,383	3,778,835
2022	16,032,196	12,279,117	11,953,782	9,155,445	4,611,052	3,531,621
2023	15,565,239	11,475,810	11,605,613	8,556,491	4,476,749	3,300,581
2024	15,111,882	10,725,056	11,267,586	7,996,720	4,346,358	3,084,655
2025	14,671,730	10,023,417	10,939,404	7,473,570	4,219,765	2,882,855
2026	14,244,398	9,367,680	10,620,780	6,984,645	4,096,860	2,694,257
2027	13,829,513	8,754,841	10,311,437	6,527,706	3,977,534	2,517,997
2028	13,426,712	8,182,094	10,011,104	6,100,659	3,861,683	2,353,268
2029	13,035,642	7,646,817	9,719,518	5,701,551	3,749,207	2,199,316
2030	12,655,963	7,146,558	9,436,426	5,328,552	3,640,007	2,055,436
2031	12,287,343	6,679,026	9,161,578	4,979,955	3,533,987	1,920,968
2032	11,929,459	6,242,080	8,894,736	4,654,164	3,431,055	1,795,297
2033	11,581,999	5,833,720	8,635,666	4,349,686	3,331,122	1,677,848



2034	11,244,660	5,452,075	8,384,142	4,065,127	3,234,099	1,568,082
2035	10,917,145	5,095,397	8,139,944	3,799,184	3,139,902	1,465,497
2036	10,599,170	4,762,053	7,902,858	3,550,639	3,048,448	1,369,624
2037	10,290,456	4,450,517	7,672,678	3,318,355	2,959,659	1,280,022
2038	9,990,734	4,159,362	7,449,202	3,101,266	2,873,455	1,196,282
2039	9,699,742	3,887,254	7,232,235	2,898,379	2,789,762	1,118,021
2040	9,417,225	3,632,948	7,021,587	2,708,766	2,708,507	1,044,879
Total 2015 Value	\$ 343,345,108	\$ 229,780,442	\$ 256,001,894	\$171,326,829	\$ 98,750,168	\$ 66,087,609

Worksheets for Table 2 in **BCAcalcs.xls: Table 1&2**

Table 3

	Freight Travel Time Savings of Project Compared to:		
	No-Build 1 one-way EB Mercer	No Build 1 (One-way Mercer) with Adjusted WB Volume	No-Build 2 Two-Way Underpass
AM WB Travel Time (min)	32.99	25.39	7.73
AM WB Volume	108	108	108
AM EB Travel Time (min)	1.27	2.97	1.95
AM EB Volume	153	153	153
Total Travel Time Per AM Hour (min)	3757	3196	1133
AM Peak Period Factor	2.70	2.70	2.70
Total AM Period Travel Time (Min)	10,144.52	8630.63	3059.61
Cost Savings - AM Travel Time (\$)	4007	3409	1208
PM WB Travel Time (min)	36.46	27.66	11.18
PM WB Volume	117	117	117
PM EB Travel Time (min)	11.50	6.19	2.60
PM EB Volume	189	189	189
Total Travel Time Per PM Hour (min)	6439.32	4406.13	1799.46
PM Peak Period Factor	2.70	2.70	2.70
Total PM Period Travel Time (Min)	17,386	11,897	4859



Cost Savings - PM Travel Time (\$)	6868	4699	1919
Cost Savings - Daily Travel Time (\$)	10,875	8108	3128
No. of Days Per Year	250	250	250
Annual Cost Savings	\$ 2,718,655	\$ 2,027,059	\$ 781,917

Worksheets for Table 3 in **BCAcalcs.xls: Table 3&4**

Table 4

2015 Value of Net Truck Travel Time Savings. Mercer West Project Compared to:						
Year	No-Build 1 One-way EB Mercer		No-Build 1 (one-way Mercer) with Adjusted WB Volume		No-Build 2 Four-lane, Two-way Underpass	
	3%	7%	3%	7%	3%	7%
2016	2,639,471	2,540,799	1,968,019	1,894,448	759,144	730,764
2017	2,562,593	2,374,579	1,910,698	1,770,512	737,033	682,957
2018	2,487,955	2,219,232	1,855,046	1,654,684	715,566	638,278
2019	2,415,490	2,074,049	1,801,016	1,546,434	694,724	596,521
2020	2,345,136	1,938,364	1,748,559	1,445,265	674,489	557,497
2021	2,276,831	1,811,555	1,697,630	1,350,715	654,844	521,025
2022	2,210,515	1,693,042	1,648,185	1,262,351	635,771	486,939
2023	2,146,131	1,582,282	1,600,179	1,179,767	617,253	455,083
2024	2,083,623	1,478,768	1,553,572	1,102,586	599,275	425,311
2025	2,022,935	1,382,026	1,508,322	1,030,454	581,820	397,487
2026	1,964,014	1,291,613	1,464,391	963,041	564,874	371,484
2027	1,906,810	1,207,115	1,421,739	900,039	548,421	347,181
2028	1,851,272	1,128,145	1,380,329	841,158	532,448	324,468
2029	1,797,351	1,054,341	1,340,125	786,129	516,940	303,241



2030	1,745,001	985,366	1,301,092	734,700	501,883	283,403
2031	1,694,176	920,903	1,263,196	686,635	487,265	264,863
2032	1,644,831	860,657	1,226,404	641,715	473,073	247,535
2033	1,596,923	804,352	1,190,684	599,734	459,294	231,341
2034	1,550,411	751,731	1,156,004	560,499	445,917	216,207
2035	1,505,253	702,552	1,122,334	523,831	432,929	202,062
2036	1,461,411	656,591	1,089,644	489,561	420,319	188,843
2037	1,418,846	613,636	1,057,907	457,534	408,077	176,489
2038	1,377,520	573,492	1,027,094	427,602	396,191	164,943
2039	1,337,398	535,974	997,179	399,628	384,652	154,152
2040	1,298,445	500,910	968,135	373,484	373,448	144,068
Total 2015 Value	47,340,344	31,682,074	35,297,482	23,622,503	13,615,650	9,112,144

Worksheets for Table 3 in **BCAcalcs.xls: Table 3&4**

**Construction Impacts** – A review of construction plans indicated that the major disruption to traffic patterns is with the construction of the underpass for Mercer Street underneath SR 99 (Aurora Avenue). The construction phasing plans identify the need to operate Aurora Avenue with two-lanes in each direction for 15 months (as opposed to three lanes), and to operate Mercer Street with two lanes in the eastbound direction for 24 months (as opposed to four lanes). This adds additional travel time and associated fuel consumption during construction. Total construction-related costs related to delays and fuel consumption are summarized in Table 5.

	Mercer Construction			SR99 Construction			Mercer and SR99
	Travel Time Cost	Fuel Cost	Total	Travel Time Cost	Fuel Cost	Total	
2013	851,017	244,296	1,095,313	3,003,333	862,148	3,865,481	4,960,794
2014	851,017	244,296	1,095,313	750,833	215,537	966,370	2,061,683
Total	1,702,033	488,592	2,190,625	3,754,167	1,077,685	4,831,852	7,022,477

Worksheets for Table 5 in **BCAcalcs.xls: Table 5**



## Environmental Sustainability

The intersection analysis software also produces estimates of emissions and fuel consumption. These were used as inputs to the benefit calculations in livability and sustainability areas. Fuel consumption and emissions (CO<sub>2</sub>, NO<sub>x</sub>, and VOC) projections were estimated for Mercer Street in the study area resulting from anticipated delays if the project is not completed, and factored according to values from the BCA guidance.

**Fuel Reduction Assumptions** – The project Synchro model was used to quantify the fuel consumption reduction benefits. The level of fuel consumption for the project was compared to the level of consumption without the project. Retail gasoline prices for the State of Washington as published by the US Energy Information Administration, were used to calculate the monetary value of the fuel savings over the 25-year life of the project. The 25-year cost benefit for fuel reduction, discounted to year 2015 at 3% and 7%, is summarized in Table 6.

Table 6

2015 Net Benefit of Fuel Reduction. Mercer West Project Compared to:						
Year	No Build 1 one-way Mercer		No Build 1 (One-way Mercer) with Adjusted WB Volume		No-Build 2 Two-Way Underpass	
	3%	7%	3%	7%	3%	7%
2016	5,221,529	5,026,331	3,154,159	3,036,247	1,286,857	1,238,751
2017	5,069,445	4,697,506	3,062,290	2,837,614	1,249,376	1,157,711
2018	4,921,792	4,390,192	2,973,097	2,651,975	1,212,986	1,081,973
2019	4,778,438	4,102,984	2,886,502	2,478,482	1,177,657	1,011,189
2020	4,639,261	3,834,564	2,802,429	2,316,338	1,143,356	945,037
2021	4,504,137	3,583,705	2,720,805	2,164,802	1,110,054	883,212
2022	4,372,948	3,349,257	2,641,559	2,023,179	1,077,723	825,432
2023	4,245,581	3,130,147	2,564,620	1,890,822	1,046,333	771,432
2024	4,121,923	2,925,371	2,489,922	1,767,123	1,015,857	720,964
2025	4,001,867	2,733,991	2,417,400	1,651,517	986,269	673,798
2026	3,885,308	2,555,132	2,346,991	1,543,474	957,543	629,718
2027	3,772,143	2,387,974	2,278,632	1,442,499	929,653	588,521



2028	3,662,275	2,231,751	2,212,264	1,348,130	902,576	550,020
2029	3,555,607	2,085,749	2,147,829	1,259,934	876,287	514,037
2030	3,452,046	1,949,298	2,085,271	1,177,509	850,764	480,409
2031	3,351,501	1,821,774	2,024,535	1,100,475	825,985	448,980
2032	3,253,884	1,702,592	1,965,568	1,028,482	801,927	419,608
2033	3,159,111	1,591,208	1,908,318	961,198	778,570	392,157
2034	3,067,098	1,487,110	1,852,736	898,316	755,893	366,502
2035	2,977,765	1,389,823	1,798,773	839,547	733,877	342,525
2036	2,891,034	1,298,900	1,746,381	784,624	712,502	320,117
2037	2,806,829	1,213,925	1,695,516	733,293	691,749	299,174
2038	2,725,077	1,134,509	1,646,132	685,321	671,601	279,602
2039	2,645,706	1,060,289	1,598,186	640,487	652,040	261,311
2040	2,568,646	990,924	1,551,637	598,586	633,049	244,215
Total 2015 Value	93,650,948	62,675,004	56,571,552	37,859,972	23,080,484	15,446,394

Worksheets for Table 6 in **BCAcalcs.xls: Table 6**

**Emissions Assumptions** – The benefits from emissions reduction were determined as an output of the peak hour intersection analysis tool. Emission benefits were calculated by comparing the output of the intersection analysis tool at peak hours for the AM and PM commute periods, half of the benefit for the adjacent hours before and after the peak hours, and none for the remainder of the day.

The 25-year cost benefit for CO2 reduction, discounted to year 2015 at 3% and 7%, is summarized in Table 7. The 25-year cost benefit for NOX and VOC reduction, discounted to year 2015 at 3% and 7%, is summarized in Table 8.



Table 7

Year	2015 Net Benefit of CO2 Reduction. Mercer West Project Compared to:						
	SCC(\$)	No Build 1 one-way Mercer		No Build 1 (one-way Mercer) w/ Adjusted WB Volumes		No Build 2 Four-lane, Two-way Underpass	
		3%	7%	3%	7%	3%	7%
2015	23.80						
2016	24.30	297,793	286,661	179,950	173,223	73,254	70,515
2017	24.80	295,068	273,420	178,303	165,221	72,584	67,258
2018	25.30	292,250	260,684	176,600	157,526	71,890	64,126
2019	25.80	289,345	248,445	174,845	150,130	71,176	61,115
2020	26.30	286,362	236,691	173,042	143,027	70,442	58,224
2021	27.00	285,421	227,094	172,474	137,228	70,210	55,863
2022	27.60	283,266	216,954	171,171	131,101	69,680	53,368
2023	28.30	281,990	207,903	170,400	125,631	69,367	51,142
2024	28.90	279,581	198,422	168,945	119,902	68,774	48,810
2025	29.60	278,013	189,933	167,997	114,772	68,388	46,721
2026	30.20	275,387	181,105	166,410	109,438	67,742	44,550
2027	30.90	273,563	173,180	165,308	104,649	67,294	42,601
2028	31.50	270,752	164,993	163,610	99,702	66,602	40,587
2029	32.10	267,873	157,137	161,870	94,954	65,894	38,654
2030	32.80	265,742	150,059	160,582	90,677	65,370	36,913
2031	33.40	262,722	142,808	158,757	86,296	64,627	35,129
2032	34.10	260,416	136,262	157,363	82,340	64,059	33,519
2033	34.70	257,279	129,589	155,468	78,308	63,288	31,877



2034	35.40	254,825	123,554	153,985	74,661	62,684	30,393
2035	36.00	251,596	117,428	152,034	70,959	61,890	28,886
2036	36.70	249,017	111,880	150,476	67,607	61,256	27,521
2037	37.30	245,717	106,270	148,481	64,217	60,444	26,141
2038	37.90	242,398	100,915	146,476	60,981	59,627	24,824
2039	38.60	239,684	96,055	144,836	58,044	58,960	23,629
2040	39.20	236,320	91,167	142,803	55,090	58,132	22,426
Total 2015 Value		6,722,380	4,328,610	4,062,187	2,615,684	1,653,634	1,064,792

Worksheets for Table 7 in **BCAcalcs.xls: Table 7**

Table 8

2015 Value of NOX and VOC Reduction Benefits. Mercer West Project Compared to:						
Year	No Build 1 one-way Mercer		No Build 1 (one-way Mercer) w/ Adjusted WB Volumes		No Build 2 Four-lane, Two-way Underpass	
	3%	7%	3%	7%	3%	7%
2016	124,156	119,514	73,865	71,104	28,452	27,388
2017	120,539	111,695	71,714	66,452	27,623	25,596
2018	117,028	104,388	69,625	62,105	26,818	23,922
2019	113,620	97,559	67,597	58,042	26,037	22,357
2020	110,311	91,177	65,628	54,245	25,279	20,894
2021	107,098	85,212	63,717	50,696	24,543	19,527
2022	103,978	79,637	61,861	47,380	23,828	18,250
2023	100,950	74,427	60,059	44,280	23,134	17,056
2024	98,010	69,558	58,310	41,383	22,460	15,940



2025	95,155	65,008	56,612	38,676	21,806	14,897
2026	92,383	60,755	54,963	36,146	21,171	13,923
2027	89,693	56,780	53,362	33,781	20,554	13,012
2028	87,080	53,066	51,808	31,571	19,955	12,161
2029	84,544	49,594	50,299	29,506	19,374	11,365
2030	82,081	46,350	48,834	27,575	18,810	10,622
2031	79,691	43,317	47,411	25,771	18,262	9,927
2032	77,370	40,484	46,030	24,085	17,730	9,277
2033	75,116	37,835	44,690	22,510	17,214	8,670
2034	72,928	35,360	43,388	21,037	16,712	8,103
2035	70,804	33,047	42,124	19,661	16,226	7,573
2036	68,742	30,885	40,897	18,375	15,753	7,078
2037	66,740	28,864	39,706	17,173	15,294	6,615
2038	64,796	26,976	38,550	16,049	14,849	6,182
2039	62,909	25,211	37,427	14,999	14,416	5,777
2040	61,076	23,562	36,337	14,018	13,996	5,399
Total 2015 Value	2,226,796	1,490,262	1,324,815	886,620	510,295	341,510

Worksheets for Table 8 in **BCAcalcs.xls: Table 8**

**Safety Benefit Assumptions** – The benefits to safety were determined by comparing the types of collisions that occurred in the corridor over a three period with an estimate of how an improved roadway would operate with a significant reduction in the number of collisions. Additional reductions in collisions due to a reduction in vehicle miles traveled were also estimated. The total collision reduction, discounted to year 2015 at 3% and 7%, is summarized in Table 9.



Table 9

Year	2015 Value of Collision Reduction Benefits.	
	3%	7%
2016	926,337	891,708
2017	899,965	833,935
2018	874,343	779,905
2019	849,449	729,376
2020	825,265	682,120
2021	801,768	637,925
2022	778,940	596,593
2023	756,762	557,939
2024	735,215	521,789
2025	714,281	487,982
2026	693,943	456,364
2027	674,183	426,795
2028	654,986	399,142
2029	636,335	373,280
2030	618,215	349,093
2031	600,611	326,474
2032	583,508	305,320
2033	566,892	285,537
2034	550,748	267,035
2035	535,064	249,732



2036	519,826	233,550
2037	505,023	218,417
2038	490,640	204,264
2039	476,667	191,028
2040	463,092	178,650
Total 2015 Value	16,732,058	11,183,954

Worksheets for Table 9 in **BCAcalcs.xls**: **Table 9, Table 9.1, Table 9.2, Table 9.2a, Table 9.2b, Table 9.2c**

Additional savings were estimated for the utilization of LED street lights. These cost estimates assumed a fixed unit cost of electricity and compared the annual cost of high pressure sodium street lights with LED street lights in the project. Savings in replacement costs for the longer-lasting LED lights is also included in the cost savings, summarized in Table 10.

Table 10

Maintenance and Operations cost savings for LED Lights		
Year	3%	7%
2016	203,523	195,914
2017	197,595	183,098
2018	191,840	171,119
2019	186,252	159,925
2020	180,827	149,462
2021	175,560	139,684
2022	170,447	130,546
2023	165,483	122,006
2024	160,663	114,024
2025	155,983	106,564
2026		



	151,440	99,593
2027	147,029	93,078
2028	142,747	86,988
2029	138,589	81,298
2030	134,552	75,979
2031	130,633	71,008
2032	126,829	66,363
2033	123,135	62,021
2034	119,548	57,964
2035	116,066	54,172
2036	112,686	50,628
2037	109,403	47,316
2038	106,217	44,220
2039	103,123	41,328
2040	100,120	38,624
Total 2015 Value	3,650,290	2,442,922

Worksheets for Table 10 in **BCAcalcs.xls: Table 10**

**State of Good Repair:**

**Utility Reconstruction** – There are two utilities with remaining life cycle years that will be replaced with the Mercer West project; 21-inch cast iron combined sewer, and 20-inch cast iron water main. The benefit to replace the utilities with Mercer West project is estimated as the additional construction costs for utility installation after the roadway has been reconstructed and new utilities installed. These additional costs include roadway demolition, roadway restoration, maintenance of traffic, and anticipated utility conflicts. Other costs include shoring that would be needed for the 21-inch cast iron combined sewer that will be provided with the project. The cost estimates to replace the 20-inch water mains and 21-inch sewer are summarized Table 11. This estimate assumes the utilities would be replaced by 2015; no present value discount is added.

Table 11



### Cost to Replace Water and Sewer Utilities Independent of the Mercer West Project

Utility	Cost
20-inch watermains (2)	\$ 550,000
21-inch Sewer	\$ 170,000
Total	\$ 720,000

Worksheets for Table 11 in **BCAcalcs.xls: Table 11.1a, Table 11.1b, Table 11.2a, Table 11.2b**

### Roadway O & M

The existing Mercer Street roadway, constructed 60 years ago, has exceeded the City of Seattle’s 40 year design life for Portland Cement Concrete (PCC) roadways. Regular maintenance is necessary to prevent degradation of the roadway to a level where full reconstruction is required. Maintenance tasks include diamond grinding to reduce rutting, jacking to reduce vaulting and panel replacement to repair localized failures. The pavement maintenance benefits are estimated assuming a life-cycle of 20-years for new concrete pavement on Mercer Street. The pavement operations and maintenance benefit, discounted to year 2015 at 3% and 7%, is summarized in Table 12.

Table 12 – Roadway Operations and Maintenance

Calendar Year	Project Annual Benefits	Project Discounted Annual Benefits (2015 Present Value)	
		3%	7%
2016	\$ 15,400	\$ 14,951	\$ 14,393
2017	\$ 15,400	\$ 14,516	\$ 13,451
2018	\$ 15,400	\$ 14,093	\$ 12,571
2019	\$ 15,400	\$ 13,683	\$ 11,749
2020	\$ 15,400	\$ 13,284	\$ 10,980
2021	\$ 15,400	\$ 12,897	\$ 10,262
2022	\$ 15,400	\$ 12,522	\$ 9,590
2023	\$ 15,400	\$ 12,157	\$ 8,963
2024	\$ 15,400	\$ 11,803	\$ 8,377
2025	\$ 15,400	\$ 11,459	\$ 7,829
2026	\$ 15,400	\$ 11,125	\$ 7,316
2027	\$ 15,400	\$ 10,801	\$ 6,838
2028	\$ 15,400	\$ 10,487	\$ 6,390
2029	\$ 15,400	\$ 10,181	\$ 5,972
2030	\$ 15,400	\$ 9,885	\$ 5,582
2031	\$ 15,400	\$ 9,597	\$ 5,217
2032	\$ 15,400	\$ 9,317	\$ 4,875
2033	\$ 15,400	\$ 9,046	\$ 4,556



2034	\$ 15,400	\$ 8,782	\$ 4,258
2035	\$ 15,400	\$ 8,527	\$ 3,980
2036	\$ (10,200)	\$ (5,483)	\$ (2,463)
2037	\$ (10,200)	\$ (5,323)	\$ (2,302)
2038	\$ (10,200)	\$ (5,168)	\$ (2,152)
2039	\$ (10,200)	\$ (5,018)	\$ (2,011)
2040	\$ (10,200)	\$ (4,872)	\$ (1,879)
<b>Total</b>	<b>\$ 257,000</b>	<b>\$ 203,249</b>	<b>\$ 152,340</b>

Worksheets for Table 12 in **BCAcalcs.xls: Table 12, Table 12.1**

### SR-99 Bridge O & M

The existing SR-99 bridge over Mercer Street is in good condition, but is showing the initial signs of aging. Recent bi-annual inspections have identified minor maintenance repairs such as patching spalled concrete in localized areas. Such repairs are likely to persist with age. The SR 99 bridge operations and maintenance benefit, discounted to year 2015 at 3% and 7%, is summarized in Table 13.

Table 13  
Bridge Operations and Maintenance Benefits

Calendar Year	Project Annual Benefits	Project Discounted Annual Benefits (2015 Present Value)	
		3%	7%
2020	\$10,000	\$ 8,626	\$ 7,130
2025	\$12,939	\$ 9,628	\$ 6,578
2030	\$18,602	\$ 11,940	\$ 6,742
2035	\$22,465	\$ 12,438	\$ 5,805
2040	\$27,684	\$ 13,222	\$ 5,101
<b>Total</b>	<b>\$ 91,690</b>	<b>\$ 55,855</b>	<b>\$ 31,356</b>

Worksheets for Table 13 in **BCAcalcs.xls: Table 13, Table 13.1**



## 4. Summary of Project Benefits

### 2015 Value Saving - Build VS No-Build 1 (with One-Way Underpass and Adjusted Volume )

Savings	3%	7%
Travel Time Saving - Auto	\$256,001,894	\$171,326,829
Travel Time Saving - Truck	35,297,482	23,622,503
Fuel Consumption Saving	56,571,552	37,859,972
CO2 Emission Saving	4,062,187	2,615,684
NOX and VOC Saving	1,324,815	886,620
Accident Reduction (Mileage Reduction)	1,718,128	1,136,025
Accident Reduction (Better Road)	15,013,930	10,047,930
LED Street Lights Saving	3,650,290	2,442,922
Water and Sewer Utility O&M Savings	720,000	720,000
Roadway O&M Savings	203,249	152,340
Bridge O&M Savings	55,855	31,356
Cost during Construction	-7,022,477	-7,022,477
<b>Total Saving</b>	<b>\$367,596,905</b>	<b>\$243,819,703</b>

### 2015 Value Saving - Build VS No-Build 2 (with Four-lane, Two-Way Underpass )

Savings	3%	7%
Travel Time Saving - Auto	\$98,750,168	\$66,087,609
Travel Time Saving - Truck	13,615,650	9,112,144
Fuel Consumption Saving	23,080,484	15,446,394
CO2 Emission Saving	1,653,634	1,064,792
NOX and VOC Saving	510,295	341,510
Accident Reduction (Mileage Reduction)	1,718,128	1,136,025
Accident Reduction (Better Road)	15,013,930	10,047,930
LED Street Lights Saving	3,650,290	2,442,922
Water and Sewer Utility O&M Savings	720,000	720,000
Roadway O&M Savings	203,249	152,340
Bridge O&M Savings	55,855	31,356
Cost during Construction	-7,022,477	-7,022,477
<b>Total Saving</b>	<b>\$151,949,207</b>	<b>\$99,560,545</b>



## 5. Sources of Methods for Benefit Analysis

Key sources used for the benefit analysis methods are listed below. The sources are organized by benefit category.

### Livability Benefit Sources

*TIGER Benefit-Cost Analysis (BCA) Resource Guide*, U.S. Department of Transportation, [www.dot.gov/tiger/docs/tiger-12\\_bca-resourceGuide.pdf](http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf), Table 1, Value of Travel Time

*Highway Capacity Manual, Fifth Edition*, Transportation Research Board, 2010, Chapter 16: Signalized Intersections (Incorporated with Synchro intersection capacity software)

*Final Environmental Impact Statement, SR 99: Alaskan Way Viaduct Replacement Project*, July 2011, Transportation Discipline Report, Travel Demand Estimates and Forecasts, background data including traffic forecasts and vehicle/user classifications

### Sustainability Benefit Sources

*TIGER Benefit-Cost Analysis (BCA) Resource Guide*, U.S. Department of Transportation, [www.dot.gov/tiger/docs/tiger-12\\_bca-resourceGuide.pdf](http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf), Table 1, Value of Emissions, Social Cost of Carbon (3%)

*Highway Capacity Manual, Fifth Edition*, Transportation Research Board, 2010, Chapter 16: Signalized Intersections (Incorporated with Synchro intersection capacity software)

*Greenhouse Gas Equivalencies Calculator*, Environmental Protection Agency, May 2011, <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

*Petroleum and Other Liquids Report*, U.S. Energy Information Administration, Seattle 2011 Annual Average, gasoline prices, [http://www.eia.gov/dnav/pet/pet\\_pri\\_gnd\\_dcus\\_Y48SE\\_a.htm](http://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_Y48SE_a.htm)

*Average Energy Prices in the Seattle Area – January 2012*, Bureau of Labor Statistics, U.S. Department of Labor, Marcy 2, 2012, Electricity per kWh, [http://www.bls.gov/ro9/cpiseat\\_energy.pdf](http://www.bls.gov/ro9/cpiseat_energy.pdf)

### State of Good Repair Sources

Utility Reconstruction Cost References

- SDOT Standard Unit Costs - 2011
- RS Means – 2012

### Roadway O & M References

- City of Seattle – Pavement Condition Report – June 8th, 2004
- Mercer Corridor Pavement Life Cycle Cost Analysis – August 20, 2009



## **Safety Benefit Sources**

*TIGER Benefit-Cost Analysis (BCA) Resource Guide*, U.S. Department of Transportation, [www.dot.gov/tiger/docs/tiger-12\\_bca-resourceGuide.pdf](http://www.dot.gov/tiger/docs/tiger-12_bca-resourceGuide.pdf), Table 1, Value of Injuries

*Desktop Reference for Crash Reduction Factors*, Federal Highway Administration, September 2008

*Seattle Collision Reports*, Seattle Department of Transportation, 2007-2009.

*Treatment of the Economic Value of a Statistical Life in Departmental Analyses*, U.S. Department of Transportation, 2008 revised guidance and 2011 update, <http://ostpxweb.dot.gov/policy/reports.htm>