

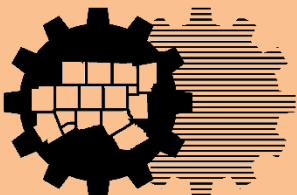
Appendix A

Benefit Cost

S. M. Wright Project – Phase II-B

Benefit Cost Appendix

April 2014



**North Central Texas
Council of Governments**

Transportation Department

Table of Contents

I. Methodology	1
a. Project Cost	1
b. Short Term Jobs	1
c. Maintenance Savings (State of Good Repair).....	1
d. Developable Land (Economic Competitiveness)	2
e. Improved Access (Economic Competitiveness)	2
f. Geometric Crash Reduction Benefit (Safety)	3
g. Regional Crash Reduction Benefit (Safety)	4
II. Analysis	5
a. Project Cost and Short Term Jobs	5
b. Maintenance Benefit	6
c. Economic Competitiveness.....	7
d. Geometric Crash Reduction.....	8
e. Regional Crash Reduction	10
III. Summary	12

I. Methodology

The following description provides the methodology for various sections within the Benefit Cost Analysis (BCA), including detailed calculations of benefits and costs of the S.M. Wright Phase II-B project for the years between 2014 and 2039, for each cost and benefit factor. Benefits are assumed to incur after project completion in 2018 for a 20-year life span of the projects to 2039.

Traffic forecasts were conducted for current conditions (2013) and for build and no-build conditions in 2019 and 2035 using the NCTCOG DFX Regional Travel Demand Model. This version of the travel demand model and the no-build transportation networks were used for *Mobility 2035 – 2013 Update: The Metropolitan Transportation Plan for North Central Texas*. The only modification made in running the two build alternatives was the addition of the S.M. Wright Phase II-B project to the transportation network.

a. Project Cost

Proposed construction costs were obtained from the Texas Department of Transportation. Annual construction costs were estimated based on the proposed construction schedule for S.M. Wright Phase II-B. The project schedule is shown in section III.c of the S.M. Wright Phase II-B FY2014 TIGER Discretionary Grant Application.

b. Short Term Jobs

Per BCA Guidance, the proposed transportation investment per quarter was divided by \$76,900 to calculate the short-term job-years and short-term jobs generated by quarter. These results were used to calculate the number of direct construction jobs created by funding the S.M. Wright Phase II-B project. No job creation benefit was included in the overall benefits of the project.

c. Maintenance Savings (State of Good Repair)

Reduced annual maintenance costs are a direct benefit of the S.M. Wright Phase II-B project. The overall paved footprint of transportation infrastructure in the project area would be reduced. The reduction in total paved area will reduce the annual cost of maintaining the transportation infrastructure. The total paved area under the no build condition was calculated based on aerial orthophotography from 2013. The paved area in the build condition was calculated from the preliminary schematic for Alternative A.

It was assumed that the annual maintenance cost for areas paved in concrete is \$10,000 per lane-mile. This figure was converted into an annual cost of \$6,875 per acre by assuming 12 foot lanes. The difference in the paved area was then multiplied by the annual cost to calculate the benefit from reduced maintenance costs.

Equation for Annual Maintenance Benefit:

$$\begin{aligned} & \text{Annual Maintenance Benefit} \\ & = (\text{Paved Footprint}_{\text{No Build}} - \text{Paved Footprint}_{\text{Build}}) \times \frac{\$6,875}{\text{acre}} \end{aligned}$$

d. Developable Land (Economic Competitiveness)

Much of the right-of-way currently dedicated to access ramps connecting S.M. Wright Freeway to IH 45 and the local thoroughfare network would be returned to other uses. The City of Dallas and TxDOT currently own this right-of-way. After the S.M. Wright Project – Phase II-B is implemented, the stock of developable land in the project area will be increased by approximately 7.5 acres. To quantify this benefit the land value for the newly developable area was assumed to be similar to the land value of existing commercial/industrial parcels near the project. Based on current 2014 parcel data from the Dallas County Appraisal District (<http://www.dallascad.org/>), there were 242 commercial and/or industrial properties within the project study area. The total area of these parcels was 168.768 acres. The assessed land value (which excludes the value of buildings and other improvements) was \$23,487,090. Therefore, the average value of this type of developable land in the project area is \$139,167.68/acre. This dollar amount was multiplied by 7.5 acres to calculate the one-time benefit of the increase in developable land.

Equation for Developable Land Benefit:

$$\begin{aligned} & \text{Developable Land Benefit (One Time)} \\ & = \text{Area of Newly Developable Land} \times \frac{\$139,167.68}{\text{acre}} \end{aligned}$$

e. Improved Access (Economic Competitiveness)

Economic development benefits from the project also stem from increased access to jobs and customers for the residents and businesses in the project area. Travel model forecasts show that approximately 3.5 percent more jobs are within a 15-minute drive of the intersection of S.M. Wright Parkway and MLK Jr. Boulevard after the project is implemented. This effect was present in both the 2019 and 2035 travel demand forecasts. The increased access is expected to increase the value of the residential and commercial land in the project area by a similar percentage. The benefit from improved access was calculated by multiplying \$45,831,190 (the total land value of the 1,787 parcels within the project study area) by 3.5 percent.

Equation for Improved Access Benefit:

$$\begin{aligned} & \text{Improved Access Benefit (One Time)} \\ & = \text{Land Value of Parcels within 0.5 mile of the Project Area} \times 3.5\% \end{aligned}$$

f. Geometric Crash Reduction Benefit (Safety)

The construction of the S.M. Wright Project – Phase II-B will reduce crashes in the project area through improvements to the configuration of the transportation system. This improved safety comes from several sources: reducing speeds and traffic levels on S.M. Wright Parkway; calming traffic on local roads by simplifying access and reducing the speed on the major thoroughfare; and adding auxiliary lanes and shifting traffic to IH 45.

Crash data between 2009 and 2013 from the Texas Department of Transportation was used in the analysis. Annual crash frequencies were developed for S.M. Wright Freeway (including the access ramps), IH 45, and for a combination of other local thoroughfares. These crash frequencies and regional travel model current year facility volume estimates were used to develop crash rates for each of the three facilities.

Three crash modification factors (CMF) were applied to the daily travel volumes in the build alternatives. The speed reduction on S.M. Wright Parkway compared to the existing access ramps will be in the 15 to 20 miles per hour range. The Crash Modification Factor Clearinghouse (<http://www.cmfclearinghouse.org/>) lists CMF ID 1240, “Lower posted speed by 15-20 mph” that was applied to the daily vehicle miles traveled on S.M. Wright Parkway in the project area. The addition of auxiliary lanes between ramps on IH 45 will increase safety for drivers on IH 45. The Crash Modification Factor Clearinghouse lists CMF ID 3898, “Provide an auxiliary lane between an entrance ramp and exit ramp” that was applied to the daily vehicle miles traveled on IH 45 in the project area. The reconfigured interactions between the local streets, IH 45 frontage roads and S.M. Wright Parkway will calm traffic on connecting facilities. The Crash Modification Factor Clearinghouse lists CMF ID 588, “Area-wide or corridor-specific traffic calming” that was applied to the daily vehicle miles traveled on local thoroughfares in the project area.

A composite expected crash rate for the project area was developed for four conditions: 2019 no build, 2019 build, 2035 no build, and 2035 build. The project area crash rate accounted for safety improvements based on shifts in the volumes traveling on each facility and the geometric improvements included in the project. The difference in expected crashes between the build condition and the no build condition is the direct safety benefit of the project. These reductions in crashes were then monetized based on the guidance in the TIGER BCA Resource Guide.

Equation for Annual Geometric Crash Reduction Benefit:

$$\begin{aligned}
 & \text{Annual Geometric Crash Reduction Benefit} \\
 & = (\text{Expected Crash Rate}_{\text{Build}} - \text{Expected Crash Rate}_{\text{No Build}})_{\text{KABCO Type}} \\
 & \times \text{KABCO to AIS Conversion} \times \text{Monetized Value}_{\text{By AIS Type}}
 \end{aligned}$$

g. Regional Crash Reduction Benefit (Safety)

The removal of direct access ramps between S.M. Wright Parkway and IH 45 and addition of access ramps and auxiliary lanes to IH 45 will encourage more vehicles to use IH 45. This redistribution of traffic helps to improve regional transportation safety because limited access facilities are relatively safer than local thoroughfares and other secondary streets. This benefit is calculated by comparing the proportion of system-wide VMT on each functional classification of roadway under the build and no build conditions.

The Iowa Department of Transportation published crash rates per HMVMT for vehicles traveling on limited access facilities based on data from 2001-2009 (http://www.iowadot.gov/crashanalysis/pdfs/crash_rate-density_comparables_segments_2001-2009_20100706_dividedroadmainline.pdf). A similar publication listed crash rates per HMVMT on secondary roadways based on data from 2002-2011 (http://www.iowadot.gov/crashanalysis/pdfs/crash_rate-density_comparables_segments_2002-2011_20130215_secondary_functionalclass.pdf). TxDOT and NCTCOG do not have similar data, so the Iowa data was used to calculate the safety benefits to transportation system users in the Dallas-Fort Worth users.

To ensure that this estimate is conservative and freeways, freeway ramps, and managed or HOV lanes were assumed to generate crashes at the same rate as “Urban Expressways” in Iowa. Freeway service (or frontage) roads were assumed to be comparable to principal arterials. Other Dallas-Fort Worth roadways were directly comparable to the Iowa classification system. This methodology is based on the assumption that the differential in crash rates between roads of each functional classifications is similar regardless of the absolute crash rate of a state or region.

Equation for Annual Regional Crash Reduction Benefit:

$$\begin{aligned}
 & \text{Annual Regional Crash Reduction Benefit} \\
 & = (\text{Daily VMT}_{\text{By Roadway Class}} (\text{Build Network}) \\
 & \quad - \text{Daily VMT}_{\text{By Roadway Class}} (\text{No Build Network})) \times 365 \text{ days} \\
 & \quad \times \text{Iowa Crash Rate}_{\text{By Roadway Class}} \times \text{KABCO to AIS Conversion} \\
 & \quad \times \text{Monetized Value}_{\text{By AIS Type}}
 \end{aligned}$$

NOTE:

A static version of the Microsoft Excel spreadsheets used to calculate the costs and benefits are included below. A copy of the Microsoft Excel file is also included in the S.M. Wright Project – Phase II-B FY2014 Grant Application submittal.

Project Cost

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]
Constant Source						{1}	
						\$ 76,900	
Equation						[D] / {1}	[G] x 4
				Total Project Spending		Short Term Jobs	
		Engineering/ ROW/Utilities Spending	Construction Spending	By Quarter	By Year	Construction JOB-YEARS BY QUARTER	Construction JOBS BY QUARTER
Year	Quarter						
2014	Q1			\$ -			
2014	Q2			\$ -			
2014	Q3			\$ -			
2014	Q4			\$ -		0.0	0
2015	Q1			\$ -		0.0	0
2015	Q2			\$ -		0.0	0
2015	Q3			\$ -		0.0	0
2015	Q4			\$ -		0.0	0
2016	Q1			\$ -		0.0	0
2016	Q2			\$ -		0.0	0
2016	Q3		\$ 1,368,421	\$ 1,368,421	\$ 4,105,263	17.8	71
2016	Q4		\$ 2,736,842	\$ 2,736,842		35.6	142
2017	Q1		\$ 4,105,263	\$ 4,105,263		53.4	214
2017	Q2		\$ 4,105,263	\$ 4,105,263	\$ 16,421,053	53.4	214
2017	Q3		\$ 4,105,263	\$ 4,105,263		53.4	214
2017	Q4		\$ 4,105,263	\$ 4,105,263		53.4	214
2018	Q1		\$ 4,105,263	\$ 4,105,263		53.4	214
2018	Q2		\$ 1,368,421	\$ 1,368,421	\$ 5,473,684	17.8	71
2018	Q3			\$ -		0.0	0
2018	Q4			\$ -		0.0	0
2019	Q1			\$ -		0.0	0
2019	Q2			\$ -		0.0	0
2019	Q3			\$ -		0.0	0
2019	Q4			\$ -		0.0	0
Total		\$ -	\$ 26,000,000	\$ 26,000,000	\$ 26,000,000		

Sources: {1} Conversion Factor: 1 job-year per \$76,900 in spending (See TIGER BCA Resource Guide - Updated 5/3/13)

Maintenance Benefit

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]
Constant Source	{1}	{2}		{3}			
				\$ 6,875			
Equation			[B] - [C]	[D] x {3}	[E] / (1.07^[H])	[E] / (1.03^[H])	
Year	No Build Transportation Facility Footprint (Paved Acres)	Build Transportation Facility Footprint (Paved Acres)	Transportation Facility Footprint Reduction (Paved Acres)	Annual Maintenance Cost Reduction Benefit	7% NPV Maintenance Cost Reduction Benefits	3% NPV Maintenance Cost Reduction Benefits	Year
2014	65			\$ -	\$ -	\$ -	1
2015	65			\$ -	\$ -	\$ -	2
2016	65			\$ -	\$ -	\$ -	3
2017	65			\$ -	\$ -	\$ -	4
2018	65			\$ -	\$ -	\$ -	5
2019	65	63	2	\$ 13,750	\$ 9,162	\$ 11,515	6
2020	65	63	2	\$ 13,750	\$ 8,563	\$ 11,180	7
2021	65	63	2	\$ 13,750	\$ 8,003	\$ 10,854	8
2022	65	63	2	\$ 13,750	\$ 7,479	\$ 10,538	9
2023	65	63	2	\$ 13,750	\$ 6,990	\$ 10,231	10
2024	65	63	2	\$ 13,750	\$ 6,533	\$ 9,933	11
2025	65	63	2	\$ 13,750	\$ 6,105	\$ 9,644	12
2026	65	63	2	\$ 13,750	\$ 5,706	\$ 9,363	13
2027	65	63	2	\$ 13,750	\$ 5,332	\$ 9,090	14
2028	65	63	2	\$ 13,750	\$ 4,984	\$ 8,826	15
2029	65	63	2	\$ 13,750	\$ 4,658	\$ 8,569	16
2030	65	63	2	\$ 13,750	\$ 4,353	\$ 8,319	17
2031	65	63	2	\$ 13,750	\$ 4,068	\$ 8,077	18
2032	65	63	2	\$ 13,750	\$ 3,802	\$ 7,841	19
2033	65	63	2	\$ 13,750	\$ 3,553	\$ 7,613	20
2034	65	63	2	\$ 13,750	\$ 3,321	\$ 7,391	21
2035	65	63	2	\$ 13,750	\$ 3,104	\$ 7,176	22
2036	65	63	2	\$ 13,750	\$ 2,901	\$ 6,967	23
2037	65	63	2	\$ 13,750	\$ 2,711	\$ 6,764	24
2038	65	63	2	\$ 13,750	\$ 2,533	\$ 6,567	25
2039	65	63	2	\$ 13,750	\$ 2,368	\$ 6,376	26
20-Year Project Life Present through 2039					\$ 106,227	\$ 182,836	

Sources: {1} Surface area covered by publicly owned transportation infrastructure based on aerial survey.
 {2} Surface area covered by publicly owned transportation infrastructure based on project schematics (Alternative A).
 {3} \$10,000 annual cost to maintain one lane-mile of concrete pavement

Economic Competitiveness

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]
Column Source	{1}		{3}					
Constant Source		{2}		{4}				
		\$ 139,167.68		3.50%				
Equation	[B] x {2}		[C] x {4}	[C] + [E]	[F] / (1.07^[I])	[F] / (1.03^[I])		
	Developable Land		Improved Access	TOTAL				Year
	Land	Benefit of an	Current	Benefit of	Annual	7% NPV	3% NPV	
	Transitioned	Increase in	Assessed	Improved	Economic	Fuel Savings	Fuel Savings	
	to Non-	the Stock of	Value of the	Access to	Development	Benefits	Benefits	
	Transportatio	Developable	Land in the	Dallas CBD	Benefit			
	n Uses (acres)	Land	Project Study	and other				
			Area	Employment				
				Centers				
2014					\$ -	\$ -	\$ -	0
2015					\$ -	\$ -	\$ -	1
2016					\$ -	\$ -	\$ -	2
2017					\$ -	\$ -	\$ -	3
2018					\$ -	\$ -	\$ -	4
2019	7.5	\$ 1,043,758	\$ 45,831,190	\$ 1,604,092	\$ 2,647,849	\$ 1,887,880	\$ 2,284,058	5
2020					\$ -	\$ -	\$ -	6
2021					\$ -	\$ -	\$ -	7
2022					\$ -	\$ -	\$ -	8
2023					\$ -	\$ -	\$ -	9
2024					\$ -	\$ -	\$ -	10
2025					\$ -	\$ -	\$ -	11
2026					\$ -	\$ -	\$ -	12
2027					\$ -	\$ -	\$ -	13
2028					\$ -	\$ -	\$ -	14
2029					\$ -	\$ -	\$ -	15
2030					\$ -	\$ -	\$ -	16
2031					\$ -	\$ -	\$ -	17
2032					\$ -	\$ -	\$ -	18
2033					\$ -	\$ -	\$ -	19
2034					\$ -	\$ -	\$ -	20
2035					\$ -	\$ -	\$ -	21
2036					\$ -	\$ -	\$ -	22
2037					\$ -	\$ -	\$ -	23
2038					\$ -	\$ -	\$ -	24
2039					\$ -	\$ -	\$ -	25
20-Year Project Present through 2039					\$ 1,887,880	\$ 2,284,058		

Sources: {1} Difference between the right-of-way needed for the No Build Condition and the right-of-way required for SM Wright Phase II-B Alternative A.

{2} Dallas County Appraisal District, 2013. There were 242 Commercial/Industrial properties within the project study area. The total area of these parcels was 168.768 acres. The assessed land value (which excludes the value of buildings and other improvements) was \$23,487,090 (2013\$). The average value of commercial/industrial sites in the project area is \$139,167.68/acre.

{3} Dallas County Appraisal District, 2013. There were 1,787 properties within the project study area. The total area of these parcels was 471.204 acres. The assessed land value (which excludes the value of buildings and other improvements) was \$45,831,190 (2013\$).

{4} Percent increase in the number of jobs within 15 minutes of the intersection of SM Wright Parkway and MLK Jr. Blvd in the Build condition compared to the No Build condition

Geometric Crash Reduction Data

Crashes on IH 45						
	# Not Injured	# of Possible Injury Crashes	# of Non-Incapacitating Injury Crashes	# of Incapacitating Injury Crashes	# Fatality Crashes	# Unknown Injury Crashes
Total Crashes (2009-2011)	84	35	11	4	4	1
Crashes Per Year	16.80000	7.00000	2.20000	0.80000	0.80000	0.80000
Daily VMT (2013)	64,394	Total VMT (2013) 23,593,810				
No Build Crashes per HM	71.47777	29.78241	9.35018	3.40370	3.40370	3.40370
Calculated CRF	Provide an auxiliary lane between an entrance ramp and exit ramp. (CMF ID: 3898) 0.8 80%					
Build Crashes per HMVM	57.18222	23.82592	7.48815	2.72296	2.72296	2.72296

<http://www.cmfclearinghouse.org/detail.cfm?facid=3898>

IH 45 Traffic Scenarios								
Scenario	Daily VMT on IH 45	Annual VMT on IH 45	Expected # Not Injured	Expected # of Possible Injury Crashes	Expected # of Non-Incapacitating Injury Crashes	Expected # of Incapacitating Injury Crashes	Expected # Fatality Crashes	Expected # Unknown Injury Crashes
2019 No Build	150427.9671	54906208	39.24573	16.35239	5.13932	1.86884	1.86884	1.86884
2019 Build	156478.7195	57114732.63	32.65947	13.60811	4.27694	1.55521	1.55521	1.55521
2035 No Build	147121.8588	53699478.45	38.38319	15.99300	5.02637	1.82777	1.82777	1.82777
2035 Build	153678.768	56092750.34	32.07508	13.36462	4.20031	1.52738	1.52738	1.52738

Crashes on SM Wright						
	# Not Injured	# of Possible Injury Crashes	# of Non-Incapacitating Injury Crashes	# of Incapacitating Injury Crashes	# Fatality Crashes	# Unknown Injury Crashes
Total Crashes (2009-2011)	24	12	7	2	2	0
Crashes Per Year	4.80000	2.40000	1.40000	0.40000	0.40000	0.00000
Daily VMT (2013)	63,553	Total VMT (2013) 23,196,845				
No Build Crashes per HM	20.69247	10.34623	6.03530	1.72437	1.72437	0.00000
Calculated CRF	Lower posted speed by 15-20 mph (CMF ID: 1240) 0.94 94%					
Build Crashes per HMVM	19.45092	9.72546	5.67319	1.62091	1.62091	0.00000

<http://www.cmfclearinghouse.org/detail.cfm?facid=1240>

SM Wright Traffic Scenarios								
Scenario	Daily VMT on SM Wright	Annual VMT on SM Wright	Expected # Not Injured	Expected # of Possible Injury Crashes	Expected # of Non-Incapacitating Injury Crashes	Expected # of Incapacitating Injury Crashes	Expected # Fatality Crashes	Expected # Unknown Injury Crashes
2019 No Build	11795.36535	4305308.354	0.89087	0.44544	0.25984	0.07424	0.07424	0.00000
2019 Build	5566.126904	2031636.32	0.39517	0.19759	0.11526	0.03293	0.03293	0.00000
2035 No Build	12965.99498	4732588.166	0.97929	0.48964	0.28563	0.08161	0.08161	0.00000
2035 Build	5326.074093	1944017.044	0.37813	0.18906	0.11029	0.03151	0.03151	0.00000

Crashes on City Streets						
	# Not Injured	# of Possible Injury Crashes	# of Non-Incapacitating Injury Crashes	# of Incapacitating Injury Crashes	# Fatality Crashes	# Unknown Injury Crashes
Total Crashes (2009-2011)	90	48	29	7	3	8
Crashes Per Year	18.00000	9.60000	5.80000	1.40000	0.60000	1.60000
Daily VMT (2013)	84,145	Total VMT (2013) 30,712,917				
No Build Crashes per HM	58.60726	31.25721	18.88456	4.55834	1.95358	5.20953
Calculated CRF	Area-wide or corridor-specific traffic calming. (CMF ID: 588) 0.94 94%					
Build Crashes per HMVM	55.09083	29.38177	17.75149	4.28484	1.95358	4.89696

<http://www.cmfclearinghouse.org/detail.cfm?facid=588>

City Street Traffic Scenarios								
Scenario	Daily VMT on City Streets	Annual VMT on City Streets	Expected # Not Injured	Expected # of Possible Injury Crashes	Expected # of Non-Incapacitating Injury Crashes	Expected # of Incapacitating Injury Crashes	Expected # Fatality Crashes	Expected # Unknown Injury Crashes
2019 No Build	13670.34195	4989674.812	2.92431	1.55963	0.94228	0.22745	0.09748	0.25994
2019 Build	15301.08583	5584896.327	3.07677	1.64094	0.99140	0.23930	0.10911	0.27349
2035 No Build	14819.33008	5409055.481	3.17010	1.69072	1.02148	0.24656	0.10567	0.28179
2035 Build	16967.31108	6193068.543	3.41181	1.81963	1.09936	0.26536	0.12099	0.30327

Project Area Expected Crash Rates						
Scenario	Expected # Not Injured	Expected # of Possible Injury Crashes	Expected # of Non-Incapacitating Injury Crashes	Expected # of Incapacitating Injury Crashes	Expected # Fatality Crashes	Expected # Unknown Injury Crashes
2019 No Build	43.06092	18.35746	6.34144	2.17053	2.04056	2.12878
2019 Build	36.13141	15.44664	5.38350	1.82745	1.69725	1.82870
2019 Crash Reduction	-6.92951	-2.91082	-0.95794	-0.34308	-0.34331	-0.30008
2035 No Build	42.53258	18.17336	6.33347	2.15594	2.01505	2.10956
2035 Build	35.86502	15.37331	5.40996	1.82426	1.67988	1.83066
2035 Crash Reduction	-6.66756	-2.80005	-0.92352	-0.33168	-0.33517	-0.27890

Year 2019 Crash Reduction												
KABCO Type →	KABCO Accident Classification System											
	O No Injury		C Possible Injury		B Non-Incapacitating		A Incapacitating		K Killed		U Injured Severity Unknown	
	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400
3	-6.92951	0.00008	-2.91082	0.01071	-0.95794	0.03191	-0.34308	0.14437	-0.34331	0.00000	-0.30008	0.03858
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000

Source: National Highway Traffic Safety Administration, July 2011.

Year 2035 Crash Reduction												
KABCO Type →	KABCO Accident Classification System											
	O No Injury		C Possible Injury		B Non-Incapacitating		A Incapacitating		K Killed		U Injured Severity Unknown	
	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400
3	-6.66756	0.00008	-2.80005	0.01071	-0.92352	0.03191	-0.33168	0.14437	-0.33517	0.00000	-0.27890	0.03858
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000

Source: National Highway Traffic Safety Administration, July 2011.

Notes for All Crash Data:

- This data consist of all locatable crashes that include latitude and longitude information
- This data consist of all crash types that occurred within 100 feet of the area bounded by Ervay Street, Pennsylvania Avenue, Atlanta Street, and Coombs Street. This area is the project area of the S.M. Wright Project – Phase II-B.
- This data is composed of TxDOT "Reportable Crashes" only
 - A "Reportable Motor Vehicle Traffic Crash" is defined by TxDOT as: any crash involving motor vehicle in transport that occurs or originates on a traffic way, results in injury to or death of any person, or damage to the property of any one person to the apparent extent of \$1,000
 - A trafficway is defined as any land way open to the public as a matter of right or custom for moving persons or property from one place to another
- Source: TxDOT's Crash Records Information System (CRIS) - 2013 January Extract - all TxDOT disclaimers apply to this information
Link: <http://www.txdot.gov/government/enforcement/crash-statistics.html>

Geometric Crash Reduction

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]	[N]	[O]	[P]	[Q]	[R]	[S]
Column Source	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{3}	{4}	{5}	{6}	{7}	{8}	{9}				
Constant Source								\$ 3,878	\$ 27,600	\$ 432,400	\$ 966,000	\$ 2,447,200	\$ 5,455,600	\$ 9,200,000				
Equation	ANNUAL REDUCTION IN CRASHES (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)							SUM([I:O])	[P] / (1.07^[S])	[P] / (1.03^[S])	Year
YEAR	0	1	2	3	4	5	Fatal	0	1	2	3	4	5	Fatal	Total Crash Reduction Benefit	7% NPV Maintenance Cost Reduction	3% NPV Maintenance Cost Reduction	
2014															\$ -			0
2015															\$ -			1
2016															\$ -			2
2017															\$ -			3
2018															\$ -			4
2019	-7.25075	-3.62435	-0.40709	-0.12341	-0.02507	-0.01077	-0.34331	\$ 28,116	\$ 100,032	\$ 176,026	\$ 119,214	\$ 61,351	\$ 58,757	\$ 3,158,452	\$ 3,701,948	\$ 2,639,437	\$ 3,193,332	5
2020	-7.23349	-3.61551	-0.40609	-0.12311	-0.02501	-0.01074	-0.34280	\$ 28,049	\$ 99,788	\$ 175,595	\$ 118,926	\$ 61,212	\$ 58,593	\$ 3,153,772	\$ 3,695,935	\$ 2,462,757	\$ 3,095,287	6
2021	-7.21623	-3.60667	-0.40510	-0.12281	-0.02496	-0.01071	-0.34229	\$ 27,982	\$ 99,544	\$ 175,164	\$ 118,638	\$ 61,073	\$ 58,429	\$ 3,149,091	\$ 3,689,921	\$ 2,297,898	\$ 3,000,244	7
2022	-7.19896	-3.59783	-0.40410	-0.12252	-0.02490	-0.01068	-0.34178	\$ 27,915	\$ 99,300	\$ 174,733	\$ 118,350	\$ 60,934	\$ 58,266	\$ 3,144,411	\$ 3,683,908	\$ 2,144,068	\$ 2,908,111	8
2023	-7.18170	-3.58899	-0.40311	-0.12222	-0.02484	-0.01065	-0.34128	\$ 27,848	\$ 99,056	\$ 174,303	\$ 118,062	\$ 60,795	\$ 58,102	\$ 3,139,730	\$ 3,677,895	\$ 2,000,531	\$ 2,818,801	9
2024	-7.16444	-3.58015	-0.40211	-0.12192	-0.02479	-0.01062	-0.34077	\$ 27,781	\$ 98,812	\$ 173,872	\$ 117,774	\$ 60,655	\$ 57,938	\$ 3,135,050	\$ 3,671,882	\$ 1,866,599	\$ 2,732,225	10
2025	-7.14718	-3.57131	-0.40111	-0.12162	-0.02473	-0.01059	-0.34026	\$ 27,714	\$ 98,568	\$ 173,441	\$ 117,486	\$ 60,516	\$ 57,775	\$ 3,130,369	\$ 3,665,869	\$ 1,741,628	\$ 2,648,302	11
2026	-7.12992	-3.56247	-0.40012	-0.12132	-0.02467	-0.01056	-0.33975	\$ 27,647	\$ 98,324	\$ 173,010	\$ 117,198	\$ 60,377	\$ 57,611	\$ 3,125,689	\$ 3,659,856	\$ 1,625,020	\$ 2,566,950	12
2027	-7.11266	-3.55363	-0.39912	-0.12103	-0.02462	-0.01053	-0.33924	\$ 27,580	\$ 98,080	\$ 172,579	\$ 116,910	\$ 60,238	\$ 57,447	\$ 3,121,008	\$ 3,653,843	\$ 1,516,215	\$ 2,488,089	13
2028	-7.09539	-3.54479	-0.39812	-0.12073	-0.02456	-0.01050	-0.33873	\$ 27,513	\$ 97,836	\$ 172,149	\$ 116,622	\$ 60,099	\$ 57,284	\$ 3,116,328	\$ 3,647,830	\$ 1,414,691	\$ 2,411,645	14
2029	-7.07813	-3.53595	-0.39713	-0.12043	-0.02450	-0.01047	-0.33822	\$ 27,446	\$ 97,592	\$ 171,718	\$ 116,334	\$ 59,959	\$ 57,120	\$ 3,111,647	\$ 3,641,817	\$ 1,319,962	\$ 2,337,544	15
2030	-7.06087	-3.52711	-0.39613	-0.12013	-0.02444	-0.01044	-0.33771	\$ 27,379	\$ 97,348	\$ 171,287	\$ 116,046	\$ 59,820	\$ 56,956	\$ 3,106,967	\$ 3,635,804	\$ 1,231,573	\$ 2,265,713	16
2031	-7.04361	-3.51827	-0.39514	-0.11983	-0.02439	-0.01041	-0.33721	\$ 27,312	\$ 97,104	\$ 170,856	\$ 115,758	\$ 59,681	\$ 56,793	\$ 3,102,286	\$ 3,629,791	\$ 1,149,099	\$ 2,196,083	17
2032	-7.02635	-3.50943	-0.39414	-0.11953	-0.02433	-0.01038	-0.33670	\$ 27,245	\$ 96,860	\$ 170,426	\$ 115,470	\$ 59,542	\$ 56,629	\$ 3,097,606	\$ 3,623,778	\$ 1,072,145	\$ 2,128,588	18
2033	-7.00908	-3.50059	-0.39314	-0.11924	-0.02427	-0.01035	-0.33619	\$ 27,179	\$ 96,616	\$ 169,995	\$ 115,182	\$ 59,403	\$ 56,465	\$ 3,092,925	\$ 3,617,765	\$ 1,000,342	\$ 2,063,161	19
2034	-6.99182	-3.49175	-0.39215	-0.11894	-0.02422	-0.01032	-0.33568	\$ 27,112	\$ 96,372	\$ 169,564	\$ 114,894	\$ 59,264	\$ 56,302	\$ 3,088,245	\$ 3,611,752	\$ 933,345	\$ 1,999,739	20
2035	-6.97456	-3.48291	-0.39115	-0.11864	-0.02416	-0.01029	-0.33517	\$ 27,045	\$ 96,128	\$ 169,133	\$ 114,606	\$ 59,124	\$ 56,138	\$ 3,083,564	\$ 3,605,739	\$ 870,833	\$ 1,938,262	21
2036	-6.95730	-3.47407	-0.39015	-0.11834	-0.02410	-0.01026	-0.33466	\$ 26,978	\$ 95,884	\$ 168,702	\$ 114,318	\$ 58,985	\$ 55,974	\$ 3,078,884	\$ 3,599,726	\$ 812,506	\$ 1,878,670	22
2037	-6.94004	-3.46523	-0.38916	-0.11804	-0.02405	-0.01023	-0.33415	\$ 26,911	\$ 95,640	\$ 168,272	\$ 114,030	\$ 58,846	\$ 55,811	\$ 3,074,203	\$ 3,593,713	\$ 758,083	\$ 1,820,905	23
2038	-6.92277	-3.45639	-0.38816	-0.11775	-0.02399	-0.01020	-0.33364	\$ 26,844	\$ 95,396	\$ 167,841	\$ 113,742	\$ 58,707	\$ 55,647	\$ 3,069,523	\$ 3,587,700	\$ 707,303	\$ 1,764,911	24
2039	-6.90551	-3.44755	-0.38717	-0.11745	-0.02393	-0.01017	-0.33314	\$ 26,777	\$ 95,152	\$ 167,410	\$ 113,454	\$ 58,568	\$ 55,483	\$ 3,064,842	\$ 3,581,687	\$ 659,923	\$ 1,710,634	25
20-Year Project Life Present through 2039																\$ 28,856,733	\$ 46,491,652	

Sources:

- {1} The annual crash reduction benefits by AIS Rating for year 2019 are taken from cells O66 to O72 in the [Geometric Crash Reduction Data] tab.
- {2} The annual crash reduction benefits by AIS Rating for year 2035 are taken from cells O80 to O86 in the [Geometric Crash Reduction Data] tab.
- {3} Value of Property Damage Only Crashes *The Economic Impact of Motor Vehicle Crashes 2000*
Note: Value adjusted from 2010\$ to 2013\$ using the BLS GDP deflator method
Link: <http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf>
- {4} Value of AIS Type 1 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {5} Value of AIS Type 2 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {6} Value of AIS Type 3 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {7} Value of AIS Type 4 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {8} Value of AIS Type 5 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {9} Value of AIS Type 6 (Fatality) Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>

Regional Crash Reduction Data

TABLE 1 - IOWA CRASH RATE DATA

Crash Rates per 100 Million Vehicle Miles of Travel (crashes/HMVMVT)									
Crash Rate Code	Roadway Type	Fatal Crash Rate	Major Injury Crash Rate	Minor Injury Crash Rate	Possible/ Unknown Injury Crash Rate	Property Damage Only Crash Rates			
[a]	[b]	[c]	[d]	[e]	[f]	[g]			
A	Urban Interstates [1]	0.53	2.08	7	13	52			
B	Urban Freeways [1]	0.61	2.26	7	12	58			
C	Urban Expressways [1]	0.63	3.29	13	25	83			
D	Principal Arterial [2]	1.86	9.28	27	40	205			
E	Minor Arterial [2]	2.09	7.71	23	35	146			
F	Major Collector [2]	2.75	8.42	20	24	106			
G	Minor Collector [2]	4.43	14.58	39	44	163			
H	Local [2]	5.97	22.08	62	74	253			

[1] Crash Rates and Crash Densities on Mainline, Divided Roads in Iowa 2001-2009, Iowa Department of Transportation, July 6, 2010, page 11
[2] Crash Rates and Crash Densities on Secondary Roads in Iowa by Functional Class 2002-2011, Iowa Department of Transportation, February 18, 2013, Page 12

TABLE 2 - YEAR 2019 CRASH RATE REDUCTION CALCULATIONS (KABCO)

Regional Crash Rate Differential (crashes/HMVMVT)											
Crash Rate Code	Roadway Type	Year 2019		Daily VMT Difference		Regional Crash Rate Differential (crashes/HMVMVT)					Property Damage Only
		No Build Condition Daily VMT	Build Condition Daily VMT	(Build - No Build)	Annual VMT Differential	Fatal Crash Rate	Major Injury Crash Rate	Minor Injury Crash Rate	Injury Crash Rate	Possible/ Unknown Injury Crash Rate	Crash Rates
[a]	[b]	[c]	[d]	[e]	[f]	[g]	[h]	[i]	[j]	[k]	[l]
						ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE
						1,ROW[a]	1,ROW[a]	1,ROW[a]	1,ROW[a]	1,ROW[a]	1,ROW[a]
C	FREEWAYS	97,628,883.75	97,640,615.25	11,731.50	4,281,997.50	0.026976584	0.140877718	0.556659675	1.070499375	3.554057925	
D	PRINCIPAL ARTERIALS	42,478,645.48	42,473,596.86	-5,048.62	-1,842,746.30	-0.034275081	-0.171006857	-0.497541501	-0.73709852	-3.777629915	
E	MINOR ARTERIALS	39,621,495.70	39,619,530.09	-1,965.61	-717,447.65	-0.014994656	-0.055315214	-0.165012959	-0.251106677	-1.047473569	
F	COLLECTORS	14,488,578.78	14,486,992.59	-1,586.19	-578,959.35	-0.015921382	-0.048748377	-0.11579187	-0.138950244	-0.613696911	
C	FREEWAY RAMP	7,735,254.09	7,724,264.04	-10,990.05	-4,011,368.25	-0.02527162	-0.131974015	-0.521477872	-1.002842062	-3.329435647	
D	FRONTAGE ROADS	8,219,265.99	8,219,975.46	709.47	258,956.55	0.004816592	0.024031168	0.069918268	0.10358262	0.530860927	
C	HOV LANES	2,111,185.38	2,120,380.58	9,195.20	3,356,248.00	0.021144362	0.110420559	0.43631224	0.839062	2.78568584	
TOTALS		212,283,309.17	212,285,354.87	2,045.70	-0.037525	-0.131715	-0.236934	-0.116854	-1.897631		
Crash Rate Reduction (crashes/HMVMVT)						-4.84295E-13	-1.69990E-12	-3.05784E-12	-1.50810E-12	-2.44906E-11	
KABCO Severity Level						K	A	B	U*	O	

*Used Unknown Severity instead of Possible Injury because it has smaller factors when converting to the AIS Rating System

TABLE 3 - YEAR 2019 CRASH RATE REDUCTION CALCULATIONS (AIS)

KABCO Type →	KABCO Accident Classification System												Crash Rate Reduction (crashes/HMVMVT)
	O No Injury		C Possible Injury		B Non-Incapacitating		A Incapacitating		K Killed		U Injured Severity Unknown		
AIS Rating System	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-1.80543E+00
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-4.66113E-01
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-6.92701E-02
3	-1.89763E+00	0.00008	0.00000E+00	0.01071	-2.36934E-01	0.03191	-1.31715E-01	0.14437	-3.75252E-02	0.00000	-1.16854E-01	0.03858	-3.12363E-02
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-7.23564E-03
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-3.85298E-03
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-3.75252E-02

Source: National Highway Traffic Safety Administration, July 2011.

TABLE 4 - YEAR 2035 CRASH RATE REDUCTION CALCULATIONS (KABCO)

Regional Crash Rate Differential (crashes/HMVMVT)											
Crash Rate Code	Roadway Type	Year 2035		Daily VMT Difference		Regional Crash Rate Differential (crashes/HMVMVT)					Property Damage Only
		No Build Condition Daily VMT	Build Condition Daily VMT	(Build - No Build)	Annual VMT Differential	Fatal Crash Rate	Major Injury Crash Rate	Minor Injury Crash Rate	Injury Crash Rate	Possible/ Unknown Injury Crash Rate	Crash Rates
[a]	[b]	[c]	[d]	[e]	[f]	[g]	[h]	[i]	[j]	[k]	[l]
						ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE	ROW[a]=TABLE
						1,ROW[a]	1,ROW[a]	1,ROW[a]	1,ROW[a]	1,ROW[a]	1,ROW[a]
C	FREEWAYS	125,685,502.69	125,716,527.24	31,024.55	11,323,960.75	0.071340953	0.372558309	1.472114897	2.830990187	9.398887422	
D	PRINCIPAL ARTERIALS	55,430,194.54	55,421,163.37	-9,031.17	-3,296,377.05	-0.061312613	-0.30590379	-0.890021804	-1.31855082	-6.757572953	
E	MINOR ARTERIALS	54,755,607.32	54,760,812.10	5,204.78	1,899,744.70	0.039704664	0.146470316	0.436941281	0.664910645	2.773627262	
F	COLLECTORS	20,633,999.80	20,629,435.97	-4,563.83	-1,665,797.95	-0.045809444	-0.140260187	-0.33315959	-0.399791508	-1.765745827	
C	FREEWAY RAMP	10,340,616.04	10,328,281.59	-12,334.45	-4,502,074.25	-0.028363068	-0.148118243	-0.585269652	-1.125518562	-3.736721627	
D	FRONTAGE ROADS	11,135,541.64	11,132,678.52	-2,863.12	-1,045,038.80	-0.019437722	-0.096979601	-0.282160476	-0.41801552	-2.14232954	
C	HOV LANES	3,617,069.86	3,605,205.41	-11,864.45	-4,330,524.25	-0.027282303	-0.142474248	-0.562968152	-1.082631062	-3.594335127	
TOTALS		281,598,531.89	281,594,104.20	-4,427.69	-0.071160	-0.314707	-0.744523	-0.848607	-5.824190		
Crash Rate Reduction (crashes/HMVMVT)						-6.92336E-13	-3.06190E-12	-7.24373E-12	-8.25639E-12	-5.66656E-11	
KABCO Severity Level						K	A	B	U*	O	

*Used Unknown Severity instead of Possible Injury because it has smaller factors when converting to the AIS Rating System

TABLE 5 - YEAR 2035 CRASH RATE REDUCTION CALCULATIONS (AIS)

KABCO Type →	KABCO Accident Classification System												Crash Rate Reduction (crashes/HMVMVT)
	O No Injury		C Possible Injury		B Non-Incapacitating		A Incapacitating		K Killed		U Injured Severity Unknown		
AIS Rating System	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	Number	Factor	
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-5.64509E+00
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-1.70159E+00
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-2.46724E-01
3	-5.82419E+00	0.00008	0.00000E+00	0.01071	-7.44523E-01	0.03191	-3.14707E-01	0.14437	-7.11595E-02	0.00000	-8.48607E-01	0.03858	-1.02397E-01
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-2.09111E-02
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-1.53125E-02
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-7.11595E-02

Source: National Highway Traffic Safety Administration, July 2011.

Regional Crash Reduction

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]	[L]	[M]	[N]	[O]	[P]	[Q]	[R]	[S]
Column Source	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{1,2}	{3}	{4}	{5}	{6}	{7}	{8}	{9}				
Constant Source																		
Equation								[B] x {3}	[C] x {4}	[D] x {5}	[E] x {6}	[F] x {7}	[G] x {8}	[H] x {9}	SUM([I:O])	[P] / (1.07^[S])	[P] / (1.03^[S])	Year
	CRASH RATE REDUCTION (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)							Total Crash Reduction Benefit	7% NPV Maintenance Cost Reduction	3% NPV Maintenance Cost Reduction	
YEAR	0	1	2	3	4	5	Fatal	0	1	2	3	4	5	Fatal				
2014								\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2015								\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2016								\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2017								\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2018								\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2019	-1.80543	-0.46611	-0.06927	-0.03124	-0.00724	-0.00385	-0.03753	\$ 7,001	\$ 12,865	\$ 29,952	\$ 30,174	\$ 17,707	\$ 21,020	\$ 345,232	\$ 463,951	\$ 330,791	\$ 400,208	5
2020	-2.04541	-0.54333	-0.08036	-0.03568	-0.00809	-0.00457	-0.03963	\$ 7,931	\$ 14,996	\$ 34,748	\$ 34,471	\$ 19,799	\$ 24,928	\$ 364,572	\$ 501,444	\$ 334,133	\$ 419,951	6
2021	-2.28538	-0.62055	-0.09145	-0.04013	-0.00895	-0.00529	-0.04173	\$ 8,862	\$ 17,127	\$ 39,544	\$ 38,767	\$ 21,890	\$ 28,835	\$ 383,911	\$ 538,937	\$ 335,623	\$ 438,205	7
2022	-2.52536	-0.69777	-0.10254	-0.04458	-0.00980	-0.00600	-0.04383	\$ 9,792	\$ 19,258	\$ 44,339	\$ 43,063	\$ 23,982	\$ 32,743	\$ 403,251	\$ 576,429	\$ 335,487	\$ 455,038	8
2023	-2.76534	-0.77498	-0.11363	-0.04903	-0.01065	-0.00672	-0.04593	\$ 10,723	\$ 21,390	\$ 49,135	\$ 47,360	\$ 26,074	\$ 36,650	\$ 422,591	\$ 613,922	\$ 333,933	\$ 470,520	9
2024	-3.00532	-0.85220	-0.12472	-0.05347	-0.01151	-0.00743	-0.04804	\$ 11,653	\$ 23,521	\$ 53,931	\$ 51,656	\$ 28,165	\$ 40,557	\$ 441,931	\$ 651,414	\$ 331,146	\$ 484,713	10
2025	-3.24530	-0.92942	-0.13582	-0.05792	-0.01236	-0.00815	-0.05014	\$ 12,584	\$ 25,652	\$ 58,727	\$ 55,952	\$ 30,257	\$ 44,465	\$ 461,270	\$ 688,907	\$ 327,295	\$ 497,681	11
2026	-3.48528	-1.00663	-0.14691	-0.06237	-0.01322	-0.00887	-0.05224	\$ 13,515	\$ 27,783	\$ 63,522	\$ 60,249	\$ 32,349	\$ 48,372	\$ 480,610	\$ 726,400	\$ 322,530	\$ 509,482	12
2027	-3.72526	-1.08385	-0.15800	-0.06682	-0.01407	-0.00958	-0.05434	\$ 14,445	\$ 29,914	\$ 68,318	\$ 64,545	\$ 34,440	\$ 52,280	\$ 499,950	\$ 763,892	\$ 316,988	\$ 520,173	13
2028	-3.96524	-1.16107	-0.16909	-0.07126	-0.01493	-0.01030	-0.05644	\$ 15,376	\$ 32,046	\$ 73,114	\$ 68,841	\$ 36,532	\$ 56,187	\$ 519,290	\$ 801,385	\$ 310,791	\$ 529,810	14
2029	-4.20522	-1.23829	-0.18018	-0.07571	-0.01578	-0.01102	-0.05855	\$ 16,306	\$ 34,177	\$ 77,909	\$ 73,138	\$ 38,624	\$ 60,094	\$ 538,629	\$ 838,877	\$ 304,048	\$ 538,443	15
2030	-4.44520	-1.31550	-0.19127	-0.08016	-0.01664	-0.01173	-0.06065	\$ 17,237	\$ 36,308	\$ 82,705	\$ 77,434	\$ 40,715	\$ 64,002	\$ 557,969	\$ 876,370	\$ 296,857	\$ 546,125	16
2031	-4.68517	-1.39272	-0.20236	-0.08461	-0.01749	-0.01245	-0.06275	\$ 18,167	\$ 38,439	\$ 87,501	\$ 81,730	\$ 42,807	\$ 67,909	\$ 577,309	\$ 913,863	\$ 289,306	\$ 552,902	17
2032	-4.92515	-1.46994	-0.21345	-0.08905	-0.01835	-0.01316	-0.06485	\$ 19,098	\$ 40,570	\$ 92,296	\$ 86,027	\$ 44,899	\$ 71,817	\$ 596,648	\$ 951,355	\$ 281,472	\$ 558,821	18
2033	-5.16513	-1.54716	-0.22454	-0.09350	-0.01920	-0.01388	-0.06696	\$ 20,028	\$ 42,702	\$ 97,092	\$ 90,323	\$ 46,990	\$ 75,724	\$ 615,988	\$ 988,848	\$ 273,425	\$ 563,926	19
2034	-5.40511	-1.62437	-0.23563	-0.09795	-0.02006	-0.01460	-0.06906	\$ 20,959	\$ 44,833	\$ 101,888	\$ 94,619	\$ 49,082	\$ 79,632	\$ 635,328	\$ 1,026,340	\$ 265,226	\$ 568,260	20
2035	-5.64509	-1.70159	-0.24672	-0.10240	-0.02091	-0.01531	-0.07116	\$ 21,889	\$ 46,964	\$ 106,684	\$ 98,916	\$ 51,174	\$ 83,539	\$ 654,668	\$ 1,063,833	\$ 256,930	\$ 571,863	21
2036	-5.88507	-1.77881	-0.25782	-0.10684	-0.02177	-0.01603	-0.07326	\$ 22,820	\$ 49,095	\$ 111,479	\$ 103,212	\$ 53,265	\$ 87,446	\$ 674,007	\$ 1,101,326	\$ 248,584	\$ 574,774	22
2037	-6.12505	-1.85603	-0.26891	-0.11129	-0.02262	-0.01674	-0.07536	\$ 23,751	\$ 51,226	\$ 116,275	\$ 107,508	\$ 55,357	\$ 91,354	\$ 693,347	\$ 1,138,818	\$ 240,230	\$ 577,030	23
2038	-6.36503	-1.93324	-0.28000	-0.11574	-0.02348	-0.01746	-0.07747	\$ 24,681	\$ 53,358	\$ 121,071	\$ 111,805	\$ 57,449	\$ 95,261	\$ 712,687	\$ 1,176,311	\$ 231,906	\$ 578,667	24
2039	-6.60501	-2.01046	-0.29109	-0.12019	-0.02433	-0.01818	-0.07957	\$ 25,612	\$ 55,489	\$ 125,866	\$ 116,101	\$ 59,540	\$ 99,169	\$ 732,027	\$ 1,213,804	\$ 223,642	\$ 579,719	25
20-Year Project Life Present through 2039															\$ 6,190,340	\$ 10,936,312		

Sources:

- {1} The annual crash reduction benefits by AIS Rating for year 2019 are taken from cells N38 to N44 in the [Regional Crash Reduction Data] tab.
- {2} The annual crash reduction benefits by AIS Rating for year 2035 are taken from cells N70 to N76 in the [Regional Crash Reduction Data] tab.
- {3} Value of Property Damage Only Crashes *The Economic Impact of Motor Vehicle Crashes 2000*
Note: Value adjusted from 2010\$ to 2013\$ using the BLS GDP deflator method
Link: <http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf>
- {4} Value of AIS Type 1 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {5} Value of AIS Type 2 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {6} Value of AIS Type 3 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {7} Value of AIS Type 4 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {8} Value of AIS Type 5 Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>
- {9} Value of AIS Type 6 (Fatality) Crashes *Guidance on Treatment of the Economic Value of Statistical Life in U.S. Department of Transportation Analyses (2013)*
Link: <http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-economic-value-statistical-life>

Summary

[A]	[B]	[C]	[D]	[E]	[G]	[H]	[I]	[J]	[K]
Column Source		{1}	{2}	{3}	{4}	{5}			
Equation							SUM([C]:[H])	[I] / (1.07^[A])	[I] / (1.03^[A])
Project Year	Calendar Year	Project Costs	Maintenance Savings Benefit	Economic Development Benefits (Costs)	Geometric Crash Reduction Benefits (Costs)	Regional Crash Reduction Benefits (Costs)	Net Benefits (Costs)	7% NPV Total Net Benefits (Costs)	3% NPV Total Net Benefits (Costs)
0	2014	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
1	2015	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2	2016	\$ (4,105,263)	\$ -	\$ -	\$ -	\$ -	\$ (4,105,263)	\$ (3,585,696)	\$ (3,869,604)
3	2017	\$ (16,421,053)	\$ -	\$ -	\$ -	\$ -	\$ (16,421,053)	\$ (13,404,470)	\$ (15,027,589)
4	2018	\$ (5,473,684)	\$ -	\$ -	\$ -	\$ -	\$ (5,473,684)	\$ (4,175,847)	\$ (4,863,298)
5	2019	\$ -	\$ 13,750	\$ 2,647,849	\$ 3,701,948	\$ 463,951	\$ 6,827,498	\$ 4,867,912	\$ 5,889,460
6	2020	\$ -	\$ 13,750	\$ -	\$ 3,695,935	\$ 501,444	\$ 4,211,128	\$ 2,806,053	\$ 3,526,754
7	2021	\$ -	\$ 13,750	\$ -	\$ 3,689,921	\$ 538,937	\$ 4,242,608	\$ 2,642,083	\$ 3,449,629
8	2022	\$ -	\$ 13,750	\$ -	\$ 3,683,908	\$ 576,429	\$ 4,274,088	\$ 2,487,558	\$ 3,374,004
9	2023	\$ -	\$ 13,750	\$ -	\$ 3,677,895	\$ 613,922	\$ 4,305,567	\$ 2,341,943	\$ 3,299,859
10	2024	\$ -	\$ 13,750	\$ -	\$ 3,671,882	\$ 651,414	\$ 4,337,047	\$ 2,204,735	\$ 3,227,170
11	2025	\$ -	\$ 13,750	\$ -	\$ 3,665,869	\$ 688,907	\$ 4,368,526	\$ 2,075,455	\$ 3,155,916
12	2026	\$ -	\$ 13,750	\$ -	\$ 3,659,856	\$ 726,400	\$ 4,400,006	\$ 1,953,655	\$ 3,086,076
13	2027	\$ -	\$ 13,750	\$ -	\$ 3,653,843	\$ 763,892	\$ 4,431,485	\$ 1,838,909	\$ 3,017,626
14	2028	\$ -	\$ 13,750	\$ -	\$ 3,647,830	\$ 801,385	\$ 4,462,965	\$ 1,730,815	\$ 2,950,546
15	2029	\$ -	\$ 13,750	\$ -	\$ 3,641,817	\$ 838,877	\$ 4,494,445	\$ 1,628,994	\$ 2,884,813
16	2030	\$ -	\$ 13,750	\$ -	\$ 3,635,804	\$ 876,370	\$ 4,525,924	\$ 1,533,087	\$ 2,820,406
17	2031	\$ -	\$ 13,750	\$ -	\$ 3,629,791	\$ 913,863	\$ 4,557,404	\$ 1,442,757	\$ 2,757,304
18	2032	\$ -	\$ 13,750	\$ -	\$ 3,623,778	\$ 951,355	\$ 4,588,883	\$ 1,357,685	\$ 2,695,485
19	2033	\$ -	\$ 13,750	\$ -	\$ 3,617,765	\$ 988,848	\$ 4,620,363	\$ 1,277,569	\$ 2,634,928
20	2034	\$ -	\$ 13,750	\$ -	\$ 3,611,752	\$ 1,026,340	\$ 4,651,842	\$ 1,202,124	\$ 2,575,612
21	2035	\$ -	\$ 13,750	\$ -	\$ 3,605,739	\$ 1,063,833	\$ 4,683,322	\$ 1,131,084	\$ 2,517,516
22	2036	\$ -	\$ 13,750	\$ -	\$ 3,599,726	\$ 1,101,326	\$ 4,714,802	\$ 1,064,193	\$ 2,460,620
23	2037	\$ -	\$ 13,750	\$ -	\$ 3,593,713	\$ 1,138,818	\$ 4,746,281	\$ 1,001,213	\$ 2,404,901
24	2038	\$ -	\$ 13,750	\$ -	\$ 3,587,700	\$ 1,176,311	\$ 4,777,761	\$ 941,919	\$ 2,350,342
25	2039	\$ -	\$ 13,750	\$ -	\$ 3,581,687	\$ 1,213,804	\$ 4,809,240	\$ 886,099	\$ 2,296,920
20-Year Project Life Present through 2039								\$ 17,249,828	\$ 39,615,396

Sources: {1} Data from [Project Cost : Column F]
 {2} Data from [Maintenance Benefit : Column E]
 {3} Data from [Economic Competitiveness : Column F]
 {4} Data from [Geometric Crash Reduction : Column P]
 {5} Data from [Regional Crash Reduction : Column P]