

**BCA Analysis Narrative**

Summary

This benefit-cost analysis (BCA) conducted for the MaineDOT’s Northern Maine U.S. 1 Road Improvement Project, for submission to the U.S. Department of Transportation (USDOT) as a requirement of a discretionary grant application for the 2023 Rural Grant Program is conducted in accordance with the benefit-cost methodology as outlined by USDOT in the Benefit-Cost Analysis Guidance for Discretionary Grant Programs, released in January 2023. The period of analysis corresponds to 30 years of benefits after operations begin in 2029, reflective of the significant reconstruction of the two roadway segments.

MaineDOT is requesting \$27.68 million of Rural Grant Program Grant funding to support the completion of this \$37.7 million (\$30.7 million in 2020 dollars).

The BCA estimates more than **\$47 million** in benefits on a discounted basis over the 30-year analysis period, yielding a **benefit cost ratio (BCR) of 1.53**. The Project will create a safer roadway environment for those who travel on this rural portion of U.S. 1 in Aroostook County. Table 1 provides an overview of the cost of the proposed improvements.

*Table 1: Project Budget for Northern Maine U.S. 1 Road Improvement Project*

Fund Sources	Previously Incurred			Construction/CE	Post Grant Award %	Fund Source Totals	Total Project Cost %
	PE	ROW	Previously Incurred %				
FHWA Formula	\$1,600,000	\$920,000	80.0%	\$6,920,000	20.0%	\$9,440,000	25.0%
MaineDOT	\$400,000	\$230,000	20.0%	\$0	0.0%	\$630,000	1.7%
Rural Grant	\$0	\$0	0.0%	\$27,680,000	80.0%	\$27,680,000	73.3%
<b>Fund Stage Totals</b>	<b>\$2,000,000</b>	<b>\$1,150,000</b>		<b>\$34,600,000</b>			
<b>Total Project Cost</b>	<b>\$37,750,000</b>						<b>100.0%</b>

The highway safety benefits for the Route 1 Frenchville project have been calculated based on the AASHTO Highway Safety Manual. The safety benefits are based on the improvements to the roadway that take into consideration traffic volumes, number of crashes, change in lane and pavement widths, change in side slopes. Additional safety benefits are realized from the avoidance of a Based on this information, the annual safety benefits are conservatively estimated at the mid-point of the range:

- Frenchville–Fort Kent - Route 1 (4.7 miles) – Annual Safety Benefit is \$119,000.
- Frenchville–Route 1 (5.7 miles) – Annual Safety Benefit is \$158,000.

NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

For the analysis period the total **safety benefit is \$2,812,714.**

Also included as benefits in the BCA are the net reduction in maintenance costs for the Project area, which over 30 years on a discounted basis exceed **\$33.2 million** as the Project allows for one-time improvements versus numerous preservation projects and higher annual maintenance that over time are far more expensive. In addition to the necessary paving costs, they include a significant near term and inevitable slope repair. These benefits were determined during a full life-cycle cost analysis of maintaining the roadway structure throughout the 30-year analysis period and beyond. Additionally, the residual value of the new stretch of roadway after 30 years in service is included in the matrix below discounted over the 30-year period at seven percent.

The Project will produce a safer, more efficient, and accommodating roadway for motorists, freight haulers, and bicyclists. The project is cost effective as stated in the BCA with \$47,020,556 of benefits, discounted at 7 percent over 30 years (emissions benefits discounted at 3 percent) and a **Benefit-Cost Ratio of 1.53**. The overall project benefit matrix is below:

Table 2: Benefit Matrix

Problem to be Addressed	Changes to Baseline	Economic Benefit	Monetized Benefits 2029-2059 (at a 7% discount rate)	Tab Reference in BCA Calculations
<b>Safety</b> - Crashes due to current configurations	Safer roadway design	Reduction in crash incidents and severity: Reduction in costs associated with fatality, injury, and property damage crashes.	\$ 2,812,714.00	Safety Benefit
<b>Maintenance Costs</b> - Aging infrastructure resulting in higher O&M costs	Newer designed roadway to reduce O&M costs	Reduced O&M Costs	\$ 33,230,595.45	Maintenance Costs
<b>Travel Time Saving</b> - Rural mobility	Updated design will improve topography of roadway and will reduce travel time	Roadway will facilitate faster travel time for all users of the roadway, allowing for greater freight mobility and travel time reductions.	\$ 6,226,228.00	Travel Time Benefit
<b>Travel Time Savings Avoided</b> - Rural mobility	Updated design will improve state of good repair and reduce the need for disruptive road closures	Reduce the delay of detours due to road closures	\$ 3,520,203.00	Detours TravTime&OpCostsAvoided
<b>Emissions</b> - Reduction in emissions	Reduced emissions with improved roadway condition	Increased environmental benefit due to reduced emissions	\$ 225,387.00	Emissions Avoided
<b>Residual Value</b>	Value of remaining useful life on Project assets	Value of roadway with numerous drainage and 100- year structure after 30 years in service	\$ 1,005,429.00	Residual Value

Project Description

The Northern Maine U.S. 1 Road Improvement Project (“Project”) will:

- Bring two substandard sections of the region’s only east-west thoroughfare into compliance creating a cohesive, modernized and standardized regional roadway.
- Upgrade the topography, subsurface, road surface, shoulders, drainage, retaining walls, and guardrails along two adjacent sections of U.S. Highway 1 (US 1) near Frenchville, Maine, a total of 10.4 miles.
- Repair, upgrade, and standardize critical safety features along the road.

## NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

- Upgrade the roadway shoulders to meet today’s standards for drivers and provide a safe surface for bicyclists along this recently-designated *U.S. Bicycle Route*.
- Ensure that vital connectivity is preserved for residents in this very rural part of the country.

There are numerous safety benefits for drivers, tourists, bicyclists, and residents living along the road, benefits that align with USDOT’s goal of capital investments in surface transportation that will have a significant local or regional impact. This Project will have both. Local impacts include safely connecting rural residents to essential goods and services offered throughout the region, including education, medical facilities, employment, food, family, and more. This is especially important for residents living in a region that sees average annual snowfall of 90 inches or more. Regional Project impacts help strengthen northern Maine’s agricultural, lumber, and tourism economy.

### *Benefit Cost Analysis Framework*

The BCA provides an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of a potential infrastructure project. Project benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of the project BCA is to assess whether the expected benefits of the project justify the costs from a national perspective.

The BCA framework attempts to capture the net welfare change created by the project, including cost savings and increases in welfare (benefits), as well as disbenefits where costs can be identified (e.g., project capital costs), and welfare reductions where some groups are expected to be made worse off because of the proposed project.

The BCA framework involves defining a Base or “No Build” scenario, which is compared to the “Build” scenario. The BCA assesses the incremental difference between the “Build” scenario and the “No Build” scenario, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project life cycle. The importance of future changes is determined through discounting, which is meant to reflect the time value of money.

#### i. Methodological Components:

The project BCA is conducted in accordance with the benefit-cost methodology recommended by the USDOT. The methodology includes the following key components:

- Defining existing and future conditions under the “No Build” (Base) scenario as well as under the “Build” scenario;
- Assessing the project benefits over the 30 years of operations beyond the Project completion when benefits accrue and using USDOT recommended values to monetize traffic crashes by severity while relying on best practices for monetization of any other benefits or disbenefits;

## NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

- Estimating the project capital costs during Project construction and Project operation and maintenance costs over the 30 years of operations beyond the Project completion when benefits accrue; and
- Discounting Project benefits and costs to 2020 dollars using a real discount rate of seven percent consistent with USDOT guidance.

### ii. Key Assumptions:

The assessment of the Project benefits and costs associated with the Safety Improvements on Oklahoma Rural Roadways project involve the following key assumptions:

- The evaluation period includes the design and engineering, right of way acquisitions, and construction during which capital expenditures are undertaken, plus 30 years of operations beyond the Project completion within which to evaluate ongoing benefits and costs.
- The construction phase of the Project will begin in 2026 ending in 2029, at which point the Project will be deemed complete.
- The Project will be opened in 2029 and the 30-year operational period will conclude in 2059. Although, segments of the project will be completed early, benefits are assumed to begin accruing when all the project segments are completed.
- All Project benefits and costs are conservatively assumed to occur at the end of each calendar year for purposes of present value discounting.
- Monetary values of Project costs and benefits are expressed in constant, year-end 2020 dollars

### iii. “Build” and “No Build” Scenarios

The analysis of the improvements presented in the Project considered how the balance of costs and benefits resulting construction would result in long-term benefits. This is accomplished by comparing the “Build” scenario relative to the “No-Build” scenario. The “No Build” (Base) scenario would consist of leaving the roadway segments as they currently stand with routine operational and maintenance costs to maintain current levels of service. The “Build” scenario would rehabilitate the roadways, adding wide paved shoulders, improving roadway geometries to improve line of sight distances, installation of guardrail, and other minor treatments. This scenario would entail the capital costs associated with the construction until the Project has been completed, and then routine operational and maintenance costs once the Project is in use over the 30-year evaluation period. A residual value of the assets of **\$1 million** (discounted) is calculated based on remaining useful life.

### iv. Project Benefits

#### a. Economic Competitiveness – Qualitative Assessment.

In northern Maine, there is but one primary highway—US 1—and two primary economic drivers: farming and lumber. The diverse crops of northern Maine include potatoes, broccoli, canola, and grains. Maine ranks 3<sup>rd</sup> in the U.S. for maple syrup production and 10<sup>th</sup> nationwide

## NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

for potatoes. These crops are shipped throughout New England and eastern Canada. Some remain in the state, such as potatoes for processing, in this case into French fries, before being shipped out once packaged which requires some crops to access US 1 twice. Transportation costs are a key element to keeping Maine wood products competitive and disjointed two-lane routes through rural areas don't make transportation as efficient as it needs to be.

As baby boomers age and exit the workforce, Aroostook County is looking to diversify its workforce while also turning the tide and increasing the population. Employers in manufacturing and trades are actively seeking women to enter careers they may not have previously considered including agriculture, heavy machinery operation, lumber mill work, and truck driving. Many see it as a win-win because it helps the local economy grow and provides good wages in a county where the cost of living is generally low. Good roads are critical component to many of these jobs, for the safety and livelihood of workers. As the state looks to replace lost lumber-related jobs in the region, US 1 will be host to the workforce of today. The travel time savings create substantial savings for the regional economy.

### b. Operations and Maintenance Cost Savings – Quantitative Assessment

The Operations and Maintenance costs (O&M) for the assets constructed under this project will be significantly less than the O&M costs for the “No Build” scenario. The Project allows for one-time improvements versus numerous preservation projects and higher annual maintenance that over time are far more expensive. In addition to the necessary paving costs, they include a significant near term and inevitable slope repair. These benefits were determined during a full life-cycle cost analysis of maintaining the roadway structure throughout the 30-year analysis period and beyond and total **\$33.2 million** discounted.

The “Build” versus “No-Build” O&M costs for both segments are:

- 30-year O&M Costs under the “No Build” scenario:
  - Repaving every seven years.
  - Slope Repair on segment West of Frenchville - \$1.1 million
  - Total 30-year “No Build” O&M = \$165.5 million (undiscounted)
- 30-year O&M Costs under the “Build” Scenario:
  - Resurface (Light Capital Paving) after 15 years - \$780,000
  - Total 30-year “Build” O&M = \$13.0 million (undiscounted)

NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

Table 3: Summarizes the “Build” versus “No Build” Project Costs by Segment.

Maintenance Costs - West of Frenchville						Maintenance Costs - East of Frenchville					
Build vs No Build						Build vs No Build					
A	B	C	D	E	F	A	B	C	D	E	F
Year	Calendar Year	Maintenance Costs (No-Build Scenario)	Maintenance Costs (post-Rural Grant) start in Year 2029	Net Maintenance Costs (C-D)	7% NPV	Year	Calendar Year	Maintenance Costs (No-Build Scenario)	Maintenance Costs (post-Rural Grant) start in Year 2029	Net Maintenance Costs (C-D)	7% NPV
0	2023 (Baseline)	\$0	\$0	\$ -	\$ -	0	2023 (Baseline)	\$0	\$0	\$ -	\$ -
1	2024	\$2,503,000	\$85,600	\$ 2,417,400	\$ 2,259,252	1	2024	\$3,044,200	\$64,200	\$ 2,980,000	\$ 2,785,047
2	2025	\$1,191,592	\$91,592	\$ 1,100,000	\$ 960,783	2	2025	\$68,694	\$68,694	\$ -	\$ -
3	2026	\$98,003	\$0	\$ 98,003	\$ 80,000	3	2026	\$73,503	\$0	\$ 73,503	\$ 60,000
4	2027	\$104,864	\$0	\$ 104,864	\$ 80,000	4	2027	\$78,648	\$0	\$ 78,648	\$ 60,000
5	2028	\$112,204	\$0	\$ 112,204	\$ 80,000	5	2028	\$84,153	\$0	\$ 84,153	\$ 60,000
6	2029	\$120,058	\$60,029	\$ 60,029	\$ 40,000	6	2029	\$90,044	\$45,022	\$ 45,022	\$ 30,000
7	2030	\$128,463	\$64,231	\$ 64,232	\$ 40,000	7	2030	\$96,347	\$48,173	\$ 48,173	\$ 30,000
8	2031	\$4,014,255	\$68,727	\$ 3,945,528	\$ 2,296,333	8	2031	\$4,871,091	\$51,546	\$ 4,819,546	\$ 2,805,019
9	2032	\$147,077	\$73,538	\$ 73,539	\$ 40,000	9	2032	\$110,308	\$55,154	\$ 55,154	\$ 30,000
10	2033	\$157,372	\$78,686	\$ 78,686	\$ 40,000	10	2033	\$118,030	\$59,015	\$ 59,015	\$ 30,000
11	2034	\$168,388	\$84,194	\$ 84,194	\$ 40,000	11	2034	\$126,291	\$63,146	\$ 63,146	\$ 30,000
12	2035	\$180,175	\$90,088	\$ 90,087	\$ 40,000	12	2035	\$135,132	\$67,566	\$ 67,566	\$ 30,000
13	2036	\$192,788	\$96,394	\$ 96,394	\$ 40,000	13	2036	\$144,591	\$72,295	\$ 72,295	\$ 30,000
14	2037	\$206,283	\$103,141	\$ 103,142	\$ 40,000	14	2037	\$154,712	\$77,356	\$ 77,356	\$ 30,000
15	2038	\$6,423,603	\$110,361	\$ 6,313,242	\$ 2,288,209	15	2038	\$7,794,342	\$82,771	\$ 7,711,571	\$ 2,795,028
16	2039	\$236,173	\$118,087	\$ 118,086	\$ 40,000	16	2039	\$177,130	\$88,565	\$ 88,565	\$ 30,000
17	2040	\$252,705	\$126,353	\$ 126,352	\$ 40,000	17	2040	\$189,529	\$94,764	\$ 94,764	\$ 30,000
18	2041	\$270,395	\$135,197	\$ 135,198	\$ 40,000	18	2041	\$202,796	\$101,398	\$ 101,398	\$ 30,000
19	2042	\$289,322	\$497,161	\$ (207,839)	\$ (57,469)	19	2042	\$216,992	\$535,996	\$ (319,004)	\$ (88,207)
20	2043	\$309,575	\$154,787	\$ 154,788	\$ 40,000	20	2043	\$232,181	\$116,091	\$ 116,091	\$ 30,000
21	2044	\$331,245	\$165,622	\$ 165,623	\$ 40,000	21	2044	\$248,434	\$124,217	\$ 124,217	\$ 30,000
22	2045	\$10,279,040	\$177,216	\$ 10,101,824	\$ 2,280,115	22	2045	\$12,471,904	\$132,912	\$ 12,338,992	\$ 2,785,073
23	2046	\$379,242	\$189,621	\$ 189,621	\$ 40,000	23	2046	\$284,432	\$142,216	\$ 142,216	\$ 30,000
24	2047	\$405,789	\$202,895	\$ 202,894	\$ 40,000	24	2047	\$304,342	\$152,171	\$ 152,171	\$ 30,000
25	2048	\$434,195	\$217,097	\$ 217,098	\$ 40,000	25	2048	\$325,646	\$162,823	\$ 162,823	\$ 30,000
26	2049	\$464,588	\$232,294	\$ 232,294	\$ 40,000	26	2049	\$348,441	\$174,221	\$ 174,221	\$ 30,000
27	2050	\$497,109	\$248,555	\$ 248,554	\$ 40,000	27	2050	\$372,832	\$186,416	\$ 186,416	\$ 30,000
28	2051	\$531,907	\$265,954	\$ 265,953	\$ 40,000	28	2051	\$398,930	\$199,465	\$ 199,465	\$ 30,000
29	2052	\$16,448,514	\$284,570	\$ 16,163,944	\$ 2,272,049	29	2052	\$19,956,583	\$213,428	\$ 19,743,156	\$ 2,775,154
30	2053	\$608,980	\$304,490	\$ 304,490	\$ 40,000	30	2053	\$456,735	\$228,368	\$ 228,368	\$ 30,000
31	2054	\$651,609	\$325,804	\$ 325,804	\$ 40,000	31	2054	\$488,707	\$244,353	\$ 244,353	\$ 30,000
32	2055	\$697,221	\$348,611	\$ 348,611	\$ 40,000	32	2055	\$522,916	\$261,458	\$ 261,458	\$ 30,000
33	2056	\$746,027	\$373,013	\$ 373,013	\$ 40,000	33	2056	\$559,520	\$279,760	\$ 279,760	\$ 30,000
34	2057	\$798,249	\$963,124	\$ (164,876)	\$ (16,524)	34	2057	\$598,687	\$983,343	\$ (384,657)	\$ (38,550)
35	2058	\$854,126	\$427,063	\$ 427,063	\$ 40,000	35	2058	\$640,595	\$320,297	\$ 320,297	\$ 30,000
36	2059	\$26,320,911	\$456,957	\$ 25,863,954	\$ 2,264,013	36	2059	\$31,933,001	\$342,718	\$ 31,590,283	\$ 2,765,270
		\$77,555,046	\$7,221,053	\$ 15,746,762				\$87,920,418	\$5,839,918	\$ 17,483,834	

c. Safety Savings

The safety benefits assessed in this analysis are based on a reduction in automotive (car and truck) crashes resulting directly from the Project.

Safety benefits result from the reduction in the number of predicted annual crashes from the “Build” scenario relative to the “No-Build” scenario. The estimation of these benefits involved the following:

- Historical crashes for the project roadway segment, over five-year timeframe was analyzed to estimate the average number of annual crashes and their severity. 4 These crashes represent the “No Build” scenario.
- The types of crashes from the “No Build” scenario was reviewed and compared to the efficacy of safety treatments envisioned for the “Build” scenario. The efficacy (crash reduction) estimates were developed using the Crash Modification Factors (CMF)

## NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

Clearinghouse compilation of research on the crash modification/reduction capabilities of various safety treatments. These are documented in the accompanying BCA spreadsheet.

- The crash reduction factors were applied to the “No Build” crashes to calculate the “Build” crashes. The reduction in crashes, monetized represent the baseline annual safety benefits of the proposed treatment.
- The average annual crash figures and costs were grown annually to reflect the overall growth in Maine’s rural State Highways AADT growth at 0.5 percent.
- Then, the number of reduced crashes by severity was multiplied by the corresponding comprehensive unit cost of motor vehicle crashes by crash severity, to determine the total safety cost reduction. All property damage only (PDO) crashes are assumed to involve 1.748 vehicles, based on crash data presented by U.S. Department of Transportation, National Highway Traffic Safety Administration.
- The cost reductions for each crash type were then summed by segment to generate the total safety benefit.

Table 4 on the following page presents the safety benefits. Due to the improvements in the project along this stretch of rural roadway, an estimated **\$2.8 million** in savings on a discounted basis over the 30-year analysis period will result from the reduction in automobile and truck crashes.

NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

Table 4: Safety Benefit by Segment

A	B	C	D	E	F
Year	Calendar Year	West of Frenchville Annual Safety Benefit	East of Frenchville Annual Safety Benefit	Total Safety Benefit (C+D)	7% NPV
0	2023 (Baseline)	\$0	\$0	\$ -	\$ -
1	2024	\$0	\$0	\$ -	\$ -
2	2025	\$0	\$0	\$ -	\$ -
3	2026	\$0	\$0	\$ -	\$ -
4	2027	\$0	\$0	\$ -	\$ -
5	2028	\$119,039	\$157,882	\$ 276,921	\$ 197,441
6	2029	\$119,634	\$158,671	\$ 278,305	\$ 185,447
7	2030	\$120,232	\$159,465	\$ 279,697	\$ 174,181
8	2031	\$120,833	\$160,262	\$ 281,095	\$ 163,600
9	2032	\$121,437	\$161,063	\$ 282,501	\$ 153,662
10	2033	\$122,045	\$161,869	\$ 283,913	\$ 144,327
11	2034	\$122,655	\$162,678	\$ 285,333	\$ 135,560
12	2035	\$123,268	\$163,491	\$ 286,759	\$ 127,325
13	2036	\$123,884	\$164,309	\$ 288,193	\$ 119,590
14	2037	\$124,504	\$165,130	\$ 289,634	\$ 112,325
15	2038	\$125,126	\$165,956	\$ 291,082	\$ 105,502
16	2039	\$125,752	\$166,786	\$ 292,538	\$ 99,093
17	2040	\$126,381	\$167,620	\$ 294,000	\$ 93,073
18	2041	\$127,013	\$168,458	\$ 295,470	\$ 87,419
19	2042	\$127,648	\$169,300	\$ 296,948	\$ 82,109
20	2043	\$128,286	\$170,147	\$ 298,433	\$ 77,121
21	2044	\$128,927	\$170,997	\$ 299,925	\$ 72,436
22	2045	\$129,572	\$171,852	\$ 301,424	\$ 68,035
23	2046	\$130,220	\$172,712	\$ 302,931	\$ 63,902
24	2047	\$130,871	\$173,575	\$ 304,446	\$ 60,021
25	2048	\$131,525	\$174,443	\$ 305,968	\$ 56,374
26	2049	\$132,183	\$175,315	\$ 307,498	\$ 52,950
27	2050	\$132,844	\$176,192	\$ 309,036	\$ 49,733
28	2051	\$133,508	\$177,073	\$ 310,581	\$ 46,712
29	2052	\$134,176	\$177,958	\$ 312,134	\$ 43,874
30	2053	\$134,846	\$178,848	\$ 313,694	\$ 41,209
31	2054	\$135,521	\$179,742	\$ 315,263	\$ 38,706
32	2055	\$136,198	\$180,641	\$ 316,839	\$ 36,354
33	2056	\$136,879	\$181,544	\$ 318,423	\$ 34,146
34	2057	\$137,564	\$182,452	\$ 320,016	\$ 32,072
35	2058	\$138,251	\$183,364	\$ 321,616	\$ 30,123
36	2059	\$138,943	\$184,281	\$ 323,224	\$ 28,294
					\$ 2,812,714



NORTHERN MAINE U.S. 1 ROAD IMPROVEMENT PROJECT

d. Travel Time Cost Savings – Quantitative Assessment

The Project creates wider lanes and shoulders as well as improved topography allowing an increase to the posted speed limit by five miles per hours in most places. This speed increase saves travel time for residents and commerce in the region yielding **\$6.23 million** in savings on a discounted basis over the 30-year analysis period. These benefits were calculated by segment of the project and are listed in the table below.

To calculate travel time cost savings, the following formula was used for both light vehicles and trucks:

- Vehicle value \* change in annual VHT due to project \* average vehicle occupancy

A	B	C	D	E	F
Year	Calendar Year	West of Frenchville Travel Time Annual Benefit	East of Frenchville Travel Time Annual Benefit	Total Travel Time Benefit (C+D)	7% NPV
0	2023 (Baseline)	\$0	\$0	\$ -	\$ -
1	2024	\$0	\$0	\$ -	\$ -
2	2025	\$0	\$0	\$ -	\$ -
3	2026	\$0	\$0	\$ -	\$ -
4	2027	\$0	\$0	\$ -	\$ -
5	2028	\$207,974	\$411,117	\$ 619,092	\$ 441,404
6	2029	\$208,848	\$413,370	\$ 622,218	\$ 414,610
7	2030	\$209,722	\$414,496	\$ 624,218	\$ 388,732
8	2031	\$210,596	\$416,749	\$ 627,345	\$ 365,121
9	2032	\$211,470	\$419,002	\$ 630,472	\$ 342,935
10	2033	\$213,217	\$421,254	\$ 634,472	\$ 322,533
11	2034	\$214,091	\$423,507	\$ 637,598	\$ 302,918
12	2035	\$214,965	\$424,634	\$ 639,599	\$ 283,989
13	2036	\$215,839	\$426,886	\$ 642,725	\$ 266,708
14	2037	\$216,713	\$429,139	\$ 645,852	\$ 250,472
15	2038	\$217,587	\$431,392	\$ 648,978	\$ 235,220
16	2039	\$219,334	\$432,518	\$ 651,852	\$ 220,805
17	2040	\$220,208	\$434,771	\$ 654,979	\$ 207,350
18	2041	\$221,082	\$437,023	\$ 658,105	\$ 194,710
19	2042	\$221,956	\$439,276	\$ 661,232	\$ 182,836
20	2043	\$222,830	\$441,529	\$ 664,358	\$ 171,683
21	2044	\$223,704	\$442,655	\$ 666,359	\$ 160,934
22	2045	\$225,451	\$444,908	\$ 670,359	\$ 151,309
23	2046	\$226,325	\$447,161	\$ 673,486	\$ 142,070
24	2047	\$227,199	\$449,413	\$ 676,612	\$ 133,392
25	2048	\$228,073	\$451,666	\$ 679,739	\$ 125,241
26	2049	\$228,947	\$452,792	\$ 681,739	\$ 117,392
27	2050	\$229,820	\$455,045	\$ 684,865	\$ 110,216
28	2051	\$230,694	\$457,298	\$ 687,992	\$ 103,476
29	2052	\$232,442	\$459,550	\$ 691,992	\$ 97,268
30	2053	\$233,316	\$460,677	\$ 693,993	\$ 91,168
31	2054	\$233,316	\$408,264	\$ 641,580	\$ 78,769
32	2055	\$233,316	\$408,264	\$ 641,580	\$ 73,616
33	2056	\$233,316	\$408,264	\$ 641,580	\$ 68,800
34	2057	\$233,316	\$408,264	\$ 641,580	\$ 64,299
35	2058	\$233,316	\$408,264	\$ 641,580	\$ 60,092
36	2059	\$233,316	\$408,264	\$ 641,580	\$ 56,161
					\$ 6,226,228

e. Travel Time Cost Avoided – Quantitative Assessment

The threat that a structural or safety component of the road will fail is ongoing. Given the remote area and lack of roads in the region, there are few opportunities for reroutes or detours. And in the years ahead, repaving will be required more frequently as the base of the road continues to deteriorate under the road surface. The improvements to both segment yield **\$3.52 million** in savings on a discounted basis over the 30-year analysis period.

Several assumptions were used in the estimation of costs avoided for reroutes/detours:

- 30 year growth factor of 1.15 percent was used.
- All AADT east of Frenchville would be detoured while only 25 percent was assumed to be detoured west of Frenchville in order to avoid double counting.
- Occurring every seven years, pavement preservation projects would result in 15 days of re-routes, while maintenance in each other year totals three days.
- For sources and calculation of unit costs, see “Unit Cost Sources” tab in the BCA excel.

f. Emission Avoided – Quantitative Assessment

Benefits of the Project also include avoided pollutant emissions from reroutes around the segments as maintenance work is performed. Building on the methodology from the Travel Time Cost Avoided, emission reductions were calculated based on the added VMT and VHT per vehicles caused by the rerouting of traffic during road closures. Four emissions were calculated based on added annual Metric Tons: Carbon Dioxide; NOx; Particulate Matter; and Sulfur Dioxide. The combined annual emissions costs of those four emissions was then discounted at three percent. The total savings due to the project over the 30 year analysis period is **\$225,387** on a discounted basis.

g. Residual Value of Assets – Quantitative Assessment

Some of the assets built under this project will have a useful life exceeding the 30-year BCA study time horizon. Therefore, per USDOT guidance, assets with useful lives beyond 30 years are valued for the remaining useful life and discounted at the 30-year discount value.

Included in the Project, 24 percent of construction costs have a 30 year life, the balance, (76 percent) are between 50-75 years. For the BCA, a conservative estimate of 50 years is used. In total, the Project yields a Net Present Value of **\$1,005,426**.