Mississippi County Rural Development Connector
TIGER 2017 Application

Benefit-Cost Analysis Methodology Summary

Overview

This project proposes to improve approximately 3.4 miles of State Highway 198 in Mississippi County, Arkansas. The existing facility generally consists of 10-foot travel lanes with 2-foot gravel shoulders. The project would widen the travel lanes to 12 feet and construct 4-foot paved shoulders.

Significant industrial development along State Highway 198 over the last five years has significantly increased traffic demands within the project area. The pavement at this location is generally poor and not designed to accommodate the truck traffic generated by the steel and agriculture industries that access State Highway 198. At the same time, narrow travel lanes and lack of paved shoulders are a source of concern in relation to safety, particularly given the vehicle composition with the project area. The matrix of problems, alternatives, impacts and benefits of the project is presented in Table 1.

Table 1. Project Matrix

Problem to be Addressed	*Proposed Solution*	*Types of Impacts*	*Economic Benefit*
Narrow travel lanes creates safety hazard	Widen travel lanes from 10 feet to 12 feet	Reduction in crashes	Monetized value of crash reduction
Lack of shoulders creates safety hazard	Add 4-foot paved shoulders	Reduction in crashes	Monetized value of crash reduction
Poor pavement condition	Improve roadway to 3R standards	Improved pavement condition	Reduction in maintenance costs

This document describes the methodology used to estimate the benefits of costs attributable to the project. This analysis was conducted in accordance with the guidelines set forth in *Benefit-Cost Analysis Guidance for TIGER and INFRA Applications* (July 2017). The anticipated benefits and costs of the project are summarized in Table 2.

Table 2. Summary of Benefit-Cost Analysis

Benefit/Cost Category	*No Discount*	*Discounted at 7%*	*Discounted at 3%*
Benefits			
Safety Improvements	$6,414,201	$2,482,129	$4,159,898
Net Maintenance	$589,600	$449,803	$523,852
Sum of Benefits	$7,003,801	$2,931,932	$4,683,750
Costs			
Capital	$6,000,000	$4,637,236	$5,360,382
Sum of Costs	$6,000,000	$4,637,236	$5,360,382
Benefit-Cost Ratio	1.17	0.63	0.87
Net Present Value	$1,003,801	($1,705,304)	($676,733)

Project Benefits

The benefits of the project are expected to be derived primarily from safety improvements and reduced maintenance expenditures.

Safety Benefits

The safety benefits of the project are summarized in Table 3. The project proposes to widen travel lanes from 10 to 12 feet and to construct 4-foot paved shoulders. Both improvements are expected to improve safety at this location.

Table 3. Undiscounted Safety Benefits by Severity by Year

Year	*Savings in Crash Cost by KABCO Level*					*Safety Benefits*
	K	*A*	*B*	*C*	*O*	
2017	$ -	$ -	$ -	$ -	$ -	$ -
2018	$ -	$ -	$ -	$ -	$ -	$ -
2019	$ -	$ -	$ -	$ -	$ -	$ -
2020	$ -	$ -	$ -	$ -	$ -	$ -
2021	$ 178,095	$ 44,965	$ 18,403	$ 12,731	$ 2,379	$ 256,572
2022	$ 180,766	$ 45,639	$ 18,679	$ 12,922	$ 2,415	$ 260,420
2023	$ 183,477	$ 46,324	$ 18,959	$ 13,116	$ 2,451	$ 264,326
2024	$ 186,230	$ 47,019	$ 19,243	$ 13,312	$ 2,488	$ 268,291
2025	$ 207,654	$ 52,428	$ 21,457	$ 14,844	$ 2,774	$ 299,157
2026	$ 210,769	$ 53,214	$ 21,779	$ 15,067	$ 2,815	$ 303,644
2027	$ 213,931	$ 54,012	$ 22,106	$ 15,293	$ 2,858	$ 308,199
2028	$ 217,140	$ 54,823	$ 22,437	$ 15,522	$ 2,900	$ 312,822
2029	$ 220,397	$ 55,645	$ 22,774	$ 15,755	$ 2,944	$ 317,514
2030	$ 223,703	$ 56,480	$ 23,115	$ 15,991	$ 2,988	$ 322,277
2031	$ 227,058	$ 57,327	$ 23,462	$ 16,231	$ 3,033	$ 327,111
2032	$ 230,464	$ 58,187	$ 23,814	$ 16,474	$ 3,078	$ 332,018
2033	$ 233,921	$ 59,060	$ 24,171	$ 16,722	$ 3,125	$ 336,998
2034	$ 237,430	$ 59,945	$ 24,534	$ 16,972	$ 3,171	$ 342,053
2035	$ 240,991	$ 60,845	$ 24,902	$ 17,227	$ 3,219	$ 347,184
2036	$ 244,606	$ 61,757	$ 25,275	$ 17,485	$ 3,267	$ 352,392
2037	$ 248,275	$ 62,684	$ 25,655	$ 17,748	$ 3,316	$ 357,677
2038	$ 251,999	$ 63,624	$ 26,039	$ 18,014	$ 3,366	$ 363,043
2039	$ 255,779	$ 64,578	$ 26,430	$ 18,284	$ 3,416	$ 368,488
2040	$ 259,616	$ 65,547	$ 26,826	$ 18,558	$ 3,468	$ 374,016
		Grand Total of Safety Benefits, without Discount				$ 6,414,201

Savings in crash costs were calculated as follows: Annual Vehicle Miles Travel (VMT) for each year of the analysis was multiplied by crash rates by accident type, resulting in an estimate of the number of crashes by type per year. For the no-build scenario, the number of crashes by type by year was monetized using standard values by KABCO level. For the build scenario, the crash costs by type by year from the no-build scenario were multiplied by crash modification factors (CMF) for lane widening and constructing paved shoulders. The difference was then taken between no-build and build crash costs to arrive at a yearly crash savings by type.

Annual VMT were calculated using Average Annual Daily Traffic data from traffic counts on State Highway 198, supplemented with trip generation data provided by local industry. Traffic estimates include phased plant expansions and assume a background traffic growth rate of 1.5 percent per year.

Given the recent and very significant increase in traffic (including truck traffic) on State Highway 198, the crash history at this location is not expected to be representative of the future crash experience. Hence, statewide average crash rates for rural two-lane facilities were applied for purposes of estimating safety benefits. Because statewide average crash rates are derived from a mix of locations of varying lane widths, with and without shoulders, this analysis is expected to produce a somewhat conservative estimate of the safety benefits of the project.

Relevant crash modification factors for widening travel lanes and constructing paved shoulders were obtained from the Crash Modification Factor Clearinghouse (www.cmfclearinghouse.org). A CMF with a value of 0.81 was selected for constructing paved shoulders, and a CMF with a value of 0.95 was selected for lane widening. A multiplicative factor (0.77) was applied to estimate crash reductions.

Net Operations and Maintenance Costs

The operations and maintenance costs for no-build and build scenarios are presented in Table 4 (following page). Both scenarios assume that this location will be maintained through a series of regular, two-inch, asphalt overlays every five years. For the no-build alternative, the overlay schedule begins in 2020. For the build alternative, the overlay schedule begins in 2025, since the project calls for 3R widening in 2020. Hence, the net maintenance cost is favorable to the project, which replaces the regular maintenance in 2020 with improvements to the roadway in that year.

Table 4. Undiscounted Operations and Maintenance Costs

Year of Expenditure	*No Build*	*Build*	*Net Cost of Operations & Maintenance*
2017			$ -
2018			$ -
2019			$ -
2020	$ 589,600		$ 589,600
2021			$ -
2022			$ -
2023			$ -
2024			$ -
2025	$ 589,600	$ 589,600	$ -
2026			$ -
2027			$ -
2028			$ -
2029			$ -
2030	$ 589,600	$ 589,600	$ -
2031			$ -
2032			$ -
2033			$ -
2034			$ -
2035	$ 589,600	$ 589,600	$ -
2036			$ -
2037			$ -
2038			$ -
2039			$ -
2040	$ 589,600	$ 589,600	$ -
Net Operations and Maintenance Cost, without Discount			$ 589,600

Project Costs

The anticipated schedule of capital costs for the project is presented in Table 5.

Table 5. Schedule of Capital Costs

Year of Expenditure	*Preliminary Engineering*	*ROW and Utilities*	*CEI*	*Construction*	*Capital Costs*
2017	$ -	$ -	$ -	$ -	$ -
2018	$ 300,000	$ -	$ -	$ -	$ 300,000
2019	$ -	$ 500,000	$ -	$ -	$ 500,000
2020	$ -	$ -	$ 500,000	$ 4,700,000	$ 5,200,000
2021	$ -	$ -	$ -	$ -	$ -
2022	$ -	$ -	$ -	$ -	$ -
2023	$ -	$ -	$ -	$ -	$ -
2024	$ -	$ -	$ -	$ -	$ -
2025	$ -	$ -	$ -	$ -	$ -
2026	$ -	$ -	$ -	$ -	$ -
2027	$ -	$ -	$ -	$ -	$ -
2028	$ -	$ -	$ -	$ -	$ -
2029	$ -	$ -	$ -	$ -	$ -
2030	$ -	$ -	$ -	$ -	$ -
2031	$ -	$ -	$ -	$ -	$ -
2032	$ -	$ -	$ -	$ -	$ -
2033	$ -	$ -	$ -	$ -	$ -
2034	$ -	$ -	$ -	$ -	$ -
2035	$ -	$ -	$ -	$ -	$ -
2036	$ -	$ -	$ -	$ -	$ -
2037	$ -	$ -	$ -	$ -	$ -
2038	$ -	$ -	$ -	$ -	$ -
2039	$ -	$ -	$ -	$ -	$ -
2040	$ -	$ -	$ -	$ -	$ -
			Grand Total Capital Cost without Discount		$ 6,000,000

These figures reflect rounded estimates from the planning-level cost workup presented in Table 6 (following page). For a discussion of the risks associated with these costs, refer to the application narrative.

Table 6. Planning-Level Cost Workup

Segment 1: Hwy. 61 – Co. Rd. 623			
Phase	*Length (mi)*	*Cost per Mile*	*Total Cost*
Construction	1.99	$ 1,250,000	$ 2,487,500
Railroad Crossing			$ 500,000
		Sub-Total Construction Cost	$ 2,987,500
Preliminary Engineering (5% of Construction Cost)			$ 149,375
Right-of-Way and Utilities (10% of Construction Cost)			$ 298,750
Construction Inspection (10% of Construction Cost)			$ 298,750
		Sub-Total Development Costs	$ 746,875
		Total Cost – All Phases – Segment 1	$ 3,734,375

Segment 2: Co. Rd. 623 – Mississippi River			
Phase	*Length (mi)*	*Cost per Mile*	*Total Cost*
Construction	1.36	$ 1,250,000	$ 1,700,000
		Sub-Total Construction Cost	$ 1,700,000
Preliminary Engineering (5% of Construction Cost)			$ 85,000
Right-of-Way and Utilities (10% of Construction Cost)			$ 170,000
Construction Inspection (10% of Construction Cost)			$ 170,000
		Sub-Total Development Costs	$ 425,000
		Total Cost – All Phases – Segment 2	$ 2,125,000

Grand Total Cost – All Phases – Segments 1 and 2	$ 5,859,375