Appendix B: Benefit-Cost Analysis Technical Memorandum

SOUTHERN MARYLAND RAPID TRANSIT STUDY

SOUTHERN MARYLAND RAPID TRANSIT STUDY

Southern Maryland Rapid Transit Project:

Benefit-Cost Analysis Memorandum

BUILD Planning Grant Application

May 18, 2020

MARYLAND DEPARTMENT OF TRANSPORTATION

Charles County in partnership with Prince George's County & Maryland Department of Transportation

Contents

1. INTRODUCTION

1.1. Project Background

Charles County, MD, partnering with Prince George's County and the Maryland Department of Transportation Maryland Transit Administration (MDOT MTA), is seeking to use available federal funding through the Better Utilizing Investments to Leverage Development (BUILD) Discretionary Grant Program to significantly improve quality of life by advancing the Southern Maryland Rapid Transit (SMRT) Project toward implementation. The SMRT Project provides improved quality of life and increased economic competitiveness for the region and for individuals who will have greater freedom to travel where they want, when they want to. Charles County, Maryland in partnership with Prince George's County, Maryland and the MDOT MTA is seeking $4.98 million to complete a Draft Environmental Impact Statement (DEIS) – an important next step in implementing a rapid transit system along the SMRT Project corridor in a dedicated transitway. More specifically, the SMRT Project envisions:

- Connecting corridor growth centers, local, and regional activity centers, such as Joint Base Andrews and the Southern Maryland Hospital, in Southern Prince George's County and the Waldorf Urbanized Area in Charles County to the greater Washington, D.C. Metropolitan region by tying into the Washington Metropolitan Area Transit Authority (WMATA) Green Line Metrorail at the Branch Avenue Station.
- Supporting Transit Oriented Development (TOD), reinvestment/redevelopment, and the creation of new employment opportunities along the SMRT Corridor near regional activity centers and planned development.
- Providing a catalyst for new investment, economic growth, and job creation.
- Enhancing the tools available to local government to allow the transit corridor to be a spine around which future growth can occur in a transit supportive manner.
- Improving accessibility to employment and services for transit-dependent populations.
- Expanding commuting options, enhancing local mobility, preserving highway capacity, and managing congestion throughout the SMRT Project corridor.
- Creating a sustainable, multi-modal transportation strategy for this rapidly growing, automobile dependent corridor.
- Promoting positive public health outcomes for residents along the SMRT Project Corridor by offering alternative transportation options.

1.2. BCA Framework

Benefit Cost Assessment (BCA) is an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of an investment alternative. Benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of a BCA is to assess whether the expected benefits of a project justify the costs from a social perspective. A BCA framework attempts to capture the net welfare change created by a project, including cost savings and increases in welfare (benefits), as well as disbenefits where costs can be identified (e.g., construction closure impact), and welfare reductions where some groups are expected to be made worse off as a result of the proposed investments.

A project-specific quantitative BCA is appropriate when that project has undergone a substantial amount of planning and preliminary design activity, along with associated cost estimation and travel-demand modeling efforts, or other technical analyses that forecast the range of potential impacts. These quantitative inputs—for example, expected changes in travel time and vehicle-miles traveled (VMT) for transit and roadway users, or reduced crashes through safety improvements—are typically combined with industry-standard monetized values to estimate the likely economic benefits from that project.

While some data needed to measure benefits and costs on the SMRT project is available, an alternative must be finalized and more data must be gathered and confirmed prior to development of a complete comprehensive BCA. This report outlines the expected analysis framework, methodology, assumptions, and other inputs that would be used for a BCA conducted after the DEIS is complete.

For a typical project seeking U.S. DOT grant funding, the BCA framework involves defining a Base Case or "No Build" Case, which is compared to the "Build" Case, where the grant request is awarded and the project is built as proposed. As part of the development of the DEIS for which BUILD Grant funding is requested, data is generated to inform the definition of the Build Case (or cases) that represents the future with the proposed service enhancements. The BCA assesses the incremental difference between the No Build Case and the Build Case (or Build Cases), which represents the net change in social welfare. BCAs are forward-looking exercises that seek to assess the incremental change in welfare over a project lifecycle. The importance of future welfare changes is determined through discounting, which is meant to reflect both the opportunity cost of capital as well as the societal preference for the present.

2. PROJECT BENEFITS

As described in the Project Narrative, the SMRT project is expected to have the following quantifiable benefits once complete:

- Travel time savings for new transit riders shifting from congested automobile travel.
- Safety improvements from reduced automobile traffic and roadway enhancements.
- Emissions reductions from reduced automobile mileage as drivers shift to transit.
- Vehicle operating cost savings for automobile drivers shifting to transit.
- Enhanced health and recreation from improved bicycle and pedestrian facilities.
- Transit-oriented development and property value increases spurred by the SMRT Project.

TABLE 1. PRELIMINARY BENEFITS USING 2017 SMRT ALTERNATIVES REPORT

	Preliminary Projected Build v. No-Build 2040	Benefit category
Increased Transit ridership	18,000 additional riders	Vehicle operating cost savings; Reduced vehicle emissions
Travel Time Savings	11-17 minutes faster than highway travel	412,500 hours of travel time savings; enhanced economic development and land values in the corridor
Safety Improvements at intersections	Qualitative improvement	Reduction in future vehicle crashes
Bikeway and pedestrian improvements	Qualitative improvement	Enhanced health and safety; Improved health outcomes, savings in health care costs; commuter mobility improvements
New recreational bicyclists	Qualitative improvement	Increase in recreational time
Increased Development and Property Values	Qualitative improvement	Increase in economic development, as represented by change in property values

More information on each of these benefits and the way in which they can be evaluated in a future analysis follows in this section.

2.1. Economic Competitiveness

The SMRT Project will enhance mobility in Prince George's and Charles counties and the larger Washington, D.C. Metropolitan region, making it faster and easier for commuters and others to travel around Southern Maryland and to/from Washington, D.C. This improved mobility translates to greater economic competitiveness, which can be measured in terms of travel time savings and vehicle operating cost savings.

The project is also expected to lead to increased economic development and property values along the SMRT corridor. While property values are often excluded from BCAs due their typical derivation from the direct economic benefits (e.g., travel time savings) already quantified in the analysis, in the case of the SMRT project, the anticipated economic development and property value gains represent factors beyond these core benefits, as described more below.

2.1.1. Vehicle Operating Cost Savings

The SMRT Project will attract riders who would otherwise drive in their personal vehicles, either within the corridor, to Branch Avenue station or all the way into Washington, D.C. The 2017

Final Alternatives Report[1] estimates that approximately 18,000 additional people will ride transit each day with implementation of SMRT, compared to a 2040 base ridership of 102,000 – representing an 18% increase. It is assumed that the majority of these trips will replace trips that would otherwise occur by automobile. By shifting to transit, these users will reduce their spending on fuel, as well as maintenance and repair, replacement of tires, and the depreciation of the vehicle over time.

The value of these vehicle operating cost savings can be calculated using the cost per Vehicle Miles Traveled (VMT) recommended by U.S. DOT (currently $0.41) for light duty vehicles. First, the total level of VMT reduction must be calculated. This will be done as part of the DEIS's study of air quality impacts.

2.1.2. Travel Time Savings

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 into more time available for work, leisure, or other activities. The SMRT Project will improve transit travel times during peak periods using a dedicated facility and other speed and reliability measures, such as Transit Signal Priority (TSP) and grade separation. SMRT Project travel times range from 37 to 42 minutes for the entire length of the corridor, which is an improvement of approximately 11 to 17 minutes faster than the highway travel time.

As a preliminary estimate of travel time savings, we can assume that the 18,000 new daily transit riders each save an average of at least 5.5 minutes per trip, reflecting half the minimum improvement based on variation in where riders will get on/off the corridor. This is equivalent to 412,500 hours of annual savings, assuming a 250-day annualization factor.

As part of the DEIS, MDOT MTA will refine the time savings estimates and the assessment of how many passengers will benefit from the savings. Total passenger hours saved can then be multiplied by the U.S. DOT-recommended value of travel time savings (currently $16.60 for all trip purposes) to determine the total value of travel time savings with the selected alternative.

2.1.3. Property Value Increases from Economic Development

The SMRT Project is expected to catalyze transit-oriented development around the Branch Avenue Metro stop and throughout the SMRT Corridor. At present, large parking lots surround the Branch Avenue station, with most people driving to the stop before taking the train into DC or Virginia. With the project, commuters will be able to walk to a SMRT stop near their home, or drive to more distributed stops, and take SMRT to Branch Avenue. This would lessen the need for parking at Branch Avenue and provide opportunities to repurpose parking lots with productive, mixed-use spaces (or at least avoid building additional parking). Other places along

---

[1] https://smrtmaryland.com/images/library/SMRT_Final_Alternatives_Report/SMRT%20Final%20Report.pdf

the corridor ripe for further development include Camp Springs, Woodyard, Mattawoman, Waldorf, and White Plains.

Furthermore, the Metropolitan Washington Council of Governments has identified a need for more jobs closer to housing—right now the areas along the SMRT corridor are primarily residential. Commercial development along the SMRT corridor, which is one of the last remaining undeveloped corridors around the Beltway, could help shift region-wide commuting patterns, counteracting the current patterns in which many more people commute from Maryland to DC and Virginia than from Virginia or DC to Maryland. The SMRT Project will facilitate this development and enable eastbound commuters to reach their final destination via transit.

Appendix K of the 2017 Final Alternatives Report[2] quantified the expected property value increases (as well as employment and income) associated with different alternatives of the SMRT project and found them to be worth at least $27 billion. While some of this may be attributable to benefits anticipated to be monetized elsewhere in the BCA, and other portions are based on additional spending on the development itself, it is assumed that at least a portion of these increased values in fact represent additional benefits that may be capturable in a future BCA.

2.2. Safety

The current transportation system in the MD 5/US 301 corridor contributes to a substantially higher-than-average rate of personal injuries in the corridor. Many crashes are clustered around signalized intersections, with especially high crash concentrations at MD 5 at Surratts Road, US 301 at Cedarville Road/McKendree Road, US 301 at Mattawoman-Beantown Road, and US 301 at MD 228. In 2016, there were approximately 850 police reported crashes along the MD 5/US 301 corridor between I-495/I-95 and MD 227. Of those, approximately 44 percent were rear end collisions, 23 percent were single vehicle only, and 18 percent were angle collisions. There were 13 crashes resulting in fatalities and 315 crashes resulting in injuries. In some segments of the corridor, injuries and fatalities were higher than the statewide average for similar roadways.

The SMRT Project is expected to reduce the number of future crash by reducing automobile traffic on MD 5/US 301 and by installing targeted treatments at signalized intersections. Possible control devices, other intersection treatments, and policies for applying each are identified in the Final Alternatives Report. The DEIS will determine exactly what treatments will be implemented. Ultimately, the impacts of these improvements on expected number of crashes will be established using the most appropriate crash modification factors. The number

---

[2] https://smrtmaryland.com/images/library/SMRT_Final_Alternatives_Report/SMRT%20Final%20Report%20-%20Appendix%20K.pdf

of reduced crashes will be monetized using U.S. DOT recommended values of crash reduction by severity of crash.

Beyond the direct benefits of reduced crash reduction, the safety improvements would have the added benefit of reducing incident-caused traffic delays, improving travel times for automobiles along the corridor. These can be calculated by identifying the average delay time per incident and the average traffic counts over a given period.

2.3. Environmental Sustainability

As discussed in Section 2.1.1, the SMRT Project is expected to reduce automobile traffic as travelers shift to SMRT, taking transit instead of driving to their final destination or to the Branch Avenue Metro station. In addition to reducing vehicle operating costs for users, the VMT reduction will also reduce tailpipe emissions from automobiles. The benefits of reducing air pollution include decreases in health complications, reduced disturbances to the natural environment, and avoided property damages. The reduction of emissions represents a benefit often enjoyed by persons who do not directly use the road facility. Five forms of emissions will be identified, measured and monetized, including: nitrous oxide (NOx), particulate matter (PM), sulfur dioxide (SO_2), volatile organic compounds (VOC), and carbon dioxide (CO_2).

2.4. Quality of Life

Quality of life benefits can result from projects that provide increased accessibility and mobility to the Southern Maryland region. Key benefits are derived from mode shift to more active transportation methods as a result of safe and direct access to improved facilities and reduction in noise levels.

The SMRT Project will introduce a protected bicycle and pedestrian path which is expected to increase cycling rates and pedestrian activity, leading to health benefits, commuter mobility benefits, and recreation improvements. The SMRT bike lanes would tie into the Waldorf Urban Redevelopment Area and its plans for an extensive network of bike/ped pathways.

2.4.1. Health Benefits

Health benefits apply to new bicyclists who would otherwise not be able to use a facility under existing conditions. These bicyclists realize benefits by increased daily physical activity, which has been shown to improve the health of users and reduce future medical costs. Creation of a new bicycle/pedestrian path along the SMRT alignment will encourage greater bike use, particularly for cyclists who may feel less confident riding on streets without dedicated bike infrastructure.

The National Cooperative Highway Research Program (NCHRP) Guidelines for Analysis of Investment in Bicycle Facilities[3] identified ten studies that estimated the overall health benefit of increased physical activity. These benefits ranged from $19 to $1,175 per new bicyclist per year, with a median value of $128 (all values in 2006 $), with detailed review available in appendix E of that document. These values were adjusted to 2018 dollars with resulting values of $23.65, $159.30, and $1,462.35 for low, likely, and high values of health benefits respectively. The NCHRP Guidelines state that this benefit is ascribed per daily new user. The benefit is thus defined as the volume of daily new bicyclists multiplied by the per capita health benefit.

2.4.2. Commuter Mobility Benefits

Commuting cyclists experience a benefit because research has shown that bicyclists and pedestrians prefer using certain facilities over others, with dedicated bicycle infrastructure showing the greatest monetized value of benefit. The connection to the Waldorf Urban Redevelopment Area enhances the ability of the SMRT bike lanes to be part of a safe and healthy commute.

The NCHRP Guidelines for Analysis of Investment in Bicycle Facilities reviewed available research and found that bicycle commuters are willing to spend 20.38 extra minutes per trip[4] to travel on an off-street bicycle trail for reasons including higher level of safety, more pleasant and lower stress experience, and lack of auto impacts such as road spray and exhaust fumes. The value for a separated bike trail adjacent to other vehicles, as in the case of the SMRT corridor, may be somewhat lower, but still a considerable benefit. These benefits can be directly applied to new commute trip bicyclists by multiplying the additional value of an off-road bike facility by the number of new bike commuters annually and multiplying this by the USDOT recommended value of travel time savings.

2.4.3. Recreation Bicycle Benefits

The NCHRP Guidelines for Analysis of Investment in Bicycle Facilities also identified benefits for recreational users of bicycle facilities. These benefits result from the time spent performing recreational activity, since this represents a revealed preference in how recreational bicyclists choose to spend their time. This time is assumed to be one hour per bicyclist including

---

[3] NCHRP Report 552 (2006). Guidelines for Analysis of Investments in Bicycle Facilities, Transportation Research Board, Washington, D.C. (http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_552.pdf), p. 33.

[4] NCHRP Report 552 (2006). Guidelines for Analysis of Investments in Bicycle Facilities, Transportation Research Board, Washington, D.C. (http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_552.pdf)

preparation and clean-up time[5]. The value of time for this benefit is assumed to be lower than the value of time used for commuters or the population at large. The NCHRP Guidelines indicate a value of $10 per hour in 2006 dollars, which becomes $12.46 per hour in 2018 dollars, and is applied to new annual recreational bicycling trips.

3. PROJECT COSTS

Total project costs must be considered as part of a BCA, including capital costs for design, engineering, and environmental review, right-of-way acquisition costs, and construction costs, as well as ongoing operating and maintenance (O&M) costs and repair and replacement costs once the project is in operation. However, costs that accrue during operation are included in the numerator of the benefit-cost equation, as a negative benefit.

Preliminary cost estimates were developed as part of the Final Alternatives Analysis, with total capital cost estimates ranging from approximately $1.1 billion to $1.94 billion depending on the alternative and mode (BRT vs. LRT) selected. Annual O&M costs also vary, with an expected range of $24-$25 million for LRT and $34-$37 million for BRT. These costs will be refined as part of the DEIS.

4. SUMMARY OF RESULTS

4.1. Evaluation Measures

A future BCA will convert potential gains (benefits) and losses (costs) into monetary units and compares them for the alternative selected as part of the DEIS process. The following common benefit-cost evaluation measures will ultimately be used in the BCA to evaluate the Project:

- 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.
- Internal Rate of Return (IRR): The IRR is the discount rate which makes the NPV from the project equal to zero. In other words, it is the discount rate at which the project breaks even. Generally, the greater the IRR, the more desirable the Project.
- Payback Period: The payback period refers to the period of time required to recover the funds expended on a project. When calculating the payback period, the time value of money (discounting) is not taken into account.

[5] Ibid, p. 39.