

Benefit-Cost Analysis Technical Report

I-35 & SH 74 in Purcell, OK

Introduction

The information provided in this technical report describes the assumptions, inputs, calculations, and results of the benefit-cost analysis (BCA) for this proposed project. The analysis was conducted in accordance with the *Benefit-Cost Analysis Guidance for Discretionary Grant Programs (March 2022, Revised)*, hereafter known as the Guidance.

By replacing the I-35 bridges over SH 74, the proposed project will accommodate future widening of I-35, allow for an interchange to improve access for the Purcell community, allow for greater emergency access for a stretch of I-35 that has over four miles between interchange (one of which is a partial interchange), and allows for multimodal connectivity within the community along SH 74. The following benefits were categorized and quantified in this BCA:

- Travel Time Benefits
- Vehicle Operating Cost Benefits
- Emissions Benefits
- Safety Benefits
- Pedestrian Improvement Benefits
- Cycling Improvement Benefits
- Active Transportation Benefits
- Emergency Services Benefits
- Operations and Maintenance
- Residual Value
- Capital Costs

Other benefits that could not be quantified are also described qualitatively in this report.

Assumptions and Inputs

General BCA assumptions and inputs include the following:

- All dollars assume 2020 as the base year.
- All future benefits and costs beyond the base year are discounted at 7%, except for carbon dioxide emissions that are discounted at 3%.
- The time period begins in 2019, the first year of the project expenditures. For future years, the analysis period is capped at 30 years from anticipated completion. Since the project is anticipated to be complete and open to traffic at the beginning of the year 2027, the study time period ends at the end of the year 2056.

Additional BCA assumptions and inputs that were used in the development of this analysis are provided below. Many of the assumptions were provided by ODOT from the July 2022 Access Justification Report (AJR) for this project.

Traffic Assumptions

In order to quantify project benefits for automobile travel, two parts of the methodology adopted from the July 2022 AJR was considered. First, traditional trip diversion due to the new interchange as part of the project was considered. Second, the anticipated reduced impact to I-35 traffic with improved emergency access due to the interchange was also considered.

To determine traditional trip diversion on the new proposed network, 2045 traffic data provided in the AJR was used. Both roadway segments were studied, I-35 and SH-74. It was assumed a linear growth rate of 1.5% for traffic on I-35, and 2.0% for traffic on SH-74 per the July 2022 AJR.

To estimate the traffic projected in the proposed network, the AJR provided existing 2025 ADT data. In this BCA analysis, year 2020 is considered as No-Build condition, while 2045 was assumed as the Build condition. Therefore, the data available required to be reduced, at a linear rate, to year 2020 for existing traffic conditions and forecasted to year 2045 at a linear rate for proposed traffic conditions. To assess between No-Build and Build, two pieces of data were included in the calculations (1) baseline traffic, and (2) interchange improvements generated traffic. Baseline traffic was obtained by applying a linear rate reduction using the rates above, this volume is also considered No-Build conditions. Meanwhile, to obtain the interchange improvement generated traffic, the traffic volumes generated by the ramp traffic was added to the baseline traffic; thus, resulting in the traffic project for Build conditions. See **Appendix A** for more details.

The second piece of the methodology revolves around estimation of reduced congestion due to incidents on I-35 with the improved emergency access. In order to determine this estimate, the Federal Highway Administration (FHWA) Traffic Incident Management (TIM) BCA Tool (version 2.0) was used. The "Dispatch Colocation" module was used and modified for this project, assuming the change was an improvement of 7 minutes per the July 2022 AJR. It should be noted that reasonable assumptions were made with respect to distribution of traffic and incident durations. Also, the tool only applies to 6-lane highways or more, so 6 lanes (or 3 per direction) was assumed. The TIM-BCA tool inputs and outputs for this project are provided in **Appendix B**.

Safety Assumptions

The safety information from the July 2022 AJR (or more specifically, Appendix A to the AJR which is the Alternative Analysis Report/Transportation Feasibility Study Report) is used to estimate safety benefits, which is based on before and after predictive safety performance of I-35 due to the proposed project. According to Table 12 from Appendix A of the AJR, the expected crash reduction is 1.3 crashes per year (35.54 versus 33.24). A crash modification factor (CMF) was estimated based on this predicted reduction = 0.96. See **Equation 1** and **Equation 2**.

$$CRF = \frac{2045 \text{ Crashes Per Year}_{proposed}}{2045 \text{ Crashes Per Year}_{existing}}^{-1} = \frac{33.24^{-1}}{34.54} = 1.039, \text{ then } CRF = 3.9\% \quad \text{Equation 1}$$

$$CMF = 1 - CRF = 1 - \frac{3.9}{100} = 0.961 \quad \text{Equation 2}$$

This CMF was then applied to the average number of annual crashes in the before (existing or no-build) condition. Based on Table 18 from the AJR Appendix A, there were an average of 13.2 crashes per year

on I-35 in the study area. The study area assumed for the basis of Table 18 is from the emergency crossover on I-35 north of the project area to the emergency crossover south of the project area, a distance of approximately 1.7 miles. Using this CMF, the expected number of crashes is 12.67 per year. The severity distribution is assumed to be the same in the before condition (using Table 18 from the AJR Appendix A) as the after (or build) condition.

Bicycle and Pedestrian Assumptions

Sidewalks nor paved shoulders are present along SH 74 for bicyclists or pedestrians to utilize. The proposed project will include a shared-use path to accommodate active transportation users, connecting the Purcell community on both sides of I-35. The new bridges will allow for sufficient clearance to provide this shared-use path through the interchange. Purcell schools, library, neighborhoods and the municipal hospital will enjoy greater connectivity with this project.

To estimate bicyclists and pedestrian usage with the proposed project, the US Census American Community Survey (ACS) data was queried. Census Tract 4003 was used, which represents the City of Purcell in McClain County. ACS data table S0801 was referenced. According to the ACS data, pedestrian mode share for commuters is 1.3%, while bicyclists were estimated at 0.0%. To understand the scale of the pedestrian percentage, this comes out to about 30 pedestrians per day (2,280 total estimated commuters in the tract).

It's understood that not all bicyclist and pedestrians are commuters. According to a Statista report (<https://www.statista.com/topics/1686/cycling/>), 12.4% of Americans bicycle on a regular basis. According to a Live Strong article (<https://www.livestrong.com/article/13730338-running-statistics/>) that references a 2020 report from the Sports & Fitness Industry Association, 15% of Americans jog on a regular basis.

With this in mind, it is assumed in this BCA that there will be increased bicycle and pedestrian usage as a result of the proposed project, estimated at 5.0% (pedestrian) and 1.0% (bicyclists) on average.

Emergency Response Assumptions

The July 2022 AJR reviewed estimated emergency response times for crashes that occur on I-35 in the project area, with and without the project. According to Table 17 of the AJR Appendix A, the average no-build response time is estimated at 11.9 minutes. This compares to an average response time of 4.8 minutes with the proposed project (a difference of 7.1 minutes on average).

According to Table 18 of the AJR Appendix A, there was one fatal and eight injury crashes in the five years (2015-2019) analyzed along I-35 near the project area that would benefit from the increased access provided by the project. To estimate the emergency response benefits, fatalities and serious injuries are considered. Because the AJR does not provide the number of injuries that resulted in a serious injury, it is assumed that two of the eight was serious. As a result, it was assumed that the average fatal and serious injuries per year that may benefit from improved emergency access is 0.6 per year.

The Guidance refers to the Federal Emergency Management Agency (FEMA) BCA guidance (Version 6.0, 2011) to quantify benefits resulting from improved emergency access. Because the FEMA BCA guide does not have an explicitly defined methodology directly applicable to this situation, a slightly modified methodology was used. The FEMA BCA Loss of Emergency Medical Services methodology was adapted for this case. The Purcell Municipal Hospital, located at the east end of the proposed project at the

corner of SH 74 and Green Avenue, is a designated Level 4 trauma center, providing basic 24-hour emergency services for stabilization and transfer to more specialized centers. Patients involved in severe crashes on nearby I-35 would likely be transported or served by this hospital, as well as the nearby emergency medical service (EMS) located in downtown Purcell (Wadley's EMS).

Travel Time Benefits

To define the reduced VHT for every year from 2027 through 2056 for the No-Build and Build conditions, travel time was estimated based on the traffic assumptions outlined earlier. Specifically, estimates were made about the regions near the proposed interchange that would benefit from the reduced travel time afforded by the increased access.

Origin-Destination Road segments were modeled to represent the approximate reduced travel distances that travelers in those regions would achieve because of the construction of the interchange. Ramps and ramp terminal traffic volume estimates were based on the Build (2045) interchange traffic volumes contained in the AJR. The traffic volumes were split into passenger vehicles and trucks. It was assumed that trucks represented 5% of the total volume and the remaining 95% was allocated to passenger vehicles. To estimate the reduced diversion of the 14,878 trips per year for passenger vehicles and 864 trips per year for trucks, common points were assumed to estimate VMT and VHT differences. The points are a simplified representation of the origins and destinations of trips. The parameters used for VHT and VMT calculations include daily traffic volume utilizing the segments modeled, estimated travel times (in minutes) using a typical Thursday (Thursday, August 25, 2022) at 1:30pm for departure, and trip length (in miles). For the proposed ramps and ramp terminals, a one-minute travel time and 0.3-mile distance was assumed. All other travel times were based on the results from Google Maps. When a range of travel time estimates was given, then an average (or median) was used.

To determine travel time savings, the VHT for each year from 2027 through 2056 for the No-Build and Build conditions was calculated. Because the traffic volumes used for the VHT calculation were performed using 2045 traffic design data from the AJR, the VHTs for the period before 2045 was reduced by 0.5% using a linear traffic growth rate to best represent existing travel conditions. Then, for VHT values on and beyond 2045 were assumed to increase by 1% using a linear traffic growth rate until the end of 2056 values.

The difference in the No-Build and Build VHTs for each year was calculated for both passenger vehicles and trucks. To calculate the monetary travel time savings, default values for vehicle occupancy and value of time from the Guidance were used. In the Guidance, Table A-4 shows a default value of 1.67 for passenger vehicles including all trips and recommends a one driver per truck occupancy rate. The value of time for passenger vehicles and trucks were taken from the Guidance, Table A-3 as \$17.80 per hour and \$32.00 per hour, respectively. The value of time was then multiplied with the occupancy annual VHT difference by year to estimate the total travel time savings benefits for passenger vehicles and trucks. The undiscounted dollars for each year were discounted at 7% per Guidance.

To determine travel time savings due to improved emergency response times with the proposed project due to incidents on I-35, the VHT for each year for the same years for the No-Build and Build conditions was calculated. The occupancy factor and value of time were the same for these calculations. The undiscounted benefits were then calculated for each year, then discounted at 7% per Guidance.

The discounted benefits for each year for all four categories were then added together for each year then totaled. See **Table 1**.

Table 1 – Travel Time Benefits

Year	Travel Time Savings - Passenger Vehicles				Travel Time Savings - Trucks				I-35 Incidents Travel Time Savings - Passenger Vehicles				I-35 Incidents Travel Time Savings - Trucks				Total Travel Time Savings
	Annual VHT Difference	Occupancy Annual VHT Difference	Annual Travel Time Savings (Undiscounted)	Annual Travel Time Savings (7% Discount) ²	Annual VHT Difference	Occupancy Annual VHT Difference	Annual Travel Time Savings (Undiscounted)	Annual Travel Time Savings (7% Discount) ²	Annual VHT Difference	Occupancy Annual VHT Difference	Annual Travel Time Savings (Undiscounted)	Annual Travel Time Savings (7% Discount) ²	Annual VHT Difference	Occupancy Annual VHT Difference	Annual Travel Time Savings (Undiscounted)	Annual Travel Time Savings (7% Discount) ²	Annual Travel Time Savings (7% Discount) ²
2019	Project Development and Construction Phases ¹				Project Development and Construction Phases ¹				Project Development and Construction Phases ¹				Project Development and Construction Phases ¹				\$ -
2020	Project Development and Construction Phases ¹				Project Development and Construction Phases ¹				Project Development and Construction Phases ¹				Project Development and Construction Phases ¹				\$ -
2021	13191.50				766.45												\$ -
2022	13257.79				770.30												\$ -
2023	13324.41				774.17												\$ -
2024	13391.37				778.06												\$ -
2025	13458.66				781.97												\$ -
2026	13526.29				785.90				404.23				170.48				\$ -
2027	13594.26	22,702.42	\$ 404,103	\$ 251,655	789.85	789.85	\$ 25,275	\$ 15,740	467.58	780.86	\$ 13,899	\$ 8,656	183.01	183.01	\$ 5,856	\$ 3,647	\$ 279,698
2028	13662.57	22,816.50	\$ 406,134	\$ 236,374	793.82	793.82	\$ 25,402	\$ 14,784	499.26	833.76	\$ 14,841	\$ 8,638	189.27	189.27	\$ 6,057	\$ 3,525	\$ 263,320
2029	13731.23	22,931.16	\$ 408,175	\$ 222,020	797.80	797.80	\$ 25,530	\$ 13,886	530.94	886.66	\$ 15,783	\$ 8,585	195.53	195.53	\$ 6,257	\$ 3,403	\$ 247,895
2030	13800.23	23,046.39	\$ 410,226	\$ 208,538	801.81	801.81	\$ 25,658	\$ 13,043	562.61	939.56	\$ 16,724	\$ 8,502	201.80	201.80	\$ 6,457	\$ 3,283	\$ 233,366
2031	13869.58	23,162.20	\$ 412,287	\$ 195,875	805.84	805.84	\$ 25,787	\$ 12,251	594.29	992.46	\$ 17,666	\$ 8,393	208.06	208.06	\$ 6,658	\$ 3,163	\$ 219,682
2032	13939.28	23,278.59	\$ 414,359	\$ 183,980	809.89	809.89	\$ 25,917	\$ 11,507	625.97	1,045.36	\$ 18,607	\$ 8,262	214.32	214.32	\$ 6,858	\$ 3,045	\$ 206,795
2033	14009.32	23,395.57	\$ 416,441	\$ 172,808	813.96	813.96	\$ 26,047	\$ 10,808	657.64	1,098.26	\$ 19,549	\$ 8,112	220.58	220.58	\$ 7,059	\$ 2,929	\$ 194,658
2034	14079.72	23,513.13	\$ 418,534	\$ 162,315	818.05	818.05	\$ 26,178	\$ 10,152	689.32	1,151.16	\$ 20,491	\$ 7,947	226.85	226.85	\$ 7,259	\$ 2,815	\$ 183,229
2035	14150.47	23,631.29	\$ 420,637	\$ 152,458	822.16	822.16	\$ 26,309	\$ 9,536	721.00	1,204.06	\$ 21,432	\$ 7,768	233.11	233.11	\$ 7,460	\$ 2,704	\$ 172,466
2036	14221.58	23,750.04	\$ 422,751	\$ 143,200	826.29	826.29	\$ 26,441	\$ 8,957	752.67	1,256.96	\$ 22,374	\$ 7,579	239.37	239.37	\$ 7,660	\$ 2,595	\$ 162,330
2037	14293.05	23,869.39	\$ 424,875	\$ 134,505	830.45	830.45	\$ 26,574	\$ 8,413	784.35	1,309.86	\$ 23,316	\$ 7,381	245.64	245.64	\$ 7,860	\$ 2,488	\$ 152,787
2038	14364.87	23,989.34	\$ 427,010	\$ 126,337	834.62	834.62	\$ 26,708	\$ 7,902	816.02	1,362.76	\$ 24,257	\$ 7,177	251.90	251.90	\$ 8,061	\$ 2,385	\$ 143,800
2039	14437.06	24,109.88	\$ 429,156	\$ 118,665	838.81	838.81	\$ 26,842	\$ 7,422	847.70	1,415.66	\$ 25,199	\$ 6,968	258.16	258.16	\$ 8,261	\$ 2,284	\$ 135,339
2040	14509.60	24,231.04	\$ 431,313	\$ 111,459	843.03	843.03	\$ 26,977	\$ 6,971	879.38	1,468.56	\$ 26,140	\$ 6,755	264.43	264.43	\$ 8,462	\$ 2,187	\$ 127,373
2041	14582.52	24,352.80	\$ 433,480	\$ 104,691	847.27	847.27	\$ 27,113	\$ 6,548	911.05	1,521.46	\$ 27,082	\$ 6,541	270.69	270.69	\$ 8,662	\$ 2,092	\$ 119,872
2042	14655.80	24,475.18	\$ 435,658	\$ 98,334	851.52	851.52	\$ 27,249	\$ 6,150	942.73	1,574.36	\$ 28,024	\$ 6,325	276.95	276.95	\$ 8,862	\$ 2,000	\$ 112,810
2043	14729.44	24,598.17	\$ 437,847	\$ 92,363	855.80	855.80	\$ 27,386	\$ 5,777	974.41	1,627.26	\$ 28,965	\$ 6,110	283.21	283.21	\$ 9,063	\$ 1,912	\$ 106,161
2044	14803.46	24,721.78	\$ 440,048	\$ 86,754	860.10	860.10	\$ 27,523	\$ 5,426	1,006.08	1,680.16	\$ 29,907	\$ 5,896	289.48	289.48	\$ 9,263	\$ 1,826	\$ 99,902
2045	14877.85	24,846.01	\$ 442,259	\$ 81,486	864.43	864.43	\$ 27,662	\$ 5,097	1,037.76	1,733.06	\$ 30,848	\$ 5,684	295.74	295.74	\$ 9,464	\$ 1,744	\$ 94,010
2046	15026.63	25,094.47	\$ 446,682	\$ 76,917	873.07	873.07	\$ 27,938	\$ 4,811	1,069.44	1,785.96	\$ 31,790	\$ 5,474	302.00	302.00	\$ 9,664	\$ 1,664	\$ 88,866
2047	15101.76	25,219.94	\$ 448,915	\$ 72,244	881.80	881.80	\$ 28,218	\$ 4,541	1,101.11	1,838.86	\$ 32,732	\$ 5,268	308.27	308.27	\$ 9,865	\$ 1,587	\$ 83,640
2048	15177.27	25,346.04	\$ 451,160	\$ 67,855	890.62	890.62	\$ 28,500	\$ 4,286	1,132.79	1,891.76	\$ 33,673	\$ 5,065	314.53	314.53	\$ 10,065	\$ 1,514	\$ 78,720
2049	15253.16	25,472.77	\$ 453,415	\$ 63,733	899.52	899.52	\$ 28,785	\$ 4,046	1,164.47	1,944.66	\$ 34,615	\$ 4,866	320.79	320.79	\$ 10,265	\$ 1,443	\$ 74,088
2050	15329.42	25,600.14	\$ 455,682	\$ 59,862	908.52	908.52	\$ 29,073	\$ 3,819	1,196.14	1,997.56	\$ 35,557	\$ 4,671	327.06	327.06	\$ 10,466	\$ 1,375	\$ 69,727
2051	15406.07	25,728.14	\$ 457,961	\$ 56,225	917.60	917.60	\$ 29,363	\$ 3,605	1,227.82	2,050.46	\$ 36,498	\$ 4,481	333.32	333.32	\$ 10,666	\$ 1,310	\$ 65,621
2052	15483.10	25,856.78	\$ 460,251	\$ 52,810	926.78	926.78	\$ 29,657	\$ 3,403	1,259.50	2,103.36	\$ 37,440	\$ 4,296	339.58	339.58	\$ 10,867	\$ 1,247	\$ 61,755
2053	15560.52	25,986.06	\$ 462,552	\$ 49,602	936.05	936.05	\$ 29,954	\$ 3,212	1,291.17	2,156.26	\$ 38,381	\$ 4,116	345.84	345.84	\$ 11,067	\$ 1,187	\$ 58,116
2054	15638.32	26,115.99	\$ 464,865	\$ 46,588	945.41	945.41	\$ 30,253	\$ 3,032	1,322.85	2,209.16	\$ 39,323	\$ 3,941	352.11	352.11	\$ 11,267	\$ 1,129	\$ 54,691
2055	15716.51	26,246.57	\$ 467,189	\$ 43,758	954.86	954.86	\$ 30,556	\$ 2,862	1,354.53	2,262.06	\$ 40,265	\$ 3,771	358.37	358.37	\$ 11,468	\$ 1,074	\$ 51,466
2056	15795.09	26,377.80	\$ 469,525	\$ 41,100	964.41	964.41	\$ 30,861	\$ 2,701	1,386.20	2,314.96	\$ 41,206	\$ 3,607	364.63	364.63	\$ 11,668	\$ 1,021	\$ 48,430
TOTAL																\$ 3,990,611	
Notes:																	
¹ Although Project Development and Construction Phases are assumed through 2026, calculations are shown starting in the year 2021 or 2025 for this table's purpose.																	
² Base year dollars is 2020 per USDOT BCA Guidance (Mar 2022).																	

Vehicle Operating Cost Benefits

To calculate vehicle operating cost savings, the annual vehicle miles traveled (VMT) for the period of 2027 through 2056 for both the No-Build and Build conditions were calculated using the traffic assumptions described earlier in this memo. The annual VMT difference in 2045 was estimated for both passenger vehicles and trucks. Then, similar to the VHTs, the VMTs for the period before 2045 were reduced by 0.5% using a linear traffic growth rate to best represent existing travel conditions. The VMT values on and beyond 2045 were assumed to increase by 1% using a linear traffic growth rate until the end of 2056 values. This step was done to calculate the differences in the No-Build VMT and Build VMT for each year.

To calculate the monetary vehicle operating cost savings, default values for passenger vehicles and trucks operating costs from the Guidance were used. Based on Table A-5 in the Guidance, assumed operating costs for typical passenger vehicles and trucks was \$0.45 and \$0.94 per mile, respectively. To obtain the undiscounted annual vehicle operating savings, the default values for operating costs were then multiplied with the annual VMT difference to estimate the annual vehicle operating cost savings for both, passenger vehicles and trucks. Then, the savings for both passenger vehicles and trucks were discounted at 7% for each year and added together. Because the net VMT increases, the net total vehicle operating cost savings is shown as a negative value. See **Table 2**.

Table 2 – Vehicle Operating Cost Benefits

Year	Vehicle Operating Cost Savings - Passenger Vehicles			Vehicle Operating Cost Savings - Trucks			Total Vehicle Operating Cost Savings
	Annual VMT Difference	Annual Vehicle Operating Savings (Undiscounted)	Annual Vehicle Operating Savings (7% Discount) ²	Annual VMT Difference	Annual Vehicle Operating Savings (Undiscounted)	Annual Vehicle Operating Savings (7% Discount) ²	Annual Vehicle Operating Savings (7% Discount) ²
2019	Project Development and Construction Phases ¹			Project Development and Construction Phases ¹			\$ -
2020							\$ -
2021	\$ (35,850.22)			\$ (1,424.94)			\$ -
2022	\$ (36,030.37)			\$ (1,432.10)			\$ -
2023	\$ (36,211.43)			\$ (1,439.30)			\$ -
2024	\$ (36,393.39)			\$ (1,446.53)			\$ -
2025	\$ (36,576.27)			\$ (1,453.80)			\$ -
2026	\$ (36,760.07)			\$ (1,461.11)			\$ -
2027	\$ (36,944.80)	\$ (16,625)	\$ (10,353)	\$ (1,468.45)	\$ (1,380)	\$ (860)	\$ (11,213)
2028	\$ (37,130.45)	\$ (16,709)	\$ (9,725)	\$ (1,475.83)	\$ (1,387)	\$ (807)	\$ (10,532)
2029	\$ (37,317.04)	\$ (16,793)	\$ (9,134)	\$ (1,483.24)	\$ (1,394)	\$ (758)	\$ (9,892)
2030	\$ (37,504.56)	\$ (16,877)	\$ (8,579)	\$ (1,490.70)	\$ (1,401)	\$ (712)	\$ (9,292)
2031	\$ (37,693.02)	\$ (16,962)	\$ (8,058)	\$ (1,498.19)	\$ (1,408)	\$ (669)	\$ (8,728)
2032	\$ (37,882.44)	\$ (17,047)	\$ (7,569)	\$ (1,505.72)	\$ (1,415)	\$ (628)	\$ (8,198)
2033	\$ (38,072.80)	\$ (17,133)	\$ (7,109)	\$ (1,513.28)	\$ (1,422)	\$ (590)	\$ (7,700)
2034	\$ (38,264.12)	\$ (17,219)	\$ (6,678)	\$ (1,520.89)	\$ (1,430)	\$ (554)	\$ (7,232)
2035	\$ (38,456.40)	\$ (17,305)	\$ (6,272)	\$ (1,528.53)	\$ (1,437)	\$ (521)	\$ (6,793)
2036	\$ (38,649.65)	\$ (17,392)	\$ (5,891)	\$ (1,536.21)	\$ (1,444)	\$ (489)	\$ (6,381)
2037	\$ (38,843.87)	\$ (17,480)	\$ (5,534)	\$ (1,543.93)	\$ (1,451)	\$ (459)	\$ (5,993)
2038	\$ (39,039.07)	\$ (17,568)	\$ (5,198)	\$ (1,551.69)	\$ (1,459)	\$ (432)	\$ (5,629)
2039	\$ (39,235.24)	\$ (17,656)	\$ (4,882)	\$ (1,559.49)	\$ (1,466)	\$ (405)	\$ (5,287)
2040	\$ (39,432.40)	\$ (17,745)	\$ (4,586)	\$ (1,567.32)	\$ (1,473)	\$ (381)	\$ (4,966)
2041	\$ (39,630.56)	\$ (17,834)	\$ (4,307)	\$ (1,575.20)	\$ (1,481)	\$ (358)	\$ (4,665)
2042	\$ (39,829.70)	\$ (17,923)	\$ (4,046)	\$ (1,583.11)	\$ (1,488)	\$ (336)	\$ (4,381)
2043	\$ (40,029.85)	\$ (18,013)	\$ (3,800)	\$ (1,591.07)	\$ (1,496)	\$ (315)	\$ (4,115)
2044	\$ (40,231.01)	\$ (18,104)	\$ (3,569)	\$ (1,599.06)	\$ (1,503)	\$ (296)	\$ (3,865)
2045	\$ (40,433.17)	\$ (18,195)	\$ (3,352)	\$ (1,607.10)	\$ (1,511)	\$ (278)	\$ (3,631)
2046	\$ (40,837.51)	\$ (18,377)	\$ (3,164)	\$ (1,623.17)	\$ (1,526)	\$ (263)	\$ (3,427)
2047	\$ (41,245.88)	\$ (18,561)	\$ (2,987)	\$ (1,639.40)	\$ (1,541)	\$ (248)	\$ (3,235)
2048	\$ (41,658.34)	\$ (18,746)	\$ (2,819)	\$ (1,655.80)	\$ (1,556)	\$ (234)	\$ (3,054)
2049	\$ (42,074.92)	\$ (18,934)	\$ (2,661)	\$ (1,672.35)	\$ (1,572)	\$ (221)	\$ (2,882)
2050	\$ (42,495.67)	\$ (19,123)	\$ (2,512)	\$ (1,689.08)	\$ (1,588)	\$ (209)	\$ (2,721)
2051	\$ (42,920.63)	\$ (19,314)	\$ (2,371)	\$ (1,705.97)	\$ (1,604)	\$ (197)	\$ (2,568)
2052	\$ (43,349.84)	\$ (19,507)	\$ (2,238)	\$ (1,723.03)	\$ (1,620)	\$ (186)	\$ (2,424)
2053	\$ (43,783.33)	\$ (19,703)	\$ (2,113)	\$ (1,740.26)	\$ (1,636)	\$ (175)	\$ (2,288)
2054	\$ (44,221.17)	\$ (19,900)	\$ (1,994)	\$ (1,757.66)	\$ (1,652)	\$ (166)	\$ (2,160)
2055	\$ (44,663.38)	\$ (20,099)	\$ (1,882)	\$ (1,775.24)	\$ (1,669)	\$ (156)	\$ (2,039)
2056	\$ (45,110.01)	\$ (20,300)	\$ (1,777)	\$ (1,792.99)	\$ (1,685)	\$ (148)	\$ (1,924)
TOTAL							\$ (157,216)

Notes:

¹ Although Project Development and Construction Phases are assumed through 2026, calculations are shown starting in the year 2021 for this table's purpose.

² Base year dollars is 2020 per USDOT BCA Guidance (Mar 2022).

Emissions Benefits

Based on the methodology from the vehicle operating cost savings, the emissions savings were calculated using the VMT difference for each year. The Guidance recommends the evaluation of four emissions (nitrogen oxide, sulfur oxide, fine particulate matter, and carbon dioxide) for both gasoline and diesel vehicles.

Various conversion factors were then applied to obtain the proper emission units for each of the four emission types. It was assumed that all passenger vehicles were gasoline powered, while all trucks were diesel powered. The other parameters and assumptions specific to the emissions analysis is shown in **Table 3**. In addition, the savings were calculated for each year using a 7% discount rate for all emissions except carbon dioxide, which was discounted at 3% per Guidance. Because the net VMT increases, the net total emissions savings is shown as a negative value. See **Table 4** for emissions savings broke down by category.

Table 3 – Emissions Parameters and Assumptions

Parameter	Value	Notes
Assumed gasoline miles per gallon (mpg)	22.3	Based on EPA website referenced in BCA Guidance https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
Assumed diesel miles per gallon (mpg)	6.1	Based on Iowa specific data from Geotab https://www.geotab.com/truck-mpg-benchmark/
NOx emission rate, gasoline (grams per mile)	0.192	Based on light-duty vehicles (2020) from BTS https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and
NOx emission rate, diesel (grams per mile)	4.169	Based on heavy-duty vehicles (2020) from BTS https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and
SOx ppm per gallon, gasoline (tier 3)	10	Based on EPA requirement https://www.transportpolicy.net/standard/us-fuels-diesel-and-gasoline/
SOx ppm per gallon, diesel	15	Based on EPA requirement https://www.transportpolicy.net/standard/us-fuels-diesel-and-gasoline/
PM 2.5 emission rate, gasoline (grams per mile)	0.010	Based on avg. light-duty vehicles/trucks (exhaust+breakwear+tirewear) (2020) from BTS https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and
PM 2.5 emission rate, diesel (grams per mile)	0.119	Based on heavy-duty vehicles/trucks (exhaust+breakwear+tirewear) (2020) from BTS https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and
CO2 emission rate, gasoline (grams per gal)	8,887	Based on EPA website referenced in BCA Guidance https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
CO2 emission rate, diesel (grams per gal)	10,180	Based on EPA website referenced in BCA Guidance https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
Conversion rate SO2 parts per million (ppm) to metric tons per gal	9.91777 E-12	Based on SO2 molecular weight https://www.teesing.com/en/page/library/tools/ppm-mg3-converter
Conversion rate grams to metric tons	1.00000 E-06	

Table 4 – Emissions Benefits

Year	NOx Savings					SOx Savings					PM 2.5 Savings					CO2 Savings					Total Emissions Savings (7% Discount for NOx, SOx, PM 2.5, 3% Discount for CO2)	
	Value per Metric Ton ¹	NOx Diff. - Gasoline (Metric Tons)	NOx Difference - Diesel (Metric Tons)	Savings (Undiscounted) ²	Savings (7% Discount) ^{2,3}	Value per Metric Ton ¹	SOx Diff. - Gasoline (Metric Tons)	SOx Difference - Diesel (Metric Tons)	Savings (Undiscounted) ²	Savings (7% Discount) ^{2,3}	Value per Metric Ton ¹	PM 2.5 Diff. - Gasoline (Metric Tons)	PM 2.5 Difference - Diesel (Metric Tons)	Savings (Undiscounted) ²	Savings (7% Discount) ^{2,3}	Value per Metric Ton ¹	CO2 Diff. - Gasoline (Metric Tons)	CO2 Difference - Diesel (Metric Tons)	Savings (Undiscounted) ²	Savings (3% Discount) ⁴		
2019																					\$ -	
2020																						\$ -
2021																						\$ -
2022																						\$ -
2023																						\$ -
2024																						\$ -
2025																						\$ -
2026																						\$ -
2027	\$17,300	-0.007	-0.01	(\$228.63)	\$(142)	\$46,500	-0.0001	0.0000	(\$3.86)	\$(2)	\$827,400	-0.0004	-0.0002	(\$434.98)	\$(271)	\$58,000	-14.723	-2.5	(\$853.95)	\$(694)	\$ (1,110)	
2028	\$17,500	-0.007	-0.01	(\$232.43)	\$(135)	\$47,300	-0.0001	0.0000	(\$3.95)	\$(2)	\$840,000	-0.0004	-0.0002	(\$444.14)	\$(258)	\$60,000	-14.797	-2.5	(\$1,035.61)	\$(818)	\$ (1,214)	
2029	\$17,700	-0.007	-0.01	(\$236.27)	\$(129)	\$48,200	-0.0001	0.0000	(\$4.04)	\$(2)	\$854,000	-0.0004	-0.0002	(\$453.49)	\$(247)	\$61,000	-14.872	-2.5	(\$1,058.16)	\$(811)	\$ (1,188)	
2030	\$18,000	-0.007	-0.01	(\$241.48)	\$(123)	\$49,100	-0.0001	0.0000	(\$4.14)	\$(2)	\$867,600	-0.0004	-0.0002	(\$463.03)	\$(235)	\$62,000	-14.946	-2.5	(\$1,080.91)	\$(804)	\$ (1,165)	
2031	\$18,000	-0.007	-0.01	(\$242.69)	\$(115)	\$49,100	-0.0001	0.0000	(\$4.16)	\$(2)	\$867,600	-0.0004	-0.0002	(\$465.35)	\$(221)	\$63,000	-15.021	-2.5	(\$1,103.87)	\$(797)	\$ (1,136)	
2032	\$18,000	-0.007	-0.01	(\$243.91)	\$(108)	\$49,100	-0.0001	0.0000	(\$4.18)	\$(2)	\$867,600	-0.0004	-0.0002	(\$467.69)	\$(208)	\$64,000	-15.097	-2.5	(\$1,127.02)	\$(790)	\$ (1,108)	
2033	\$18,000	-0.007	-0.01	(\$245.14)	\$(102)	\$49,100	-0.0001	0.0000	(\$4.20)	\$(2)	\$867,600	-0.0004	-0.0002	(\$470.04)	\$(195)	\$65,000	-15.173	-2.5	(\$1,150.38)	\$(783)	\$ (1,082)	
2034	\$18,000	-0.007	-0.01	(\$246.37)	\$(96)	\$49,100	-0.0001	0.0000	(\$4.22)	\$(2)	\$867,600	-0.0004	-0.0002	(\$472.40)	\$(183)	\$66,000	-15.249	-2.5	(\$1,173.95)	\$(776)	\$ (1,057)	
2035	\$18,000	-0.007	-0.01	(\$247.61)	\$(90)	\$49,100	-0.0001	0.0000	(\$4.24)	\$(2)	\$867,600	-0.0004	-0.0002	(\$474.78)	\$(172)	\$67,000	-15.326	-2.6	(\$1,197.73)	\$(769)	\$ (1,032)	
2036	\$18,000	-0.007	-0.01	(\$248.85)	\$(84)	\$49,100	-0.0001	0.0000	(\$4.27)	\$(1)	\$867,600	-0.0004	-0.0002	(\$477.16)	\$(162)	\$69,000	-15.403	-2.6	(\$1,239.68)	\$(773)	\$ (1,020)	
2037	\$18,000	-0.007	-0.01	(\$250.10)	\$(79)	\$49,100	-0.0001	0.0000	(\$4.29)	\$(1)	\$867,600	-0.0004	-0.0002	(\$479.56)	\$(152)	\$70,000	-15.480	-2.6	(\$1,263.97)	\$(765)	\$ (997)	
2038	\$18,000	-0.007	-0.01	(\$251.36)	\$(74)	\$49,100	-0.0001	0.0000	(\$4.31)	\$(1)	\$867,600	-0.0004	-0.0002	(\$481.97)	\$(143)	\$71,000	-15.558	-2.6	(\$1,288.46)	\$(757)	\$ (975)	
2039	\$18,000	-0.008	-0.01	(\$252.62)	\$(70)	\$49,100	-0.0001	0.0000	(\$4.33)	\$(1)	\$867,600	-0.0004	-0.0002	(\$484.39)	\$(134)	\$72,000	-15.636	-2.6	(\$1,313.18)	\$(749)	\$ (954)	
2040	\$18,000	-0.008	-0.01	(\$253.89)	\$(66)	\$49,100	-0.0001	0.0000	(\$4.35)	\$(1)	\$867,600	-0.0004	-0.0002	(\$486.83)	\$(126)	\$73,000	-15.715	-2.6	(\$1,338.11)	\$(741)	\$ (933)	
2041	\$18,000	-0.008	-0.01	(\$255.17)	\$(62)	\$49,100	-0.0001	0.0000	(\$4.37)	\$(1)	\$867,600	-0.0004	-0.0002	(\$489.27)	\$(118)	\$74,000	-15.794	-2.6	(\$1,363.25)	\$(733)	\$ (914)	
2042	\$18,000	-0.008	-0.01	(\$256.45)	\$(58)	\$49,100	-0.0001	0.0000	(\$4.40)	\$(1)	\$867,600	-0.0004	-0.0002	(\$491.73)	\$(111)	\$75,000	-15.873	-2.6	(\$1,388.62)	\$(725)	\$ (895)	
2043	\$18,000	-0.008	-0.01	(\$257.74)	\$(54)	\$49,100	-0.0001	0.0000	(\$4.42)	\$(1)	\$867,600	-0.0004	-0.0002	(\$494.20)	\$(104)	\$77,000	-15.953	-2.7	(\$1,432.81)	\$(726)	\$ (886)	
2044	\$18,000	-0.008	-0.01	(\$259.04)	\$(51)	\$49,100	-0.0001	0.0000	(\$4.44)	\$(1)	\$867,600	-0.0004	-0.0002	(\$496.69)	\$(98)	\$78,000	-16.033	-2.7	(\$1,458.71)	\$(718)	\$ (867)	
2045	\$18,000	-0.008	-0.01	(\$260.34)	\$(48)	\$49,100	-0.0001	0.0000	(\$4.46)	\$(1)	\$867,600	-0.0004	-0.0002	(\$499.18)	\$(92)	\$79,000	-16.113	-2.7	(\$1,484.84)	\$(709)	\$ (850)	
2046	\$18,000	-0.008	-0.01	(\$262.94)	\$(45)	\$49,100	-0.0001	0.0000	(\$4.51)	\$(1)	\$867,600	-0.0004	-0.0002	(\$504.17)	\$(87)	\$80,000	-16.275	-2.7	(\$1,518.67)	\$(704)	\$ (837)	
2047	\$18,000	-0.008	-0.01	(\$265.57)	\$(43)	\$49,100	-0.0001	0.0000	(\$4.55)	\$(1)	\$867,600	-0.0004	-0.0002	(\$509.22)	\$(82)	\$81,000	-16.437	-2.7	(\$1,553.03)	\$(699)	\$ (825)	
2048	\$18,000	-0.008	-0.01	(\$268.23)	\$(40)	\$49,100	-0.0001	0.0000	(\$4.60)	\$(1)	\$867,600	-0.0004	-0.0002	(\$514.31)	\$(77)	\$82,000	-16.602	-2.8	(\$1,587.93)	\$(694)	\$ (812)	
2049	\$18,000	-0.008	-0.01	(\$270.91)	\$(38)	\$49,100	-0.0001	0.0000	(\$4.64)	\$(1)	\$867,600	-0.0004	-0.0002	(\$519.45)	\$(73)	\$83,000	-16.768	-2.8	(\$1,623.37)	\$(689)	\$ (801)	
2050	\$18,000	-0.008	-0.01	(\$273.62)	\$(36)	\$49,100	-0.0001	0.0000	(\$4.69)	\$(1)	\$867,600	-0.0004	-0.0002	(\$524.65)	\$(69)	\$85,000	-16.935	-2.8	(\$1,679.11)	\$(692)	\$ (797)	
2051	\$18,000	-0.008	-0.01	(\$276.35)	\$(34)	\$49,100	-0.0001	0.0000	(\$4.74)	\$(1)	\$867,600	-0.0004	-0.0002	(\$529.89)	\$(65)	\$85,000	-17.105	-2.8	(\$1,695.90)	\$(678)	\$ (778)	
2052	\$18,000	-0.008	-0.01	(\$279.12)	\$(32)	\$49,100	-0.0001	0.0000	(\$4.78)	\$(1)	\$867,600	-0.0004	-0.0002	(\$535.19)	\$(61)	\$85,000	-17.276	-2.9	(\$1,712.86)	\$(665)	\$ (759)	
2053	\$18,000	-0.008	-0.01	(\$281.91)	\$(30)	\$49,100	-0.0001	0.0000	(\$4.83)	\$(1)	\$867,600	-0.0004	-0.0002	(\$540.54)	\$(58)	\$85,000	-17.449	-2.9	(\$1,729.99)	\$(652)	\$ (741)	
2054	\$18,000	-0.008	-0.01	(\$284.73)	\$(29)	\$49,100	-0.0001	0.0000	(\$4.88)	\$(0)	\$867,600	-0.0004	-0.0002	(\$545.95)	\$(55)	\$85,000	-17.623	-2.9	(\$1,747.29)	\$(640)	\$ (723)	
2055	\$18,000	-0.009	-0.01	(\$287.57)	\$(27)	\$49,100	-0.0001	0.0000	(\$4.93)	\$(0)	\$867,600	-0.0004	-0.0002	(\$551.41)	\$(52)	\$85,000	-17.799	-3.0	(\$1,764.76)	\$(627)	\$ (706)	
2056	\$18,000	-0.009	-0.01	(\$290.45)	\$(25)	\$49,100	-0.0001	0.0000	(\$4.98)	\$(0)	\$867,600	-0.0004	-0.0002	(\$556.92)	\$(49)	\$85,000	-17.977	-3.0	(\$1,782.41)	\$(615)	\$ (690)	
																						TOTAL
																						\$ (27,851)

Notes:

¹ Based on USDOT BCA Guidance for Discretionary Grant Programs (Mar 2022) Table A-6. Note Table A-6 does not go beyond 2050; therefore, 2050 values are assumed constant through 2055.

² Values are negative since VMT increases.

³ Base year dollars is 2020 per USDOT BCA Guidance (Mar 2022).

⁴ Base year dollars is 2022 per USDOT BCA Guidance (Mar 2022). Note 3% discount rate per Guidance.

Safety Benefits

The safety information from the July 2022 AJR Appendix A is used to estimate safety benefits, which is based on before and after predictive safety performance of I-35 due to the proposed project. Based on the safety assumptions outlined earlier, the expected number of crashes were reduced by severity level (using the same severity distribution as the before condition) to quantify benefits (see **Table 5**).

The expected number of crashes per year was multiplied by the crash value for each severity in accordance with Table A-1 (for fatal and injury) and Table A-2 (for PDO) in the Guidance. The crash costs for each severity under the no-build scenario were added together for each year, as well as the build scenario. The undiscounted dollars for each year were then discounted at 7% for each scenario. Finally, the difference between the two crash costs for each year was taken, then added together. See **Table 6**.

Table 5 – Expected Number of Crashes Per Year on I-35

Severity Level	No-Build	Build
Fatal	0.20	0.19
Injury	1.60	1.54
Property Damage Only	11.40	10.94

Table 6 – Safety Benefits

Year	Safety Cost - I-35 (No-Build)					Safety Cost - I-35 (Build)					Total Safety Benefits
	Fatal	Injury	No Injury	Safety Cost (Undiscounted)	Safety Cost (7% Discount) ¹	Fatal	Injury	No Injury	Safety Cost (Undiscounted)	Safety Cost (7% Discount) ¹	Safety Savings (7% Discount)
2019	Project Development and Construction Phases										\$ -
2020											\$ -
2021											\$ -
2022											\$ -
2023											\$ -
2024											\$ -
2025											\$ -
2026	\$ -										
2027	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,933,065	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,855,742	\$ 77,323
2028	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,806,603	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,734,339	\$ 72,264
2029	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,688,414	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,620,877	\$ 67,537
2030	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,577,957	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,514,839	\$ 63,118
2031	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,474,726	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,415,737	\$ 58,989
2032	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,378,249	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,323,119	\$ 55,130
2033	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,288,083	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,236,560	\$ 51,523
2034	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,203,816	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,155,663	\$ 48,153
2035	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,125,061	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,080,059	\$ 45,002
2036	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 1,051,459	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 1,009,401	\$ 42,058
2037	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 982,672	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 943,365	\$ 39,307
2038	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 918,385	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 881,650	\$ 36,735
2039	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 858,304	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 823,972	\$ 34,332
2040	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 802,153	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 770,067	\$ 32,086
2041	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 749,676	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 719,689	\$ 29,987
2042	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 700,632	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 672,606	\$ 28,025
2043	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 654,796	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 628,604	\$ 26,192
2044	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 611,959	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 587,481	\$ 24,478
2045	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 571,924	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 549,047	\$ 22,877
2046	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 534,509	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 513,128	\$ 21,380
2047	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 499,541	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 479,559	\$ 19,982
2048	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 466,860	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 448,186	\$ 18,674
2049	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 436,318	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 418,865	\$ 17,453
2050	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 407,774	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 391,463	\$ 16,311
2051	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 381,097	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 365,853	\$ 15,244
2052	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 356,166	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 341,919	\$ 14,247
2053	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 332,865	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 319,550	\$ 13,315
2054	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 311,089	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 298,645	\$ 12,444
2055	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 290,737	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 279,108	\$ 11,629
2056	\$ 2,567,480	\$ 484,160	\$ 52,440	\$ 3,104,080	\$ 271,717	\$ 2,464,781	\$ 464,794	\$ 50,342	\$ 2,979,917	\$ 260,848	\$ 10,869
TOTAL											\$ 1,026,664
Notes:											
¹ Base year dollars is 2020 per USDOT BCA Guidance (Mar 2022).											

Pedestrian Improvement Benefits

The project will construct a shared-use path that will connect the community across I-35. Because no sidewalks or paved shoulders currently exist, it is expected that estimated pedestrian usage can be quantified consistent with the Guidance assumptions. The benefits of the estimated usage are captured in the BCA.

To calculate the pedestrian improvement benefits, first the average annual pedestrian trips expected with the project were estimated (see previous assumptions discussion). The estimated trips were multiplied by the value per person-mile (\$0.10 per foot, Guidance Table A-8 “Expand Sidewalk”), the width of the new shared-use path (10 ft), and the length of the new shared-use path (1.04 miles). This undiscounted benefit was then discounted for each year at 7% per Guidance. See **Table 7**.

Table 7 – Pedestrian Improvement Benefit

Total Pedestrian Benefits			
Year	Assumed Estimated Pedestrian Traffic on SH 74	Pedestrian Benefits (Undiscounted)	Pedestrian Benefits (7% Discount)
2019			\$ -
2020	176		\$ -
2021	180		\$ -
2022	183		\$ -
2023	187		\$ -
2024	191		\$ -
2025	194		\$ -
2026	198		\$ -
2027	201	\$209.14	\$ 130
2028	205	\$212.81	\$ 124
2029	208	\$216.48	\$ 118
2030	212	\$220.15	\$ 112
2031	215	\$223.82	\$ 106
2032	219	\$227.49	\$ 101
2033	222	\$231.15	\$ 96
2034	226	\$234.82	\$ 91
2035	229	\$238.49	\$ 86
2036	233	\$242.16	\$ 82
2037	236	\$245.83	\$ 78
2038	240	\$249.50	\$ 74
2039	243	\$253.17	\$ 70
2040	247	\$256.84	\$ 66
2041	250	\$260.51	\$ 63
2042	254	\$264.18	\$ 60
2043	258	\$267.85	\$ 57
2044	261	\$271.51	\$ 54
2045	265	\$275.18	\$ 51
2046	268	\$278.85	\$ 48
2047	272	\$282.52	\$ 45
2048	275	\$286.19	\$ 43
2049	279	\$289.86	\$ 41
2050	282	\$293.53	\$ 39
2051	286	\$297.20	\$ 36
2052	289	\$300.87	\$ 35
2053	293	\$304.54	\$ 33
2054	296	\$308.21	\$ 31
2055	300	\$311.88	\$ 29
2056	303	\$315.54	\$ 28
TOTAL			\$ 2,025

Cycling Improvement Benefits

The project will construct a shared-use path that will allow bicyclists to utilize and connect neighborhoods on either side of I-35. Because comparable facilities nearby do not currently exist, it is expected that estimated cyclist usage can be quantified consistent with Guidance assumptions. The benefits of the estimated usage are captured in the BCA.

To calculate the cycling improvement benefits, first the average annual bicycle trips expected with the project were estimated (see previous assumptions discussion). The estimated trips were multiplied by the value per cycling-mile (\$1.42 per mile, Guidance Table A-9 “Cycling Path with At-Grade Crossings”), and the length of the project (1.04 miles). This undiscounted benefit was then discounted for each year at 7% per Guidance. See **Table 8**.

Table 8 – Cycling Improvement Benefits

Total Cycling Benefits			
Year	Assumed Estimated Bicycle Traffic on SH 74	Cycling Benefits (Undiscounted)	Cycling Benefits (7% Discount)
2019			\$ -
2020	35		\$ -
2021	36		\$ -
2022	37		\$ -
2023	37		\$ -
2024	38		\$ -
2025	39		\$ -
2026	40		\$ -
2027	40	\$59.40	\$ 37
2028	41	\$60.44	\$ 35
2029	42	\$61.48	\$ 33
2030	42	\$62.52	\$ 32
2031	43	\$63.56	\$ 30
2032	44	\$64.61	\$ 29
2033	44	\$65.65	\$ 27
2034	45	\$66.69	\$ 26
2035	46	\$67.73	\$ 25
2036	47	\$68.77	\$ 23
2037	47	\$69.82	\$ 22
2038	48	\$70.86	\$ 21
2039	49	\$71.90	\$ 20
2040	49	\$72.94	\$ 19
2041	50	\$73.98	\$ 18
2042	51	\$75.03	\$ 17
2043	52	\$76.07	\$ 16
2044	52	\$77.11	\$ 15
2045	53	\$78.15	\$ 14
2046	54	\$79.19	\$ 14
2047	54	\$80.24	\$ 13
2048	55	\$81.28	\$ 12
2049	56	\$82.32	\$ 12
2050	56	\$83.36	\$ 11
2051	57	\$84.40	\$ 10
2052	58	\$85.45	\$ 10
2053	59	\$86.49	\$ 9
2054	59	\$87.53	\$ 9
2055	60	\$88.57	\$ 8
2056	61	\$89.61	\$ 8
TOTAL			\$ 575

Health Benefits

Because the new bridges allow for the shared-use path that will facilitate bicyclist and pedestrian travel, there are health benefits that can be quantified and included in the BCA. Consistent with the methodology and assumptions outlined in Table A-12 of the Guidance, the calculation of health benefits consists of the following.

- The average annual expected pedestrian trips from the assumptions outlined earlier was multiplied with the value per induced trip – walking for ages 20-74 (\$7.08), then multiplied by 68% (the default age range percentage).
- The average annual expected bicycle trips from the assumptions outlined earlier was multiplied with the value per induced trip – cycling for ages 20-64 (\$6.31), then multiplied by 59% (the default age range percentage).
- These two values were added together, then multiplied by the length of the project (1.04 miles). This undiscounted benefit was then discounted for each year at 7% per Guidance. See **Table 9**.

Table 9 – Health Benefits

Health Benefits				
Year	Assumed Estimated Pedestrian Traffic on SH 74	Assumed Estimated Bicycle Traffic on SH 74	Health Benefits (Undiscounted)	Health Benefits (7% Discount)
2019				\$ -
2020	176	35		\$ -
2021	180	36		\$ -
2022	183	37		\$ -
2023	187	37		\$ -
2024	191	38		\$ -
2025	194	39		\$ -
2026	198	40		\$ -
2027	201	40	\$1,162.60	\$ 724
2028	205	41	\$1,183.00	\$ 689
2029	208	42	\$1,203.40	\$ 655
2030	212	42	\$1,223.79	\$ 622
2031	215	43	\$1,244.19	\$ 591
2032	219	44	\$1,264.59	\$ 561
2033	222	44	\$1,284.98	\$ 533
2034	226	45	\$1,305.38	\$ 506
2035	229	46	\$1,325.78	\$ 481
2036	233	47	\$1,346.17	\$ 456
2037	236	47	\$1,366.57	\$ 433
2038	240	48	\$1,386.97	\$ 410
2039	243	49	\$1,407.36	\$ 389
2040	247	49	\$1,427.76	\$ 369
2041	250	50	\$1,448.16	\$ 350
2042	254	51	\$1,468.55	\$ 331
2043	258	52	\$1,488.95	\$ 314
2044	261	52	\$1,509.35	\$ 298
2045	265	53	\$1,529.74	\$ 282
2046	268	54	\$1,550.14	\$ 267
2047	272	54	\$1,570.54	\$ 253
2048	275	55	\$1,590.93	\$ 239
2049	279	56	\$1,611.33	\$ 226
2050	282	56	\$1,631.73	\$ 214
2051	286	57	\$1,652.12	\$ 203
2052	289	58	\$1,672.52	\$ 192
2053	293	59	\$1,692.91	\$ 182
2054	296	59	\$1,713.31	\$ 172
2055	300	60	\$1,733.71	\$ 162
2056	303	61	\$1,754.10	\$ 154
TOTAL				\$ 11,257

Emergency Services Benefits

Federal Emergency Management Agency (FEMA) BCA methodology was adapted to estimate the benefits of improved emergency access to I-35 to and from Purcell. The FEMA BCA Guide (Version 6.0, December 2011) was used as referenced in the Guidance. As mentioned earlier, the Loss of Emergency Medical Services method was adapted from the FEMA BCA guide for the purposes of estimating improved emergency response times due to the new interchange.

The first step in the calculation is to estimate the number of incidents per year that may be considered for this benefit. As discussed in the assumptions, the assumed number of incidents on I-35 this methodology may apply to is 0.6 per year. Also as mentioned in the assumptions, the average response time before and after the project was also estimated. Using the FEMA methodology, the survival probability before and after, and the estimated number of fatalities before and after was determined. Using these parameters and assumptions outlined in **Table 10**, the undiscounted benefit was calculated for each year then discounted at 7% per Guidance. See **Table 11**.

Table 10 – Emergency Services Parameters and Assumptions

Parameter	Value	Notes
Estimated average response time (RT) (No-Build)	11.90	In minutes. Based on FEMA BCAR Guidelines (2011).
Estimated average response time (RT) (Build)	4.80	In minutes. Based on FEMA BCAR Guidelines (2011).
Survival probability (No-Build)	0.0457	Based on FEMA BCAR Guidelines (2011), eq. 24.
Survival probability (Build)	0.2142	Based on FEMA BCAR Guidelines (2011), eq. 24.
No. of incidents/year on I-35 resulting in fatality or serious injury	0.6	See Emergency Response Assumptions
Value of fatality	\$11,600,000	Based on USDOT BCA Guidance for Discretionary Grant Programs (Mar 2022) Table A-1, in base year (2020) dollars.
No. of deaths per year on I-35 - before	0.5726	Based on FEMA BCAR Guidelines (2011), eq. 25.
No. of deaths per year on I-35 - after	0.4715	Based on FEMA BCAR Guidelines (2011), eq. 26.
No. of deaths per year on I-35 - net difference	0.1011	Based on FEMA BCAR Guidelines (2011), eq. 27.

Table 11 – Emergency Services Benefits

Emergency Services Benefits		
Year	Emergency Services Benefits (Undiscounted)	Emergency Services Benefits (7% Discount)
2019	Project Development and Construction Phases	\$ -
2020		\$ -
2021		\$ -
2022		\$ -
2023		\$ -
2024		\$ -
2025		\$ -
2026		\$ -
2027	\$ 1,172,704.72	\$ 730,302
2028	\$ 1,172,704.72	\$ 682,525
2029	\$ 1,172,704.72	\$ 637,874
2030	\$ 1,172,704.72	\$ 596,144
2031	\$ 1,172,704.72	\$ 557,144
2032	\$ 1,172,704.72	\$ 520,695
2033	\$ 1,172,704.72	\$ 486,631
2034	\$ 1,172,704.72	\$ 454,795
2035	\$ 1,172,704.72	\$ 425,042
2036	\$ 1,172,704.72	\$ 397,236
2037	\$ 1,172,704.72	\$ 371,248
2038	\$ 1,172,704.72	\$ 346,961
2039	\$ 1,172,704.72	\$ 324,263
2040	\$ 1,172,704.72	\$ 303,049
2041	\$ 1,172,704.72	\$ 283,224
2042	\$ 1,172,704.72	\$ 264,695
2043	\$ 1,172,704.72	\$ 247,378
2044	\$ 1,172,704.72	\$ 231,195
2045	\$ 1,172,704.72	\$ 216,070
2046	\$ 1,172,704.72	\$ 201,934
2047	\$ 1,172,704.72	\$ 188,724
2048	\$ 1,172,704.72	\$ 176,377
2049	\$ 1,172,704.72	\$ 164,839
2050	\$ 1,172,704.72	\$ 154,055
2051	\$ 1,172,704.72	\$ 143,976
2052	\$ 1,172,704.72	\$ 134,557
2053	\$ 1,172,704.72	\$ 125,755
2054	\$ 1,172,704.72	\$ 117,528
2055	\$ 1,172,704.72	\$ 109,839
2056	\$ 1,172,704.72	\$ 102,653
TOTAL		\$ 9,696,706

Operations and Maintenance

The operations and maintenance (O&M) savings due to the project were included in the BCA. Consistent with the Guidance, the savings was included in the numerator along with other benefits. The O&M estimated costs were based on similar activity costs in the region. Routine O&M costs were estimated on an average annual basis for both Build and No-Build conditions, which includes activities such as inspection and flushing of deicing salts. More intensive rehabilitation maintenance costs for both Build and No-Build conditions were also estimated. The existing rehab activities account for the recent rehabilitation that took place on both bridges in 2017. O&M costs for each year were then calculated using a 7% discount rate, then summed. See **Table 12** for O&M assumptions and **Table 13** for total O&M savings.

Table 12 – O&M Assumptions

Parameter	Value	Notes
Existing Bridge Assumptions (expected activities within study time period)		
Maintenance Activity 1	\$1.00 per sf	1 year interval (inspection & flushing of deicing salts)
Maintenance Activity 2	\$10.00 per sf	5 year interval (bridge deck sealing)
Maintenance Activity 3	\$75.00 per sf	25 year interval (rehab)
Maintenance Activity 4	\$175.00 per sf	50 year interval (total reconstruction)
New Bridge Assumptions (expected activities within study time period)		
Maintenance Activity 1	\$0.50 per sf	1 year interval (inspection & flushing of deicing salts)
Maintenance Activity 2	\$5.00 per sf	15 year interval (bridge deck sealing)
Maintenance Activity 3	\$50.00 per sf	40 year interval (redeck & rehab)
Maintenance Activity 4	\$175.00 per sf	75 year interval (total reconstruction)
Parameters		
Existing Bridges - Bridge Deck Area (sf)	8,842 sf	Bridges 16940 & 16941
New Bridges - Bridge Deck Area (sf)	22,400 sf	56'x200' bridges
Calculated Cost Assumptions		
Existing - 1 year interval cost	\$8,842	in base year 2020 dollars
Existing - 10 year interval cost	\$84,820	in base year 2020 dollars
Existing - 25 year interval cost	\$636,150	in base year 2020 dollars
New - 1 year interval cost	\$11,200	in base year 2020 dollars
New - 15 year interval cost	\$112,000	in base year 2020 dollars

Table 13 – O&M Savings

Year	O&M Costs - No-Build					O&M Costs - Build				O&M Savings
	Activity 1 Cost	Activity 2 Cost	Activity 3 Cost	Total O&M Cost (Undiscounted)	O&M Cost (7% Discount) ¹	Activity 1 Cost	Activity 2 Cost	Total O&M Cost (Undiscounted)	O&M Cost (7% Discount) ¹	O&M Costs (7% Discount)
2019	Project Development and Construction Phases					Project Development and Construction Phases				\$ -
2020										\$ -
2021										\$ -
2022										\$ -
2023										\$ -
2024										\$ -
2025										\$ -
2026										\$ -
2027	\$ 8,482	\$ 84,820	\$ -	\$ 93,302	\$ 58,104	\$ 11,200	\$ -	\$ 11,200	\$ 6,975	\$ 51,129
2028	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 4,937	\$ 11,200	\$ -	\$ 11,200	\$ 6,519	\$ (1,582)
2029	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 4,614	\$ 11,200	\$ -	\$ 11,200	\$ 6,092	\$ (1,478)
2030	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 4,312	\$ 11,200	\$ -	\$ 11,200	\$ 5,694	\$ (1,382)
2031	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 4,030	\$ 11,200	\$ -	\$ 11,200	\$ 5,321	\$ (1,291)
2032	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 3,766	\$ 11,200	\$ -	\$ 11,200	\$ 4,973	\$ (1,207)
2033	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 3,520	\$ 11,200	\$ -	\$ 11,200	\$ 4,648	\$ (1,128)
2034	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 3,289	\$ 11,200	\$ -	\$ 11,200	\$ 4,344	\$ (1,054)
2035	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 3,074	\$ 11,200	\$ -	\$ 11,200	\$ 4,059	\$ (985)
2036	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 2,873	\$ 11,200	\$ -	\$ 11,200	\$ 3,794	\$ (921)
2037	\$ 8,482	\$ 84,820	\$ -	\$ 93,302	\$ 29,537	\$ 11,200	\$ -	\$ 11,200	\$ 3,546	\$ 25,991
2038	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 2,510	\$ 11,200	\$ -	\$ 11,200	\$ 3,314	\$ (804)
2039	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 2,345	\$ 11,200	\$ -	\$ 11,200	\$ 3,097	\$ (752)
2040	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 2,192	\$ 11,200	\$ -	\$ 11,200	\$ 2,894	\$ (702)
2041	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 2,049	\$ 11,200	\$ 112,000	\$ 123,200	\$ 29,754	\$ (27,706)
2042	\$ 8,482	\$ -	\$ 636,150	\$ 644,632	\$ 145,502	\$ 11,200	\$ -	\$ 11,200	\$ 2,528	\$ 142,974
2043	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,789	\$ 11,200	\$ -	\$ 11,200	\$ 2,363	\$ (573)
2044	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,672	\$ 11,200	\$ -	\$ 11,200	\$ 2,208	\$ (536)
2045	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,563	\$ 11,200	\$ -	\$ 11,200	\$ 2,064	\$ (501)
2046	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,461	\$ 11,200	\$ -	\$ 11,200	\$ 1,929	\$ (468)
2047	\$ 8,482	\$ 84,820	\$ -	\$ 93,302	\$ 15,015	\$ 11,200	\$ -	\$ 11,200	\$ 1,802	\$ 13,213
2048	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,276	\$ 11,200	\$ -	\$ 11,200	\$ 1,685	\$ (409)
2049	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,192	\$ 11,200	\$ -	\$ 11,200	\$ 1,574	\$ (382)
2050	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,114	\$ 11,200	\$ -	\$ 11,200	\$ 1,471	\$ (357)
2051	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 1,041	\$ 11,200	\$ -	\$ 11,200	\$ 1,375	\$ (334)
2052	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 973	\$ 11,200	\$ -	\$ 11,200	\$ 1,285	\$ (312)
2053	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 910	\$ 11,200	\$ -	\$ 11,200	\$ 1,201	\$ (291)
2054	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 850	\$ 11,200	\$ -	\$ 11,200	\$ 1,122	\$ (272)
2055	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 794	\$ 11,200	\$ -	\$ 11,200	\$ 1,049	\$ (255)
2056	\$ 8,482	\$ -	\$ -	\$ 8,482	\$ 742	\$ 11,200	\$ -	\$ 11,200	\$ 980	\$ (238)
TOTAL										\$ 187,387

Notes:

¹ Base year dollars is 2020 per USDOT BCA Guidance (Mar 2022).

Residual Value

Because many transportation assets are designed for long-term use and, therefore, have an expected life that exceeds the analysis period, the residual value (a.k.a. salvage value or remaining service life) may be quantified and included in the BCA. The residual value of the project was estimated based on the cost estimates of the project components and useful life assumptions, using a 7% discount rate. See **Table 14** for assumed remaining residual value factors. See also **Table 15** for parameters and assumptions, and **Table 16** for total residual value.

Table 14 – Remaining Residual Value Factors

Analysis Period (years)	Expected Remaining Life* at:				
	25	40	50	60	100
30	0.00	0.28	0.44	0.55	0.77

*Based on MnDOT Benefit-Cost Analysis for Transportation Projects, Appendix A
<https://www.dot.state.mn.us/planning/program/benefitcost.html>

Table 15 – Parameters and Assumptions

Parameter	Value	Notes
Useful Life (yrs) - Major Structures	60	Based on MnDOT Benefit-Cost Analysis for Transportation Projects https://www.dot.state.mn.us/planning/program/benefitcost.html
Useful Life (yrs) - Grading & Drainage	50	
Useful Life (yrs) - Sub-Base and Base	40	
Useful Life (yrs) - Surface	25	
Useful Life (yrs) - Roadway	40	Weighted average assuming 50% grading and drainage; 25% sub-base and base; 25% surface. Rounded to nearest 10.
Residual Value - Roadway	\$ 6,020,000	Applying factor from Table 14 with estimated roadway cost from Table 18 .
Useful Life (yrs) - Structures	60	Based on MnDOT Benefit-Cost Analysis for Transportation Projects https://www.dot.state.mn.us/planning/program/benefitcost.html
Residual Value - Structures	\$ 3,866,500	Applying factor from Table 14 with estimated structures cost from Table 18 .

Table 16 – Residual Value

Parameter	Residual Value
Residual Value - Roadway	\$ 6,020,000
Residual Value - Structures	\$ 3,866,500
Total Residual Value	\$ 9,886,500
Total Residual Value (2056) (7% Discount)	\$ 865,419

Capital Costs

Project costs previously expended and anticipated in the future for various project development activities were obtained by year of activity. Previously expended costs were adjusted to real dollars using inflation adjustment factors provided in the Guidance. Future anticipated costs were adjusted using 7% discount rate. All capital costs were then summed. See **Table 17** for capital cost breakdown by activity, **Table 18** for construction cost breakdown by activity (used for residual value calculation), and **Table 19** for costs by activity for each year along with total capital cost.

Table 17 – Capital Cost by Activity

Activity	Previous	Future
PE - Surveys	\$ 100,000	\$ 0
PE - Environmental	\$ 90,000	\$ 0
PE - Design	\$ 600,000	\$ 300,000
Right-of-Way (ROW)	\$ 600,000	\$ 2,600,000
Engineering and Inspection	\$ 0	\$ 2,000,000
Construction (excluding E&I)	\$ 0	\$ 35,120,000

Table 18 – Construction Cost Breakout

Activity	Future
Roadway	\$ 21,500,000
Structures	\$ 7,030,000
Traffic	\$ 4,830,000
Staking & Mobilization	\$ 1,760,000
Total Construction (excluding E&I)	\$ 35,120,000

Table 19 – Estimated Capital Costs

Capital Costs									
Year	Preliminary Engineering (PE) - Surveys	Preliminary Engineering (PE) - Environmental ¹	Preliminary Engineering (PE) - Design ¹	Right-of-Way (ROW)	Construction Engineering & Inspection	Construction	Total Capital Costs (Nominal \$, Undiscounted) ²	Total Capital Costs (Real \$, Undiscounted) ³	Capital Costs (7% Discount)
2013	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2014	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2015	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2016	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2017	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2018	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2019	\$ 100,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 100,000	\$ 101,000	\$ 101,000
2020	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2021	\$ -	\$ 50,000.00	\$ 300,000.00	\$ -	\$ -	\$ -	\$ 350,000	\$ 350,000	\$ 327,103
2022	\$ -	\$ 40,000.00	\$ 300,000.00	\$ 600,000.00	\$ -	\$ -	\$ 940,000	\$ 940,000	\$ 821,032
2023	\$ -	\$ -	\$ 300,000.00	\$2,600,000.00	\$ -	\$ -	\$ 2,900,000	\$ 2,900,000	\$ 2,367,264
2024	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2025	\$ -	\$ -	\$ -	\$ -	\$ 380,387.93	\$ 6,679,612.07	\$ 7,060,000	\$ 7,060,000	\$ 5,033,682
2026	\$ -	\$ -	\$ -	\$ -	\$ 1,619,612.07	\$ 28,440,387.93	\$ 30,060,000	\$ 30,060,000	\$ 20,030,247
2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2028	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2029	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2030	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2031	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2032	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2034	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2035	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2036	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2037	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2038	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2039	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2040	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2041	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2042	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2043	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2044	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2045	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2046	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2047	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2048	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2049	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2050	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2051	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2052	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2053	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2054	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2055	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2056	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
TOTAL									\$ 28,680,329
Notes:									
¹ Previously incurred costs include design, environmental, and survey related work.									
² Nominal, or year-of-expenditure, dollars.									
³ Previously expended costs are shown in 2020 dollars using inflation adjustment values provided in USDOT BCA Guidance Table A-7.									

Other Non-Quantified Benefits

Several potential benefits were identified by the ODOT team preparing this application, but the benefits were not quantified. The following are included for consideration of the other potential benefits not captured in the BCA estimates.

- **Future I-35 Widening** – The proposed wider bridge decks will enable the future widening of I-35 through the greater Oklahoma City metropolitan area, an initiative that includes the portion of I-35 in the project area. Future widening will improve reliable travel times along this critical Interstate corridor.
- **Work Zone Delays** – The impact to the motoring public along I-35 and SH 74 during construction of the proposed project is not included in the BCA. Similarly, the work zone impact of more frequent maintenance activities for the no-build scenario with the existing bridges is also not accounted for.
- **Mode Shift** – While the benefits for the use of more active modes was accounted for in this BCA, the estimated reduction in vehicular trips due to any mode shift toward more active modes was not assumed when calculating vehicular benefits to travel time, emissions, or operating costs.
- **Development** – The traffic projections from the July 2022 AJR does not account for a new 400-unit residential development planned near the project area. The emergency response assumptions from the July 2022 AJR also do not account for the location of the new Purcell hospital that is currently under construction northeast of the project area. The new hospital location is not expected to drastically change the response time assumptions.
- **Resiliency** – The proposed new bridges will be designed to modern standards and will be more resilient than the existing bridges.
- **SH 74 Clearance** – The proposed new bridges will allow for greater horizontal and vertical clearance along SH 74.

Summary

The BCA summary includes all benefits compared with the capital costs and is expressed as a ratio. As shown in **Table 20**, the benefit-cost ratio using the discount rates required by the Guidance is 0.54.

Table 20 – Benefit-Cost Analysis Summary

Benefit-Cost Analysis Summary											
Year	Travel Time Savings (7% Discount)	Vehicle Operating Savings (7% Discount)	Emissions Savings (7%/3% Discount)*	Safety Benefits (7% Discount)	Pedestrian Benefits (7% Discount)	Cycling Benefits (7% Discount)	Health Benefits (7% Discount)	Emergency Services Benefits (7% Discount)	O&M (7% Discount)	Residual Value (7% Discount)	Capital Costs (7% Discount)
2019	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 101,000
2020	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2021	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 327,103
2022	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 821,032
2023	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 2,367,264
2024	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2025	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 5,033,682
2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 20,030,247
2027	\$ 279,698	\$ (11,213)	\$ (1,110)	\$ 77,323	\$ 130	\$ 37	\$ 724	\$ 730,302	\$ 51,129	\$ -	\$ -
2028	\$ 263,320	\$ (10,532)	\$ (1,214)	\$ 72,264	\$ 124	\$ 35	\$ 689	\$ 682,525	\$ (1,582)	\$ -	\$ -
2029	\$ 247,895	\$ (9,892)	\$ (1,188)	\$ 67,537	\$ 118	\$ 33	\$ 655	\$ 637,874	\$ (1,478)	\$ -	\$ -
2030	\$ 233,366	\$ (9,292)	\$ (1,165)	\$ 63,118	\$ 112	\$ 32	\$ 622	\$ 596,144	\$ (1,382)	\$ -	\$ -
2031	\$ 219,682	\$ (8,728)	\$ (1,136)	\$ 58,989	\$ 106	\$ 30	\$ 591	\$ 557,144	\$ (1,291)	\$ -	\$ -
2032	\$ 206,795	\$ (8,198)	\$ (1,108)	\$ 55,130	\$ 101	\$ 29	\$ 561	\$ 520,695	\$ (1,207)	\$ -	\$ -
2033	\$ 194,658	\$ (7,700)	\$ (1,082)	\$ 51,523	\$ 96	\$ 27	\$ 533	\$ 486,631	\$ (1,128)	\$ -	\$ -
2034	\$ 183,229	\$ (7,232)	\$ (1,057)	\$ 48,153	\$ 91	\$ 26	\$ 506	\$ 454,795	\$ (1,054)	\$ -	\$ -
2035	\$ 172,466	\$ (6,793)	\$ (1,032)	\$ 45,002	\$ 86	\$ 25	\$ 481	\$ 425,042	\$ (985)	\$ -	\$ -
2036	\$ 162,330	\$ (6,381)	\$ (1,020)	\$ 42,058	\$ 82	\$ 23	\$ 456	\$ 397,236	\$ (921)	\$ -	\$ -
2037	\$ 152,787	\$ (5,993)	\$ (997)	\$ 39,307	\$ 78	\$ 22	\$ 433	\$ 371,248	\$ 25,991	\$ -	\$ -
2038	\$ 143,800	\$ (5,629)	\$ (975)	\$ 36,735	\$ 74	\$ 21	\$ 410	\$ 346,961	\$ (804)	\$ -	\$ -
2039	\$ 135,339	\$ (5,287)	\$ (954)	\$ 34,332	\$ 70	\$ 20	\$ 389	\$ 324,263	\$ (752)	\$ -	\$ -
2040	\$ 127,373	\$ (4,966)	\$ (933)	\$ 32,086	\$ 66	\$ 19	\$ 369	\$ 303,049	\$ (702)	\$ -	\$ -
2041	\$ 119,872	\$ (4,665)	\$ (914)	\$ 29,987	\$ 63	\$ 18	\$ 350	\$ 283,224	\$ (27,706)	\$ -	\$ -
2042	\$ 112,810	\$ (4,381)	\$ (895)	\$ 28,025	\$ 60	\$ 17	\$ 331	\$ 264,695	\$ 142,974	\$ -	\$ -
2043	\$ 106,161	\$ (4,115)	\$ (886)	\$ 26,192	\$ 57	\$ 16	\$ 314	\$ 247,378	\$ (573)	\$ -	\$ -
2044	\$ 99,902	\$ (3,865)	\$ (867)	\$ 24,478	\$ 54	\$ 15	\$ 298	\$ 231,195	\$ (536)	\$ -	\$ -
2045	\$ 94,010	\$ (3,631)	\$ (850)	\$ 22,877	\$ 51	\$ 14	\$ 282	\$ 216,070	\$ (501)	\$ -	\$ -
2046	\$ 88,866	\$ (3,427)	\$ (837)	\$ 21,380	\$ 48	\$ 14	\$ 267	\$ 201,934	\$ (468)	\$ -	\$ -
2047	\$ 83,640	\$ (3,235)	\$ (825)	\$ 19,982	\$ 45	\$ 13	\$ 253	\$ 188,724	\$ 13,213	\$ -	\$ -
2048	\$ 78,720	\$ (3,054)	\$ (812)	\$ 18,674	\$ 43	\$ 12	\$ 239	\$ 176,377	\$ (409)	\$ -	\$ -
2049	\$ 74,088	\$ (2,882)	\$ (801)	\$ 17,453	\$ 41	\$ 12	\$ 226	\$ 164,839	\$ (382)	\$ -	\$ -
2050	\$ 69,727	\$ (2,721)	\$ (797)	\$ 16,311	\$ 39	\$ 11	\$ 214	\$ 154,055	\$ (357)	\$ -	\$ -
2051	\$ 65,621	\$ (2,568)	\$ (778)	\$ 15,244	\$ 36	\$ 10	\$ 203	\$ 143,976	\$ (334)	\$ -	\$ -
2052	\$ 61,755	\$ (2,424)	\$ (759)	\$ 14,247	\$ 35	\$ 10	\$ 192	\$ 134,557	\$ (312)	\$ -	\$ -
2053	\$ 58,116	\$ (2,288)	\$ (741)	\$ 13,315	\$ 33	\$ 9	\$ 182	\$ 125,755	\$ (291)	\$ -	\$ -
2054	\$ 54,691	\$ (2,160)	\$ (723)	\$ 12,444	\$ 31	\$ 9	\$ 172	\$ 117,528	\$ (272)	\$ -	\$ -
2055	\$ 51,466	\$ (2,039)	\$ (706)	\$ 11,629	\$ 29	\$ 8	\$ 162	\$ 109,839	\$ (255)	\$ -	\$ -
2056	\$ 48,430	\$ (1,924)	\$ (690)	\$ 10,869	\$ 28	\$ 8	\$ 154	\$ 102,653	\$ (238)	\$ 865,419	\$ -
TOTAL	\$ 3,990,611	\$ (157,216)	\$ (27,851)	\$ 1,026,664	\$ 2,025	\$ 575	\$ 11,257	\$ 9,696,706	\$ 187,387	\$ 865,419	\$ 28,680,329

Notes:

*All emission types are discounted at 7% except for CO2, which is discounted at 3%, per USDOT BCA Guidance (Mar 2022).

Sum of Benefits	\$ 15,595,579
Sum of Costs	\$ 28,680,329
Benefit-Cost Ratio	0.54