I-35 / I-69W International Freight Gateway

Benefit-Cost Analysis

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GLOSSARY OF TERMS

Benefit-Cost Analysis (BCA)
Benefit/Cost Ratio (B/C Ratio)
Carbon Dioxide (CO_2)
California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C)
Crash Records Information System (CRIS)
Nitrogen Oxides (NO_x)
Particulate Matters (PM)
Property Damage Only (PDO)
Texas Department of Transportation (TxDOT)
Texas Transportation Institute (TTI)
United States Department of Transportation (USDOT)
Vehicle Hours Travelled (VHT)
Vehicle Miles Travelled (VMT)
Volatile Organic Compounds (VOC)

1.0 COST-EFFECTIVENESS ANALYSIS

A Benefit-Cost Analysis (BCA) was prepared for the I-35/I-69W International Freight Gateway. Separate BCAs were conducted for each component of the project, including:

- The I-69W/Loop 20 overpass over I-35 and associated additional lanes on I-69W only (Overpass)
- Overpass with each of the five missing direct connectors linking I-69W/Loop 20 and I-35 evaluated individually
    - Northbound I-35 to eastbound Loop 20 (NB-EB)
    - Southbound I-35 to eastbound Loop 20 (SB-EB)
    - Eastbound I-69W to southbound I-35 (EB-SB)
    - Westbound Loop 20 to northbound I-35 (WB-NB)
    - Westbound Loop 20 to southbound I-35 (WB-SB)
- Overpass and all missing direct connectors (Full Interchange)

This document presents the inputs used and BCA results for each project component, along with composite results of the entire project.

1.1 Cal-B/C Model

The BCA was conducted using version 5.0 of the California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C)[1]. Cal-B/C is a spreadsheet-based model developed by the California Department of Transportation for life-cycle cost analysis of proposed highway projects in accordance with USDOT guidance. All monetary values are presented in 2016 dollars. A seven percent (7%) discount rate was used to compute the net present value (NPV) of benefits and costs.

Two versions of Cal-B/C are available, a Corridor model, and a TIGER model. The Corridor model is appropriate where detailed travel demand model or traffic simulation model forecasts are available. The Corridor version of Cal-B/C was utilized for this analysis because detailed traffic simulation model results were available from a recent study by the Texas Transportation Institute. Because the Corridor version does not evaluate safety benefits like the TIGER version, a supplemental analysis of crashes at the existing intersection of I-35 and Loop 20 was conducted and incorporated in the results. Also, unit values in the Corridor version were updated to reflect values in the TIGER version and USDOT guidance.

[1] Publicly available at http://www.dot.ca.gov/hq/tpp/offices/eab/LCBC_Analysis_Model.html.

Cal-B/C relies on project-specific inputs. These include construction duration, estimated project costs, and initial year and future year vehicle trips, vehicle-miles travelled (VMT), and vehicle hours travelled (VHT) for no-build and build conditions. With these inputs the model calculates life-cycle costs, life-cycle benefits, annual benefits, the NPV of costs and benefits, a resulting B/C ratio, and the internal rate of return and payback period. Additionally, other default parameters and assumptions within the model are customizable for a more accurate calculation. Chapter 2 discusses the inputs used and parameters modified for this analysis.

Cal-B/C evaluates benefits in the following four categories: travel time, vehicle operating costs, accidents, and emissions. Chapter 3 details the individual and composite BCA results.

Chapter 4 summarizes the BCA results and B/C ratio of the project and its individual components.

2.0 MODEL INPUTS AND PARAMETERS

2.1 Global Parameters

Cal-B/C includes a variety of default global parameters. These include various economic, emissions and crash rate assumptions. Many of these parameters were updated with local (Webb County) or statewide (Texas) statistics. Other parameters were adjusted to reflect USDOT TIGER BCA guidance. Default values were used unless stated below.

Table 2-1: Changes to Economic Parameters

GENERAL ECONOMIC		
Year of Current Dollars for Model	2016	
Real Discount Rate	7.0%	
VALUE OF TIME		
Automobile[A]	$11.25	/hr/person
Truck[B]	$17.57	/hr/vehicle
VEHICLE OPERATING COSTS		
Average Fuel Price		
Automobile (regular unleaded)[C]	$2.47	/gallon
Truck (diesel)[D]	$2.77	/gallon
Sales and Fuel Taxes		
State Sales Tax (gasoline)[E]	0.00%	
State Sales Tax (diesel)[E]	0.00%	
Average Local Sales Tax[E]	0.00%	
State Fuel Excise Tax (gasoline)[E]	$0.20	/gallon
State Fuel Excise Tax (diesel)[E]	$0.20	/gallon
ACCIDENT COSTS		
Cost of a Fatality[F]	$9,655,144	/ event
Cost of an Injury		
Level A (Severe)[G]	$4,780,042	/ event
Level B (Moderate)[H]	$605,319	/ event
Level C (Minor)[I]	$21,562	/ event
Cost of Property Damage[J]	$0.20	/ event

Notes:

A. U.S. Bureau of Labor Statistics. Occupational Employment Statistics for the State of Texas, May 2015. All occupations median wage x 50%. Accessed at http://www.bls.gov/oes/tables.htm. Escalated to 2016$ based on CPI.

B. U.S. Bureau of Labor Statistics. Occupational Employment Statistics for the State of Texas, May 2015. Average of Heavy and Tractor Trailer Truck Drivers and Light Truck and Delivery Service Drivers median wages. Accessed at http://www.bls.gov/oes/tables.htm. Escalated to 2016$ based on CPI.

C. U.S. Energy Information Administration. Short-Term Energy Outlook, September 2016. Real Annual Average Gasoline Price in current dollars as reported in 'Gasoline-A' worksheet of 'real_prices.xlsx', available at http://www.eia.gov/forecasts/steo/realprices/. Escalated to 2016$ based on CPI.

D. U.S. Energy Information Administration. Short-Term Energy Outlook, September 2016. Real Annual Average Diesel Price in current dollars as reported in 'Diesel-A' worksheet of 'real_prices.xlsx', available at http://www.eia.gov/forecasts/steo/realprices/. Escalated to 2016$ based on CPI.

E. State of Texas Comptroller. https://www.comptroller.texas.gov/taxes/fuels/.

F. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Statistical Life (VSL), page 2. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Escalated to 2016$ based on CPI.

G. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Injuries, page 3. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Composite of AIS 0 and AIS 1. Escalated to 2016$ based on CPI.
H. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Injuries, page 3. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Composite of AIS 2 and AIS 3. Escalated to 2016$ based on CPI.
I. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Injuries, page 3. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Composite of AIS 4 and AIS 5. Escalated to 2016$ based on CPI.
J. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Property Damage Only (PDO) Crashes, page 4. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Escalated to 2016$ based on CPI.

Table 2-2: Changes to Accident Parameters

STATEWIDE HIGHWAY ACCIDENT RATES		
Fatal Accident[K]	0.0047	/ M veh-mi
Injury Accident[K]	0.70	/ M veh-mi
PDO Accident[K]	1.40	/ M veh-mi
Non-Freeway[K]	3.03	/ M veh-mi
HIGHWAY INJURY SEVERITY FREQUENCY		
Severe Injury (A)[L]	1.48%	
Other Visible Injury (B)[L]	14.26%	
Complaint of Pain (C)[L]	84.27%	
FATALITIES		
per Fatal Accident[M]	1.23	/ fatal acdt
INJURIES		
per Fatal Accident[M]	0.00	/ fatal acdt
per Injury Accident[M]	1.66	/ injury acdt
DISTRIBUTION OF ACCIDENT TYPES		
Fatal Accident[M]	0.22%	
Injury Accident[M]	33.26%	
PDO Accident[M]	66.52%	

Notes:
K. Texas Department of Transportation. Crashes and Injuries by County. Webb County, 2015. http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2015/12.pdf and Statewide Traffic Crash Rates, 2015. http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2015/02.pdf.
L. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Statistical Life (VSL), page 2. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Escalated to 2016$ based on CPI. Combination of AIS probability rates (0 and 1, 2 and 3, 4 and 5).

M. Texas Department of Transportation. Crashes and Injuries by County. Webb County, 2015. http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2015/12.pdf.

Table 2-3: Changes to Emissions Parameters

HEALTH COST OF TRANSPORTATION EMISSIONS		
CO_{2e}[N]	$43	/ ton
NO_X[O]	$8,056	/ ton
PM[O]	$379,916	/ ton
SO_X[O]	$47,613	/ ton
VOC[O]	$2,044	/ ton

N. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Social Cost of Carbon, page 7. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf. Escalated to 2016$ based on CPI.

O. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Emissions, page 6. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf. Escalated to 2016$ based on CPI and converted $PM_{2.5}$ to PM_{10} using factor from U.S. Environmental Protection Agency.

2.2 Project-Specific Inputs

Cal-B/C requires project-specific information to calculate the B/C ratio and corresponding benefits. The project-specific information used to conduct the BCA is described below.

2.2.1 Length of Construction

Based on the project schedule, a length of construction period and time until construction begins (both in years) was assumed. These time periods are shown in Table 2-4.

Table 2-4: Length of Construction (Years)

	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB	Full Int.
Construction Period	2	2	2	2	2	2	4
Time to Const. Start	1	3	3	3	3	3	1

2.2.2 Project Costs

Total project costs for the project were provided by TxDOT. Costs were assigned to the I-69W/Loop 20 overpass and the additional lanes on I-69W, as well as the combined cost of all missing direct connectors. While the cost of each direct connector will be refined during the design process, total direct connector costs were allocated evenly between each individual direct connector for this analysis. Ten percent (10%) of project costs were

assumed for project support. The remaining 90% of costs were assumed for construction. No right-of-way costs are expected. Costs for each component were distributed evenly over the assumed construction period. Assumed project costs are shown in Table 2-5.

Table 2-5: Project Costs

	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB	Full Int.
Project Support	$4.5	$2.3	$2.3	$2.3	$2.3	$2.3	$16.0
Construction	$40.5	$20.7	$20.7	$20.7	$20.7	$20.7	$144.0
Total	**$45.0**	**$23.0**	**$23.0**	**$23.0**	**$23.0**	**$23.0**	**$160.0**

2016$, M

2.2.3 Traffic Volume Data

The Cal-B/C Corridor model relies on traffic model data for the build and no-build scenarios. The model requires number of trips, vehicle miles travelled (VMT), and vehicle hours travelled (VHT), both in year one and year 20. Base year traffic simulation model results were provided by the Texas Transportation Institute (TTI)[2]. Because the study did not specifically evaluate the additional lanes on I-69W, no benefits are calculated for these improvements.

A statewide forecasted increase in vehicle trips (1.51% per year from 2010 to 2040) developed by TxDOT[3] was then used to project growth in each parameter from year one to year 20. The I-69W/Loop 20 overpass and the Full Interchange were compared to the no-build traffic data. Because the direct connectors cannot be built without the I-69W/Loop 20 overpass, the no-build scenario for each direct connector was assumed to be the overpass build scenario without any direct connectors. Traffic simulation model data is shown in Table 2-6.

[2] *IH-35 and Loop 20 Direct Connector Analysis*. TTI. October 2016. Peak hour data was provided, then converted to annual data by multiplying by a TTI-provided K-Factor of 0.091 and an annualization factor of 365 days. VMT and VHT values were normalized to correct for minor differences in total trips entering and exiting the study area across traffic simulation scenarios.

[3] *Texas Transportation Plan 2040*. TxDOT. Exhibit 4-2. Accessed 11/14/2016 at http://ftp.dot.state.tx.us/pub/txdot-info/tpp/2040/plan/chapter-4.pdf.

Table 2-6: Traffic Simulation Model Data

	No Build	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB	Full Int.
Year 1								
Trips	96,763	96,763	96,763	96,763	96,763	96,763	96,763	96,763
VMT	113,429	113,451	113,407	112,035	113,842	110,495	113,262	108,320
VHT	7,023	6,504	6,359	5,622	3,837	5,812	5,120	2,900
Year 20								
Trips	128,759	128,759	128,759	128,759	128,759	128,759	128,759	128,759
VMT	150,936	150,966	150,907	149,081	151,486	147,032	150,714	144,138
VHT	9,346	8,654	8,461	7,482	5,106	7,734	6,814	3,860

Source: TTI

Average Vehicle Occupancy (AVO) was assumed to be 1.67 based on the most recent National Household Travel Survey[4]. The percentage of truck traffic was assumed to be 16% for all components. This is consistent with truck traffic levels assumed by TTI in developing their traffic volumes.

3.0 MODEL RESULTS

The Cal-B/C Corridor model evaluates benefits related to travel time, vehicle operating costs, and emissions costs. For each component, accident cost savings were calculated separately and added to the model results. The itemized benefits of each component of the Laredo Bundle over a 20-year lifecycle are shown in Table 3-1. The share of benefits for each component are shown in Figure 3-1 through Figure 3-7.

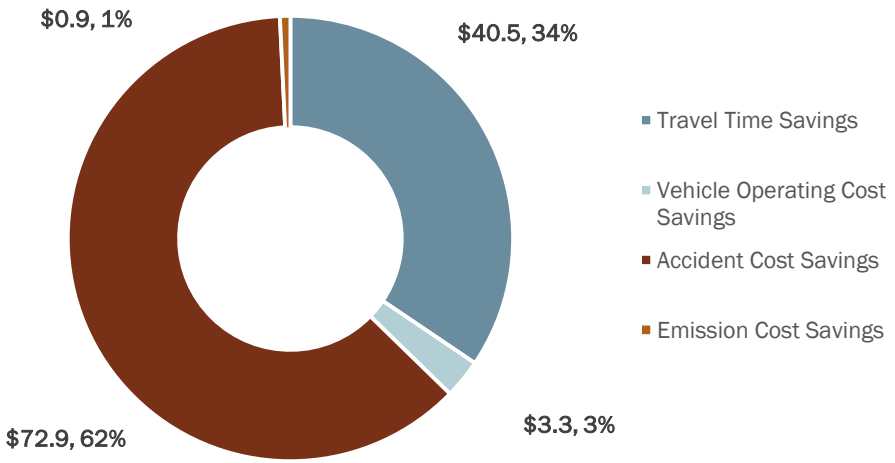
[4] Summary of Travel Trends - 2009 National Household Travel Survey. Available at http://nhts.ornl.gov/2009/pub/stt.pdf.

Table 3-1: Itemized Benefits (20 Year Total)

	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB	Full Int.
Travel Time Savings	$40.5	$9.9	$60.0	$181.6	$47.1	$94.2	$280.8
Vehicle Operating Cost Savings	$3.3	$0.1	$8.1	$23.2	$10.6	$12.9	$40.6
Accident Cost Savings	$72.9	$33.6	$12.1	$37.7	$11.7	$28.0	$186.9
Emission Cost Savings	$0.9	$0.0	$1.9	$6.5	$2.2	$3.6	$10.0
TOTAL	$117.7	$43.5	$82.2	$249.0	$71.7	$138.7	$518.3
Person-Hours of Time Saved (M)	7.4	2.1	12.5	37.9	9.8	19.7	58.6
CO_2 Emissions Saved (tons)	32,280	290	73,270	263,822	82,405	142,011	390,437
CO_2 Emissions Saved	$0.8	$0.0	$1.6	$5.7	$1.8	$3.1	$8.5

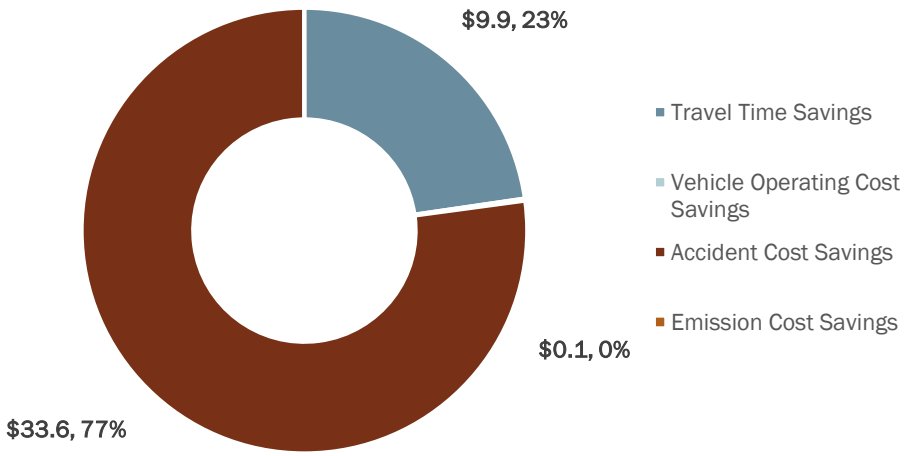
2016$, M

Figure 3-1: Benefits Share – Overpass



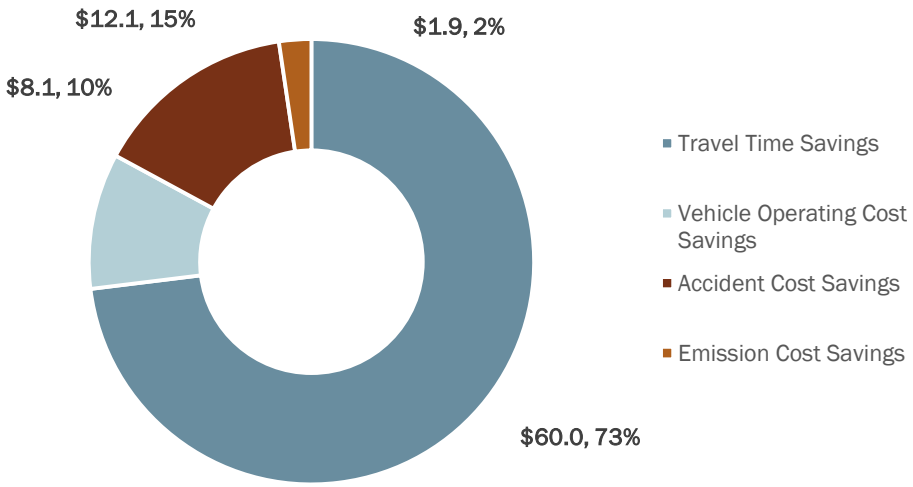
2016$, M

Figure 3-2: Benefits Share – NB-EB



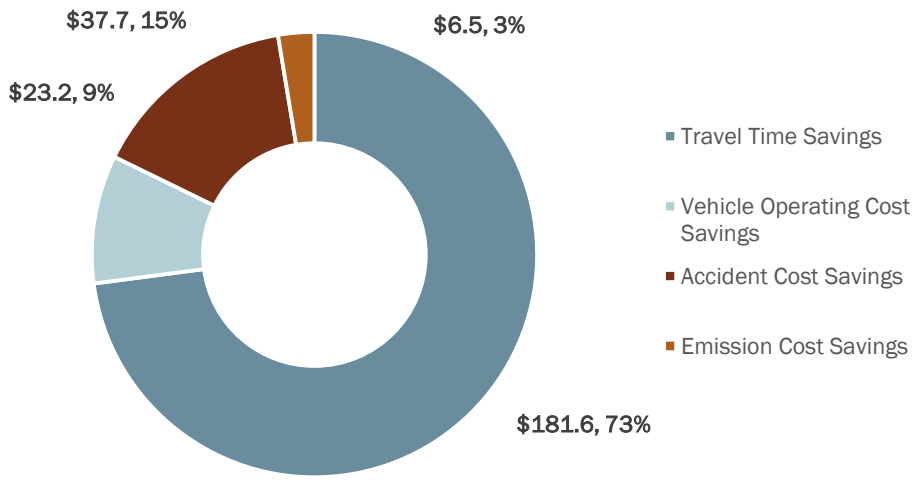
2016$, M

Figure 3-3: Benefits Share – SB-EB



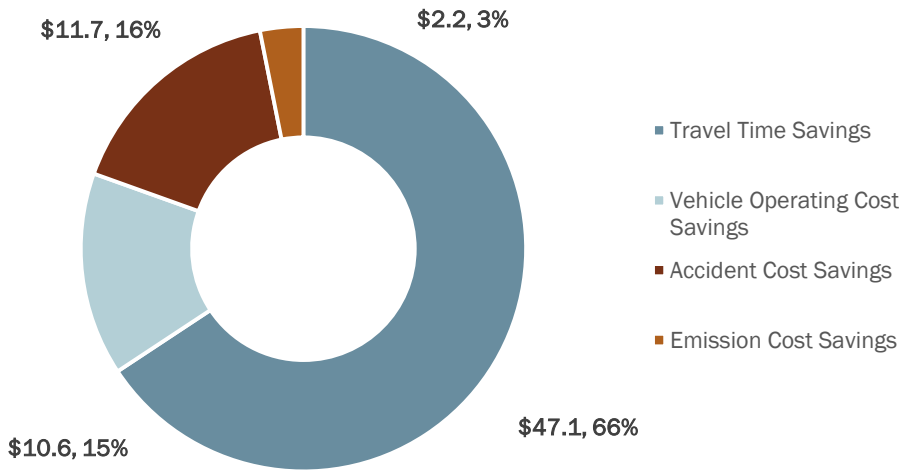
2016$, M

Figure 3-4: Benefits Share – EB-SB



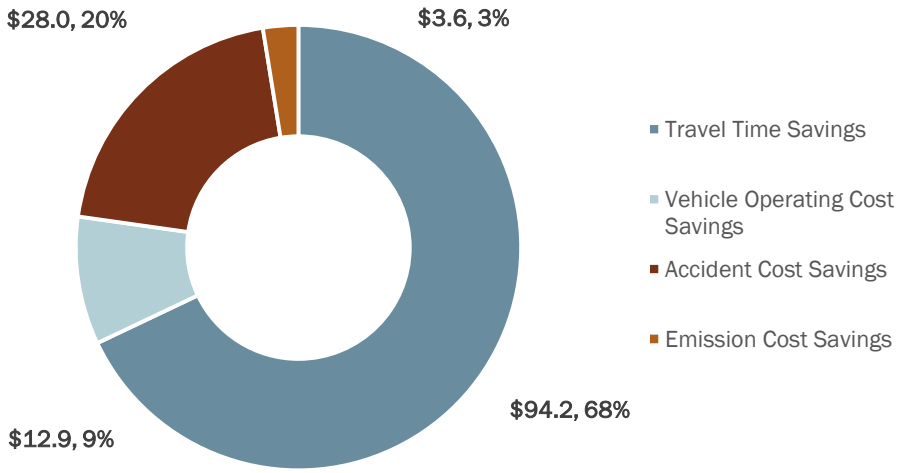
2016$, M

Figure 3-5: Benefits Share – WB-NB



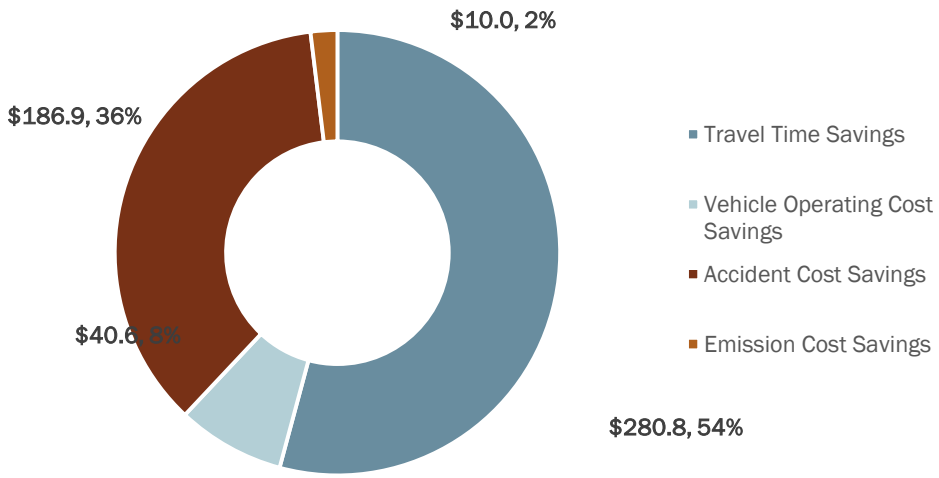
2016$, M

Figure 3-6: Benefits Share – WB-SB



2016$, M

Figure 3-7: Benefits Share – Full Interchange



2016$, M

3.1 Travel Time Savings

Cal-B/C evaluates travel time benefits with five formulas that calculate average annual volume, travel time, travel time savings, and induced travel. Average value of time varies by vehicle type. The model interpolates traffic volumes and travel speeds between the base

year and year 20 of the project. Refer to the formulas provided below for more information about each calculation.

Average Annual Volume = Average Daily Traffic x Number of Days in Model Year

Travel Time = Average Vehicle Occupancy x Average Annual Volume x Affected Length/ Speed

Travel Time Savings = Travel Time Reduction x Average Value of Time

Induced Travel = Change in Trips x Change in Travel Time x 0.5

3.2 Vehicle Operating Cost Savings

Cal-B/C determines vehicle operating cost savings by calculating VMT, fuel cost, and non-fuel costs. The model generates calculations for vehicles and trucks based on the assumed percent of trucks. Refer to the formulas provided below for more information about each calculation.

Vehicles Miles Traveled = Affected Length x Average Annual Volume

Fuel Cost = Vehicle Miles Traveled x Fuel Consumption x Fuel Price

Non - Fuel Cost = Vehicle Miles Traveled x Cost Per Mile

3.3 Accident Cost Savings

Because the Cal-B/C Corridor model does not calculate accident cost savings, these savings were calculated separately, then added to the other benefit outputs. Accident cost savings are based on historical crash data at the I-35/Loop 20 intersection which would be diverted to limited access components of the project in the future.

Historical crash data was provided by TxDOT's Crash Records Information System (CRIS). Accidents over a three-year period which occurred inside the intersection of I-35 and I-69W/Loop 20 (including main lines and frontage roads) were allocated to various project components. These allocations were based on the share of turning movement volume to all traffic moving through the intersection[5]. Turning movements that will be replaced by project components (I-35 northbound frontage road to Loop 20 eastbound which would be replaced by a northbound to eastbound direct connector, for example) were matched to their corresponding component. Accidents were then assigned to each project component by multiplying the total number of accidents through the intersection by each component's

[5] Based on 2018 AADT from TxDOT Transportation Planning and Programming (TPP) Division. Figure 1. AADT-Based Hourly Volumes for Current Network (2018). *IH-35 and Loop 20 Direct Connector Analysis*. TTI. October 2016.

corresponding share of total intersection movements. These three-year accident totals were divided by 3 years to calculate the average number of accidents over the past three years assigned to each project component. No accidents benefits associated with the additional lanes on I-69W are included in the analysis. Accidents assigned to each project component are shown in Table 3-2.

Table 3-2: Assigned Accidents per Laredo Bundle Component

	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB
Fatal Accidents	1	1	0	1	0	0
Injury Accidents	121	64	23	72	22	53
PDO[1] Accidents	237	125	45	140	44	104
Total Accidents	**359**	**189**	**68**	**213**	**66**	**158**

Note: PDO is Property Damage Only

After accident statistics were assigned to each project component, accident cost savings were then calculated. Table 3-3 shows how accident cost savings were calculated from total accidents per component. The annual accident cost savings for each project component are shown in Table 3-4. The net present value (7% discount rate) of accident cost savings for each project component are shown in Table 3-5.

Table 3-3: Accident Cost Savings Calculations

ASSIGNED ACCIDENTS PER PROJECT COMPONENT				
(a)	Fatal Accidents per Project Component		*varies*	
(b)	Injury Accidents per Project Component		*varies*	
(c)	PDO Accidents per Project Component		*varies*	
CRASH RATE REDUCTION DUE TO ROAD TYPE IMPROVEMENT				
(d)	4 or more lanes, undivided[A]		356.03	crashes/ 100M VMT
(e)	4 or more lanes, divided[A]		164.74	crashes/ 100M VMT
(f)	Reduction Factor =	*(e) / (d)*	46%	
EXPECTED CRASH REDUCTION DUE TO ROAD TYPE IMPROVEMENT				
(g)	Fatal Accidents =	*(a) x (f)*	*varies*	crashes/year
(h)	Injury Accidents =	*(b) x (f)*	*varies*	crashes/year
(i)	PDO Accidents =	*(c) x (f)*	*varies*	crashes/year
VALUE PER CRASH AVOIDED				
(j)	Fatal Accident[B]		$11,900,000	/crash
(k)	Injury Accident[B]		$300,200	/crash
(l)	PDO Accident[B]		$8,600	/crash
VALUE OF CRASHES AVOIDED				
(m)	Fatal Accident =	*(g) x (j)*	*varies*	
(n)	Injury Accident =	*(h) x (k)*	*varies*	
(o)	PDO Accident =	*(i) x (l)*	*varies*	

Notes:

A. Texas Department of Transportation. Statewide Crash Rates by Road Type, 2015. http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2015/02.pdf.

B. As derived from USDOT and TxDOT data:
   a. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Statistical Life (VSL), page 2. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Escalated to 2016$ based on CPI.
   b. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Injuries, page 3. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Composite of AIS 0 and AIS 1. Escalated to 2016$ based on CPI.
   c. U.S. Department of Transportation. TIGER Benefit-Cost Analysis (BCA) Resource Guide, March 1, 2016. Table 1 Recommended Monetized Values, Value of Property Damage Only (PDO) Crashes, page 4. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf. Escalated to 2016$ based on CPI.
   d. Texas Department of Transportation. Crashes and Injuries by County. Webb County, 2015. http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2015/12.pdf.

Table 3-4: Annual Accident Cost Savings for Cal-B/C Corridor Model Project Components (2016$ M)

	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB	Full Int.
Fatal Accidents	$2.0	$1.0	$0.4	$1.2	$0.4	$0.9	$5.7
Injury Accidents	$5.6	$3.0	$1.1	$3.3	$1.0	$2.5	$16.5
PDO Accidents	$0.3	$0.2	$0.1	$0.2	$0.1	$0.1	$0.9
Total Savings	**$7.9**	**$4.2**	**$1.5**	**$4.7**	**$1.5**	**$3.5**	**$23.1**

Table 3-5: Net Present Value of Lifecycle Accident Cost Savings for Cal-B/C Corridor Model Project Components (2016$ M)

Overpass	$72.9
NB-EB	$33.6
SB-EB	$12.1
EB-SB	$37.7
WB-NB	$11.7
WB-SB	$28.0

3.4 Emissions Cost Savings

Cal-B/C determines emissions cost savings by calculating VMT and highway emissions costs. Emissions costs are calculated by emissions type. Refer to the formulas provided below for more information about each calculation.

Vehicle Miles Traveled = Affected Length x Average Annual Volume

Highway Emissions Cost = VMT x Rate x CostMile

4.0 BENEFIT-COST ANALYSIS SUMMARY

A favorable benefit/cost (B/C) ratio above 1.0 means the 20-year life-cycle benefits of a project exceed the estimated project-related costs over the same period. This BCA indicates a favorable B/C ratio for all Laredo Bundle components. Table 4-1 summarizes the Cal-B/C results.

Table 4-1: Summary Results

	Overpass	NB-EB	SB-EB	EB-SB	WB-NB	WB-SB	Bundle
Life-Cycle Costs	$40.7	$18.2	$18.2	$18.2	$18.2	$18.2	$135.5
Life-Cycle Benefits	$117.7	$43.5	$82.2	$249.0	$71.7	$138.7	$518.3
Net Present Value	$77.0	$25.4	$64.0	$230.9	$53.5	$120.5	$382.8
Benefit/Cost Ratio	2.9	2.4	4.5	13.7	3.9	7.6	3.8
Rate of ROI	19%	12%	33%	82%	29%	51%	24%
Payback Period	4 years	5 years	3 years	1 year	3 years	2 years	3 years

Note: 2016$, M