Appendix E1 Benefit Cost Analysis

Executive Summary

This memorandum summarizes the approach used for conducting benefit-cost (BCA) and economic impact (EIA) analyses for the widening project (CA0601) along I-30 in Saline County, Arkansas. Table 1 summarizes the project matrix for the proposed corridor. The project matrix describes types of impacts and a summary of results.

Table 1: I-30 Corridor – Project Matrix

Type of Impact	Economic Benefit	Summary of Results	
		Discounted at 3%	**Discounted at 7%**
Increased capacity Improved travel speeds and travel time	Monetized value of reduced travel time	$111,297,823	$65,897,956
Reduced vehicle operating costs Improved accessibility	Monetized value of reduced vehicle operating costs	$51,973,315	$30,700,850
Greater safety for users of motorized and non-motorized transportation modes in the vicinity of the project	Monetized value of reduced traffic accidents	$58,340,421	$35,079,786
Reduced air emissions generated by motor vehicles	Monetized value of reduced Social Cost of Emissions	$16,651,306	$9,727,266
Job creation in the development, construction and maintenance phases of the project	Short-term job-years due to project during development and construction	1,445 Job-Years	

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Proposed Alternative Benefit- Cost Analysis

This section describes the method used for estimating benefits and life cycle costs of the I-30 Corridor Project. This analysis emphasizes the importance and full benefits of the project. In conducting the benefit-cost analysis, CS followed Federal guidance regarding evaluation criteria, discount and monetization rates, and evaluation methods prescribed in the 2016 TIGER and FASTLANE Guidance and supporting documents.

Travel Patterns

The estimation of the benefits involved establishing the Baseline and Build Scenario and calculating the differences between the Build and the Baseline in the benchmark years. The project team prepared and analyzed the following four model scenarios traffic and level-of-service forecasts from the Interchange Justification Report (IJR)[1] and the Traffic Count Plan (TCP)[2]:

- 2020 No Build Baseline
- 2040 No Build Baseline
- 2020 Build –I-30 Corridor Project
- 2040 Build –I-30 Corridor Project

The forecasts for each of the study scenarios used in the estimation of the benefits included the following:

- Projections of total daily traffic counts for the years 2016 and 2036.
- Projections of peak hour level-of-service and traffic counts for each link in the study area for the build and no build scenarios for the years 2018 and 2038.

In order to convert level-of-service ratings into hours of delay, assumptions had to be made about the average delay per vehicle each level-of-service implies. The following table (Table 2) displays the assumed delay per vehicle. The average peak hour delay per vehicle was applied to the peak hour traffic counts in order to calculate daily peak hour delay. It is assumed that the peak hour conditions last for two hours in the morning and two hours in the evening, and therefore peak hour delay is doubled in order to calculate daily delay.

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[1] *Interchange Justification Report for AHTD Job No. CA0601: F.A.P. No 9991 Interstate 30 Highway 70 - Sevier Street (Widening) Saline County Arkansas.* Bridgefarmer & Associaes, Inc. Job No. 14407. September 3, 2015

[2] *Traffic Count Plan, Traffic Projection Plan and Traffic Forecast CA0601 - I-30 Widening, Highway 70 to Sevier Street.* Arkansas State Highway and Transportation Connecting Arkansas Program (CAP). May 6, 2014

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Table 2: Calculation of Average Delay per Vehicle for Each Scenario.

Level-of-Service	Assumed Delay (seconds per vehicle)
A	0
B	10
C	20
D	35
E	55
F	80

Total traffic counts, used to calculate the impact of safety costs, have been taken from the TCP. It is assumed that there will be no change in total traffic counts between the build and no-build scenarios. The Vehicle miles travelled (VMT) were calculated by making the assumption that each vehicle traverses 85 percent of the extent of the project (5.2 miles X 0.85 = 4.42 miles).

Since the project completion date is scheduled for 2020, a straight-line growth pattern was assumed for traffic counts and delay from 2020 to 2040 for the No-Build scenario and Build scenario. In this way the intermittent years during the 20-year study period (2020 to 2040) have been estimated. The focus of the travel efficiency portion of the benefit-cost analysis is the difference between the build and no-build scenarios.

Daily VMT and delay accruing to auto trips were annualized by assuming 260 working days a year (i.e., 52 weeks). Daily VMT and delay for truck trips were annualized by multiplying daily VMT and delay by 365 days.

Table 3 provides traffic forecasts for the four model scenarios. As shown in the table, passenger cars and trucks would benefit from the added capacity provided by the project.

Table 3: Daily Traffic in 2020 and 2040

Scenario	Passenger Cars		Trucks	
	2020 VMT	**2020 Delay**	**2020 VMT**	**2020 Delay**
2020 Build (A)	309,816	1,276	63,456	211
2020 No Build (B)	309,816	754	63,456	132
Changes = (A) - (B)	**0**	**522**	**0**	**79**
Scenario	**Passenger Cars**		**Trucks**	
	2040 VMT	**2040 Delay**	**2040 VMT**	**2040 Delay**
2040 Build (C)	574,888	3,317	117,748	615
2040 No Build (D)	574,888	2,116	117,748	413
Changes = (C) - (D)	**0**	**1,201**	**0**	**202**

Source: Forecasts from the IJP and TCP

Table 4 reflects changes in peak hour delay, respectively, over the 20-year analysis period. The improvements are expected to have a substantial positive impact on corridor users, in terms of hours of delay.

Table 4: Changes in Vehicle Miles Traveled (VMT) and Delay over the 20-year Analysis Period

t	Year	Change in Hours of Delay (Build – No Build)
0	2020	-164,281
1	2021	-175,374
2	2022	-186,467
3	2023	-197,559
4	2024	-208,652
5	2025	-219,745
6	2026	-230,838
7	2027	-241,931
8	2028	-253,024
9	2029	-264,117
10	2030	-275,210
11	2031	-286,303
12	2032	-297,395
13	2033	-308,488
14	2034	-319,581
15	2035	-330,674
16	2036	-341,767
17	2037	-352,860
18	2038	-363,953
19	2039	-375,046
20	2040	-386,139
Totals =		**-5,779,402**

Note: Negative values represent a reduction while positive values represent an increase

Project Benefits

The primary benefits of the Project are:

- Reduced travel time for passengers cars and trucks
- Reduced vehicle operating costs (fuel and non-fuel costs)
- Reduced air emissions generated by motor vehicles
- Greater safety for users of motorized and non-motorized transportation modes in the vicinity of the project

Consistent with USDOT grant methodology and guidance, the benefits resulting from the I-30 Corridor Project (see Table 8) are broken down into the following major categories: a) Economic Competitiveness, b) Environmental Sustainability, and c) Safety. The benefits of the I-30 Corridor Project are calculated in 2015 dollars over a time horizon of 20 years, starting in 2020 and ceasing in 2040.

Table 5: Direct Benefits Resulting from the I-30 Corridor Project

Benefit Category	Metrics
A. Economic Competitiveness	Travel Time Costs Vehicle Operating Costs (VOC)
B. Environmental Sustainability	Social Cost of Carbon (SCC) Emissions Non-Carbon Emissions Costs
C. Safety	Traffic Accident Costs

Travel Time Cost Benefits/Disbenefits

The expected reduction in delay along the corridor will result in higher travel speeds and reduced travel time for highway users. In contrast, increased delay will result in lower travel speeds and added travel time for highway users.

Annual changes in peak hour delay by vehicle type over the 20-year analysis period are multiplied by the corresponding Average Vehicle Occupancy (AVO) and Value of Time (VOT). Travel time cost benefits/disbenefits resulting from the project are summarized in Table 7. These values are used in the Benefit-Cost Analysis. For the Economic Impact Analysis, auto value of time is given 50% of the full value of time.

Table 6: Average Vehicle Occupancy and Value of Time by Vehicle Type/Trip Purpose

Trip Purpose	Average Vehicle Occupancy (AVO)	Value of Time (VOT) in 2015$
Auto	1.5	$20.40
Truck	1	$27.20

Source of AVO: Estimated based on the occupancy rates provided by the Arkansas Travel Demand Model

Source of VOT: *Benefit-Cost Analysis (BCA) Resource Guide (November 2016)*.

Table 7: Travel Time Cost Benefits/Disbenefits

t	Calendar Year	Monetary Value of Travel Time Cost Saved/Wasted (in 2015$)	PV of Travel Time Cost Saved/Wasted	
			3%	7%
			NPV = [Value/(1+3%)^t]	NPV = [Value/(1+7%)^t]
0	2020	$4,929,137	$4,379,475	$3,760,415
1	2021	$5,260,911	$4,538,108	$3,750,957
2	2022	$5,592,685	$4,683,785	$3,726,642
3	2023	$5,924,459	$4,817,127	$3,689,455
4	2024	$6,256,232	$4,938,728	$3,641,184
5	2025	$6,588,006	$5,049,158	$3,583,439
6	2026	$6,919,780	$5,148,966	$3,517,665
7	2027	$7,251,554	$5,238,677	$3,445,161
8	2028	$7,583,328	$5,318,793	$3,367,088
9	2029	$7,915,101	$5,389,799	$3,284,486
10	2030	$8,246,875	$5,452,156	$3,198,280
11	2031	$8,578,649	$5,506,308	$3,109,297
12	2032	$8,910,423	$5,552,681	$3,018,268
13	2033	$9,242,197	$5,591,681	$2,925,843
14	2034	$9,573,970	$5,623,699	$2,832,592
15	2035	$9,905,744	$5,649,107	$2,739,021
16	2036	$10,237,518	$5,668,265	$2,645,569
17	2037	$10,569,292	$5,681,515	$2,552,622
18	2038	$10,901,066	$5,689,184	$2,460,514
19	2039	$11,232,839	$5,691,587	$2,369,532
20	2040	$11,564,613	$5,689,023	$2,279,924
Totals =		**$173,184,379**	**$111,297,823**	**$65,897,956**

Note: Positive values represent savings and negative values represent losses

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Vehicle Operating Costs Benefits/Disbenefits

The reduction in peak hour delay also generates savings in the cost associated with the operation and maintenance of passenger cars and trucks. In contrast, increased delay would lead to increased vehicle operating costs (VOC). VOC include fuel and non-fuel costs. The non-fuel component is comprised of all the necessary replacement items on the vehicle and regular maintenance (e.g., oil and fluid changes, tire rotations, tire replacements, and wiper replacement) as well as truck/trailer lease or purchase payments, permits and licenses, and other related costs to owners of commercial vehicles.

The method to assess VOC benefits/disbenefits involves estimation of the VOC per vehicle type. Average per-mile VOC for passenger vehicles is estimated based on the VOC for three size categories of sedans (i.e., small, medium and large sedans), four wheel-drive sport utility vehicles (SUV) and minivans provided by the American Automobile Association (AAA) (see Table 8). This analysis uses the average auto VOC resulting from 15,000 miles traveled per year. Average per-mile VOC for trucks is estimated using published analyses of the operational costs for trucking based on information provided directly by motor carriers to the American Transportation Research Institute (ATRI) (see Table 9). The VOC for autos and trucks are inflated from 2014 to 2015 dollars using the Consumer Price Index (CPI).

Table 8: Average Marginal Vehicle Operating Cost for Passenger Vehicles

Auto Type	**VOC (in cents/mile) in 2014**		
	Miles per Year		
	10,000	**15,000**	**20,000**
Small Sedan	58.2	44.9	38.0
Medium Sedan	75.9	58.1	49.0
Large Sedan	93.3	71.0	59.5
Sedan (Composite Average)	75.8	58.0	48.8
4WD Sport Utility Vehicle	92.6	70.8	59.7
Minivan	81.2	62.5	52.9
Average =	**83.2**	**63.8**	53.8

Source: Your Driving Costs, 2015 Edition (AAA)
Notes: (1) VOC per mile derived from a popular model of each type listed assuming ownership of more than 5 years or 75,000 miles before replacement. (2) VOC per mile includes costs for fuel, maintenance, tires, full-coverage insurance, fees (license, registration and taxes), depreciation, and financing.

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Table 9: Average Marginal Vehicle Operating Cost for Trucks for the Southeast Region ($/mile)

Operating Cost	VOC (in $/mile) in 2015 Dollars
Truck/Trailer Lease or Purchase Payments	$0.21
Repair & Maintenance	$0.19
Truck Insurance Premiums	$0.06
Permits and Licenses	$0.009
Tires	$0.04
Total =	**$0.51**

Source: An Analysis of the Operational Costs of Trucking: 2015 Update (ATRI, September 2015), Table 15, p. 27.

Fuel operating cost are calculated by multiplying the price of fuel per gallon by the average fuel efficiency, to come up with a fuel cost per mile. This is then applied to the change in vehicle miles traveled to produce the change in fuel cost. Fuel prices ($2.26 per gallon for gasoline, all grades and $2.58 for diesel, all types) were taken from the US Energy Information Administration, using the 2015 annual average for the Gulf Coast. Fuel efficiency numbers (autos: 0.05 gallons per mile and trucks: 0.159 gallons per mile)are taken from the Environmental Protection Agency, and The Department of Energy.

The per-mile costs are converted to per-hour costs by assuming the vehicles are travelling at the highway speeds used by the U.S. Environment Protection Agency in order to estimate fuel consumption (48.3 miles per hour)[3]. VOC benefits/disbenefits are estimated by multiplying the average marginal VOC by vehicle type by its corresponding annual changes in peak hour delay over the 20-year analysis period. The results from this estimation are shown in Table 10.

[3] U.S. Environmental Protection Agency, Office of Transportation & Air Quality: https://www.fueleconomy.gov/feg/fe_test_schedules.shtml

Table 10: Vehicle Operating Cost Benefits/Disbenefits

Calendar Year	Non-Fuel VOC Savings	Fuel VOC Savings	Total Vehicle Operating Cost Savings	PV of VOC Savings (3%) [C/(1+3%)^A]	PV of VOC Savings (7%) [C/(1+7%)^A]
2020	$945,646	$1,301,390	$2,247,036	$1,996,463	$1,714,253
2021	$1,014,361	$1,393,741	$2,408,102	$2,077,250	$1,716,943
2022	$1,083,076	$1,486,091	$2,569,168	$2,151,637	$1,711,945
2023	$1,151,791	$1,578,442	$2,730,233	$2,219,930	$1,700,252
2024	$1,220,506	$1,670,792	$2,891,299	$2,282,418	$1,682,762
2025	$1,289,222	$1,763,143	$3,052,365	$2,339,383	$1,660,284
2026	$1,357,937	$1,855,493	$3,213,430	$2,391,094	$1,633,545
2027	$1,426,652	$1,947,844	$3,374,496	$2,437,808	$1,603,199
2028	$1,495,367	$2,040,195	$3,535,562	$2,479,772	$1,569,832
2029	$1,564,082	$2,132,545	$3,696,627	$2,517,223	$1,533,969
2030	$1,632,797	$2,224,896	$3,857,693	$2,550,390	$1,496,080
2031	$1,701,513	$2,317,246	$4,018,759	$2,579,488	$1,456,583
2032	$1,770,228	$2,409,597	$4,179,824	$2,604,728	$1,415,851
2033	$1,838,943	$2,501,947	$4,340,890	$2,626,310	$1,374,215
2034	$1,907,658	$2,594,298	$4,501,956	$2,644,424	$1,331,966
2035	$1,976,373	$2,686,648	$4,663,021	$2,659,256	$1,289,364
2036	$2,045,088	$2,778,999	$4,824,087	$2,670,980	$1,246,636
2037	$2,113,804	$2,871,349	$4,985,153	$2,679,765	$1,203,980
2038	$2,182,519	$2,963,700	$5,146,218	$2,685,773	$1,161,569
2039	$2,251,234	$3,056,050	$5,307,284	$2,689,157	$1,119,555
2040	$2,319,949	$3,148,401	$5,468,350	$2,690,066	$1,078,067
Total Value of Time Savings	**$34,288,747**	**$46,722,806**	**$81,011,553**	**$51,973,315**	**$30,700,850**

Note: Positive values represent savings and negative values represent losses.

Emission Cost Benefits/Disbenefits

This category of project benefits (disbenefits) captures the savings (or additional expenditures) in emission damage costs resulting from reduced (increased) peak hour delay under the Build Scenario (compared to the No Build).

This analysis applies the running emission rates pertain to Carbon Dioxide (CO_2), Volatile Organic Compound (VOC), Nitrogen Oxides (NOx), Particular Matter (PM) and Sulfur Dioxide (SOx) for passenger cars and trucks on urban restricted access roads estimated by Cambridge Systematics (CS) using data from the Environmental Protection Agency, and The Department of Energy.

The emissions rates (in grams per mile) of non-carbon emissions (VOC, NOx, PM and SOx) are multiplied by the assumed speed (48.3 mile per hour) and then by the annual changes in delay resulting from the implementation of the I-30 Corridor Project, converted to metric tons and then, multiplied by the emission cost metric ton depicted in Table 11. The CO_2 emissions rates (in grams per mile) are multiplied by the annual changes in VMT resulting from the implementation of the Project, converted to metric tons and then, multiplied by the emission cost per metric ton depicted in Table 12. It should be noted that the social cost of carbon (SCC) dioxide emissions increases annually and values for these emissions are to be discounted at a value of 3 percent rather than the 7 percent recommendation for all other non-carbon benefits or costs. The expected emission cost benefits/disbenefits are shown in Table 13.

Table 11: Emission Damage Costs

Emission Type	Emission Damage Cost ($/metric ton) in 2015$
	gram/mile
VOCs	$2,032
NOx	$8,010
PM	$366,414
SOx	$47,341

Source: 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide; Corporate Average Fuel Economy for MY2017-MY2025 Passenger Cars and Light Trucks (August 2012), page 922, Table VIII-16, "Economic Values Used for Benefits Computations (2010 dollars)."
Note: The 2016 Benefit-Cost Analysis (BCA) Resource Guide converts the emission damage cost value into 2015 dollars.

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Table 12: Social Cost of Carbon (3%)

Year	3% SCC ($/metric tons) in 2015$
2025	$47
2021	$47
2022	$48
2023	$50
2024	$51
2025	$52
2026	$53
2027	$54
2028	$55
2029	$55
2030	$56
2031	$58
2032	$59
2033	$60
2034	$61
2035	$62
2036	$63
2037	$64
2038	$65
2039	$67
2045	$68

Source: 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide; Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013; revised July 2015), page 17, Table A1 "Annual SCC Values: 2010-2050 (2007$/metric ton CO_2).
Note: The 2016 Benefit-Cost Analysis (BCA) Resource Guide converts the social cost of carbon (SCC) into 2015 dollars.

Table 13: Emissions Cost Benefits/Disbenefits

Calendar Year	Emissions Reduction Savings	PV of Emissions Reduction Savings (3%) [C/(1+3%)^A]	PV of Emissions Reduction Savings (7%) [C/(1+7%)^A]
2020	$659,142	$585,639	$502,857
2021	$707,776	$610,533	$504,634
2022	$762,269	$638,389	$507,932
2023	$823,716	$669,757	$512,969
2024	$880,031	$694,705	$512,186
2025	$937,075	$718,190	$509,707
2026	$994,847	$740,260	$505,730
2027	$1,053,348	$760,961	$500,438
2028	$1,112,577	$780,339	$493,997
2029	$1,164,124	$792,712	$483,070
2030	$1,224,446	$809,503	$474,861
2031	$1,294,635	$830,977	$469,235
2032	$1,356,778	$845,499	$459,588
2033	$1,419,649	$858,911	$449,425
2034	$1,483,249	$871,253	$438,840
2035	$1,547,578	$882,562	$427,918
2036	$1,612,635	$892,877	$416,735
2037	$1,678,420	$902,234	$405,360
2038	$1,744,934	$910,668	$393,855
2039	$1,824,230	$924,322	$384,816
2040	$1,892,565	$931,017	$373,113
Total Emissions Reduction Savings	**$26,174,024**	**$16,651,306**	**$9,727,266**

Note: Positive values represent savings and positive values represent losses.

Traffic Safety Benefits/Disbenefits

The reduction (or increase) of traffic accidents depends on the reduction (or increase) of vehicle-miles traveled by passenger cars and trucks under the Build Scenario (compared to the No Build), as well as any change in the crash rates due to the infrastructure improvements. The method to assess safety benefits/disbenefits resulting from the implementation of the I-30 Corridor involves applying the regional fatality, injury and property damage only (PDO) crash rates to the annual VMT and then, estimating the dollar value by using comprehensive cost of motor vehicle crashes by injury level.

This analysis uses the average fatality, injury and PDO crash rates in the project area, estimated based on the reported crash statistics for 2010 through 2014, and the average monetized value of fatalities, injuries and PDO crashes prescribed in the 2016 Benefit-Cost Analysis (BCA) Resource Guide (see Table 15). The results from this estimation are shown in Table 16. It is assumed that the addition of the extra lanes will reduce crash rates by 15 percent for the build scenario.

Table 14: Traffic Fatality and Injury Rates Project Area 2010-2014

	Rate per 1 Million VMT
Fatal Crashes	1.66
Injury Crashes	22.75
PDO Crashes	54.75

Table 15: Average Comprehensive Cost of Motor Vehicle Crashes

Average Monetized Value of Accidents	Value (in 2015$)	Units
- Fatal Accident Cost	$9,600,000	$/crash
- Injury Accident Cost	$135,098	$/crash
- Property Damage Only (PDO) Crash Cost	$4,198	$/crash

Source of Fatal Accident Cost: 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide supplement to the 2016 Benefit-Cost Analysis Guidance for Grant Applicants. *Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses* (2016).

Source of Injury Accident Cost: estimated based on the KABCO/Unknown - AIS Data Conversion Matrix developed by the NHTSA (July 2011) and provided in the 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide, page 13 of 20.

Source of PDO Crash Cost: The Economic and Societal Impact of Motor Vehicle Crashes, 2010

Table 16: Traffic Accident Cost Benefits/Disbenefits

Calendar Year	Crash Reduction Savings	PV of Crash Reduction Savings (3%) [C/(1+3%)^A]	PV of Crash Reduction Savings (7%) [C/(1+7%)^A]
2020	$2,993,069	$2,659,303	$2,283,398
2021	$3,121,109	$2,692,296	$2,225,308
2022	$3,249,150	$2,721,112	$2,165,046
2023	$3,377,190	$2,745,965	$2,103,144
2024	$3,505,231	$2,767,062	$2,040,076
2025	$3,633,271	$2,784,600	$1,976,259
2026	$3,761,312	$2,798,769	$1,912,060
2027	$3,889,352	$2,809,751	$1,847,803
2028	$4,017,393	$2,817,718	$1,783,770
2029	$4,145,433	$2,822,838	$1,720,207
2030	$4,273,474	$2,825,270	$1,657,327
2031	$4,401,514	$2,825,165	$1,595,311
2032	$4,529,555	$2,822,669	$1,534,317
2033	$4,657,595	$2,817,922	$1,474,475
2034	$4,785,636	$2,811,057	$1,415,897
2035	$4,913,676	$2,802,201	$1,358,672
2036	$5,041,717	$2,791,476	$1,302,875
2037	$5,169,757	$2,778,999	$1,248,564
2038	$5,297,798	$2,764,881	$1,195,783
2039	$5,425,838	$2,749,228	$1,144,564
2040	$5,553,879	$2,732,140	$1,094,928
Total Crash Reduction Savings	**$89,742,950**	**$58,340,421**	**$35,079,786**

Note: Positive values represent savings and negative values represent losses

Economic Impact Analysis

The transportation costs savings and increased public expenditures are expected to have a positive impact on the regional and state economies in terms of increases in the number of jobs, income and overall gross state product.

Short-term job growth is stimulated by the expenditure on construction. The construction spending for the project will be $111.1 million. Based on the TIGER guidelines, construction spending of $1 billion should result in the generation of 13,000 jobs. Based on this the construction project should generate 1,445 jobs.

In terms of long-term impacts, the "out-of-pocket" travel time changes for auto and truck trips and the vehicle operating costs changes for all trips were entered in a regional IMPLAN

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economic model. The model estimates the direct, indirect and induced impacts arising from changes in regional transportation costs. The results of this analysis are displayed in Table 17. It is estimated that the improvements in the I-30 corridor will support long-term economic impacts, averaging 57 jobs, $2.0 million in income and $7.0 million in GSP annually.

These benefits are not included in the B/C calculation.

Table 17: Long-term Economic Impact, Average Annual Impacts

Impact Type	**Employment**	**Income**	**Gross State Product**
Direct Effect	18	$735,722	$2,256,668
Indirect Effect	4	$113,646	$371,986
Induced Effect	35	$1,195,172	$4,347,659
Total Effect	**57**	**$2,044,540**	**$6,976,314**

Total Monetized Benefits

Table 18 summarizes the monetized benefits (undiscounted and discounted) for each benefit category.

Table 18: Total Monetized Benefits by Benefit Category

Benefit Category	Savings	In 2015$	Discounted at 3%	Discounted at 7%
A. Economic Competitiveness	Travel Time Costs	$173,184,379	$111,297,823	$65,897,956
	Vehicle Operating Costs	$81,011,553	$51,973,315	$30,700,850
B. Sustainability	Social Cost of Emissions	$26,174,024	$16,651,306	$9,727,266
C. Safety	Motor Vehicle Crashes	$89,742,950	$58,340,421	$35,079,786
Total Benefits (B)		**$370,112,906**	**$238,262,865**	**$141,405,858**

Project Life Cycle Cost Analysis

The cost of the I-30 Project consist of capital expenditures, including design, land acquisition and construction, as well as operation and maintenance (O&M). The Arkansas State Highway and Transportation Department (AHTD) provided capital cost estimates (in 2015 dollars). The project is expected to require $129.2 million (in 2015 dollars) in capital expenditures.

The cost of average cost maintenance for Arkansas (based on FHWA Highway Statistics) is around $3,614 per lane-mile annually. This analysis uses this value to estimate the annual O&M cost of net increase of 10.8 lane miles. Annual O&M expenditures are estimated assuming O&M costs start in 2020.

Table 19 presents the life cycle cost of the project.

Table 19: I-30 Corridor Project - Life Cycle Cost Analysis

Calendar Year	Initial Capital Cost	Operations & Maintenance Costs	Total Life Cycle Costs	PV of Life Cycle Costs (3%) [E/(1+3%)^A]	PV of Life Cycle Costs (7%) [E/(1+7%)^A]
2016	$8,614,617	$0	$8,614,617	$8,614,617	$8,614,617
2017	$925,956	$0	$925,956	$898,986	$865,379
2018	$39,874,766	$0	$39,874,766	$37,585,791	$34,828,165
2019	$39,874,766	$0	$39,874,766	$36,491,059	$32,549,687
2020	$39,874,766	$0	$39,874,766	$35,428,213	$30,420,268
2021	$0	$39,034	$39,034	$33,671	$27,831
2022	$0	$39,034	$39,034	$32,691	$26,010
2023	$0	$39,034	$39,034	$31,738	$24,309
2024	$0	$39,034	$39,034	$30,814	$22,718
2025	$0	$39,034	$39,034	$29,917	$21,232
2026	$0	$39,034	$39,034	$29,045	$19,843
2027	$0	$39,034	$39,034	$28,199	$18,545
2028	$0	$39,034	$39,034	$27,378	$17,332
2029	$0	$39,034	$39,034	$26,580	$16,198
2030	$0	$39,034	$39,034	$25,806	$15,138
2031	$0	$39,034	$39,034	$25,055	$14,148
2032	$0	$39,034	$39,034	$24,325	$13,222
2033	$0	$39,034	$39,034	$23,616	$12,357
2034	$0	$39,034	$39,034	$22,929	$11,549
2035	$0	$39,034	$39,034	$22,261	$10,793
2036	$0	$39,034	$39,034	$21,612	$10,087
2037	$0	$39,034	$39,034	$20,983	$9,427
2038	$0	$39,034	$39,034	$20,372	$8,811
2039	$0	$39,034	$39,034	$19,778	$8,234
2040	$0	$39,034	$39,034	$19,202	$7,695
Total Project Life Cycle Costs	**$129,164,870**	**$780,686**	**$129,945,556**	**$119,534,639**	**$107,593,595**

Summary of Benefit-Cost Results

This memorandum describes the methodology used for conducting benefit-costs analysis (BCA) for the proposed I-30 Corridor. The analysis quantifies the economic benefits of the project in terms of savings in travel time costs and vehicle operating costs, emission damages, and traffic accident costs.

Table 20 summaries the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (20 years). As stated earlier, construction is expected to be completed by the end of 2019 and benefits to be accrued during the full operation of the project. The project

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has a benefit-cost ratio of 2.0 at a real discount rate of 3 percent and 1.3 at a real discount rate of 7 percent. The Net Present Value (NPV) of the project is $118.7 million at 3 percent and $33.8 million at 7 percent over the assumed 20-year project life, from 2020 to 2040. These findings demonstrate that there are significant long-term economic benefits associated with the Project, and is regionally an important project.

Table 20: Summary of Benefit-Cost Analysis of I-30 Corridor Project

Benefit-Cost Analysis Summary		@ 3% Discount Rate	@ 7% Discount Rate
NET PRESENT VALUE = (B) - (C) =		**$118,728,226**	**$33,812,263**
BENEFIT-COST RATIO = (B) / (C) =		**2.0**	**1.3**
Project Costs			
Cost Categories	-	**Discounted at 3%**	**Discounted at 7%**
	-		
Capital Costs	-	$119,018,666	$107,278,115
O&M Costs	-	$515,973	$315,480
	Total Costs (C) =	**$119,534,639**	**$107,593,595**
Project Benefits			
Benefit Category	**Savings**	**Discounted at 3%**	**Discounted at 7%**
B. Economic Competitiveness	Travel Time Costs	$111,297,823	$65,897,956
	Vehicle Operating Costs	$51,973,315	$30,700,850
D. Sustainability	Social Cost of Emissions	$16,651,306	$9,727,266
E. Safety	Motor Vehicle Crashes	$58,340,421	$35,079,786
	Total Benefits (B) =	**$238,262,865**	**$141,405,858**

Economic Impact Analysis

The transportation costs savings and increased public expenditures are expected to have a positive impact on the regional and state economies in terms of increases in the number of jobs, income and overall gross state product.

The expenditure of public sector dollars on construction in the amount of $111.1 million is expected to create short-term jobs in the development and construction phases and maintenance of the I-30 Corridor Project (see Table 21). The benefit of increase in the job-years as a result of the Project during development and construction was computed as a product of the undiscounted project cost and the value on government dollars spent to create a single job-year (i.e., $76,900 in 2015$).

In terms of long-term impacts, the "out-of-pocket" travel time changes auto and truck trips, and the vehicle operating costs changes for all trips were entered in a regional IMPLAN economic model. For the Economic Impact Analysis, auto value of time is given 50% of the full value of time. The model estimates the direct, indirect and induced impacts arising from changes in regional transportation costs. The results of this analysis are displayed in Table 22. It is estimated that the improvements in the I-30 corridor will support long-term economic impacts, averaging 57 jobs, $2.0 million in income and $7.0 million in GSP annually. These benefits are not counted in the B/C calculation.

Table 21: Construction Spending Job Creation Benefits

Job Creation	Value
Increase in Short-Term Job-Years due to Project during Development and Construction	1,445 Job-Years

Table 22: Long-term Economic Impact, Average Annual Impacts

Impact Type	**Employment**	**Labor Income**	**GSP**
Direct Effect	18	$735,722	$2,256,668
Indirect Effect	4	$113,646	$371,986
Induced Effect	35	$1,195,172	$4,347,659
Total Effect	**57**	**$2,044,540**	**$6,976,314**

Source: CS calculations using IMPLAN