I-37/US 77 Nueces River Project

Appendix A: Benefit-Cost Analysis

TIGER FY17 Grant Application

October 2017

I. COST-EFFECTIVENESS ANALYSIS

A Benefit-Cost Analysis (BCA) was conducted in conformance with US DOT guidance to assess the impacts of the I-37 / US 77 Nueces River project. The grant request is for construction costs. The BCA conducted for the project indicates 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 for the BCA.

The 2017 Cal-B/C TIGER and INFRA Grant Application (v 6.0) version of a model developed by the California Department of Transportation (Caltrans) was used for the BCA. This version incorporates project costs by category and benefits related to travel time, vehicle operation, accidents, and emissions. The model incorporated the parameter updates, including unit values for emissions, accidents, and other factors made by Caltrans to reflect USDOT guidance for 2017 TIGER and INFRA grants. Other parameters were revised to reflect Texas-specific values.

A summary of the BCA is provided in Section (i) of this appendix. Section (ii) and Section (iii) discuss the Cal-B/C inputs used for analysis of the project. Section (iv) provides details regarding the BCA results. All monetary values presented in this appendix are presented in 2016 dollars, the default value of the Cal-B/C model. A seven percent (7%) discount rate was used to compute the net present value of benefits and costs.

A. BENEFIT-COST ANALYSIS SUMMARY

Table 1 provides a project matrix highlighting how the project generates the benefits quantified in the BCA.

TABLE 1: PROJECT MATRIX

	Nueces River Bridge
Current Status / Baseline & Problem to be Addressed	The I-37/US 77 Nueces River project is located on I-37 between the I-37/I-69E and the I-37/US 77 interchanges near Corpus Christi, Texas. Merging and diverging of two major freeways (I-37 and I-69E, and I-37 and US 77) causes a lane balance issue resulting in safety and mobility concerns and the Nueces River bridges have a low chord at the river that varies from 14 to 15 feet. This elevation results in a potential for inundation during extreme flood and/or storm surge events.
Change to Baseline / Alternatives	Project would add northbound and southbound travel lanes (without additional right-of-way), replacing and elevating the northbound bridge.
Type of Impacts	Project increases highway capacity, addresses lane balance and weaving issues, and improves conditions during hurricane evacuations, emergency responsiveness, hazardous material containment during spills, and reduces potential for traffic crashes.
Affected Population	The Nueces and San Patricio counties had a population of 405,027 in 2010 decennial census. The region consists of 1,532 square miles with a population density of 264 residents per square mile. The AADT in the project area is forecast to increase from 48,477 in 2016 to 64,770 in 2040.
Economic Benefit	The Cal-B/C model indicates that the project will result in travel time, vehicle operation, accident reduction, and emission reduction benefits.
Summary of Results	B/C = 1.5, NPV = $31.7 million

The Cal-B/C model calculates the B/C ratio based on inputs including the type of project, existing and future highway design and traffic data, and estimated project costs. Table 2 provides a summary of the Cal-B/C results for the project.

Table 2. CAL-B/C Results

	7% Discount Rate
Life-Cycle Costs (mil. $)	$69.2
Life-Cycle Benefits (mil. $)	$100.8
Net Present Value (mil. $)	$31.7
Benefit / Cost Ratio:	1.5
Rate of Return on Investment:	11.0%
Payback Period:	7

B. CAL-B/C MODEL INPUTS

The Cal-B/C model includes a number of default parameters including hourly wage, value of time, fuel price and taxes, accident costs by type of accident, and a maximum volume-to-capacity ratio. Sources for these default values include the Office of Management and Budget (OMB), the Bureau of Labor Statistics (BLS), USDOT Department Guidance, the IDAS model, the American Transportation Research Institute, AAA, the California Department of Transportation, and the California Board of Equalization. Parameters were updated by Caltrans to support 2017 TIGER and INFRA applications. California-specific parameters were replaced with Texas-specific parameters, including statewide average hourly wage rate[1], truck driver hourly wage rate[2], state sales tax and fuel tax rates[3], and statewide highway crash rates[4]. The default values were used in this BCA unless otherwise stated.[5]

[1] U.S. Bureau of Labor Statistics. May 2016 State Occupational Employment and Wage Estimates, Texas, all occupations, available at https://www.bls.gov/oes/current/oes_tx.htm#00-0000

[2] U.S. Bureau of Labor Statistics. May 2016 State Occupational Employment and Wage Estimates, Texas, weighted average of Heavy and Tractor-Trailer Truck Drivers (53-3032) and Light Truck and Delivery Services Drivers (53-3033), available at https://www.bls.gov/oes/current/oes_tx.htm#00-0000

[3] Texas does not impose sales tax on motor fuels. See https://comptroller.texas.gov/taxes/fuels/

Users are also required to input project-specific data into the model. These inputs are discussed in the following subsections. The model identifies the required project-specific data inputs with green cells.

1. Project Data

The Cal-B/C model requires users to select the project type from a list. The project was identified as a General Highway project. Users must also select a project location that corresponds to California urban or rural peak traffic and accident parameters. The I-37 US 77 Nueces River Bridge project was identified as rural. The model allows users to override default settings that indicate whether other inputs reflect one-way or two-way data. Data for the project was entered as two-way data and coded in this section accordingly. The length of the construction period was identified as four years for the project. Table 3 provides the project data entered for the project.

Table 3. Cal-B/C Project Data

Type of Project		
Select project type from list	General Highway	
Project Location (enter 1 for So. Cal., 2 for No. Cal., or 3 for rural)	3	
Length of Construction Period	7	years
One- or Two-Way Data	2	enter 1 or 2
	Current	
Length of Peak Period(s) (up to 24 hrs)	3	hours

2. Highway Design and Traffic Data

The Cal-B/C model also requires project-specific information regarding highway design and traffic data. In the highway design section of the model, users must enter the roadway type, number of lanes, free-flow speed, ramp design speed, and the length of the highway segment. The model also requires average daily traffic (ADT) data. This information must be provided for the current (or "base") year, and also forecasted for year 20 under a "no build" scenario. The model then calculates the "build" scenario. Inputs for current ADT (2016) and truck percentage

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[4] TxDOT. Taxas Motor Vehicle Crash Statistics, 2016. Available at https://www.txdot.gov/government/enforcement/annual-summary.html

[5]California Department of Transportation. 2017. *2017 Cal-B/C TIGER and INFRA Grant Application Model (version 6.0).* Retrieved on 9/29/2017 from http://www.dot.ca.gov/hq/tpp/offices/eab/LCBC_Analysis_Model.html

were derived from TxDOT most recent traffic counts.[6] Forecasted ADT for 2040 was developed by TxDOT. The No Build speed was estimated based on posted speed limit signs.[7] The Cal-B/C model estimated Build and future speeds based on its built-in volume-delay function. Table 4 summarizes the project-specific data entered in the highway design and traffic data sections for the project.

Table 4. cal-B/C Highway and Traffic Data

Highway Design		No Build	Build
Roadway Type (Fwy, Exp, Conv Hwy)		F	F
Number of General Traffic Lanes		4	6
Number of HOV/HOT Lanes		0	0
HOV Restriction (2 or 3)			
Exclusive ROW for Buses (y/n)		N	
Highway Free-Flow Speed		75	75
Ramp Design Speed (if aux. lane/off-ramp proj.)		35	35
Length (in miles)	Highway Segment	4.2	4.2
	Impacted Length	4.2	4.2

Average Daily Traffic			
	Current	48,477	
		No Build	Build
	Base (Year 1)	53,412	53,412
	Forecast (Year 20)	66,807	66,807
Average Hourly HOV/HOT Lane Traffic		0	0
Percent of Induced Trips in HOV (if HOT or 2-to-3 conv.)			100%
Percent Traffic in Weave			0.0%
Percent Trucks (include RVs, if applicable)		16%	16%
Truck Speed		75	

3. Accident Data

In the last five years, 321 crashes, including 5 fatal crashes have been reported in the project area. Average annual crash counts were derived from 2012 through 2016 crash data pulled from

[6] TxDOT. 2016 Corpus Christi District Traffic Map., lower of two volumes reported in project area. Available at http://ftp.dot.state.tx.us/pub/txdot-info/tpp/traffic_counts/2016/crp-base.pdf

TxDOT's Texas Motor Vehicle Crash Statics reports for undivided and divided highways in rural areas.[8] Table 5 shows the Cal-B/C accident data inputs for the project.

The default fatality crash rate was adjusted in the Cal-B/C model to reflect the effect of the proposed I-37 improvements on evacuation during extreme weather events. Based on a direct hit storm frequency of once every 15 years as described in Section II of the TIGER application, and more than 230,000 evacuees on the coast who use I-37 to seek safety,[9] and death tolls per storm ranging from 82 (Hurricane Harvey 2017) to thousands (1,800 in Hurricane Katrina 2005, 6,000 to 12,000 in Galveston 1900), we assume that improved highway capacity and the assured availability of the I-37 evacuation route made possible by the elevated and expanded bridge would facilitate the prevention of at least 1 death of a coastal resident per year on average.

Table 5. Cal-B/C Highway Accident Data

Actual 3-Year Accident Data (from Table B)	Count (No.)	Rate
Total Accidents (Tot)	193	0.86
Fatal Accidents (Fat)	3	0.013
Injury Accidents (Inj)	64	0.29
Property Damage Only (PDO) Accidents	126	0.57

C. PROJECT COSTS

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

The initial design and construction costs for the project are approximately **$90 million**, including $16 million for project support, as described in more detail in Section III of the TIGER application. As illustrated in Section V.B or the TIGER application, the design period is assumed to be 2.5 years beginning in 2017 and running through early 2020, followed by a 3-year construction period ending by mid-2023. Annual design and construction expenditures were assumed to be allocated equally throughout the design and construction periods. Because the proposed facilities are a replacement for existing facilities, no incremental costs were assumed

[8] TxDOT. Texas Crash Records Information System, 2012-2016. Available at http://www.txdot.gov/government/enforcement/annual-summary.html

[9] Based on 405,027 population (as described in Section II of the TIGER application) multiplied by 57% who use I-37 to evacuate (as described in Section IV.A of the TIGER application).

for operations and maintenance. The total project cost is **$69.2 million** in present value terms. The breakdown of project costs as reflected in the Cal B/C analysis is indicated in Table 6.

Table 6. Cal-B/C Project Costs

Year	DIRECT PROJECT COSTS					Mitigation	Transit Agency Cost Savings	TOTAL COSTS (in dollars)	
	INITIAL COSTS			SUBSEQUENT COSTS					
	Project Support	R / W	Construction	Maint./ Op.	Rehab.			Constant Dollars	Present Value
Construction Period									
1	$1,600							$1,600,000	$1,600,000
2	6,400							6,400,000	5,981,308
3	6,400							6,400,000	5,590,008
4	1,600		12,333					13,933,333	11,373,750
5			24,667					24,666,667	18,818,082
6			24,667					24,666,667	17,586,992
7			12,333					12,333,333	8,218,221
8								0	0
Project Open									
1								$0	$0
2								0	0
3								0	0
4								0	0
5								0	0
6								0	0
7								0	0
8								0	0
9								0	0
10								0	0
11								0	0
12								0	0
13								0	0
14								0	0
15								0	0
16								0	0
17								0	0
18								0	0
19								0	0
20								0	0
Total	$16,000	$0	$74,000	$0	$0	$0	$0	$90,000,000	$69,168,362

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

D. CAL-B/C MODEL RESULTS

The Cal-B/C model evaluates benefits related to travel time savings, vehicle operating cost savings, accident reduction, and emissions reduction, as described below. The Cal-B/C model calculates negligible time savings, vehicle operating cost savings, and emissions benefits. The majority of benefits are in the form of accident cost savings due to improved weaving conditions on I-37 and reduced exposure to extreme weather events that require evacuation via I-37. The total monetized project benefits are **$100.8 million** in present value terms.

1. Travel Time Savings

The Cal-B/C model 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 Cal-B/C model interpolates traffic volumes and travel speeds between the base year and year 20 of the project. Refer to the formulas provided for more information about each calculation. Table 7 shows the total travel time benefit and the travel time benefit by year for the project.

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

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

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

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

Table 7. Cal-B/C Travel Time Savings Benefits

Year	AVERAGE VOLUME (vehicles/yr)		AVERAGE SPEED (mph)		ANNUAL PERSON-TRIPS (trips/yr)		AVERAGE TRAVEL TIME (hours)		TIME BENEFIT (person-hours/yr)		Constant Dollars	Present Value at 7%
	No Build	Build	No Build	Build	No Build	Build	No Build	Build	Existing Users	New (Induced)		
1	19,495,343	19,495,343	75.0	75.0	21,128,942	21,128,942	0.45	0.45	0	0	$0	$0
20	24,384,418	24,384,418	74.9	75.0	26,427,693	26,427,693	0.45	0.45	1,984	0	$31,858	$5,486
2	19,752,663	19,752,663	75.0	75.0	21,407,823	21,407,823	0.45	0.45	84	0	$1,351	$787
3	20,009,983	20,009,983	75.0	75.0	21,686,705	21,686,705	0.45	0.45	171	0	$2,739	$1,490
4	20,267,302	20,267,302	75.0	75.0	21,965,587	21,965,587	0.45	0.45	259	0	$4,162	$2,116
5	20,524,622	20,524,622	75.0	75.0	22,244,468	22,244,468	0.45	0.45	350	0	$5,622	$2,671
6	20,781,942	20,781,942	75.0	75.0	22,523,350	22,523,350	0.45	0.45	443	0	$7,117	$3,160
7	21,039,262	21,039,262	75.0	75.0	22,802,232	22,802,232	0.45	0.45	539	0	$8,649	$3,589
8	21,296,581	21,296,581	75.0	75.0	23,081,113	23,081,113	0.45	0.45	636	0	$10,216	$3,962
9	21,553,901	21,553,901	75.0	75.0	23,359,995	23,359,995	0.45	0.45	736	0	$11,820	$4,284
10	21,811,221	21,811,221	75.0	75.0	23,638,877	23,638,877	0.45	0.45	838	0	$13,460	$4,559
11	22,068,541	22,068,541	74.9	75.0	23,917,758	23,917,758	0.45	0.45	943	0	$15,137	$4,792
12	22,325,860	22,325,860	74.9	75.0	24,196,640	24,196,640	0.45	0.45	1,049	0	$16,849	$4,985
13	22,583,180	22,583,180	74.9	75.0	24,475,521	24,475,521	0.45	0.45	1,158	0	$18,598	$5,142
14	22,840,500	22,840,500	74.9	75.0	24,754,403	24,754,403	0.45	0.45	1,269	0	$20,383	$5,267
15	23,097,819	23,097,819	74.9	75.0	25,033,285	25,033,285	0.45	0.45	1,383	0	$22,205	$5,363
16	23,355,139	23,355,139	74.9	75.0	25,312,166	25,312,166	0.45	0.45	1,498	0	$24,062	$5,431
17	23,612,459	23,612,459	74.9	75.0	25,591,048	25,591,048	0.45	0.45	1,616	0	$25,957	$5,475
18	23,869,779	23,869,779	74.9	75.0	25,869,930	25,869,930	0.45	0.45	1,737	0	$27,887	$5,498
19	24,127,098	24,127,098	74.9	75.0	26,148,811	26,148,811	0.45	0.45	1,859	0	$29,855	$5,501
Total												**$79,558**

2. Vehicle Operating Cost Savings

The Cal-B/C model determines the vehicle operating costs benefit by calculating vehicle miles traveled, fuel cost, and non-fuel costs. The model generates calculations for vehicles and trucks based on a Percent Trucks input value. The Percent Trucks was entered as 16.2% based on values shown on the 2015 statewide traffic map.[10] Refer to the formulas for more information about each calculation. Table 8 provides the total vehicle operating cost benefit and the vehicle operating cost benefit by year for the project.

$$Vehicles\ Miles\ Traveled = Affected\ Length\ x\ Average\ Annual\ Volume$$

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

$$Non\text{-}Fuel\ Cost = Vehicle\ Miles\ Traveled\ x\ Cost\ Per\ Mile$$

[10] TxDOT. Truck percentage based on ratio of volumes in 2015 TxDOT Texas Truck Flowband Map and 2015 TxDOT Texas Traffic Flowband Map. Available at https://www.txdot.gov/inside-txdot/division/transportation-planning/maps/statewide-2015.html

Table 8. CAL-B/C Vehicle Operating Cost Savings Benefits

Year	AVERAGE VOLUME (vehicles/yr)		AVERAGE SPEED (mph)		TOTAL VMT (veh-miles/yr)		BENEFITS ($/yr)		Constant Dollars	Present Value at 7%
	No Build	Build	No Build	Build	No Build	Build	Fuel Costs	Non-Fuel Costs		
1	19,495,343	19,495,343	75.0	75.0	81,880,441	81,880,441	$0	$0	$0	$0
20	24,384,418	24,384,418	74.9	75.0	102,414,556	102,414,556	$0	$0	$0	$0
2	19,752,663	19,752,663	75.0	75.0	82,961,184	82,961,184	$0	$0	$0	$0
3	20,009,983	20,009,983	75.0	75.0	84,041,927	84,041,927	$0	$0	$0	$0
4	20,267,302	20,267,302	75.0	75.0	85,122,670	85,122,670	$0	$0	$0	$0
5	20,524,622	20,524,622	75.0	75.0	86,203,413	86,203,413	$0	$0	$0	$0
6	20,781,942	20,781,942	75.0	75.0	87,284,156	87,284,156	$0	$0	$0	$0
7	21,039,262	21,039,262	75.0	75.0	88,364,899	88,364,899	$0	$0	$0	$0
8	21,296,581	21,296,581	75.0	75.0	89,445,641	89,445,641	$0	$0	$0	$0
9	21,553,901	21,553,901	75.0	75.0	90,526,384	90,526,384	$0	$0	$0	$0
10	21,811,221	21,811,221	75.0	75.0	91,607,127	91,607,127	$0	$0	$0	$0
11	22,068,541	22,068,541	74.9	75.0	92,687,870	92,687,870	$0	$0	$0	$0
12	22,325,860	22,325,860	74.9	75.0	93,768,613	93,768,613	$0	$0	$0	$0
13	22,583,180	22,583,180	74.9	75.0	94,849,356	94,849,356	$0	$0	$0	$0
14	22,840,500	22,840,500	74.9	75.0	95,930,099	95,930,099	$0	$0	$0	$0
15	23,097,819	23,097,819	74.9	75.0	97,010,842	97,010,842	$0	$0	$0	$0
16	23,355,139	23,355,139	74.9	75.0	98,091,585	98,091,585	$0	$0	$0	$0
17	23,612,459	23,612,459	74.9	75.0	99,172,327	99,172,327	$0	$0	$0	$0
18	23,869,779	23,869,779	74.9	75.0	100,253,070	100,253,070	$0	$0	$0	$0
19	24,127,098	24,127,098	74.9	75.0	101,333,813	101,333,813	$0	$0	$0	$0
Total										**$0**

3. Accident Reduction

The model evaluates the accident cost benefits by calculating vehicle-miles traveled and highway accident costs. Highway accident costs are calculated by accident type. Refer to the formulas provided for more information about each calculation. Table 9 shows the total accident cost savings benefit and the accident cost savings benefit by year for the project.

$$Vehicle\ Miles\ Traveled = Affected\ Length\ x\ Average\ Volume$$

$$Highway\ Accident\ Costs = Vehicle\ Miles\ Traveled\ x\ Rate\ x\ Cost/Mile$$

Table 9. Cal-B/C Accident Reduction Benefits

Year	AVERAGE VOLUME (vehicles/yr)		TOTAL VMT (veh-miles/yr)		ACCIDENT COSTS ($/yr)		Constant Dollars	Present Value at 7%
	No Build	Build	No Build	Build	No Build	Build		
1	19,495,343	19,495,343	81,880,441	81,880,441	$25,974,850	$12,960,848	$13,014,003	$8,104,467
20	24,384,418	24,384,418	102,414,556	102,414,556	$32,488,867	$16,211,191	$16,277,676	$2,802,943
2	19,752,663	19,752,663	82,961,184	82,961,184	$26,317,693	$13,131,918	$13,185,775	$7,674,241
3	20,009,983	20,009,983	84,041,927	84,041,927	$26,660,536	$13,302,989	$13,357,547	$7,265,621
4	20,267,302	20,267,302	85,122,670	85,122,670	$27,003,379	$13,474,060	$13,529,320	$6,877,620
5	20,524,622	20,524,622	86,203,413	86,203,413	$27,346,222	$13,645,130	$13,701,092	$6,509,290
6	20,781,942	20,781,942	87,284,156	87,284,156	$27,689,065	$13,816,201	$13,872,864	$6,159,718
7	21,039,262	21,039,262	88,364,899	88,364,899	$28,031,908	$13,987,272	$14,044,637	$5,828,025
8	21,296,581	21,296,581	89,445,641	89,445,641	$28,374,751	$14,158,343	$14,216,409	$5,513,368
9	21,553,901	21,553,901	90,526,384	90,526,384	$28,717,594	$14,329,413	$14,388,181	$5,214,939
10	21,811,221	21,811,221	91,607,127	91,607,127	$29,060,437	$14,500,484	$14,559,953	$4,931,960
11	22,068,541	22,068,541	92,687,870	92,687,870	$29,403,280	$14,671,555	$14,731,726	$4,663,687
12	22,325,860	22,325,860	93,768,613	93,768,613	$29,746,123	$14,842,625	$14,903,498	$4,409,407
13	22,583,180	22,583,180	94,849,356	94,849,356	$30,088,966	$15,013,696	$15,075,270	$4,168,438
14	22,840,500	22,840,500	95,930,099	95,930,099	$30,431,809	$15,184,767	$15,247,043	$3,940,126
15	23,097,819	23,097,819	97,010,842	97,010,842	$30,774,652	$15,355,837	$15,418,815	$3,723,846
16	23,355,139	23,355,139	98,091,585	98,091,585	$31,117,495	$15,526,908	$15,590,587	$3,519,001
17	23,612,459	23,612,459	99,172,327	99,172,327	$31,460,338	$15,697,979	$15,762,359	$3,325,021
18	23,869,779	23,869,779	100,253,070	100,253,070	$31,803,181	$15,869,049	$15,934,132	$3,141,360
19	24,127,098	24,127,098	101,333,813	101,333,813	$32,146,024	$16,040,120	$16,105,904	$2,967,500
Total								**$100,740,576**

4. Emissions Reduction

The Cal-B/C model determines an emissions reduction benefit by calculating vehicles-miles traveled and highway emissions costs. Emissions costs are calculated by emissions type. Refer to the formulas for more information about each calculation. Table 10 provides the total emissions benefit and the emissions benefit by year for the project.

$$Vehicle\ Miles\ Traveled = Affected\ Length\ x\ Average\ Annual\ Volume$$

$$Highway\ Emissions\ Cost = (VMT\ x\ Rate\ x\ Cost/Mile)$$

Table 10. Cal-B/C Emissions Reduction Benefits

Year	AVERAGE VOLUME (vehicles/yr)		AVERAGE SPEED (mph)		TOTAL VMT (veh-miles/yr)		RUNNING EMISSIONS ($/yr)		STARTING EMISSIONS ($/yr)		Constant Dollars	Present Value at 7%
	No Build	Build	No Build	Build	No Build	Build	No Build	Build	No Build	Build		
1	19,495,343	19,495,343	75.0	75.0	81,880,441	81,880,441	$1,032,670	$1,032,670	$18,724	$18,724	$0	$0
20	24,384,418	24,384,418	74.9	75.0	102,414,556	102,414,556	$843,823	$843,823	$13,988	$13,988	$0	$0
2	19,752,663	19,752,663	75.0	75.0	82,961,184	82,961,184	$1,061,652	$1,061,652	$19,075	$19,075	$0	$0
3	20,009,983	20,009,983	75.0	75.0	84,041,927	84,041,927	$1,091,499	$1,091,499	$19,432	$19,432	$0	$0
4	20,267,302	20,267,302	75.0	75.0	85,122,670	85,122,670	$1,122,246	$1,122,246	$19,794	$19,794	$0	$0
5	20,524,622	20,524,622	75.0	75.0	86,203,413	86,203,413	$1,153,924	$1,153,924	$20,164	$20,164	$0	$0
6	20,781,942	20,781,942	75.0	75.0	87,284,156	87,284,156	$1,186,569	$1,186,569	$20,539	$20,539	$0	$0
7	21,039,262	21,039,262	75.0	75.0	88,364,899	88,364,899	$1,220,216	$1,220,216	$20,922	$20,922	$0	$0
8	21,296,581	21,296,581	75.0	75.0	89,445,641	89,445,641	$546,593	$546,593	$10,988	$10,988	$0	$0
9	21,553,901	21,553,901	75.0	75.0	90,526,384	90,526,384	$566,774	$566,774	$11,209	$11,209	$0	$0
10	21,811,221	21,811,221	75.0	75.0	91,607,127	91,607,127	$587,691	$587,691	$11,434	$11,434	$0	$0
11	22,068,541	22,068,541	74.9	75.0	92,687,870	92,687,870	$609,371	$609,371	$11,664	$11,664	$0	$0
12	22,325,860	22,325,860	74.9	75.0	93,768,613	93,768,613	$631,843	$631,843	$11,899	$11,899	$0	$0
13	22,583,180	22,583,180	74.9	75.0	94,849,356	94,849,356	$655,135	$655,135	$12,139	$12,139	$0	$0
14	22,840,500	22,840,500	74.9	75.0	95,930,099	95,930,099	$679,278	$679,278	$12,385	$12,385	$0	$0
15	23,097,819	23,097,819	74.9	75.0	97,010,842	97,010,842	$704,303	$704,303	$12,637	$12,637	$0	$0
16	23,355,139	23,355,139	74.9	75.0	98,091,585	98,091,585	$730,241	$730,241	$12,895	$12,895	$0	$0
17	23,612,459	23,612,459	74.9	75.0	99,172,327	99,172,327	$757,128	$757,128	$13,158	$13,158	$0	$0
18	23,869,779	23,869,779	74.9	75.0	100,253,070	100,253,070	$784,996	$784,996	$13,428	$13,428	$0	$0
19	24,127,098	24,127,098	74.9	75.0	101,333,813	101,333,813	$813,882	$813,882	$13,705	$13,705	$0	$0
Total												$0

5. Summary of Benefits and Costs

Table 11 and Table 12 summarizes the discounted benefits and costs for the project.

Table 11. Summary of Discounted Project Costs

Year	Project Year	Undiscounted						Discounted
		Project Support	ROW	Construct	O&M	Rehab.	Total Costs	PV Costs
2017	Design	$1,600,000	$0	$0			$0	$1,600,000
2018	Design	$6,400,000	$0	$0			$0	$5,981,308
2019	Design	$6,400,000	$0	$0			$0	$5,590,008
2020	Design/Const	$1,600,000	$0	$12,333,333			$0	$11,373,750
2021	Const	$0	$0	$24,666,667			$0	$18,818,082
2022	Const	$0	$0	$24,666,667			$0	$17,586,992
2023	Const	$0	$0	$12,333,333			$0	$8,218,221
2024	1				$0	$0	$0	$0
2025	2				$0	$0	$0	$0
2026	3				$0	$0	$0	$0
2027	4				$0	$0	$0	$0
2028	5				$0	$0	$0	$0
2029	6				$0	$0	$0	$0
2030	7				$0	$0	$0	$0
2031	8				$0	$0	$0	$0
2032	9				$0	$0	$0	$0
2033	10				$0	$0	$0	$0
2034	11				$0	$0	$0	$0
2035	12				$0	$0	$0	$0
2036	13				$0	$0	$0	$0
2037	14				$0	$0	$0	$0
2038	15				$0	$0	$0	$0
2039	16				$0	$0	$0	$0
2040	17				$0	$0	$0	$0
2041	18				$0	$0	$0	$0
2042	19				$0	$0	$0	$0
2043	20				$0	$0	$0	$0
Total (2016$)		**$16,000,000**	**$0**	**$74,000,000**	**$0**	**$0**	**$0**	**$69,168,362**

Table 12. Summary of Discounted Project Benefits

Year	Project Year	Undiscounted					Discounted
		Travel Time Savings	Vehicle Operating Cost Savings	Accident Reduction Savings	Emissions Reduction Savings	Total Benefits	PV Benefits
2017	Design						
2018	Design						
2019	Design						
2020	Des/Con						
2021	Const						
2022	Const						
2023	Const						
2024	1	$0	$0	$13,014,003	$0	$13,014,003	$8,104,467
2025	2	$1,351	$0	$13,185,775	$0	$13,187,126	$7,675,028
2026	3	$2,739	$0	$13,357,547	$0	$13,360,286	$7,267,110
2027	4	$4,162	$0	$13,529,320	$0	$13,533,482	$6,879,736
2028	5	$5,622	$0	$13,701,092	$0	$13,706,714	$6,511,961
2029	6	$7,117	$0	$13,872,864	$0	$13,879,981	$6,162,878
2030	7	$8,649	$0	$14,044,637	$0	$14,053,285	$5,831,614
2031	8	$10,216	$0	$14,216,409	$0	$14,226,625	$5,517,331
2032	9	$11,820	$0	$14,388,181	$0	$14,400,001	$5,219,223
2033	10	$13,460	$0	$14,559,953	$0	$14,573,414	$4,936,519
2034	11	$15,137	$0	$14,731,726	$0	$14,746,862	$4,668,479
2035	12	$16,849	$0	$14,903,498	$0	$14,920,347	$4,414,392
2036	13	$18,598	$0	$15,075,270	$0	$15,093,868	$4,173,580
2037	14	$20,383	$0	$15,247,043	$0	$15,267,426	$3,945,393
2038	15	$22,205	$0	$15,418,815	$0	$15,441,019	$3,729,208
2039	16	$24,062	$0	$15,590,587	$0	$15,614,650	$3,524,432
2040	17	$25,957	$0	$15,762,359	$0	$15,788,316	$3,330,496
Total (2016$)		**$297,927**	**$0**	**$292,916,792**	**$0**	**$293,214,719**	**$100,815,435**