

Gateway  
228

MARS RAILROAD BRIDGE WEST

MISSING  
LINK TO **GATEWAY 228**  
**CORRIDOR**

**BENEFIT-COST ANALYSIS NARRATIVE**

**TABLE OF CONTENTS**

Executive Summary ..... 3  
     Project Costs ..... 4  
     Project Benefits ..... 4  
 Introduction ..... 5  
     BCA Framework..... 5  
     Scope of the Analysis..... 5  
         Additional Capacity:..... 6  
         Safe Connections ..... 6  
         Non-Motorized Transportation Improvements: ..... 6  
     MRBW Project Scope of Work..... 7  
     Analysis Period ..... 8  
     Discount Rate ..... 8  
     Data ..... 8  
 Project Costs ..... 8  
     Capital Costs..... 8  
     O&M Costs ..... 8  
 Project Benefits..... 10  
     Safety ..... 10  
     Travel Time Savings..... 12  
     Vehicle Operating Cost Savings..... 13  
     Emissions Reductions ..... 14  
     Pedestrian Improvements ..... 15  
 Results..... 16  
     Evaluation Measures ..... 16  
         Net Present Value (NPV):..... 16  
         Benefit Cost Ratio (BCR):..... 16  
     BCA Results..... 16

**LIST OF TABLES**

Table 1. Benefit-Cost Analysis Summary ..... 3  
 Table 2. Project Costs and Funding Source ..... 4  
 Table 3. Discounted Project Costs (\$2022) ..... 4  
 Table 4. Summary of Project Benefits..... 4  
 Table 5. Project Costs and Schedule..... 8  
 Table 6. Summary Crash Data (2016 - 2022) ..... 10  
 Table 7. Crash Modification Factors ..... 10  
 Table 8. KABCO Translation Table..... 11  
 Table 9. Annual Estimated Safety Savings with Project Improvements ..... 11  
 Table 10. Idle Fuel Consumption by Vehicle Type ..... 14  
 Table 11. NO<sub>x</sub> and PM<sub>2.5</sub> Emissions for Idling Passenger and Commercial Vehicles ..... 14

## EXECUTIVE SUMMARY

A benefit-cost analysis (BCA) was conducted for the *Mars Railroad Bridge West Project* (“MRBW Project”) for submission to the U.S. Department of Transportation (“USDOT”) as a requirement of a discretionary grant application for the Infrastructure For Rebuilding America (“INFRA”) and MEGA discretionary grant programs. The analysis was conducted in accordance with the benefit-cost methodology as outlined by USDOT in the [Benefit-Cost Analysis Guidance for Discretionary Grant Programs](#). The period of analysis corresponds to 30 years, including 8 years of Project implementation and 22 years of benefits after operations begin in 2031.

The Project represents a critical investment in Butler County’s most urgent transportation initiative – Gateway 228. This multi-jurisdictional, multimodal investment spans along State Route 228 (“SR 228”), and Freedom Road State Route 3020 (Freedom Road), which serves as a lifeline to the vitality of local communities and larger region. This 26.4-mile corridor traverses seven municipalities (Cranberry, New Sewickley, Seven Fields, Adams, Middlesex, Clinton, and Buffalo), two counties (Butler and Beaver), and is the heart of economic opportunity for Butler County’s rural and suburban communities. SR 228, a principal arterial on the National Highway System (“NHS”), and Freedom Road are key connections to Interstate 79 and the Pennsylvania Turnpike (Interstate 76), linking Butler County to the region, state, and nation. The Pennsylvania Department of Transportation (“PennDOT”) classifies SR 228 as an Urban Arterial Highway.

**The benefit-cost ratio (“BCR”) is estimated to be 2.15 for the MRBW Project, yielding net benefits with a present value of \$114.1 million in discounted benefits.** Benefits including reduced congestion, travel time savings, new pedestrian enhancements, reduced emissions, and increased safety address the key outcome criteria for the MPDG Program.

**TABLE 1. BENEFIT-COST ANALYSIS SUMMARY**

MRBW PROJECT	30-YEAR ANALYSIS PERIOD
<b>COSTS</b>	
Capital Costs	\$99,057,468
O& M Costs	\$248,206
<b>TOTAL COSTS</b>	<b>\$99,305,675</b>
<b>BENEFITS</b>	
Safety	\$37,233,774
Travel Time	\$151,312,777
Emissions	\$10,626,476
Operating Costs	\$13,995,089
Pedestrian Improvements	\$235,626
<b>TOTAL BENEFITS</b>	<b>\$213,403,742</b>
<b>BCR</b>	<b>2.15</b>
<b>Net Present Value of Benefits</b>	<b>\$114,098,067</b>

Completing the MRBW Project is vital as it's the last Gateway 228 section awaiting reconstruction and modernization. Its central position on SR 228 means that leaving it unfinished will cause a bottleneck, decreasing corridor efficiency. With a wider five-lane section to the west and ongoing PennDOT activities to the east, the existing MRBW segment forms a 3.25-mile-long two-lane bottleneck. Without enhancements, this bottleneck will hinder connectivity between present and future corridor enhancements, negating more than one hundred million dollars’ worth of improvements previously completed in the corridor. While the Project has wider reaching impacts and is part of a larger scale project, this BCA only considers the benefits and costs related to the MRBW Project segment.

## PROJECT COSTS

The total cost to complete the MRBW Project is \$119,550,000 and includes \$17.9 million in previously incurred or ineligible future costs. Capital costs for the Project are expected to be \$101,650,000 in undiscounted dollars through 2030. Table 2 provides a summary of project costs.

**TABLE 2. PROJECT COSTS AND FUNDING SOURCE**

Milestone Description	Project Cost
Preliminary Engineering	\$2,100,000
Final Design	\$2,300,000
Right-of-Way	\$9,300,000
Utilities	\$4,200,000
Construction	\$101,650,000
<b>Total:</b>	<b>\$119,550,000</b>

At a 3.1% discount rate, the capital costs including future ineligible expenses are valued at \$99,057,468 (\$2022). Discounted operation and maintenance (O&M) costs for the MRBW Project segment are projected to be \$248,206 (\$2022) during the analysis period. Table 3 provides a summary of the discounted project costs.

**TABLE 3. DISCOUNTED PROJECT COSTS (\$2022)**

Monetized Costs	Summary of Results (\$2022 Real Dollars Discounted at 3.1%)
MRBW Project Costs	\$99,057,468
Operations and Maintenance Costs	\$248,206
<b>TOTAL</b>	<b>\$99,305,675</b>

## PROJECT BENEFITS

The Project is expected to generate \$213,403,742 (\$2022) in discounted benefits over the analysis period. The Project benefits quantified address many of the outcome criteria included in the MPDG application including safety, quality of life, environmental sustainability, improved mobility and connectivity, and economic competitiveness and opportunity. These benefits accrue regionally both to residents of Butler County and travelers throughout Southwestern Pennsylvania that utilize SR 228 to commute to work or connect to resources across the region. Table 4 details the monetized benefits included in this BCA.

**TABLE 4. SUMMARY OF PROJECT BENEFITS**

Benefit	Value of Benefit	
	Total Value of Benefit	Discounted \$2022 Real Dollars
Safety	\$66,277,386	\$37,233,774
Travel Time	\$272,977,755	\$151,312,777
Emissions	\$16,047,797	\$10,626,476
Operating Costs	\$25,247,641	\$13,995,089
Pedestrian Improvements	\$422,910	\$235,626
<b>TOTAL BENEFITS:</b>	<b>\$380,973,489</b>	<b>\$213,403,742</b>



## INTRODUCTION

A benefit-cost analysis (BCA) was conducted for the *Mars Railroad Bridge West Project* (“MRBW Project”) for submission to the U.S. Department of Transportation (“USDOT”) as a requirement of a discretionary grant application for the FY25 INFRA/MEGA Program. The analysis relies on several source documents and details provided by Butler County and its partners. Other project partners that provided data include the Southwestern Pennsylvania Commission (SPC) and Butler County’s primary partner the Pennsylvania Department of Transportation (PennDOT) District 10. SPC is the federally certified Metropolitan Planning Organization (MPO), Local Development District (LDD), and Economic Development District (EDD) serving the 10-county region in Southwestern Pennsylvania. This region includes Allegheny including the City of Pittsburgh, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Washington and Westmoreland counties. The following section describes the BCA framework, evaluation metrics, and report contents.

### BCA FRAMEWORK

A Benefit-Cost Analysis (BCA) evaluates the economic advantages and disadvantages of an investment by quantifying benefits and costs in monetary terms. Its goal is to determine whether the expected benefits of a project outweigh the costs from a national perspective. The BCA framework compares a "Build" scenario, where the project is completed, to a "No Build" scenario, where the project is not undertaken. By calculating the difference between these scenarios, the net welfare benefit of the project is determined. BCAs are forward-looking and consider the incremental change in welfare over a project's life cycle. Future welfare changes are discounted to reflect the opportunity cost of capital and societal preference for the present.

The analysis was conducted in accordance with the benefit-cost methodology as recommended by USDOT in the December 2023 (Update) [Benefit-Cost Analysis Guidance for Discretionary Grant Programs](#). The analysis methodology includes the following:

- Defining existing and future conditions under a “no build” base case as well as the “build” case.
- Estimating benefits and costs during project construction and operation, including 22 years of operations beyond the Project completion when benefits accrue.
- Using U.S. DOT recommended monetized values while relying on best practices for monetization of other benefits or costs.
- Discounting future benefits and costs with real discount rates of 2% for carbon dioxide emissions and 3.1% for all other benefit categories.

### SCOPE OF THE ANALYSIS



The MRBW Project will expand capacity and improve safety along the only unimproved section of SR 228. This Project is located from Franklin Road in Cranberry Township to just east of Beaver Street Extension in Adams Township, Butler County, Pennsylvania, spanning a total of 3.25-miles. The following studies have been completed to inform the design of the Project. A [2018 Traffic Design Report](#) completed for MRBW Project assessed current and anticipated traffic operations, capacity, mobility, and safety, compiling relevant data to inform design. A "confidential" Safety Study based on corridor-specific crash histories was conducted to analyze existing and future safety conditions and determine proposed improvements. An [Addendum](#) was issued in 2020 to address changes to intersection configurations, supplementing the original report and validating updates within the current Design Field View package. Furthermore, the Project received a

[Categorical Exclusion, Class 2](#) resulting from completion and approval of the NEPA process on February 20, 2024.

## ADDITIONAL CAPACITY:

MRBW Project will widen and add lanes (17,161 linear feet) to the 3.25-mile segment of SR 228 and modernize 8 intersections. Specifically, four 11-foot lanes (two in each direction), a 16-foot median, and 10-foot shoulders will be installed. Additionally, turning lanes will be strategically integrated at various points, including at side roads along the corridor, to enhance capacity and alleviate queuing and congestion.

## SAFE CONNECTIONS

**Heritage Creek Single-Lane Roundabout:** Just south of SR 228, the intersection of Heritage Creek Drive and Scharberry Lane will be updated to a new single-lane roundabout configuration. The roundabout is anticipated to serve local traffic and planned developments in the immediate vicinity. This roundabout will also cater to motorists intending to turn left into Fox Trot Drive (from SR 228 East). These motorists will, instead, continue along SR 228 East to Heritage Creek Drive, turn right to access this new roundabout at Heritage Creek Drive and Scharberry Lane, and then use the roundabout to turnaround and return to Fox Trot Drive via SR 228 West.

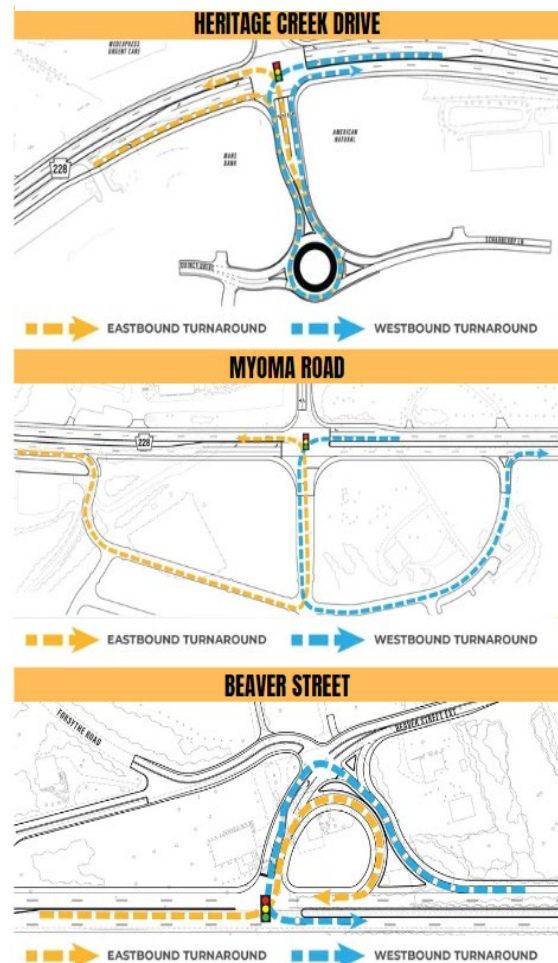
**Mars Alliance/Church Road:** Movement at the Mars Alliance Church driveway on SR 228 will be restricted to right in/right out only. Access to the church will be added via Roxsan Drive from Myoma Road. An access road (Roxsan Drive) will be introduced, enabling departing traffic to make left turns eastbound onto SR 228 from Myoma Road and from Roxsan Drive onto SR 228.

**Beaver Street Extension:** The intersection of Beaver Street Extension and SR 228 will be relocated approximately 700' to the east. The new intersection will incorporate a signalized jughandle offering access to Beaver Street and a turnaround for both eastbound and westbound traffic on SR 228. The new layout will include adequate storage length per the Traffic Design Report, including a 345' eastbound left-turn lane, 295' westbound right-turn lane, and a 75' southbound left-turn lane. The new jughandle will require a cul-de-sac modification at Scharberry Lane.

## NON-MOTORIZED TRANSPORTATION IMPROVEMENTS:

No bicycle or pedestrian facilities exist along SR 228 within the Project area. Thus, the Project will include sidewalk connections at two key locations: from Castle Creek Drive to Shoppes at Adams Ridge Driveway/Seven Fields Boulevard and from Heritage Creek Drive south to the Heritage Creek Drive/Scharberry Lane roundabout. To bolster safety enhancements, the Project will install a total of 42 LED pedestrian countdown signals and 42 pedestrian push buttons at all improved and newly constructed intersections. Crosswalks and ADA curb cuts will also be installed at these locations to reduce crossing conflicts and enhance pedestrian safety.

**FIGURE 1. SAFE CONNECTIONS**



**INTERSECTION IMPROVEMENTS:** Within the MRBW Project, various intersection-specific improvements will be implemented, including additional turning and through lanes. The specific improvements that will be made at each intersection include:

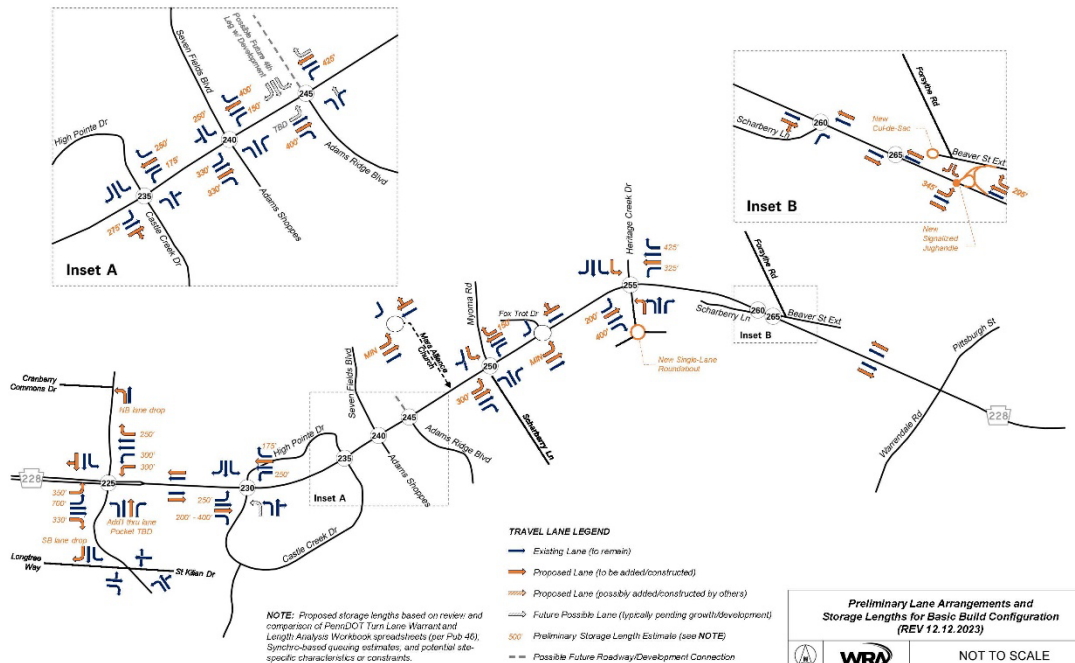
<b>SR 228/Franklin Road (#225)</b> <ul style="list-style-type: none"> <li>SR 228 EB: 300' left and 250' right turn lanes</li> <li>SR 228 WB: 350' left and 330' right turn lanes</li> <li>Franklin SB: Right turn and through lanes</li> <li>Franklin NB: Through lane</li> </ul>	<b>SR 228/Heritage Creek Drive (#255):</b> <ul style="list-style-type: none"> <li>SR 228 EB/WB: Passthrough lanes</li> <li>Heritage Creek SB: right turn lane</li> <li>Heritage Creek NB: Left turn lane</li> <li>SR 228 EB/WB: Additional through lane</li> </ul>
<b>SR 228/Castle Creek Dr East (#235):</b> <ul style="list-style-type: none"> <li>SR 228 EB: 275' right turn and through lane</li> <li>SR 228 WB: Additional through lane</li> </ul>	<b>SR 228/Scharberry Lane (#260):</b> <ul style="list-style-type: none"> <li>SR 228 EB: Right turn and passthrough lanes</li> <li>SR 228 WB: Passthrough lane</li> </ul>
<b>SR 228/Adams Ridge Blvd (#245):</b> <ul style="list-style-type: none"> <li>Restricted right-in/right-out movements</li> <li>Installation of median islands along SR 228</li> <li>SR 228 EB/WB: Additional through lane</li> </ul>	<b>SR 228/Myoma Road (#250):</b> <ul style="list-style-type: none"> <li>SR 228 EB: 300' left turn and through lanes</li> <li>SR 228 WB: 150' right turn and through lanes</li> <li>Myoma SB: Left turn lane onto SR 228</li> </ul>
<b>SR 228/High Pointe Drive (#230)</b> <ul style="list-style-type: none"> <li>SR 228 EB/WB: Additional through lane</li> </ul>	<b>SR 228/Seven Fields Blvd (#240):</b> <ul style="list-style-type: none"> <li>SR 228 EB/WB: Additional through lane</li> </ul>

**TRAFFIC SIGNAL ENHANCEMENTS:** The Project will enhance corridor operations by installing new traffic signal equipment and system upgrades. This encompasses eight video detection systems, eight advanced radar detection systems, eight acoustic emergency vehicle preemption systems, and eight CCTV video cameras. These enhancements will optimize traffic signal operations and minimize both recurring and non-recurring congestion.

## MRBW PROJECT SCOPE OF WORK

The benefit-cost analysis relies on a thorough intersection capacity analysis, sketch-level modeling, and other details provided by Butler County and its partners, PennDOT District 10 and SPC. The analysis scope encompasses SR 228 in both east and westbound directions from Franklin Road in Cranberry Township to just east of Beaver Street Extension in Adams Township, Butler County, Pennsylvania.

**FIGURE 2. MRBW PROJECT – PROPOSED IMPROVEMENTS**



## ANALYSIS PERIOD

For the Project, the evaluation period includes the final design and construction phases, during which capital expenditures are undertaken, plus 22 years of operations beyond Project completion within which to evaluate ongoing benefits and costs, for a total evaluation period of 30 years.

## DISCOUNT RATE

For purposes of present-value discounting, all benefits and costs are conservatively assumed to occur at the end of each year. Benefits accruing from the improvements are assumed to begin in the calendar year immediately following the final construction year. The real discount rate used for this analysis is 3.1 percent, consistent with U.S. DOT guidance for Discretionary Grant Programs. For carbon dioxide emissions, a 2 percent discount rate was used, in accordance with DOT guidance.

## DATA

All data used in this BCA Analysis was sourced from PennDOT District 10 and the Southwestern Pennsylvania Commission (SPC), unless otherwise stated. Given the size of the referenced data files, they can be found at the hyperlinks throughout the document.

## PROJECT COSTS

### CAPITAL COSTS

The expected total cost of the Project is \$119,550,000 in undiscounted dollars through 2030. This cost includes preliminary design, utilities, right of way, final design, and construction costs. In 2022 real dollars, discounted at 3.1%, the total project cost is \$98,742,199.

**TABLE 5. PROJECT COSTS AND SCHEDULE (NOMINAL DOLLARS)**

Year	Preliminary Engineering	Final Design	ROW	Utilities	Construction	Total
2016	\$262,500					\$262,500
2017	\$262,500					\$262,500
2018	\$262,500					\$262,500
2019	\$262,500					\$262,500
2020	\$262,500					\$262,500
2021	\$262,500					\$262,500
2022	\$262,500					\$262,500
2023	\$262,500					\$262,500
2024	\$262,500	\$766,667	\$3,100,000	\$1,400,000		\$5,529,167
2025		\$766,667	\$3,100,000	\$1,400,000		\$5,266,667
2026		\$766,667	\$3,100,000	\$1,400,000		\$5,266,667
2027					\$33,883,333	\$33,883,333
2028						
2029					\$33,883,333	\$33,883,333
2030					\$33,883,333	\$33,883,333
<b>TOTAL</b>	<b>\$2,100,000</b>	<b>\$2,300,000</b>	<b>\$9,300,000</b>	<b>\$4,200,000</b>	<b>\$101,650,000</b>	<b>\$119,550,000</b>

### O&M COSTS

Operations and maintenance costs were also considered in this application. SR 228 is a state-owned road that travels through Butler County. PennDOT recommends that major roadways be resealed every 7 years



and resurfaced every 20 years. Sealing and resurfacing per mile costs were provided in the [PennDOT Road Maintenance and Preservation \(MaP\)](#) guidance. Following this guidance, the 3.25 miles of roadway will cost \$85,894 to sealcoat and \$352,618 to resurface at each maintenance milestone. Sealing will occur twice in the analysis period, and resurfacing will occur once. Total there will be \$524,407 in O&M costs, which will be discounted to \$248,206.

## PROJECT BENEFITS

### SAFETY

The safety benefits for the investment area were determined by projecting reductions in fatalities and injuries, as well as a reduction in other property damage crash costs after the improvements are implemented. PennDOT District 10 provided detailed data for observed crashes by severity over the most recent seven-year period (2016-2022) for the specific road segments that will be improved. For the purposes of this analysis, the intersections and roadway were separated into the following segments:

- SR 228: Franklin Road to Pittsburgh Street EB/WB (excluding intersections)
- SR 228 and Franklin Road
- SR 228 and Castle Creek Drive (West)
- SR 228 and Castle Creek Drive (East)
- SR 228 and Seven Fields Boulevard
- SR 228 and Adams Ridge Boulevard
- SR 228 and Myoma Road
- SR 228 and Heritage Creek Drive
- SR 228 and Beaver Street Extension

Table 6 provides a summary of the crash data utilized in this analysis. These totals reflect all accidents for the corridor and targeted intersections.

**TABLE 6. SUMMARY CRASH DATA (2016 - 2022)**

	2016	2017	2018	2019	2020	2021	2022	Total (2016-2022)
Suspected Serious Injury	1	0	1	0	0	0	3	5
Suspected Minor Injury	3	10	19	2	9	1	16	60
Possible Injury	2	8	5	14	3	7	4	43
Unknown Severity	4	6	4	3	4	3	9	33
Unknown if Injured	1	1	0	0	0	0	0	2
Property Damage Only	36	33	30	36	42	27	58	262
<b>TOTAL:</b>	<b>47</b>	<b>58</b>	<b>59</b>	<b>55</b>	<b>58</b>	<b>38</b>	<b>90</b>	<b>405</b>

To calculate the annual benefit of the improvements to safety, the annual total for each year (2016-2022) of each type of accident was recorded (See Table 6). With this data an average annual accident occurrence was calculated for each type of accident and for each segment and intersection. Using crash modification factors (CMF) collected from the CMF Clearinghouse, the number accidents avoided under the Build scenario were calculated using the following formula:

$$\text{Average Annual Accidents (AAA) avoided} = (\text{AAA "No Build"}) * (1 - \text{CMF})$$

**TABLE 7. CRASH MODIFICATION FACTORS**

Transportation Improvement	CMF	Clearinghouse ID	Crash Type	Crash Severity	Area Type
Increase 2 to 4 lanes	0.314	7566	All	All	Urban
Left Turn Lane on both Major Road Approaches	0.52	275	All	All	Urban
Install Right Turn Lane	0.7	5650	All	All	All
Install Left Turn Lane	0.79	3948	All	All	Urban

Using the expected number of avoided accidents, the expected accidents in the “Build” scenario were calculated by subtracting the AAA avoided in the “Build” scenario from the AAA “No Build”. Using the

monetized values found in Table A-1 of the DOT BCA Guidance for Discretionary Grant Programs (also shown in Table 8) the average annual cost of accidents in the “Build” and “No Build” Scenarios were calculated by multiplying the Average Annual Accident count for the “Build” and “No Build” scenarios by the monetization factor for each KABCO level.

**TABLE 8. KABCO TRANSLATION TABLE**

KABCO Level	PennDOT level	Monetized Value
K – Killed	Fatality	\$12,500,000
A – Incapacitating	Suspected Serious Injury	\$1,188,200
B – Non-Incapacitating	Suspected Minor Injury	\$233,800
C – Possible Injury	Possible Injury	\$111,700
U – Injury (Unknown Severity)	Unknown Severity	\$217,600
Property Damage Only	Property Damage Only	\$9,100
O – No Injury	Unknown if Injured	\$5,000

The average annual cost of accidents in the “Build” scenario was subtracted from the average annual cost of accidents in the “No Build” scenario to identify the average annual benefit of increased safety from the Project. The average annual benefit was assigned to all years between 2031 and 2052, and then discounted at a rate of 3.1%.

**TABLE 9. ANNUAL ESTIMATED SAFETY SAVINGS WITH PROJECT IMPROVEMENTS**

Crash Severity	No-Build Alternative		After Project Improvements	
	Average Annual Occurrence	Average Annual Economic Loss	Average Annual Occurrence	Average Annual Economic Loss
Suspected Serious Injury	0.714	\$848,714	0.244	\$289,412
Suspected Minor Injury	8.571	\$2,004,000	3.530	\$825,314
Possible Injury	6.143	\$686,157	2.297	\$256,559
Unknown Severity	4.714	\$1,025,829	1.779	\$387,017
Unknown if Injured	0.286	\$1,429	0.097	\$487
Property Damage Only	37.429	\$340,600	14.872	\$135,331
<b>TOTAL</b>	<b>57.857</b>	<b>\$4,906,729</b>	<b>22.818</b>	<b>\$1,894,120</b>

Data-driven forecasts indicate that the MRBW Project’s proposed improvements will lead to a notable reduction in fatalities and serious injuries. The anticipated implementation of these improvements is expected to result in a 65% decrease in serious accidents and a 59% decrease in minor accidents. The high occurrence of Rear-End crashes (70%) and Intersection-related accidents (68%) in the MRBW Project area highlights the urgent need for intervention. Projections for the Project indicate a significant 45% reduction in crash activity at key intersections like Castle Creek Drive (East), Seven Fields Boulevard, Adams Ridge Boulevard, Myoma Road, and Beaver Street Extension.

In the Build scenario, there is expected to be a 61% reduction in accidents, with an average of 23 accidents per year. Suspected serious accidents are expected to be less common, happening once every four years in the “Build” scenario. Accidents resulting in minor injury are anticipated to average 4 occurrences per year, with about 15 property damage only accidents. These major increases in safety reflect the focus of the Project and reflect the necessity to move forward with the Project.

***The safety benefits accrued from the Project during the analysis period total \$37,233,774 in discounted 2022\$ dollars.***

## TRAVEL TIME SAVINGS

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In this analysis, travel time savings reflect in-vehicle travel time savings for persons traveling in passenger and commercial vehicles. Travel time is considered a cost to users, and its value depends on the disutility that travelers attribute to time spent traveling. A reduction in travel time translates to improved quality of life and increased economic competitiveness as there is more time available for work or leisure.

SR 228, classified as an Urban Arterial Highway by the Pennsylvania Department of Transportation (PennDOT), serves as a critical link between Butler County, Interstate 79, and the Pennsylvania Turnpike (Interstate 76), connecting the region to the state and nation. As a principal arterial on the National Highway System (NHS), it plays a pivotal role in commuter traffic and regional freight transportation. However, rapid development along the corridor has led to escalating traffic congestion and deteriorating transportation conditions. Anticipated traffic growth is expected to increase Average Annual Daily Traffic (AADT) by over 33%, with the expansion of major development parcels potentially pushing the growth rate to nearly 52%.

Expected delays were sourced from the [2045 Design Year Build Scenario Summary Tables](#). In the [PennDOT District 10: Traffic Design Report Route 228 Mars RR Bridge West Expansion](#), peak hour traffic was identified to occur 6AM-9AM and 3PM-6PM on weekdays, and 11AM-2PM on weekend days. Utilizing the traffic count data provided in the [Appendices to the Traffic Design Study](#), peak hour traffic delays were calculated for each lane (Left/Through/Right, East Bound/West Bound/North Bound/South Bound) at each intersection along the route. This process was completed for the peak hour savings: AM, PM, and Saturday (SAT) when available. The intersections analyzed are listed below:

1. SR 228 and Franklin Road
2. SR 228 and Castle Creek Drive (West)
3. SR 228 and Castle Creek Drive (East)
4. SR 228 and Seven Fields Boulevard
5. SR 228 and Adams Ridge Boulevard
6. SR 228 and Myoma Road
7. SR 228 and Heritage Creek Drive
8. SR 228 and Beaver Street Extension

Using documented commercial vehicle percentages ([Traffic Design Report Appendix D&E](#)), the proportion of commercial and passenger vehicles was calculated. To calculate the expected travel time savings, vehicle persons per hour values were calculated using the recommended occupancy numbers given in Table A-3 of the USDOT BCA Guidelines for Discretionary Grants. Total annual delay was calculated by multiplying the estimated delay by the number of occupants and the annualization factor. Using the monetization factors for passenger vehicles and commercial vehicles, the value of the delay was calculated. This process was repeated for the “No Build” Scenario.

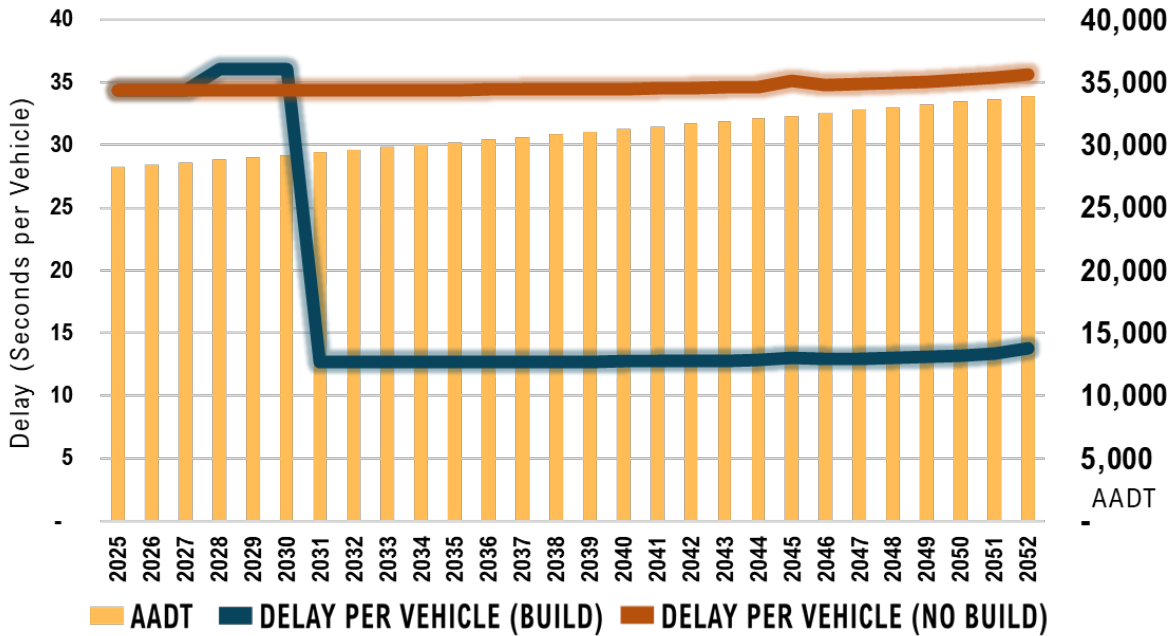
The MRBW Project will have minimal impacts on traffic delays during construction. To account for construction delays, PennDOT District 10 estimated a minimal 5% delay, as most of the construction will occur outside of the existing road footprint and, therefore, no road closures or detours will be required. This represents the disbenefit of reduced speeds and increased congestion in the segment stemming from construction of the improvements.

To extend this analysis into the future, the number of passenger and commercial vehicles were increased at a rate equal to the expected population growth through this corridor (0.68%). The benefit of travel time savings was then calculated for each year and discounted at a rate of 3.1%. The net savings from each intersection was aggregated to represent the total benefit to travel time stemming from this Project. The detailed analysis can be found in the [Travel Time BCA Spread Sheet Appendix](#).

Over the 30-year period studied, the Project will improve travel time at 7 of the 8 intersections analyzed. The biggest improvements to travel time are realized at Castle Creek West intersection, where there were previously no turning lanes and long wait times to make turns. Across the entire MRBW Project, there is expected to be a total saving of 15,017,528 hours, with 14,728,362 hours of that time coming from passenger vehicles and 289,167 hours of commercial time.

**63% REDUCTION IN PEAK HOUR DELAYS**  
**\$151 MILLION TRAVEL TIME SAVINGS**

**FIGURE 3. PER VEHICLE DELAY BUILD VERSUS NO BUILD**



*The travel time savings benefits accrued from the Project during the analysis period total \$151,312,777 in 2022\$ discounted dollars.*

**VEHICLE OPERATING COST SAVINGS**

Reduced congestion and vehicle idling has valuable future impacts for environmental sustainability, as well as economic competitiveness through reduced vehicle operating costs in the form of fuel consumption. The analysis estimates the consumer cost savings of reduced fuel consumption as a result of reduced congestion along the Project corridor. To calculate the value of these savings, the annual time savings for commercial and passenger vehicles was multiplied by the average fuel usage per hour to calculate the total reduction in fuel usage. These values were monetized using current 2023 market rates for passenger gasoline and commercial diesel fuel. These annual savings were then discounted at 3.1%.

Over the 30-year analysis period approximately 15 million personal vehicle hours are saved and just under 290,000 commercial vehicle hours are saved. With the decrease in que times, vehicles spend less time idling, resulting in an estimated 6.48 million gallons of gasoline usage reduction and 325 thousand gallons of diesel fuel usage reduction.

*Using current US average prices, the vehicle operating cost savings accrued from this Project during the analysis period total \$13,995,089 in 2022\$ discounted dollars.*

## EMISSIONS REDUCTIONS

The Project improvements will result in reduced congestion along the SR 228 Corridor, which results in less vehicle idling time and reductions in vehicle emissions. This analysis models the Project's impact on greenhouse gas vehicle emissions including CO<sub>2</sub>, NO<sub>x</sub>, and PM<sub>2.5</sub>. The impact on Sulfur Dioxide emissions was not included for the purposes of this analysis.

The benefit of reduced carbon dioxide emissions was calculated using the fuel savings from the Operating Cost Savings section. Using the [EPA value](#) of CO<sub>2</sub> emissions per gallon of gasoline and gallon of diesel, the emission reductions were calculated for each year. These were monetized using the values in Table A-6 of the 2024 BCA Guidance for Discretionary Grant Programs and discounted at a 2% rate.

The analysis of PM<sub>2.5</sub> and NO<sub>x</sub> emissions is based on the hours of transportation reduced. To calculate emissions reduced, the number of travel time hours reduced was multiplied by the EPA average emissions per hour. Total emissions reduced were monetized using the values for PM 2.5 and NOX in Table A-6 of the 2024 BCA Guidance for Discretionary Grant Programs. These emissions were discounted at a 3.1% discount rate.

**TABLE 10. IDLE FUEL CONSUMPTION BY VEHICLE TYPE**

Fuel Consumption Efficiency	Fuel Type	Idling Fuel Use (gal/hr.) no load	Idling Fuel Use (gal/hr.) with load
Compact Sedan	Gasoline	0.16	0.29
Large Sedan	Gasoline	0.39	0.59
Delivery Truck	Diesel	0.84	1.1
Tractor-Semitrailer	Diesel	0.64	1.15

**TABLE 11. NOX AND PM<sub>2.5</sub> EMISSIONS FOR IDLING PASSENGER AND COMMERCIAL VEHICLES**

	NOX (g/hr.)	PM2.5 (g/hr.)
Light Duty Gasoline Vehicle	3.515	
Light Duty Gasoline Truck	4.065	
Average LDGV	3.79	
Heavy Duty Gasoline Vehicle	5.33	
Heavy Duty Deisel Vehicle Class V	18.655	1.008
Heavy Duty Deisel Vehicle Class VIIIa	35.758	1.07
Average HDDV Class V and Class VIIIa	27.2065	1.039

Due to reduced idling from the traffic improvements, over the 30-year period vehicles travelling SR 228 and intersecting routes use less fuel and emit less pollution. Across all three categories of pollution, the MRBW Project improvements decrease the amount of CO<sub>2</sub>, PM<sub>2.5</sub>, and NO<sub>x</sub> emissions. The emissions prevented/reduced is as follows:

- CO<sub>2</sub> Reduction: 60,904 metric tons
- PM<sub>2.5</sub> Reduction: 940,838 grams
- NO<sub>x</sub> Reduction: 63,687,700 grams

Using the valuations specific to each of these pollutants there is savings of \$13,886,043 from CO<sub>2</sub> emissions, which is discounted to \$9,431,405 at the 2% rate and savings of \$894,737 for PM<sub>2.5</sub> and \$1,261,016 for NO<sub>x</sub> emissions, which combined and then discounted results in \$1,195,069 total reduction.

***The emissions reduction benefits accrued from the Project during the analysis period total \$13,995,089 in 2022\$ dollars discounted at the respective rates identified above and in the BCA Guidance.***

## PEDESTRIAN IMPROVEMENTS

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No bicycle or pedestrian facilities currently exist along SR 228 within the Project area. To address this, the Project will include sidewalk connections at two key locations: from Castle Creek Drive to Shoppes at Adams Ridge Driveway/Seven Fields Boulevard and from Heritage Creek Drive south to the Heritage Creek Drive/Scharberry Lane roundabout. Additionally, forty-two (42) crosswalks and pedestrian signals will be installed to enhance pedestrian safety.

Due to the lack of designated crossings and high-speed traffic along the current roadway configuration, pedestrian counts were deemed inaccurate for assessing demand. Instead, pedestrian estimates were derived using data from Urban Footprint, an online mapping application, indicating a population of 14,464 within a mile of the Project. Assuming that 2.5% of the population walks to work and a quarter of these walkers will cross SR 228 in the Project area, an estimated 90 uses of the signalized crosswalk per day are expected. These estimates were then used to calculate the total benefit by multiplying the benefit/use provided in Table A-8 of the 2024 BCA Guidance for Discretionary Grants and discounting it at 3.1%.

Using the estimation method identified above, over the 30-year period it is estimated that 96 trips daily in 2031 will use one of the 42 installed crosswalks (average usage of each crosswalk: 2.3 times/day). With the expected growth for the region, the number of crosswalk trips reaches 111 by 2052. Using the \$0.51/use metric provided in Table A-8 of the 2024 BCA Guidance for Discretionary Grant Programs.

***The pedestrian amenities benefits accrued from the Project during the analysis period total \$235,626 in 2022\$ discounted dollars.***

**RESULTS**

**EVALUATION MEASURES**

The BCA converts potential gains (benefits) and losses (costs) from the Project into monetary units and compares them. The following common benefit-cost evaluation measures are included in this BCA:

**NET PRESENT VALUE (NPV):**

NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today’s dollar terms.

**BENEFIT COST RATIO (BCR):**

The evaluation also estimates the benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. The BCR expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project’s benefits either exceed or fall short of the costs.

**BCA RESULTS**

The table below presents the evaluation results for the MRBW Project. Results are discounted at the respective 3.1% or 2% (emissions) discount rate as prescribed by the USDOT BCA Guidance. All benefits and costs were estimated in constant dollar over an evaluation period extending 22 years after Project.

The total benefits from the Project’s improvements within the analysis period are calculated to be \$213,403,742 in 2022 discounted dollars. The total Project costs, including capital costs and O&M are \$99,305,675. The net present value (NPV) of the project is \$114,098,067, resulting in an overall project BCR of 2.15.

**TABLE 12. BCA RESULTS**

<b>MRBW PROJECT</b>	<b>30-YEAR ANALYSIS PERIOD</b>
<b>COSTS</b>	
Capital Costs	\$99,057,468
O& M Costs	\$248,206
<b>TOTAL COSTS</b>	<b>\$99,305,675</b>
<b>BENEFITS</b>	
Safety	\$37,233,774
Travel Time	\$151,312,777
Emissions	\$15,190,159
Operating Costs	\$9,431,406
Pedestrian Improvements	\$235,626
<b>TOTAL BENEFITS</b>	<b>\$213,403,742</b>
<b>BCR</b>	<b>2.15</b>
<b>Net Present Value of Benefits</b>	<b>\$114,098,067</b>