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FY 2020 Federal-State Partnership for Consolidated Rail Infrastructure and Safety Improvements

Attachment 4: Benefit-Cost Analysis – Trespass Prevention and Pedestrian Safety Enhancements on the Michigan Line

Technical Memorandum

To: **Rob Lippert, P.E.**
Michigan Department of Transportation (MDOT)
Office of Rail

Subject: **Trespass Prevention and Pedestrian Safety Enhancements on the Michigan Line**

Prepared by: **Quandel Consultants**

Date: **June 19, 2020**

Executive Summary

A Benefit-Cost Analysis (BCA) was performed for the Trespass Prevention and Pedestrian Safety Enhancements on the Michigan Line Project (Project) to support the Michigan Department of Transportation's (MDOT) grant application for the United States Department of Transportation (USDOT) Federal-State Partnership for Consolidated Rail Infrastructure and Safety Improvements (CRISI) grant program. The analysis was conducted in accordance with the USDOT's 2020 Benefit-Cost Analysis Guidance for Discretionary Grant Programs and BCA FAQ from the Federal Railroad Administration (FRA). The BCA analyzes the initial capital costs to construct pedestrian safety improvements and trespasser deterrents throughout the corridor as well as 30 years of benefits and costs after the construction is complete, which is anticipated to be in 2024. The estimated Benefit-Cost Ratio (BCR) for the Project is 3.24. The BCR is calculated by dividing the total 30-year discounted benefit (\$79.62 million) by the total Project discounted cost (\$24.55 million). All monetary values are discounted at a real discount rate of 7% to the year 2018 and expressed in 2018 dollars.

Table 1 presents the Impact Summary Matrix, which describes the baseline, the Project, and the resulting impacts.

Table 1 - Impact Summary Matrix

| Current Condition | Improvements | Impacts |
|--|---|---|
| Amtrak trains operating on the Michigan Line have struck 12 trespassers or pedestrians over the last four years | The construction of pedestrian safety and trespasser deterrent devices will address locations where 10 of the 12 strikes in the last four years occurred. | Improved safety-reduced strikes. |
| Amtrak trains operating on the Michigan Line incur delays of an average of 239.2 minutes per trespasser strike, 9.19 minutes per "near-miss," and 6.82 minutes per reported trespasser. | The construction of trespasser deterrents will prevent trespassers from accessing the railroad right-of-way. | Travel time savings and improved reliability. |

Table 2 summarizes the results of the BCA calculations. Taken in total, the Project provides \$79.62 million in discounted benefits – travel time savings and trespasser strike cost savings – over the analysis period, using a 7% real discount rate. Compared to the estimated discounted costs, the BCR for the Project is 3.24 and the overall net present value is \$55.08 million.

Table 2 - BCA Summary

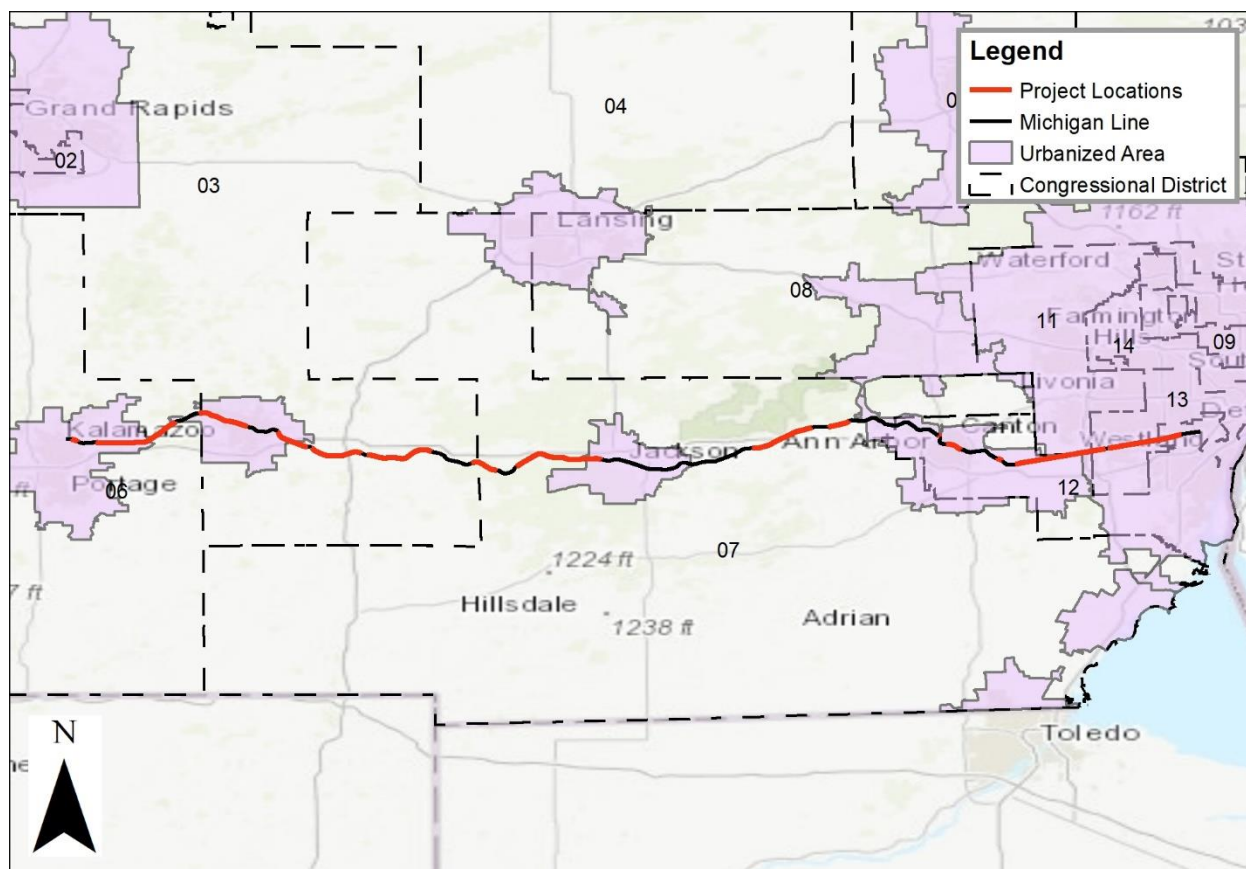
| Overall Project 7% Discount Rate | |
|--|----------------|
| Costs | |
| Capital Cost | \$22.48 |
| Operating and Maintenance Costs | \$2.07 |
| <i>Total Costs</i> | <i>\$24.55</i> |
| Benefits | |
| Safety Benefits | |
| Reduced Trespasser Strikes | \$79.38 |
| Sub-Total | \$79.38 |
| Economic Competitiveness Benefits | |
| Travel Time Savings | \$0.24 |
| Sub-Total | \$0.24 |
| Environmental Sustainability | |
| <i>Qualitatively Described</i> | <i>\$0.00</i> |
| Sub-Total | <i>\$0.00</i> |
| Quality of Life | |
| <i>Qualitatively Described</i> | <i>\$0.00</i> |
| Sub-Total | <i>\$0.00</i> |
| <i>Total Benefits</i> | <i>\$79.62</i> |
| Outcome | |
| Net Present Value | \$55.08 |
| Benefit-Cost Ratio | 3.24 |

Note: Values are displayed in millions of 2018 dollars.

Description of Project

The State of Michigan (MDOT) supports the only American rail corridor currently offering passenger train speeds of 110 MPH in the country outside of Amtrak's Northeast Corridor (Boston to Washington D.C.) and Keystone Corridor (Philadelphia to Harrisburg). MDOT is seeking financial assistance to improve pedestrian safety and deter trespassers on the Chicago-Detroit/Pontiac passenger rail corridor. The Project will consist of the enhancement of safety at select grade crossings including active warning devices and channelization for pedestrians as well as fencing to deter trespassers. The loss of life from being struck by a train is tragic for families and communities and trespassers cause delays to train services in the corridor. The Project will improve public safety as well as reduce delays.

Figure 1 - Map of Project Location



Analysis Assumptions

A BCA was conducted in accordance with the Benefit-Cost Analysis Guidance from the USDOT in the 2020 Discretionary Grant Benefit-Cost Analysis Guidanceⁱ and BCA FAQ from the FRAⁱⁱ.

This grant application uses conservative assumptions for benefits and costs directly associated with the Project. The analysis also assumes that only Amtrak's Wolverine and Blue Water Services would receive this benefit even though the Norfolk Southern Railroad (NS) and Grand Elk Railroad (Grand Elk) utilize the portions of the corridor identified to receive the improvements. There are too many unknowns to adequately quantify the benefits these services may realize, and therefore they are described qualitatively later in this memo. A list of assumptions for the Project is provided in the BCA spreadsheet (see Inputs tab in Attachment 3).

Base Condition and Build Condition

The BCA compares the benefits and costs of the Project (Build condition) to the benefits and costs of a baseline (No-Build) condition that assumes the Project would not be built. Under the

No-Build condition, the purpose of and need for the Project would not be met and existing safety issues would continue to effect operations in the corridor.

Analysis Period and Project Service Life

The total Project period of analysis is 30 years, beginning in 2025 after construction is anticipated to be complete. It was assumed the Project would be fully operational and benefits would begin accruing on January 1, 2025. The BCA includes all design, construction, and maintenance costs associated with the Project.

Discount Rate

The BCA provides costs discounted at a real discount rate of 7%. Dollar amounts were converted to 2018 dollars using the Bureau of Economic Analysis Table 1.1.9. Implicit Price Deflators for Gross Domestic Productⁱⁱⁱ. The BCA tables are provided in Attachment 3.

Ridership

The compound annual growth rate in ridership from 1999 to 2019 was 2.03% for the Wolverine Service and 2.35% for the Blue Water Service. The ridership growth rate is assumed to be the same for the Build and No-Build conditions. The annual ridership figures are provided on the Ridership tabs in Attachment 3.

Costs

Capital Costs

The estimated future capital cost for the Project is expected to be \$30.39 million in undiscounted 2018 dollars and \$22.48 million when discounted at 7%. The capital cost estimate includes PE/NEPA, final design, material costs, labor costs, surveying costs, flagging costs, professional services, construction management, and a 20% unallocated contingency. It is assumed that the capital costs will be incurred equally between 2021, 2022, and 2023, and 2024. Table 3 presents the capital costs in undiscounted 2018 dollars for the Project.

Table 3 - Capital Costs

| Category | Description | Cost (2018 \$) |
|--------------|----------------------------------|---------------------|
| 10 | Track Structures & Track | \$0 |
| 20 | Stations & Terminals | \$0 |
| 30 | Support Facilities | \$0 |
| 40 | Sitework, Right of Way, Land | \$24,346,488 |
| 50 | Communications & Signaling | \$0 |
| 60 | ROW, Land, Existing Improvements | \$243,231 |
| 10-60 | Construction Subtotal | \$24,589,719 |
| 70 | Vehicles | \$0 |
| 80 | Professional Services | \$737,692 |
| 10-80 | Subtotal Allocated Costs | \$25,327,410 |
| 90 | Unallocated Contingency | \$5,065,482 |
| Total | | \$30,392,893 |

Operations and Maintenance Costs

The future operations and maintenance costs^{iv} for the Project over the 30-year analysis period are estimated to be \$7.50 million in undiscounted 2018 dollars and \$2.07 million when discounted at 7%.

The operations and maintenance costs include vegetation control, maintenance, and repairs. Throughout the corridor, weed spray and tree trimming will be necessary to maintain a clean fence line. Additionally, over the course of time, it is likely that fencing will be vandalized and require repairs. An annual cost of \$250,000 was estimated to address any future maintenance needs for the fencing.

Benefits

The primary goal of the Project is to improve public safety and reduce trespassing in the corridor. Implementing the Project will reduce the risk of trespasser and pedestrian strikes and result in safety cost savings and trip time savings for the Wolverine and Blue Water services.

Safety

The Project will improve eight grade crossings and install approximately 157 miles of fence. These improvements will enhance public safety and prevent trespassers. In the No-Build condition, the safety enhancements would not be constructed, and pedestrians and trespassers would continue to have uninhibited access to the railroad right-of-way. In this scenario, despite “no trespassing” signs currently on display, trespassers at “hotspots” would continue and trains striking trespassers or pedestrians would be expected over the 30-year analysis period. The value of a statistical life is \$9,600,000^v. It is assumed that the No-Build condition would result in three trespasser strikes per year, which is consistent with the number of strikes from 2016 to

2019. The Build condition assumes that one fatality due to an Amtrak train striking a person would be prevented per year. This is a conservative assumption given that the Project addresses ten of the twelve strikes from 2016 to 2019.

The reduction in future strikes results in an undiscounted benefit of \$288.00 million over the 30-year analysis period in undiscounted 2018 dollars, or \$79.38 million when discounted at 7%.

Economic Competitiveness

The Project will result in economic competitiveness benefits by reducing causes of delays to passenger rail traffic, resulting in travel time savings. The methodologies for calculating these benefits are described below.

Travel Time Savings

For each occurrence, Wolverine service trains are delayed an average of 239.20 minutes for strikes, 9.19 minutes for “near-misses”, and 6.82 minutes for reports of trespassers. Similarly, Blue Water service trains are delayed an average of 10.00 minutes for “near-misses” per occurrence and did not experience any delays due to strikes or reported trespassers^{vi}. The reduction in delays will improve the reliability of the service, helping to retain and potentially grow Amtrak ridership.

Based on the delays described above, rail passengers will avoid approximately 43,236 hours of delay over the 30-year analysis period. ***Based on an assumed value of time of \$21.30 per hour for riders on personal travel and \$27.10 per hour for business travel (in 2018 dollars), the undiscounted benefit of future travel time savings is valued at \$0.98 million, or \$0.24 million when discounted at 7%.***

Qualitative Benefits

Freight railroads in the corridor will also benefit from the Project. The NS and Grand Elk will have fewer delays due to trespasser or pedestrian strikes in the corridor. As a result of the Project, both freight operators will also be less likely to strike pedestrians or trespassers in the corridor. Safety benefits and travel time savings were not included in the quantitative analysis as a conservative assumption and because the benefits are more difficult to accurately quantify.

The Project will also save locomotive emissions from all three railroads in this corridor. Fewer delays will result in less idling time, which will reduce emissions. This benefit is described qualitatively due to the unknowns in freight train delays and is the benefit is expected to have a minimal impact on the analysis.

Total Benefits and Costs

The total benefits in undiscounted 2018 dollars are \$291,992,683, or \$79,887,208 when discounted at 7%. The total capital and operations and maintenance costs in undiscounted 2018 dollars are \$30,294,669, or \$24,546,673 when discounted at 7%.

Summary

The benefits of the Project exceed the costs by about 325%. In total, the capital and operations and maintenance costs of the Project are \$30,294,669 in undiscounted 2018 dollars, or \$24,546,673 when discounted at 7%. ***The Project results in total future benefits of \$288,975,750 in undiscounted 2018 dollars, or \$79,623,119 when discounted at 7%, with a BCR of 3.24.*** There are also several qualitative benefits that will be realized upon completion of the Project. Table 4 shows the benefits and costs for the Project.

Table 4 - BCA Summary

| Overall Project 7% Discount Rate | |
|--|----------------|
| Costs | |
| Capital Cost | \$22.48 |
| Operating and Maintenance Costs | \$2.07 |
| <i>Total Costs</i> | <i>\$24.55</i> |
| Benefits | |
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| Travel Time Savings | \$0.24 |
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| <i>Qualitatively Described</i> | |
| Sub-Total | \$0.00 |
| Quality of Life | |
| <i>Qualitatively Described</i> | |
| Sub-Total | \$0.00 |
| <i>Total Benefits</i> | <i>\$79.62</i> |
| Outcome | |
| Net Present Value | \$55.08 |
| Benefit-Cost Ratio | 3.24 |

Note: Values are displayed in millions of 2018 dollars.

List of Supporting Documents

- ⁱ Benefit-Cost Analysis Guidance for Discretionary Grant Programs, USDOT, 2020.
https://www.transportation.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf
- ⁱⁱ Consolidated Rail Infrastructure and Safety Improvements Program Benefit-Cost Analysis FAQs, FRA, 2019.
<https://www.fra.dot.gov/eLib/Details/L19367>
- ⁱⁱⁱ Table 1.1.9. Implicit Price Deflators for Gross Domestic Product, BEA, 2018.
<https://www.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=3&isuri=1&1921=survey&1903=13>
- ^{iv} Operations and Maintenance Costs included in project costs in accordance with the FY20 Consolidated Rail Infrastructure and Safety Improvements (CRISI) Grants NOFO Webinar held on May 7, 2020, Slide 40.
https://railroads.dot.gov/sites/fra.dot.gov/files/2020-05/FY20-CRISI-May2020-Webinar-FINAL_0.pdf
- ^v Table A-1: Value of Reduced Fatalities and Injuries
https://www.transportation.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf
- ^{vi} Amtrak Conductor Log Reports (2016-2019).