APPENDIX A

Rural Surface Transportation Grant:

Benefit-Cost Analysis

May 23, 2022

Location: Carbondale, Illinois

Project Type: Rural

Applicant: City of Carbondale

Type of Applicant: City Government

Funding Requested: $7,645,705

DUNS Number: 096712948

Website: https://www.explorecarbondale.com/831/Rural-Surface-Transportation-Grant

Contact: Cody Lueker, Economic Development Coordinator

phone: (618) 457-3232, email: clueker@explorecarbondale.com

A1.0 Summary

Table 1: Summary of Benefit-Cost Analysis

Analysis Item	Outcome
Current Status/Baseline & Problem to be addressed	• Existing, aging, deteriorating infrastructure • Curb/sidewalk transitions need ADA upgrades • No state of good repair – roads have become unsafe • Does not enhance economic growth
Change to Baseline/Alternatives	• Pavement structural repairs, resurfacing, sidewalk transitions, enhanced cycling infrastructure will enhance pedestrian access • Will encourage alternative transportation modes, reducing emissions • No-Build
Type of Impacts	• Revitalize main corridors to Carbondale • Encourages more cycling improving health outcomes • Create new jobs • Improve transportation connectivity • Expands transportation alternatives • Meet ADA design standards to provide transportation access to all users
Population Affected by Impacts	• Historically disadvantaged populations • Residents living in persistent poverty • SIUC students, faculty, and staff • Tourists to Carbondale & Southern Illinois region • Business travelers • Key assets to include Southern Illinois Healthcare, Carbondale Community High School, District #95 Elementary School, mental health services, rural transit users
Economic Benefit	Monetized value of: • Reduced fuel consumption • Reduced emissions • Reduced travel time (due to congestion) • Increased cycling
Summary of Results	Estimated dollar value of: • Time savings • Reduced pollution • Reduced fuel consumption • Reduced vehicle operations & maintenance
B/C Ratio	The results of the BCA are: • No Discount: 13:1 • 3% Discount: 14:1 • 7% Discount: 15:1

A2.0 Introduction

This document provides a description of the input data and the methodological standards utilized for the benefit-cost analysis (BCA) of the rural transportation project as submitted by the City of Carbondale, Illinois for Rural Surface Transportation Grant funding.

BCA is a conceptual framework that quantifies, in monetary terms, as many of the costs and benefits of a project as possible. Benefits are broadly defined. They represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to a BCA is the idea that people are best able to judge what is "good" for them, what improves their well-being or welfare.

BCA also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse-off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life-cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns.

A2.1 Analysis Framework

The Carbondale project is expected to produce both quantifiable and less tangible qualitative benefits. The benefit-cost analysis conducted for this project includes the quantifiable benefits and considers impacts and externalities of sufficient quality.

The specific methodology developed for this application was developed using the above BCA principles and the *Benefit-Cost Analysis Guidance for Discretionary Grant Programs (March, 2022)* published by the US Department of Transportation. In particular, the methodology involves:

- Establishing existing and future conditions under the "build" and "no-build" scenarios.
- Assessing benefits with respect to each of the long-term outcomes identified in the Notice of Funding Opportunity (NOFO).
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement.
- Using DOT guidance for the valuation of travel time savings, benefits, reductions in air emissions, and cycling values while relaying on industry best practice for the valuation of other effects.
- Discounting future benefits and costs with the real discount rates recommended by the DOT (7% and 3% for sensitivity analysis).
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

A typical benefit-cost analysis uses a standard 20-year lifecycle to facilitate comparisons across projects. Per the guidelines, and based on our realization of the effect road resurfacing improvements will have on motorists and detour routes that increase project costs, a 10-year lifecycle was used for this analysis. We believe this is a truer reflection of the time period that we should assess the benefits and costs of this project. A typical benefit-cost analysis for a transportation project measures four primary categories of user benefits:

- Travel time savings
- Vehicle operating cost reductions
- Safety improvements
- Emission reductions, including greenhouse gases

For the Carbondale Grant application, the benefit-cost analysis has been modified to exclude safety costs/benefits as we believe they are minor in impact. We did add cycling infrastructure as this is a transportation mode that is encouraged in the community and an area where we believe we will see a measurable impact.

Project capital costs include costs the City is currently planning to incur for temporary solutions and also include the actual design and construction work. Costs are only shown in 2024 as we believe this project can be completed in one construction season and will be let as one bid package. Project capital costs include:

- Engineering and design
- Construction

Several sources of input data were consulted, examples include:

- *City of Carbondale Comprehensive Plan,* City of Carbondale, June 2010
- *Carbondale Bicycle Master Plan,* 2017
- *Carbondale Sustainability Action Plan,* April 2022
- *Benefit-Cost Analysis Guidance for Discretionary Grant Programs (March, 2022)* published by the US Department of Transportation

A3.0 Economic Assumptions

This section summarizes the economic assumptions utilized for the BCA for the Carbondale project to comply with the guidelines of the Rural Surface Transportation grant. In the cases where the grant guidelines did not specify value, documented standard values were utilized.

A3.1 Discount Rate

The guidance in the Federal Register for the discount is 7%. For the sensitivity analysis, the discount rate is 3%.

A3.2 Study Period

The City of Carbondale has begun the preliminary engineering and has started the environmental review process. Preparation of the final engineering plans, specifications, and construction documents will begin followong award and USDOT's contract process. Reasonably we would expect to have the authority to begin final plans by summer, 2023. Final construction plans and documents will be completed within 6 months. The project will be advertised for bid for contractors by the second quarter of 2024 and the contract for the construction should be awarded shortly thereafter. The construction is expected to be completed by mid-2025.

The BCA study period is 10 years, beginning in 2024 and ends in 2033.

A4.0 Project Overview

The project under analysis consists of the design and construction of several key transportation routes in Carbondale. This project has strategically included roads that will improve industrial, commercial, and residential infrastructure, thereby improving access for residents and visitors alike. Ultimately, these improvements will enhance transportation linkages within and around Carbondale, better integrating local roads with IDOT 13, US Highway 51, and beyond to Interstate-57.

The purposes of the proposed project are to:

- Allow workers to travel more efficiently to employment centers
- Stimulate economic development
- Making equitable infrastructure investments to benefit residents in high-poverty, historically disadvantaged neighborhoods
- Making the area more accessible to manufacturing and warehousing, ensuring direct routes to medical centers and reducing obstacles for emergency response vehicles, reducing commute times, encouraging alternative transportation options
- Create high-paying construction jobs
- Reduce emissions which enhances environmental sustainability

A5.0 Base Scenario and Alternatives

The base or, "no build", scenario assumes no infrastructure improvement (See USDOT Benefit-Cost Analysis Guidance for BUILD and INFRA Applications). The alternative or "build" scenario includes the construction/repair of several roads included in the grant. An annualization factor of (.5) was used to correspond with a 180-day build time for the construction.

A6.0 Costs

The costs for this project include engineering design and construction. Table 2 includes a summary of the project costs.

Table 2: Project Costs

Project Task	Cost
Design & Engineering (not included in total)	$1,592,855
Construction – Federal Share	7,645,705
Construction – Local Share	$1,911,426
Total Future Project Costs	**$9,557,131**

A7.0 Benefits

A7.1 Travel Time/Travel Delay Savings

The BCA includes a "travel time savings" calculation. This is based on detour route savings that improving the included roads will facilitate. Currently, because there is no "state of good repair" it's reasonable to conclude that drivers are choosing alternate routes to avoid driving on deteriorating roads. In fact, the City often receives this very feedback and receive more citizen requests for pothole/road repairs than any other item. Using google earth, the shortest possible detour route was established to move drivers around the roads being proposed for construction.

The BCA also includes a "vehicle operating costs savings" benefit which is directly related to the reduction of costs associated with the total detour distance defined in the "travel time savings" calculation.

The BCA includes a "damage costs for emissions" calculation which utilizes data in the *Benefit-Cost Analysis Guidance for Discretionary Grant Programs (March, 2022)* published by the US Department of Transportation to calculate the volume of emissions that would be created if current and future drivers continue to accumulate additional vehicle miles as a result of utilizing the detour routes that have been defined.

Finally, a "cycling benefits" calculation in the BCA to show added benefits that will occur when bike infrastructure is improved. As a certified "bike-friendly city) by the League of American Bicyclists, we are confident that road improvements will result in more bicycle users.

SIMMS Benefit Cost Analysis Exhibits

Exhibit 1 – Benefit-Cost Analysis Spreadsheet

Exhibit 2 – Vehicle Operating Costs Savings

Exhibit 3 – Travel Time Savings

Exhibit 4 – Damage Costs for Emissions

Exhibit 5 – Cycling Benefits

Exhibit 1- BCA Summary

								COSTS				
YEAR	Vehicle Operating Cost Savings	Travel Time Savings	Emissions Savings	Cycling Benefits	Total Benefits (2022 Dollars)	Discounted Values 3%	7%	Costs to Date	Design & Construction Costs	TOTAL COSTS	Discounted Values 3%	7%
								$500,000	$0	$500,000	$471,298	$436,719
								$500,000	$ -	$500,000	$457,571	$408,149
2024	$ 28,382	$ 434,000	11,978,773	-	$ 12,441,155	12,078,791	11,627,247	$0	$9,557,131	$9,557,131	$8,491,387	$7,291,089
2025	$ 28,382	$ 434,000	12,187,763	96,127	$ 12,746,272	12,375,021	11,912,404	$0	$0	$0	$0	$0
2026	$ 28,382	$ 434,000	12,384,045	96,127	$ 12,942,554	12,565,586	12,095,845	$0	$0	$0	$0	$0
2027	$ 28,382	$ 434,000	12,581,739	96,127	$ 13,140,248	12,757,522	12,280,606	$0	$0	$0	$0	$0
2028	$ 28,382	$ 434,000	12,783,683	96,127	$ 13,342,192	12,953,585	12,469,339	$0	$0	$0	$0	$0
2029	$ 28,382	$ 434,000	12,989,849	96,127	$ 13,548,359	13,153,746	12,662,017	$0	$0	$0	$0	$0
2030	$ 28,382	$ 434,000	13,200,251	96,127	$ 13,758,761	13,358,020	12,858,655	$0	$0	$0	$0	$0
2031	$ 28,382	$ 434,000	13,200,266	96,127	$ 13,758,775	13,358,034	12,858,668	$0	$0	$0	$0	$0
2032	$ 28,382	$ 434,000	13,200,280	96,127	$ 13,758,789	13,358,047	12,858,681	$0	$0	$0	$0	$0
2033	$ 28,382	$ 434,000	13,200,294	96,127	$ 13,758,803	13,358,061	12,858,694	$0	$0	$0	$0	$0
	$ 283,824	$ 4,339,996	127,706,942	865,145	$ 133,195,907	129,316,414	124,482,156	$1,000,000	$9,557,131	$10,557,131	$9,420,256	$8,135,958

Benefit Cost Analysis Summary			
	TOTAL	Discounted 3%	Discounted 7%
Benefits	133,195,907	129,316,414	124,482,156
Costs	$10,557,131	$9,420,256	$8,135,958
B/C Ratio	**13:1**	**14:1**	**15:1**

Exhibit 2 – Vehicle Operating Costs Savings

	Annual Vehicle Operating Cost Savings	Incremental Detour	AADT	Vehicle Operating Cost per mile	Annualization Factor		
2024		4.32	29200	0.45	0.5	$	28,382
2025		4.32	29200	0.45	0.5	$	28,382
2026		4.32	29200	0.45	0.5	$	28,382
2027		4.32	29200	0.45	0.5	$	28,382
2028		4.32	29200	0.45	0.5	$	28,382
2029		4.32	29200	0.45	0.5	$	28,382
2030		4.32	29200	0.45	0.5	$	28,382
2031		4.32	29200	0.45	0.5	$	28,382
2032		4.32	29200	0.45	0.5	$	28,382
2033		4.32	29200	0.45	0.5	$	28,382
2034						$	283,824

	Incremental Detour	AADT	Vehicle Operating Cost per mile	Annualization Factor		
Giant City Road	0.79	11300	0.45	180	$	723,087
Pleasant Hill	2.54	9500	0.45	180	$	1,954,530
Washington	0.2	1100	0.45	180	$	17,820
Oak	0.19	2100	0.45	180	$	32,319
Poplar	0.4	2900	0.45	180	$	93,960
Marion	0.2	2300	0.45	180	$	37,260
	4.32	29200			$	2,858,976

Exhibit 3 – Travel Time Savings

	Incremental Detour	Marginal Detour Time	AADT	Vehicle Operating Cost per mile	Vehicle Occupancy	Annualization Factor	TOTAL SAVINGS
2024	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2025	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2026	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2027	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2028	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2029	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2030	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2031	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2032	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
2033	4.32	0.12	29,200	17.80	1.67	0.5	$ 434,000
							$ 4,339,996

	Incremental Detour	Marginal Detour Time	AADT	Hourly Value of Time	Vehicle Occupancy	Annualization Factor	
Giant City Road	0.79	0.02	11300	17.80	1.67	180	$ 1,364,729
Pleasant Hill	2.54	0.07	9500	17.80	1.67	180	$ 3,688,912
Washington	0.2	0.01	1100	17.80	1.67	180	$ 33,633
Oak	0.19	0.01	2100	17.80	1.67	180	$ 60,998
Poplar	0.4	0.01	2900	17.80	1.67	180	$ 177,337
Marion	0.2	0.01	2300	17.80	1.67	180	$ 70,323
	4.32	0.12	29200	17.80	1.67	180	$ 5,395,931

Exhibit 4 – Damage Costs for Emissions

	Incremental Detour	AADT	TOTAL MILES DRIVEN	4.6 metric tons emissions per year	Multiplier = (AADT x Total)/11,500	Nox	Sox	PM2.5	CO2	Total Monetized Value per Emission Type	TOTAL DAMAGE COSTS FOR EMISSIONS PER METRIC TON
2024	4.32	29200.00	35296.00	4.6	14.12	$ 16,200.00	$ 44,000.00	$ 788,100.00	$ 55.00	$ 848,355.00	$ 11,978,772.60
2025	4.32	29200.00	35296.00	4.6	14.12	$ 16,500.00	$ 44,900.00	$ 801,700.00	$ 56.00	$ 863,156.00	$ 12,187,762.72
2026	4.32	29200.00	35296.00	4.6	14.12	$ 16,800.00	$ 45,700.00	$ 814,500.00	$ 57.00	$ 877,057.00	$ 12,384,044.84
2027	4.32	29200.00	35296.00	4.6	14.12	$ 17,100.00	$ 46,500.00	$ 827,400.00	$ 58.00	$ 891,058.00	$ 12,581,738.96
2028	4.32	29200.00	35296.00	4.6	14.12	$ 17,400.00	$ 47,300.00	$ 840,600.00	$ 60.00	$ 905,360.00	$ 12,783,683.20
2029	4.32	29200.00	35296.00	4.6	14.12	$ 17,700.00	$ 48,200.00	$ 854,000.00	$ 61.00	$ 919,961.00	$ 12,989,849.32
2030	4.32	29200.00	35296.00	4.6	14.12	$ 18,100.00	$ 49,100.00	$ 867,600.00	$ 62.00	$ 934,862.00	$ 13,200,251.44
2031	4.32	29200.00	35296.00	4.6	14.12	$ 18,100.00	$ 49,100.00	$ 867,600.00	$ 63.00	$ 934,863.00	$ 13,200,265.56
2032	4.32	29200.00	35296.00	4.6	14.12	$ 18,100.00	$ 49,100.00	$ 867,600.00	$ 64.00	$ 934,864.00	$ 13,200,279.68
2033	4.32	29200.00	35296.00	4.6	14.12	$ 18,100.00	$ 49,100.00	$ 867,600.00	$ 65.00	$ 934,865.00	$ 13,200,293.80
											$ 127,706,942.12
						$ 16,500.00	$ 44,900.00	$ 801,700.00	$ 56.00		

	Incremental Detour	AADT	TOTAL MILES DRIVEN	4.6 metric tons emissions per year	Multiplier = (AADT x Total)/11,500	Nox	Sox	PM2.5	CO2
Giant City Road	0.79	11300	8927	4.6	3.5708	$ 58,918.20	$ 160,328.92	$ 2,862,710.36	$ 199.96
Pleasant Hill	2.54	9500	24130	4.6	9.652	$ 159,258.00	$ 433,374.80	$ 7,738,008.40	$ 540.51
Washington	0.2	1100	220	4.6	0.088	$ 1,452.00	$ 3,951.20	$ 70,549.60	$ 4.93
Oak	0.19	2100	399	4.6	0.1596	$ 2,633.40	$ 7,166.04	$ 127,951.32	$ 8.94
Poplar	0.4	2900	1160	4.6	0.464	$ 7,656.00	$ 20,833.60	$ 371,988.80	$ 25.98
Marion	0.2	2300	460	4.6	0.184	$ 3,036.00	$ 8,261.60	$ 147,512.80	$ 10.30
	4.32	29200.00	35296.00	4.6	14.1184	$ 232,953.60	$ 633,916.16	$ 11,318,721.28	$ 790.63

Exhibit 5 – Cycling Benefits

	Distance	No. of Cyclists	Bike Lane Value Per Mile	Annualization Factor	TOTAL
2024					
2025	6.32	50.00	1.69	180	96,127.20
2026	6.32	50.00	1.69	180	96,127.20
2027	6.32	50.00	1.69	180	96,127.20
2028	6.32	50.00	1.69	180	96,127.20
2029	6.32	50.00	1.69	180	96,127.20
2030	6.32	50.00	1.69	180	96,127.20
2031	6.32	50.00	1.69	180	96,127.20
2032	6.32	50.00	1.69	180	96,127.20
2033	6.32	50.00	1.69	180	96,127.20
					865,144.80

	Distance	No. of Cyclists	Bike Lane Value Per Mile	Annualization Factor	TOTAL
Giant City Road	0.75	20.00	1.69	180	4,563.00
Pleasant Hill	1.54	20.00	1.69	180	9,369.36
Washington	1.2	20.00	1.69	180	7,300.80
Oak	0.9	20.00	1.69	180	5,475.60
Poplar	0.76	20.00	1.69	180	4,623.84
Marion	1.17	20.00	1.69	180	7,118.28
	6.32	20.00			38,450.88