IH 30/IH 35W Managed Lane Access Ramp

Benefit Cost Appendix

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North Central Texas
Council of Governments

Transportation Department

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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 IH 30/IH 35W Managed Lane Access Ramp 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 2018 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 IH 30/IH 35W Managed Lane Access Ramp project to the transportation network.

a. Project Cost

Proposed construction costs were obtained from the North Tarrant Express Segment 3A (NTE 3A) project team. Annual construction costs were estimated based on the proposed construction schedule for the IH 30/IH 35W Managed Lane Access Ramp. The project schedule is shown in section III.c of the IH 30/IH 35W Managed Lane Access Ramp 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 IH 30/IH 35W Managed Lane Access Ramp project. No job creation benefit was included in the overall benefits of the project.

c. Direct User Cost (Economic Competitiveness)

The direct cost to users of the managed lane system is difficult to calculate precisely. According to the project website (http://www.texpresslanes.com/pricing/how-pricing), “TEXpress Lanes use congestion-management pricing to help manage traffic flow and provide faster, more predictable travel. Roadside equipment recalculates real-time prices every 5 minutes, 24 hours a day, aiming to ensure the lanes are moving at 50 mph or faster.” The “exact toll prices after the first 6 months of the project opening are difficult to predict since they are based on real-time traffic demand. Average toll prices may range from 10 cents to 25 cents per mile during lighter traffic, and 45 cents to 75 cents during rush hour.”

To ensure that the estimated cost to users applied in the BCA is conservative, the highest cost is assumed for all users. For morning and evening peak periods the 75 cents per mile rate is used, and for the off-peak periods the 45 cents per mile rate is applied. The per-mile costs are multiplied by the number of users during each period, and then they are multiplied again by 2.5 miles – the distance between the new IH 30/IH 35W Managed Lane Access Ramp and the next managed lane entrance ramp near NE 28th Street in Fort Worth.

Note that model results were used to forecast user volumes for the years 2018 and 2035. Intermediate years were estimated based on a linear progression. Travel volumes after 2035 were assumed to remain constant.

Equation for Annual Direct User Cost:

$$\begin{aligned} &Annual\ Direct\ User\ Cost \\ &= Peak\ Period\ Users\ (Daily) \times\ 365\ days\ \times 2.5\ miles\ \times \frac{\$0.75}{mile} \\ &+ Offpeak\ Period\ Users\ (Daily) \times\ 365\ days\ \times 2.5\ miles\ \times \frac{\$0.45}{mile} \end{aligned}$$

d. Travel Time Benefit (Economic Competitiveness)

Regional travel time benefits were calculated based on travel demand modeling conducted for the project. Travel time benefits were calculated at the metropolitan planning area level to reflect all shifts in regional traffic patterns that would result from the construction of the project. These travel time benefits reflect the reduced traffic congestion experienced by managed lane system users and all other users of the transportation facilities in the region.

Equation for Annual Travel Time Benefit:

$$\begin{aligned} &Annual\ Travel\ Time\ Benefit \\ &= \big(Daily\ Hours\ of\ Congestion\ Delay\ (Build\ Network) \\ &- Daily\ Hours\ of\ Congestion\ Delay\ (No\ Build\ Network)\big) \times\ 365\ days \\ &\times \frac{\$12.81}{hour} \end{aligned}$$

e. Geometric Crash Reduction Benefit (Safety)

The construction of this project will allow some traffic to travel directly from the eastbound IH 30 to IH 35W ramp to the managed lane system without entering the IH 35W general purpose lanes. The area where ramp traffic merges into the general purpose lanes is a short auxiliary lane. Ramp traffic not bound for westbound Spur 280 is required to transition one lane to the left. This weaving section is followed by another weaving section where a combined ramp from northbound US 287 and eastbound IH 30 also join northbound IH 35W. This

entrance ramp is also configured as an auxiliary lane that transitions into a ramp from IH 35W to eastbound SH 121.

Regional safety is increased by providing an opportunity for managed lane users to bypass these two weaving sections. The total length of the two auxiliary lane sections is 0.78 miles. The annual crash frequency for this stretch of IH 35W was calculated based on data from 2012-2013. This data was then normalized by the annual VMT for this roadway based on travel demand model current year estimates and multiplied by 100 million to yield a crash rate per HMVMT.

No specific weaving length crash modification factor was available from the Crash Modification Factor Clearinghouse (http://www.cmfclearinghouse.org/). The Texas Transportation Institute published a paper (http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-4703-5.pdf) with accident modification factors based on specific transportation facility design elements. The following equation was derived for weaving sections on freeways:

$$AMF_{wev} = e^{152.9/L^{*}_{wev}}$$

Based on the measured length of the weaving section, 1,275 feet, the AMF for existing conditions is 1.1274. The option of bypassing the weaving section completely would yield and AMF for the managed lane ramp users of 1.0. Combining these two results, the calculated CMF for the managed lane users is 1.0/1.1274 or 0.887. This CMF was applied to the crash rates on IH 35W to estimate the build condition crash rate for managed lane ramp users based on the KABCO rating system used by TxDOT.

Equation for Annual Geometric Crash Reduction Benefit:

$$\begin{aligned} &Annual\ Geometric\ Crash\ Reduction\ Benefit \\ &\quad = Managed\ Lane\ Ramp\ Users\ (Daily) \times 365\ days \times 0.78\ miles \\ &\quad \times KABCO\ Crash\ Reduction\ Rate \times KABCO\ to\ AIS\ Conversion \\ &\quad \times Monetized\ Value_{By\ AIS\ Type} \end{aligned}$$

f. Regional Crash Reduction Benefit (Safety)

Traffic that transitions to the managed lane system frees up capacity on the general purpose lanes. This additional capacity allows some traffic from local thoroughfares to transition to limited access facilities. 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:

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

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 IH 30/IH 35W Managed Lane Access Ramp project 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**	
Year	**Quarter**	**Engineering/ ROW/Utilities Spending**	**Construction Spending**	**By Quarter**	**By Year**	**Construction JOB-YEARS BY QUARTER**	**Construction JOBS BY QUARTER**
2014	Q1			$ -			
2014	Q2			$ -			
2014	Q3			$ -	$ -		
2014	Q4			$ -		0.0	0
2015	Q1			$ -		0.0	0
2015	Q2			$ -		0.0	0
2015	Q3	$ 528,281		$ 528,281	$ 1,056,563	0.0	0
2015	Q4	$ 528,281		$ 528,281		0.0	0
2016	Q1	$ 528,281		$ 528,281		0.0	0
2016	Q2	$ 528,281		$ 528,281		0.0	0
2016	Q3	$ 457,738	$ 1,156,389	$ 1,614,127	$ 5,441,206	15.0	60
2016	Q4	$ 457,738	$ 2,312,779	$ 2,770,516		30.1	120
2017	Q1		$ 3,469,168	$ 3,469,168		45.1	180
2017	Q2		$ 3,469,168	$ 3,469,168		45.1	180
2017	Q3		$ 3,469,168	$ 3,469,168	$ 13,876,673	45.1	180
2017	Q4		$ 3,469,168	$ 3,469,168		45.1	180
2018	Q1		$ 3,469,168	$ 3,469,168		45.1	180
2018	Q2		$ 1,156,389	$ 1,156,389		15.0	60
2018	Q3			$ -	$ 4,625,558	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		**$ 3,028,601**	**$ 21,971,399**	**$ 25,000,000**	**$ 25,000,000**		

Sources: {1} Conversion Factor: 1 job-year per $76,900 in spending (See TIGER BCA Resource Guide - Updated 3/28/14)

Direct User Cost

[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]	[J]	[K]
Column Source	**{1}**									
Constant Source	**{2}**	**{3}**	**{4}**			**{5}**				
	365	2.5	$ 0.75			$ 0.25				
Equation		**[B] x {2} x {3}**	**[C] x {4}**		**[B] x {2} x {3}**	**[C] x {5}**	**[D] + [G]**	**[H] / (1.07^[K])**	**[H] / (1.03^[K])**	
Year	**AM and PM Peak Period Daily Trips**	**AM and PM Peak Period VMT**	**Maximum Expected Cost**	**Off-Peak Period Daily Trips**	**Off-Peak Period VMT**	**Maximum Expected Cost**	**Maximum Expected Annual User Cost Paid in**	**7% NPV Maintenance Cost Reduction Benefits**	**3% NPV Maintenance Cost Reduction Benefits**	**Year**
2014	0	0	$ -	0	0	$ -	**$ -**	$ -	$ -	1
2015	0	0	$ -	0	0	$ -	**$ -**	$ -	$ -	2
2016	0	0	$ -	0	0	$ -	**$ -**	$ -	$ -	3
2017	0	0	$ -	0	0	$ -	**$ -**	$ -	$ -	4
2018	588.0	536,550	$ (402,412.50)	4113.0	3,753,113	$ (938,278.13)	**$ (1,340,691)**	$ (955,894)	$ (1,156,492)	5
2019	589.1	537,570	$ (403,177.39)	3899.0	3,557,838	$ (889,459.38)	**$ (1,292,637)**	$ (861,338)	$ (1,082,563)	6
2020	590.2	538,590	$ (403,942.28)	3685.0	3,362,563	$ (840,640.63)	**$ (1,244,583)**	$ (775,064)	$ (1,011,960)	7
2021	591.4	539,610	$ (404,707.17)	3471.0	3,167,288	$ (791,821.88)	**$ (1,196,529)**	$ (696,391)	$ (944,551)	8
2022	592.5	540,629	$ (405,472.06)	3257.0	2,972,013	$ (743,003.13)	**$ (1,148,475)**	$ (624,694)	$ (880,211)	9
2023	593.6	541,649	$ (406,236.95)	3043.0	2,776,738	$ (694,184.38)	**$ (1,100,421)**	$ (559,398)	$ (818,817)	10
2024	594.7	542,669	$ (407,001.84)	2829.0	2,581,463	$ (645,365.63)	**$ (1,052,367)**	$ (499,972)	$ (760,253)	11
2025	595.8	543,689	$ (407,766.73)	2615.0	2,386,188	$ (596,546.88)	**$ (1,004,314)**	$ (445,927)	$ (704,405)	12
2026	596.9	544,709	$ (408,531.62)	2401.0	2,190,913	$ (547,728.13)	**$ (956,260)**	$ (396,814)	$ (651,166)	13
2027	598.1	545,729	$ (409,296.51)	2187.0	1,995,638	$ (498,909.38)	**$ (908,206)**	$ (352,218)	$ (600,431)	14
2028	599.2	546,749	$ (410,061.40)	1973.0	1,800,363	$ (450,090.63)	**$ (860,152)**	$ (311,759)	$ (552,099)	15
2029	600.3	547,768	$ (410,826.29)	1759.0	1,605,088	$ (401,271.88)	**$ (812,098)**	$ (275,086)	$ (506,073)	16
2030	601.4	548,788	$ (411,591.18)	1545.0	1,409,813	$ (352,453.13)	**$ (764,044)**	$ (241,877)	$ (462,259)	17
2031	602.5	549,808	$ (412,356.07)	1331.0	1,214,538	$ (303,634.38)	**$ (715,990)**	$ (211,836)	$ (420,569)	18
2032	603.6	550,828	$ (413,120.96)	1117.0	1,019,263	$ (254,815.63)	**$ (667,937)**	$ (184,690)	$ (380,915)	19
2033	604.8	551,848	$ (413,885.85)	903.0	823,988	$ (205,996.88)	**$ (619,883)**	$ (160,189)	$ (343,214)	20
2034	605.9	552,868	$ (414,650.74)	689.0	628,713	$ (157,178.13)	**$ (571,829)**	$ (138,104)	$ (307,386)	21
2035	607.0	553,888	$ (415,415.63)	475.0	650,156	$ (162,539.06)	**$ (577,955)**	$ (130,452)	$ (301,630)	22
2036	607.0	553,888	$ (415,415.63)	475.0	650,156	$ (162,539.06)	**$ (577,955)**	$ (121,918)	$ (292,845)	23
2037	607.0	553,888	$ (415,415.63)	475.0	650,156	$ (162,539.06)	**$ (577,955)**	$ (113,942)	$ (284,315)	24
2038	607.0	553,888	$ (415,415.63)	475.0	650,156	$ (162,539.06)	**$ (577,955)**	$ (106,488)	$ (276,034)	25
2039	607.0	553,888	$ (415,415.63)	475.0	650,156	$ (162,539.06)	**$ (577,955)**	$ (99,521)	$ (267,995)	26
20-Year Project Life Present through 2039								**$ (8,263,572)**	**$ (13,006,183)**	

Sources: {1} Daily ramp volumes are forecast using the NCTCOG DFX Regional Travel Demand Model
{2} Number of days in one year
{3} Length on planned NTE managed lane before the first northbound entrance north of the proposed ramp.
{4} The maximum expected peak period per-mile cost to use the NTE managed lanes
http://www.texpresslanes.com/pricing/how-pricing
{5} The maximum expected off-peak period per-mile cost to use the NTE managed lanes
http://www.texpresslanes.com/pricing/how-pricing

Travel Time

[A]	[B]	[C]	[D]	[E]	[F]	[G]
Column Source	**{1}**					
Constant Source		**{2}**	**{3}**			
		365	$ 12.81			
Equation		**[B] x {2}**	**[C] x {3}**	**[D] / (1.07^[G])**	**[D] / (1.03^[G])**	
Year	**Regional Vehicle Hours of Congestion Delay Reduced (hours/day)**	**Regional Vehicle Hours of Congestion Delay Reduced (hours/year)**	**Total Time Savings Benefit**	**7% NPV Time Savings Benefits**	**3% NPV Time Savings Benefits**	**Year**
2014			$ -	$ -	$ -	1
2015			$ -	$ -	$ -	2
2016			$ -	$ -	$ -	3
2017			$ -	$ -	$ -	4
2018	845.74	308,695	$ 3,954,384	$ 2,819,421	$ 3,411,087	5
2019	821.81	299,959	$ 3,842,474	$ 2,560,403	$ 3,218,011	6
2020	797.87	291,223	$ 3,730,564	$ 2,323,208	$ 3,033,290	7
2021	773.94	282,487	$ 3,618,653	$ 2,106,089	$ 2,856,598	8
2022	750.00	273,750	$ 3,506,743	$ 1,907,436	$ 2,687,627	9
2023	726.07	265,014	$ 3,394,833	$ 1,725,761	$ 2,526,074	10
2024	702.13	256,278	$ 3,282,922	$ 1,559,693	$ 2,371,653	11
2025	678.20	247,542	$ 3,171,012	$ 1,407,967	$ 2,224,084	12
2026	654.26	238,806	$ 3,059,102	$ 1,269,418	$ 2,083,099	13
2027	630.33	230,070	$ 2,947,191	$ 1,142,972	$ 1,948,441	14
2028	606.39	221,333	$ 2,835,281	$ 1,027,636	$ 1,819,859	15
2029	582.46	212,597	$ 2,723,371	$ 922,500	$ 1,697,115	16
2030	558.52	203,861	$ 2,611,461	$ 826,722	$ 1,579,977	17
2031	534.59	195,125	$ 2,499,550	$ 739,527	$ 1,468,222	18
2032	510.65	186,389	$ 2,387,640	$ 660,202	$ 1,361,638	19
2033	486.72	177,653	$ 2,275,730	$ 588,092	$ 1,260,016	20
2034	462.78	168,916	$ 2,163,819	$ 522,591	$ 1,163,160	21
2035	438.85	160,180	$ 2,051,909	$ 463,143	$ 1,070,876	22
2036	414.92	151,444	$ 1,939,999	$ 409,237	$ 982,981	23
2037	390.98	142,708	$ 1,828,088	$ 360,401	$ 899,298	24
2038	367.05	133,972	$ 1,716,178	$ 316,204	$ 819,656	25
2039	343.11	125,236	$ 1,604,268	$ 276,248	$ 743,891	26
20-Year Project Life	**Present through 2039**			**$ 25,934,870**	**$ 41,226,653**	

Sources: {1} Daily reduction in vehicle hours of congestion delay is forecast using the NCTCOG DFX Regional Travel Demand Model
{2} Number of days in one year
{3} Conversion Factor: Average value of time for roadway users = $12.81 (See TIGER BCA Resource Guide - Updated 3/28/14)

Geometric Crash Reduction Data

Crashes on IH 35W from DC Ramp to SP 280 Exit Ramp to SH 121 Exit Ramp

	# Not Injured	# of Possible Injury Crashes	# of Non-Incapacitating Injury Crashes	# of Incapacitating Injury Crashes	# Fatality Crashes	# Unknown Injury Crashes
Total Crashes (2012-201	148	43	22	12	1	2
Crashes Per Year	74.00000	21.50000	11.00000	6.00000	0.50000	1.00000
Daily Volume (2013)	143,626	Daily VMT (2013)	112,028	Total VMT (2013)	40,890,220	
No Build Crashes per HM	180.97237	52.57981	26.90130	14.67344	1.22279	2.44557
Calculated CRF	Managed lane users avoid weaving sections on IH 35W (Calculated CMF)				0.887	89%
Build Crashes per HMVM	160.52249	46.63829	23.86145	13.01534	1.08461	2.16922
Managed Lane Benefit	-20.44988	-5.94152	-3.03985	-1.65810	-0.13817	-0.27635
Daily Volume (2018)	4,700	Daily VMT (2018)	3,666	Total VMT (2013)	1,338,090	
Build Crashes per HMVM	-0.27364	-0.07950	-0.04068	-0.02219	-0.00185	-0.00370
Daily Volume (2035)	1,082	Daily VMT (2035)	844	Total VMT (2013)	308,045	
Build Crashes per HMVM	-0.06299	-0.01830	-0.00936	-0.00511	-0.00043	-0.00085

1. This data consist of all locatable crashes that include latitude and longitude information
2. This data consist of all crash types that occurred within 100 feet of IH 35W in the project area
3. This data is composed of TxDOT "Reportable Crashes" only
   a. 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
   i. 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
4. 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

Year 2019 Crash Reduction

KABCO Accident Classification System

KABCO Type →	O		C		B		A		K		U		
	No Injury		Possible Injury		Non-Incapacitating		Incapacitating		Killed		Injured Severity Unknown		
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Annual Crash Reduction**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-0.27680
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-0.12055
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-0.01508
3	-0.27364	0.00008	-0.07950	0.01071	-0.04068	0.03191	-0.02219	0.14437	-0.00185	0.00000	-0.00370	0.03858	-0.00552
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.00127
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.00049
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.00185

Source: National Highway Traffic Safety Administration, July 2011.

Year 2035 Crash Reduction

KABCO Accident Classification System

KABCO Type →	O		C		B		A		K		U		
	No Injury		Possible Injury		Non-Incapacitating		Incapacitating		Killed		Injured Severity Unknown		
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Annual Crash Reduction**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-0.06372
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-0.02775
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-0.00347
3	-0.06299	0.00008	-0.01830	0.01071	-0.00936	0.03191	-0.00511	0.14437	-0.00043	0.00000	-0.00085	0.03858	-0.00127
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.00029
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.00011
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.00043

Source: National Highway Traffic Safety Administration, July 2011.

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}											
Constant Source								{3}	{4}	{5}	{6}	{7}	{8}	{9}				
								$ 3,878	$ 27,600	$ 432,400	$ 966,000	$ 2,447,200	$ 5,455,600	$ 9,200,000				
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])	
	ANNUAL REDUCTION IN CRASHES (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)								7% NPV	3% NPV	Year
YEAR	0	1	2	3	4	5	Fatal	0	1	2	3	4	5	Fatal	Total Crash Reduction Benefit	Maintenance Cost Reduction	Maintenance Cost Reduction	
2014								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			0
2015								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			1
2016								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			2
2017								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -			3
2018	-0.27680	-0.12055	-0.01508	-0.00552	-0.00127	-0.00049	-0.00185	$ 1,073	$ 3,327	$ 6,521	$ 5,332	$ 3,108	$ 2,673	$ 17,020	$ 39,055	$ 29,795	$ 34,700	4
2019	-0.26427	-0.11509	-0.01440	-0.00527	-0.00121	-0.00047	-0.00177	$ 1,025	$ 3,177	$ 6,225	$ 5,091	$ 2,967	$ 2,551	$ 16,252	$ 37,287	$ 26,585	$ 32,164	5
2020	-0.25173	-0.10963	-0.01371	-0.00502	-0.00115	-0.00045	-0.00168	$ 976	$ 3,026	$ 5,930	$ 4,849	$ 2,826	$ 2,429	$ 15,483	$ 35,519	$ 23,668	$ 29,747	6
2021	-0.23920	-0.10417	-0.01303	-0.00477	-0.00110	-0.00042	-0.00160	$ 928	$ 2,875	$ 5,635	$ 4,608	$ 2,685	$ 2,307	$ 14,715	$ 33,752	$ 21,019	$ 27,443	7
2022	-0.22666	-0.09871	-0.01235	-0.00452	-0.00104	-0.00040	-0.00152	$ 879	$ 2,725	$ 5,339	$ 4,366	$ 2,544	$ 2,185	$ 13,946	$ 31,984	$ 18,615	$ 25,249	8
2023	-0.21413	-0.09326	-0.01167	-0.00427	-0.00098	-0.00038	-0.00143	$ 830	$ 2,574	$ 5,044	$ 4,125	$ 2,403	$ 2,064	$ 13,178	$ 30,217	$ 16,436	$ 23,159	9
2024	-0.20160	-0.08780	-0.01098	-0.00402	-0.00092	-0.00036	-0.00135	$ 782	$ 2,423	$ 4,749	$ 3,883	$ 2,262	$ 1,942	$ 12,409	$ 28,449	$ 14,462	$ 21,169	10
2025	-0.18906	-0.08234	-0.01030	-0.00377	-0.00087	-0.00033	-0.00127	$ 733	$ 2,273	$ 4,453	$ 3,642	$ 2,120	$ 1,820	$ 11,641	$ 26,682	$ 12,676	$ 19,275	11
2026	-0.17653	-0.07688	-0.00962	-0.00352	-0.00081	-0.00031	-0.00118	$ 685	$ 2,122	$ 4,158	$ 3,400	$ 1,979	$ 1,698	$ 10,872	$ 24,914	$ 11,062	$ 17,474	12
2027	-0.16399	-0.07142	-0.00893	-0.00327	-0.00075	-0.00029	-0.00110	$ 636	$ 1,971	$ 3,863	$ 3,159	$ 1,838	$ 1,576	$ 10,104	$ 23,147	$ 9,605	$ 15,762	13
2028	-0.15146	-0.06596	-0.00825	-0.00302	-0.00069	-0.00027	-0.00101	$ 587	$ 1,821	$ 3,568	$ 2,917	$ 1,697	$ 1,454	$ 9,335	$ 21,379	$ 8,291	$ 14,134	14
2029	-0.13892	-0.06050	-0.00757	-0.00277	-0.00064	-0.00024	-0.00093	$ 539	$ 1,670	$ 3,272	$ 2,676	$ 1,556	$ 1,332	$ 8,567	$ 19,611	$ 7,108	$ 12,588	15
2030	-0.12639	-0.05504	-0.00688	-0.00252	-0.00058	-0.00022	-0.00085	$ 490	$ 1,519	$ 2,977	$ 2,434	$ 1,415	$ 1,210	$ 7,798	$ 17,844	$ 6,044	$ 11,120	16
2031	-0.11386	-0.04959	-0.00620	-0.00227	-0.00052	-0.00020	-0.00076	$ 441	$ 1,369	$ 2,682	$ 2,193	$ 1,274	$ 1,088	$ 7,030	$ 16,076	$ 5,089	$ 9,726	17
2032	-0.10132	-0.04413	-0.00552	-0.00202	-0.00046	-0.00018	-0.00068	$ 393	$ 1,218	$ 2,386	$ 1,951	$ 1,133	$ 966	$ 6,261	$ 14,309	$ 4,233	$ 8,405	18
2033	-0.08879	-0.03867	-0.00484	-0.00177	-0.00041	-0.00015	-0.00060	$ 344	$ 1,067	$ 2,091	$ 1,710	$ 992	$ 844	$ 5,493	$ 12,541	$ 3,468	$ 7,152	19
2034	-0.07625	-0.03321	-0.00415	-0.00152	-0.00035	-0.00013	-0.00051	$ 296	$ 917	$ 1,796	$ 1,468	$ 851	$ 722	$ 4,724	$ 10,774	$ 2,784	$ 5,965	20
2035	-0.06372	-0.02775	-0.00347	-0.00127	-0.00029	-0.00011	-0.00043	$ 247	$ 766	$ 1,500	$ 1,227	$ 710	$ 600	$ 3,956	$ 9,006	$ 2,175	$ 4,841	21
2036	-0.05119	-0.02229	-0.00279	-0.00102	-0.00023	-0.00009	-0.00035	$ 198	$ 615	$ 1,205	$ 985	$ 569	$ 478	$ 3,188	$ 7,238	$ 1,634	$ 3,778	22
2037	-0.03865	-0.01683	-0.00210	-0.00077	-0.00017	-0.00007	-0.00026	$ 150	$ 465	$ 910	$ 744	$ 428	$ 356	$ 2,419	$ 5,471	$ 1,154	$ 2,772	23
2038	-0.02612	-0.01137	-0.00142	-0.00052	-0.00012	-0.00004	-0.00018	$ 101	$ 314	$ 615	$ 502	$ 286	$ 234	$ 1,651	$ 3,703	$ 730	$ 1,822	24
2039	-0.01358	-0.00591	-0.00074	-0.00027	-0.00006	-0.00002	-0.00010	$ 53	$ 163	$ 319	$ 261	$ 145	$ 112	$ 882	$ 1,936	$ 357	$ 925	25
20-Year Project Life	**Present through 2039**															**$ 226,991**	**$ 329,369**	

Sources:

{1} The annual crash reduction benefits by AIS Rating for year 2018 are taken from cells O27 to O33 in the [Crash Reduction Analysis] tab.

{2} The annual crash reduction benefits by AIS Rating for year 2035 are taken from cells O41 to O47 in the [Crash Reduction Analysis] 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

TABLE 1 - IOWA CRASH RATE DATA

		Crash Rates per 100 Million Vehicle Miles of Travel (crashes/HMVMT)				
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 2018 CRASH RATE REDUCTION CALCULATIONS (KABCO)

	Year 2018	No Build	IH 30/IH 35W Managed Lane Access Ramp Build		Regional Crash Rate Differential (crashes/HMVMT)				
Crash Rate Code	Roadway Type	No Build Condition Daily VMT	Build Condition Daily VMT	Daily VMT Difference (Build - No Build)	Annual VMT Differential	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]	[h]	[i]	[j]	[k]
				[f] - [g]	[c] x 365	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]
C	FREEWAYS	96,264,335.04	96,279,948.02	15,612.98	5,698,737.70	0.035902048	0.18748847	0.740835901	1.424684425	4.729952291
D	PRINCIPAL ARTERIALS	41,592,775.09	41,587,544.74	-5,230.35	-1,909,077.75	-0.035508846	-0.177162415	-0.515450993	-0.7636311	-3.913609388
E	MINOR ARTERIALS	38,721,451.80	38,715,800.95	-5,650.85	-2,062,560.25	-0.043107509	-0.159023395	-0.474388857	-0.721896087	-3.011337965
F	COLLECTORS	14,105,993.98	14,092,118.83	-13,875.15	-5,064,429.75	-0.139271818	-0.426424985	-1.01288595	-1.21546314	-5.368295535
C	FREEWAY RAMPS	7,674,378.17	7,651,590.23	-22,787.94	-8,317,598.10	-0.052400868	-0.273648977	-1.081287753	-2.079399525	-6.903606423
D	FRONTAGE ROADS	8,092,480.84	8,064,497.15	-27,983.69	-10,214,046.85	-0.189981271	-0.947863548	-2.757792649	-4.08561874	-20.93879604
C	HOV LANES	2,046,211.94	2,100,550.71	54,338.77	19,833,651.05	0.124952002	0.65252712	2.578374637	4.958412763	16.46193037
TOTALS		208,497,626.86	208,492,050.63	-5,576.23		-0.299416	-1.144108	-2.522596	-2.482911	-18.943763
					Crash Rate Reduction (crashes/HMVMT)	-3.93453E-12	-1.50343E-11	-3.31486E-11	-3.26271E-11	-2.48934E-10
					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 2018 CRASH RATE REDUCTION CALCULATIONS (AIS)

KABCO Type →	**KABCO Accident Classification System**												
	O		**C**		**B**		**A**		**K**		**U**		
	No Injury		**Possible Injury**		**Non-Incapacitating**		**Incapacitating**		**Killed**		**Injured Severity Unknown**		**Crash Rate Reduction**
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**(crashes/HMVMT)**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	-18.31407
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	-5.50506
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	-0.80985
3	-18.94376	0.00008	0.00000	0.01071	-2.52260	0.03191	-1.14411	0.14437	-0.29942	0.00000	-2.48291	0.03858	-0.34298
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	-0.07222
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	-0.04919
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	-0.29942

Source: National Highway Traffic Safety Administration, July 2011.

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

	Year 2035	No Build	IH 30/IH 35W Managed Lane Access Ramp Build		Regional Crash Rate Differential (crashes/HMVMT)				
Crash Rate Code	Roadway Type	No Build Condition Daily VMT	Build Condition Daily VMT	Daily VMT Difference (Build - No Build)	Annual VMT Differential	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]	[h]	[i]	[j]	[k]
				[f] - [g]	[c] x 365	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]	ROW[a]=TABLE 1,ROW[a]
C	FREEWAYS	125,637,648.04	125,635,568.62	-2,079.42	-758,988.30	-0.004781626	-0.024970715	-0.098668479	-0.189747075	-0.629960289
D	PRINCIPAL ARTERIALS	55,450,162.01	55,438,594.07	-11,567.94	-4,222,298.10	-0.078534745	-0.391829264	-1.140020487	-1.68891924	-8.655711105
E	MINOR ARTERIALS	54,757,527.81	54,758,700.23	1,172.42	427,933.30	0.008943806	0.032993657	0.098424659	0.149776655	0.624782618
F	COLLECTORS	20,631,759.38	20,633,987.85	2,228.47	813,391.55	0.022368268	0.068487569	0.16267831	0.195213972	0.862195043
C	FREEWAY RAMPS	10,342,214.90	10,348,191.95	5,977.05	2,181,623.25	0.013744226	0.071775405	0.283611022	0.545405812	1.810747297
D	FRONTAGE ROADS	11,142,795.87	11,152,623.29	9,827.42	3,587,008.30	0.066718354	0.33287437	0.968492241	1.43480332	7.353367015
C	HOV LANES	3,618,473.40	3,621,668.22	3,194.82	1,166,109.30	0.007346489	0.038364996	0.151594209	0.291527325	0.967870719
TOTALS		281,580,581.41	281,589,334.23	8,752.82		0.035805	0.127696	0.426111	0.738061	2.333291
					Crash Rate Reduction (crashes/HMVMT)	3.48363E-13	1.24242E-12	4.14586E-12	7.18097E-12	2.27018E-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**												
	O		**C**		**B**		**A**		**K**		**U**		
	No Injury		**Possible Injury**		**Non-Incapacitating**		**Incapacitating**		**Killed**		**Injured Severity Unknown**		**Crash Rate Reduction**
AIS Rating System	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**Number**	**Factor**	**(crashes/HMVMT)**
0		0.92534		0.23437		0.08347		0.03437		0.00000		0.21538	2.35801
1		0.07257		0.68946		0.76843		0.55449		0.00000		0.62728	1.03054
2		0.00198		0.06391		0.10898		0.20908		0.00000		0.10400	0.15451
3	2.33329	0.00008	0.00000	0.01071	0.42611	0.03191	0.12770	0.14437	0.03580	0.00000	0.73806	0.03858	0.06069
4		0.00000		0.00142		0.00620		0.03986		0.00000		0.00442	0.01099
5		0.00003		0.00013		0.00101		0.01783		0.00000		0.01034	0.01041
Fatal		0.00000		0.00000		0.00000		0.00000		1.00000		0.00000	0.03580

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}											
Constant Source								{3}	{4}	{5}	{6}	{7}	{8}	{9}				
								$ 3,878	$ 27,600	$ 432,400	$ 966,000	$ 2,447,200	$ 5,455,600	$ 9,200,000				
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])	
	CRASH RATE REDUCTION (BY AIS Rating Category)							ANNUAL CRASH REDUCTION BENEFIT (BY AIS Rating Category)								7% NPV	3% NPV	
															Total Crash	Maintenance	Maintenance	
															Reduction	Cost	Cost	
YEAR	**0**	**1**	**2**	**3**	**4**	**5**	**Fatal**	**0**	**1**	**2**	**3**	**4**	**5**	**Fatal**	**Benefit**	**Reduction**	**Reduction**	**Year**
2014								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0
2015								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	1
2016								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	2
2017								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	3
2018	-18.31407	-5.50506	-0.80985	-0.34298	-0.07222	-0.04919	-0.29942	$ 71,015	$ 151,940	$ 350,181	$ 331,316	$ 176,734	$ 268,355	$ 2,754,630	$ 4,104,169	$ 3,131,051	$ 3,646,501	4
2019	-17.09807	-5.12062	-0.75313	-0.31923	-0.06732	-0.04568	-0.27970	$ 66,300	$ 141,329	$ 325,652	$ 308,378	$ 164,755	$ 249,229	$ 2,573,216	$ 3,828,858	$ 2,729,923	$ 3,302,807	5
2020	-15.88207	-4.73617	-0.69640	-0.29549	-0.06243	-0.04218	-0.25998	$ 61,584	$ 130,718	$ 301,123	$ 285,440	$ 152,776	$ 230,103	$ 2,391,802	$ 3,553,547	$ 2,367,878	$ 2,976,039	6
2021	-14.66606	-4.35172	-0.63967	-0.27174	-0.05753	-0.03867	-0.24026	$ 56,869	$ 120,108	$ 276,594	$ 262,502	$ 140,797	$ 210,977	$ 2,210,388	$ 3,278,235	$ 2,041,520	$ 2,665,505	7
2022	-13.45006	-3.96727	-0.58294	-0.24800	-0.05264	-0.03517	-0.22054	$ 52,154	$ 109,497	$ 252,065	$ 239,564	$ 128,819	$ 191,851	$ 2,028,975	$ 3,002,924	$ 1,747,729	$ 2,370,536	8
2023	-12.23405	-3.58283	-0.52622	-0.22425	-0.04774	-0.03166	-0.20082	$ 47,439	$ 98,886	$ 227,536	$ 216,626	$ 116,840	$ 172,725	$ 1,847,561	$ 2,727,613	$ 1,483,641	$ 2,090,488	9
2024	-11.01805	-3.19838	-0.46949	-0.20051	-0.04285	-0.02815	-0.18110	$ 42,724	$ 88,275	$ 203,007	$ 193,688	$ 104,861	$ 153,599	$ 1,666,147	$ 2,452,301	$ 1,246,626	$ 1,824,743	10
2025	-9.80204	-2.81393	-0.41276	-0.17676	-0.03795	-0.02465	-0.16138	$ 38,009	$ 77,665	$ 178,478	$ 170,750	$ 92,883	$ 134,473	$ 1,484,733	$ 2,176,990	$ 1,034,272	$ 1,572,704	11
2026	-8.58604	-2.42949	-0.35603	-0.15301	-0.03306	-0.02114	-0.14167	$ 33,293	$ 67,054	$ 153,949	$ 147,812	$ 80,904	$ 115,347	$ 1,303,320	$ 1,901,679	$ 844,368	$ 1,333,799	12
2027	-7.37003	-2.04504	-0.29931	-0.12927	-0.02816	-0.01764	-0.12195	$ 28,578	$ 56,443	$ 129,420	$ 124,874	$ 68,925	$ 96,222	$ 1,121,906	$ 1,626,367	$ 674,885	$ 1,107,477	13
2028	-6.15403	-1.66059	-0.24258	-0.10552	-0.02327	-0.01413	-0.10223	$ 23,863	$ 45,832	$ 104,891	$ 101,936	$ 56,946	$ 77,096	$ 940,492	$ 1,351,056	$ 523,963	$ 893,207	14
2029	-4.93802	-1.27614	-0.18585	-0.08178	-0.01838	-0.01063	-0.08251	$ 19,148	$ 35,222	$ 80,362	$ 78,998	$ 44,968	$ 57,970	$ 759,079	$ 1,075,745	$ 389,899	$ 690,480	15
2030	-3.72202	-0.89170	-0.12912	-0.05803	-0.01348	-0.00712	-0.06279	$ 14,433	$ 24,611	$ 55,833	$ 56,060	$ 32,989	$ 38,844	$ 577,665	$ 800,433	$ 271,135	$ 498,804	16
2031	-2.50601	-0.50725	-0.07240	-0.03429	-0.00859	-0.00361	-0.04307	$ 9,717	$ 14,000	$ 31,304	$ 33,122	$ 21,010	$ 19,718	$ 396,251	$ 525,122	$ 166,240	$ 317,708	17
2032	-1.29001	-0.12280	-0.01567	-0.01054	-0.00369	-0.00011	-0.02335	$ 5,002	$ 3,389	$ 6,775	$ 10,184	$ 9,031	$ 592	$ 214,837	$ 249,811	$ 73,910	$ 146,738	18
2033	-0.07400	0.26165	0.04106	0.01320	0.00120	0.00340	-0.00363	$ 287	$ (7,221)	$ (17,754)	$ (12,754)	$ (2,947)	$ (18,534)	$ 33,424	$ (25,500)	$ (7,051)	$ (14,543)	19
2034	1.14200	0.64609	0.09779	0.03695	0.00610	0.00690	0.01609	$ (4,428)	$ (17,832)	$ (42,283)	$ (35,692)	$ (14,926)	$ (37,660)	$ (147,990)	$ (300,812)	$ (77,735)	$ (166,552)	20
2035	2.35801	1.03054	0.15451	0.06069	0.01099	0.01041	0.03580	$ (9,143)	$ (28,443)	$ (66,812)	$ (58,630)	$ (26,905)	$ (56,786)	$ (329,404)	$ (576,123)	$ (139,141)	$ (309,695)	21
2036	3.57401	1.41499	0.21124	0.08444	0.01589	0.01391	0.05552	$ (13,859)	$ (39,054)	$ (91,341)	$ (81,568)	$ (38,883)	$ (75,912)	$ (510,818)	$ (851,434)	$ (192,180)	$ (444,357)	22
2037	4.79002	1.79944	0.26797	0.10818	0.02078	0.01742	0.07524	$ (18,574)	$ (49,664)	$ (115,870)	$ (104,506)	$ (50,862)	$ (95,038)	$ (692,231)	$ (1,126,746)	$ (237,684)	$ (570,913)	23
2038	6.00602	2.18388	0.32470	0.13193	0.02568	0.02093	0.09496	$ (23,289)	$ (60,275)	$ (140,399)	$ (127,444)	$ (62,841)	$ (114,164)	$ (873,645)	$ (1,402,057)	$ (276,411)	$ (689,719)	24
2039	7.22203	2.56833	0.38142	0.15568	0.03057	0.02443	0.11468	$ (28,004)	$ (70,886)	$ (164,928)	$ (150,382)	$ (74,820)	$ (133,290)	$ (1,055,059)	$ (1,677,368)	$ (309,054)	$ (801,121)	25
20-Year Project Life Present through 2039																**$ 17,487,784**	**$ 22,440,637**	

Sources:

{1} The annual crash reduction benefits by AIS Rating for year 2018 are taken from cells O27 to O33 in the [Crash Reduction Analysis] tab.
{2} The annual crash reduction benefits by AIS Rating for year 2035 are taken from cells O41 to O47 in the [Crash Reduction Analysis] 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	Direct User Cost Paid in Tolls	Travel Time 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	$ (1,056,563)	$ -	$ -	$ -	$ -	$ (1,056,563)	$ (987,442)	$ (1,025,789)
2	2016	$ (5,441,206)	$ -	$ -	$ -	$ -	$ (5,441,206)	$ (4,752,560)	$ (5,128,859)
3	2017	$ (13,876,673)	$ -	$ -	$ -	$ -	$ (13,876,673)	$ (11,327,499)	$ (12,699,122)
4	2018	$ (4,625,558)	$ (1,340,691)	$ 3,954,384	$ 39,055	$ 4,104,169	$ 2,131,360	$ 1,626,004	$ 1,893,686
5	2019	$ -	$ (1,292,637)	$ 3,842,474	$ 37,287	$ 3,828,858	$ 6,415,982	$ 4,574,507	$ 5,534,483
6	2020	$ -	$ (1,244,583)	$ 3,730,564	$ 35,519	$ 3,553,547	$ 6,075,047	$ 4,048,060	$ 5,087,756
7	2021	$ -	$ (1,196,529)	$ 3,618,653	$ 33,752	$ 3,278,235	$ 5,734,112	$ 3,570,917	$ 4,662,357
8	2022	$ -	$ (1,148,475)	$ 3,506,743	$ 31,984	$ 3,002,924	$ 5,393,176	$ 3,138,878	$ 4,257,423
9	2023	$ -	$ (1,100,421)	$ 3,394,833	$ 30,217	$ 2,727,613	$ 5,052,241	$ 2,748,084	$ 3,872,122
10	2024	$ -	$ (1,052,367)	$ 3,282,922	$ 28,449	$ 2,452,301	$ 4,711,306	$ 2,394,989	$ 3,505,654
11	2025	$ -	$ (1,004,314)	$ 3,171,012	$ 26,682	$ 2,176,990	$ 4,370,370	$ 2,076,331	$ 3,157,248
12	2026	$ -	$ (956,260)	$ 3,059,102	$ 24,914	$ 1,901,679	$ 4,029,435	$ 1,789,117	$ 2,826,165
13	2027	$ -	$ (908,206)	$ 2,947,191	$ 23,147	$ 1,626,367	$ 3,688,500	$ 1,530,596	$ 2,511,689
14	2028	$ -	$ (860,152)	$ 2,835,281	$ 21,379	$ 1,351,056	$ 3,347,564	$ 1,298,243	$ 2,213,134
15	2029	$ -	$ (812,098)	$ 2,723,371	$ 19,611	$ 1,075,745	$ 3,006,629	$ 1,089,741	$ 1,929,841
16	2030	$ -	$ (764,044)	$ 2,611,461	$ 17,844	$ 800,433	$ 2,665,694	$ 902,963	$ 1,661,172
17	2031	$ -	$ (715,990)	$ 2,499,550	$ 16,076	$ 525,122	$ 2,324,758	$ 735,959	$ 1,406,517
18	2032	$ -	$ (667,937)	$ 2,387,640	$ 14,309	$ 249,811	$ 1,983,823	$ 586,942	$ 1,165,287
19	2033	$ -	$ (619,883)	$ 2,275,730	$ 12,541	$ (25,500)	$ 1,642,888	$ 454,272	$ 936,916
20	2034	$ -	$ (571,829)	$ 2,163,819	$ 10,774	$ (300,812)	$ 1,301,952	$ 336,449	$ 720,859
21	2035	$ -	$ (577,955)	$ 2,051,909	$ 9,006	$ (576,123)	$ 906,837	$ 219,013	$ 487,470
22	2036	$ -	$ (577,955)	$ 1,939,999	$ 7,238	$ (851,434)	$ 517,848	$ 116,885	$ 270,261
23	2037	$ -	$ (577,955)	$ 1,828,088	$ 5,471	$ (1,126,746)	$ 128,859	$ 27,182	$ 65,292
24	2038	$ -	$ (577,955)	$ 1,716,178	$ 3,703	$ (1,402,057)	$ (260,130)	$ (51,284)	$ (127,967)
25	2039	$ -	$ (577,955)	$ 1,604,268	$ 1,936	$ (1,677,368)	$ (649,120)	$ (119,600)	$ (310,023)
20-Year Project Life	**Present through 2039**							**$ 16,026,748**	**$ 28,873,572**

Sources: {1} Data from [Project Cost : Column F]
{2} Data from [Direct User Cost : Column H]
{3} Data from [Travel Time : Column D]
{4} Data from [Geometric Crash Reduction : Column P]
{5} Data from [Regional Crash Reduction : Column P]