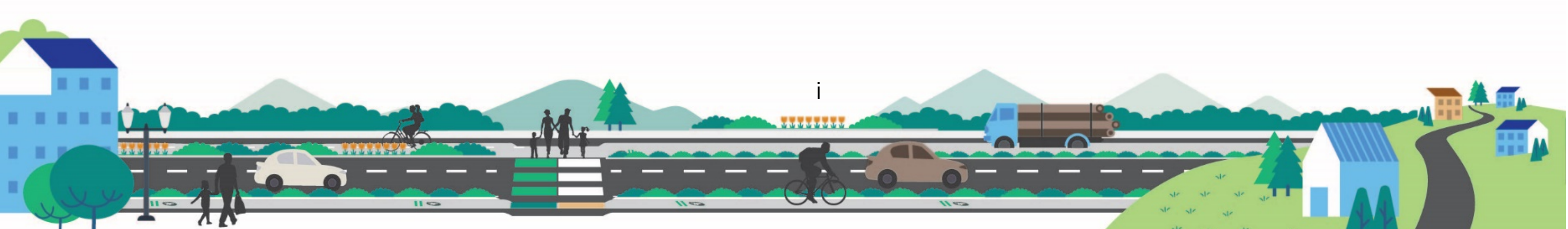
FRANKLIN BOULEVARD OPPORTUNITY ZONE CORRIDOR
Transforming a Corridor through Innovation and Investments

Benefit-Cost Analysis Supplementary Documentation

USDOT BUILD Grant Program

Franklin Boulevard Opportunity Zone Corridor

City of Eugene and City of Springfield, Oregon
May 18, 2020



CONTENTS

List of Figures

List of Tables

EXECUTIVE SUMMARY

Franklin Boulevard is a major arterial street that connects downtown Eugene to the University of Oregon and Springfield. In its present condition, Franklin represents a State highway with fast speeds that does not adequately or safely serve the multi-modal needs of our urban Eugene community. As Eugene and Springfield grow, the region's transportation system must evolve.

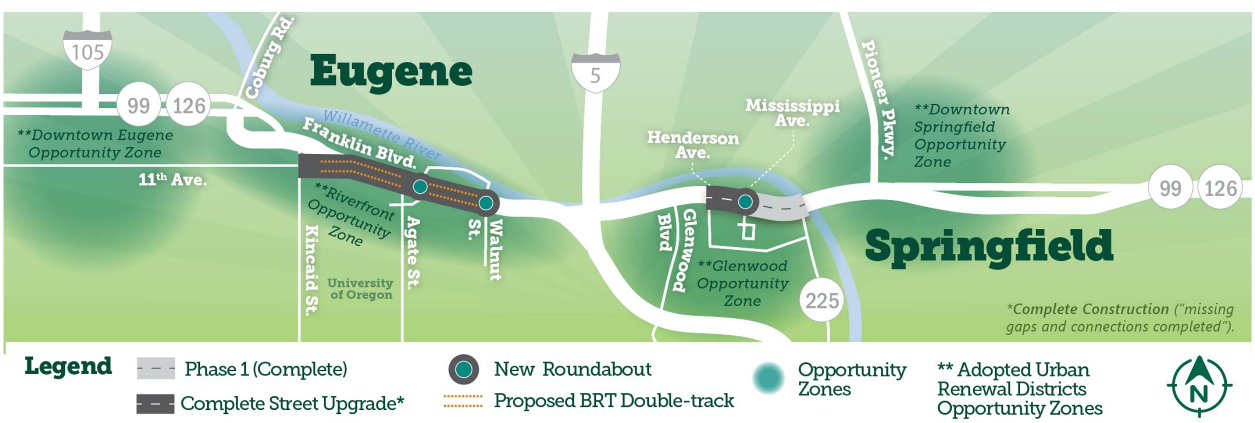
Eugene and Springfield have been planning for Franklin Boulevard's upgrade for years. Eugene's Walnut Station Specific Area Plan (adopted 2010) and the Glenwood Refinement Plan (adopted 2012, amended 2014) envision a corridor transformation so that this segment of Franklin Boulevard could serve as a catalyst for modernization and redevelopment of the corridor. To do this, however, Franklin Boulevard needs improvements.

With the Franklin Boulevard Opportunity Zone Corridor, the Cities of Eugene and Springfield are looking to develop multimodal alternative designs to reconfigure the 1.5 miles of Franklin Boulevard from Alder Street to Interstate 5, then 0.2 miles from Henderson Avenue to Mississippi Avenue, to:

1. Transform Franklin Boulevard from a dangerous auto-oriented thoroughfare to a safe, comfortable, multimodal street that works for the corridor and for the region;
2. Redevelop Franklin Boulevard consistent with adopted plans to support continued economic growth, improve crossings, and increase efficiency;
3. Strengthen connections for all modes across and along Franklin Boulevard; and
4. Reinforce Franklin Boulevard as the spine of the regional transit system.

A project map is provided in Figure 1.

Figure 1. Franklin Boulevard Opportunity Zone Corridor



To achieve the goals, project improvements will include roundabout construction, lane reconfiguration, resurfacing, bicycle and pedestrian facilities (separated), streetscaping, storm water treatments, BRT signalization, cameras, station functions, and other pedestrian/bicycle-related detection equipment. Expected benefits are summarized in Table ES- 1, and annual benefits and costs are reported in Table ES- 2.

Table ES- 1: Summary of Infrastructure Improvements and Associated Benefits, 2018 $ at 7 Percent Discount Rate

Current Status or Baseline & Problems to Be Addressed	Changes to Baseline / Alternatives	Type of Impacts	Economic Benefit	Summary of Results (Discounted)
Challenge 1: Deficient bicycle & pedestrian network	Install sidewalks and bicycle paths separated from vehicles	Improved safety conditions for pedestrians and bicyclists, improved quality of life	Quality of Life (Travel Time Savings, Bicyclists)	$13.4M
			Quality of Life (Travel Time Savings, Pedestrians)	Not Quantified
			Quality of Life (Health Benefit & Willingness to Pay for Safety)	Not Quantified
Challenge 2: Poor street network, parallel streets, & connectivity	Reconfigured network with BRT as catalyst for TOD	Increased connectivity to local businesses and homes	Quality of Life (Economic Development)	$18.1M (Sensitivity Analysis Only)
Challenge 3: Current street design at odds w/ urban land uses around it	Reconstruct with roundabouts and active transportation infrastructure	Improved travel speeds, reduced congestion and crashes	Economic Competitiveness (Travel Time and Out of Pocket Cost Savings)	$11.6M
			State of Good Repair	$0.5M
			Environmental Sustainability (Reduction in Emission Costs)	$0.2M
			Safety (Accident Reduction Savings)	$0.1M
Challenge 4: At-capacity EmX BRT system	Enhance BRT service with reduced headways	Improved travel speeds, reduced congestion	Economic Competitiveness (Travel Time and Out of Pocket Cost Savings)	$40.9M

Table ES- 2: Summary of Monetized Benefits and Costs (2018 $ million, discounted at 7 Percent)

Calendar Year	Project Year	Total Benefits	State of Good Repair	Economic Competitiveness	Environmental Sustainability	Safety	Quality of Life	Incremental O&M	Capital Cost
2018	1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2019	2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2020	3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.7
2021	4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.5
2022	5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.3
2023	6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$9.4
2024	7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$8.8
2025 (Opening)	8	$2.2	$0.0	$1.7	$0.0	$0.0	$1.1	$0.7	$0.0
2026	9	$2.3	$0.0	$1.9	$0.0	$0.0	$1.0	$0.6	$0.0
2027	10	$2.4	$0.0	$2.0	$0.0	$0.0	$1.0	$0.6	$0.0
2028	11	$2.5	$0.0	$2.1	$0.0	$0.0	$0.9	$0.6	$0.0
2029	12	$2.6	$0.0	$2.2	$0.0	$0.0	$0.9	$0.5	$0.0
2030	13	$2.7	$0.0	$2.3	$0.0	$0.0	$0.8	$0.5	$0.0
2031	14	$2.8	$0.0	$2.4	$0.0	$0.0	$0.8	$0.5	$0.0
2032	15	$2.8	$0.0	$2.5	$0.0	$0.0	$0.7	$0.4	$0.0
2033	16	$2.9	$0.0	$2.6	$0.0	$0.0	$0.7	$0.4	$0.0
2034	17	$3.0	$0.0	$2.7	$0.0	$0.0	$0.7	$0.4	$0.0
2035	18	$3.0	$0.0	$2.7	$0.0	$0.0	$0.6	$0.3	$0.0
2036	19	$3.1	$0.0	$2.8	$0.0	$0.0	$0.6	$0.3	$0.0
2037	20	$3.1	$0.0	$2.9	$0.0	$0.0	$0.5	$0.3	$0.0
2038	21	$3.2	$0.0	$3.0	$0.0	$0.0	$0.5	$0.3	$0.0
2039	22	$3.2	$0.0	$3.0	$0.0	$0.0	$0.5	$0.3	$0.0
2040	23	$3.3	$0.0	$3.1	$0.0	$0.0	$0.5	$0.2	$0.0
2041	24	$3.3	$0.0	$3.1	$0.0	$0.0	$0.4	$0.2	$0.0
2042	25	$3.4	$0.0	$3.2	$0.0	$0.0	$0.4	$0.2	$0.0
2043	26	$3.4	$0.0	$3.2	$0.0	$0.0	$0.4	$0.2	$0.0
2044	27	$3.4	$0.0	$3.2	$0.0	$0.0	$0.4	$0.2	$0.0
2045	28	$0.5	$0.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total		$59.1	$0.5	$52.5	$0.2	$0.1	$13.4	$7.7	$25.8

I. INTRODUCTION

This document provides detailed technical information on the economic analyses conducted in support of the BUILD grant application for the Franklin Boulevard Opportunity Zone Corridor project. It is organized into the following sections:

- Methodological Framework introduces the conceptual framework used in the BCA;
- Project Overview provides an overview of the project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of expected impacts;
- General Assumptions discusses the general assumptions used in the estimation of project costs and benefits;
- Demand Projections presents estimates of travel demand and traffic growth;
- Benefits Measurement Data and Assumptions provides specific data elements and assumptions pertaining to the long-term outcome selection criteria, along with associated benefit estimates.
- Summary of Findings and BCA Outcomes reports estimates of the project's Net Present Value (NPV), its benefit-cost ratio (BCR) and other project evaluation metrics
- BCA Sensitivity Analysis provides the outcomes of the sensitivity analysis. Additional data tables are provided within the BCA model including annual estimates of benefits and costs to assist the U.S. Department of Transportation (USDOT) in its review of the application.[1]

II. METHODOLOGICAL FRAMEWORK

The BCA conducted for this project includes the monetized benefits and costs measured using USDOT guidance, as well as the quantitative and qualitative merits of the project. A BCA provides estimates of the benefits that are expected to accrue from a project over a specified period and compares them to the anticipated costs of the project. Costs include both the resources required to develop the project and the costs of maintaining the new or improved asset over time. Estimated benefits are based on the projected impacts of the project on both users and non-users of the facility, valued in monetary terms.[2]

While a BCA is just one of many tools that can be used in making decisions about infrastructure investments, USDOT believes that it provides a useful benchmark from which to evaluate and compare potential transportation investments.[3]

---

[1] The BCA model is provided separately as part of the application. COE FBT BUILD2020 BCA_15May2020.xlsx

[2] USDOT, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. https://cms8.dot.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf. Accessed March 18, 2020.

[3] Ibid.

The specific methodology for this application was developed using the BCA guidance published by USDOT in January 2020 and is consistent with the BUILD program guidelines. In particular, the methodology involves:

- Establishing existing and future conditions under the "build" and "no build" scenarios;
- Assessing benefits with respect to each of the eight merit criteria identified in the Notice of Funding Opportunity (NOFO);
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using USDOT guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs with the real discount rates recommended by USDOT (7 percent); and
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

III. PROJECT OVERVIEW

1) Base Case and Alternatives

The **Franklin Boulevard Opportunity Zone Corridor** will significantly upgrade and transform the connection between Eugene and Springfield as a multi-modal transportation corridor that will catalyze further development of prime real estate in four Opportunity Zones. The new Franklin Boulevard will be a complete street that increases functionality for all users and improves safety, travel time, travel costs, economic resilience, environmental health, and physical health — all indicators of an improved quality of life for residents of the region. Franklin Boulevard's reconstruction will make room for physically separated bike facilities, wider sidewalks and pathways, safer intersections and crossings, expanded bus rapid transit (BRT), and cleaner stormwater – all by modernizing the roadway design to allow the efficient and safe movement of freight, motor vehicles, and active transportation users through the corridor.

Franklin Boulevard, is a relic—a former State highway ill-suited to the urban development patterns around it, endangering pedestrians, and hindering economic growth. Due to Franklin Boulevard's origins as a State-owned highway, its outdated design emphasizes auto-oriented development, yet the development occurring throughout the corridor today is walkable and multimodal. This juxtaposition is harmful to everyone and puts lives at risk.

The only alternative to the "no-build" base case, includes the following in the "build" scenario:

1. Construction of modern roundabouts at three intersections;
2. Dedicated bike and pedestrian areas to close gaps in those networks with marked and signalized pedestrian islands as well as green pavement markings at key lane entry points;
3. Increased BRT headway from ten minutes to 7.5 minutes;
4. Streetscaping;
5. Signalized intersection; and
6. Stormwater treatments.

2) Types of Impacts

Eugene and Springfield envision a transformed Franklin Boulevard that is representative of their community – collaborative, active, technologically savvy, interconnected, and community-minded. Addressing Franklin Boulevard's challenges now is critical as the area prepares for continued growth and development that is consistent with the community visions of both cities. The following summarizes the impacts due to the project:

1. Transform Franklin Boulevard from a dangerous auto-oriented thoroughfare to a safe, comfortable, multimodal street that works for the corridor and for the region;
2. Redevelop Franklin Boulevard consistent with adopted plans to support continued economic growth, better crossings, and increased efficiency.
3. Strengthen connections for all modes across and along Franklin Boulevard; and
4. Reinforce Franklin Boulevard as the spine of the regional BRT system;

3) Project Cost and Schedule

Eugene and Springfield are well-positioned to meet the local-match funding and schedule requirements of BUILD grant funding. A 30 percent match will come from:

- City of Springfield Transportation and Street System Development Charges Funding
- City of Springfield Stormwater Capital Funding
- City of Eugene Pavement Preservation Bond Measure
- City of Eugene System Development Charges
- State of Oregon Lottery Bond to Lane Transit District

The two tables below summarize project cost and schedule:

Table 1: Project Cost

Project Costs	Millions of 2020$
Construction	$26.4
Design & Construction Administration	$5.7
ROW	$3.6
Total	$35.7

Table 2: Project Schedule

Activities	Dates
Planning	Now – June 2020
NEPA & Preliminary Engineering[4]	June 2020 – June 2021
Final Design/ROW	June 2021 – June 2022
Bidding	June 2022 – September 2022
Construction	October 2022 – December 2024

4) Disruptions Due to Construction

Disruptions to businesses and traffic along Franklin Boulevard are not quantified in the BCA. The project's expedited schedule is expected to minimize disruptions.

5) Effects on Selection Criteria

The following table relates project impacts to primary selection criteria:

Table 3: Benefit Categories and Expected Effects on Selection Criteria

Primary Selection Criteria	Benefit or Impact Categories	Description	Monetized	Quantified	Described Qualitatively
Safety	Crash Cost savings	Reconstruct with roundabouts and signals to improve vehicular travel	✓	✓	✓
State of Good Repair	O&M Cost Savings	Reconstruct with roundabouts and signals to improve vehicular travel	✓	✓	✓
Economic Competitiveness	Travel Time Savings	Reconstruct with roundabouts and signals to improve travel speeds and reduced congestion	✓	✓	✓
	Vehicle Operating Cost Savings	Reconstruct with roundabouts and signals to improve travel speeds and reduced congestion	✓		✓

[4] The City of Springfield obtained a NEPA Categorical Exclusion decision for the full length of Franklin Boulevard in its jurisdiction in 2016. The dates shown in the right column reflect what remains for the portion of Franklin Boulevard west of Interstate 5 in Eugene's jurisdiction.

Primary Selection Criteria	Benefit or Impact Categories	Description	Monetized	Quantified	Described Qualitatively
Environmental Sustainability	Emission Cost Savings	Decrease/increase in emissions from improved vehicular travel with roundabouts and signals	✓	✓	✓
Quality of Life	Accessibility Enhancements	Improved connectivity between the residential areas and the rest of region The shared use path and sidewalks improve connectivity for pedestrians and bicyclists between residential areas and commercial developments	✓ (sensitivity only)	✓	✓
		Encouraged more bicycling as part of a healthier lifestyle	✓	✓	✓

IV. GENERAL ASSUMPTIONS

The BCA measures benefits against costs throughout a period of analysis beginning at the start of project development and including 20 years of operations. The monetized benefits and costs are estimated in 2018 dollars with future dollars discounted in compliance with BUILD requirements using a 7 percent real rate to the year 2018.

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2018 dollars;
- The period of analysis begins in 2018 and ends in 2045. It includes project development (2020-2023), construction (2023-2024), and 20 years of operations (2025-2044);
- A constant 7 percent real discount rate is assumed throughout the period of analysis;
- Opening year demand is an input to the BCA and is assumed to be fully realized in Year 1 (no ramp-up); and
- Unless specified otherwise, the results shown in this document correspond to the effects of the build scenario defined in the Base Case and Alternatives section.

The BCA produces several important measures to assess the cost-effectiveness of a proposed infrastructure project. The benefit-cost ratio (BCR) calculated by dividing the project's discounted societal benefits by its discounted project costs, measures the societal return on each dollar spent in project costs. A BCR of more than 1.0 indicates that for each dollar spent, more than one-dollar worth of benefits will be generated by the project. Another important measure is the net present value (NPV), calculated by subtracting the discounted project costs from the discounted societal benefits created by the project. This measure indicates the net social worth created by the project, after accounting for its costs.

However, the BCR and NPV only account for benefits that can be successfully quantified and monetized; some benefits generated by a project may be difficult to quantify or monetize, and are therefore excluded from the measures described above. It is important that the BCR and NPV of a project be considered in conjunction with other criteria when judging a project's overall worth.

V. DEMAND PROJECTIONS

The impacts to automobiles are modeled through a regional travel demand model (TDM) from Lane Council of Governments from 2016 updated to 2018 with a project-specific traffic Vissim and Synchro model at nine intersections. The 2035 regional TDM was used to develop projected AADT and peak hour volumes for both the no-build and build improvements. The no-build assumed no reduction in capacity along Franklin Boulevard, maintaining a 6-lane corridor. The build alternative included the proposed roundabouts and reduced the number of lanes to a 4-lane corridor. The build model also provides two BRT lanes compared to the bidirectional single BRT lane for the no-build model. Additionally, the posted speed limit was also reduced for the build model. The delta in projected volume accounts for the increase in transit ridership and diversion that is anticipated by reducing the speed and number of travel lanes along the corridor. The 2035 regional TDM was also used to develop projected transit ridership. Transit ridership growth is developed based on reduced headways and increase number of dedicated BRT lanes from one to two.

Additional assumptions used in the modeling include those reported in Table 4.

Table 4: Assumptions Used in the Estimation of Demand

Variable Name	Unit	Value	Source
Diversion from Auto	Percent	11%	Lane COG Travel Demand Model with HDR's Vissum/Synchro project modeling
Average Trip Length	Mile	1.5	
Average Speed	Mile per Hour	19.2	
Passenger Vehicle Occupancy Rate	Person per Vehicle	1.67	USDOT, BUILD Benefit-Cost Analysis Resource Guide, updated 2020

The estimation of benefits from the improved bike/pedestrian facilities is driven by the profile of cyclists and pedestrians. The analysis approach is based on the methodology in the Transportation

Research Board's (TRB) National Cooperative Highway Research Program (NCHRP) Report 552: Guidelines for Analysis of Investments in Bicycle Facilities.[5]

Population estimates for 2018 are determined from the 2014-2018 Census American Community Survey for Lane County. Table 5 and Table 6 summarize the estimates for the project.

Table 5: Profile of Commuters

Distance Buffer	Workers 16 Years and Over	Bicyclists	Pedestrians
<1/4-Mile	1,536	228	480
Between 1/4-1/2- Mile	2,667	121	787
Between 1/2-1-Mile	11,850	1,039	2,378
Total within 1 Mile	16,053	1,388	3,645

Table 6: Profile of Commuters, Percentages

Distance Buffer	Auto	Transit	Bicyclists	Pedestrians
<1/4-Mile	45%	6%	16%	33%
Between 1/4-1/2-Mile	53%	7%	5%	33%
Between 1/2-1-Mile	62%	7%	9%	21%
Total within 1 Mile	59%	7%	9%	24%

This analysis applies NCHRP parameters with existing levels of use to estimate the numbers of new users. The number of new users depends on their proximity to the corridor. NCHRP reports new demand factors for the ¼ mile, ½ mile and one-mile sub-zones. However, because the one-mile factor is not statistically significant, it is not included in the baseline analysis.

Pedestrians, while prominent, are not included in this analysis. NCHRP argues that value for pedestrians is not appropriate in urban areas because there are already well-developed and safe pedestrian facilities. The main application document describes the poor safety conditions of the current sidewalks, but the benefits of sidewalk improvements are not quantified.

---

[5] Krizek, et al, 2006.

Figure 2: Demand Forecast Framework - Bicyclists

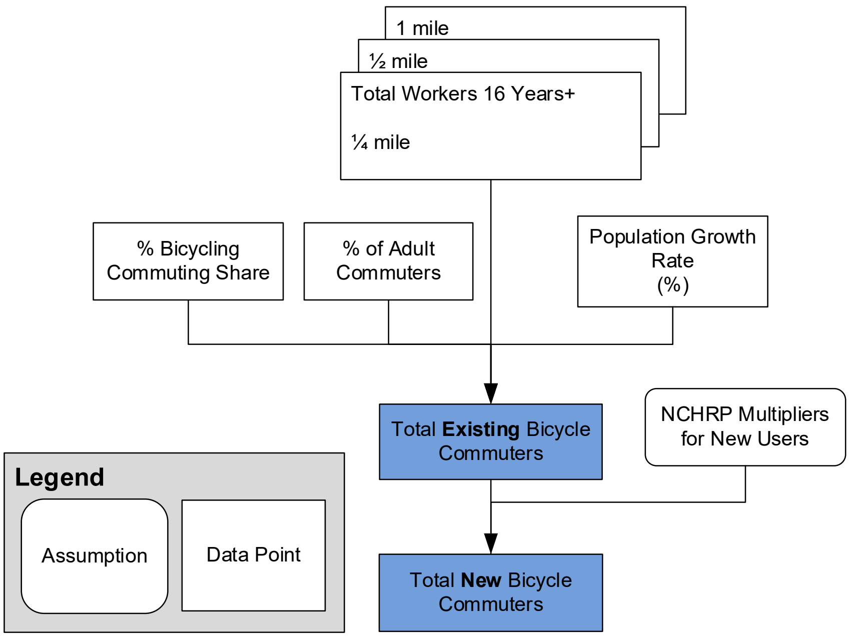


Table 7. Demand Projections

Variable Name	In Project Opening Year 2025	2034	2044
Bicyclists	607	659	721
BRT Ridership	3,621	4,830	6,717
Diverted from Auto	410	1,002	2,061
Reduction in VMT	583	-175	-671
Auto AADT	3,700	3,791	3,710

VI. BENEFITS MEASUREMENT, DATA AND ASSUMPTIONS

1) Economic Competitiveness

The project will contribute to enhancing the economic competitiveness of the Nation through improvements in the mobility of people and goods within and across the study area. In this analysis, two measures of mobility are presented: travel-time savings and out-of-pocket transportation cost savings.

The framework used in the estimation of user benefits is based upon the theory of demand and involves the estimation of changes in consumer surplus.

The demand for travel is an inverse relationship between the number of trips "demanded" and the generalized cost of travel, which includes both travel time and out-of-pocket costs (such as vehicle operating and parking costs for auto users, or fare payments for transit riders). That relationship is depicted in Figure 2 on the next page. The term "consumer surplus" refers to the area between the demand curve and the actual cost of travel at any point in time. It is a measure of welfare to the extent that people who are traveling at that cost are "paying" less than what they would be willing to pay; in other words, the value they are placing on a trip (as measured by their willingness-to-pay along the demand curve) is higher than what they are actually paying.

The project will reduce the general cost of travel and result in benefits to both existing and new trip-makers.

Benefits to existing trip-makers are represented by the red rectangle in Figure 3. They are estimated as the difference between the generalized cost of travel in the base case and the generalized cost of travel in the build scenario multiplied by the number of existing trips.

In addition, as the generalized cost of travel is being reduced, additional trips (beyond those diverted from other modes) are expected. These induced trip-makers represent a portion of all potential trip-makers who did not make a trip (or as many trips) in the no-build scenario, but are now "attracted" to the lower generalized cost allowed by the investment.

User benefits resulting from new trips are depicted by the blue triangle in Figure 3. They are estimated using the "rule-of-a-half." Note that the change in generalized cost from no-build to build conditions only represents the change in user costs (travel time plus out-of-pocket costs). Social costs, including air emissions, accident occurrences, and congestion externalities are assumed not to affect trip making or modal decisions in this analysis. The elasticity of demand (the slope of the demand curve) is estimated, based on existing knowledge about travel costs in the corridor and ridership forecasts developed for the project.

Figure 3: Framework for the Estimation of User Benefits

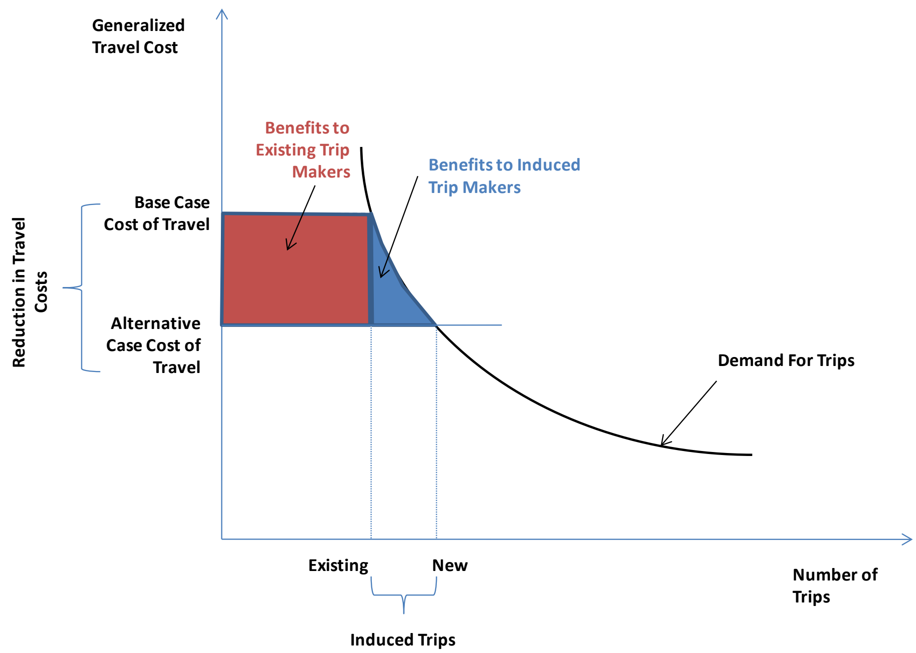
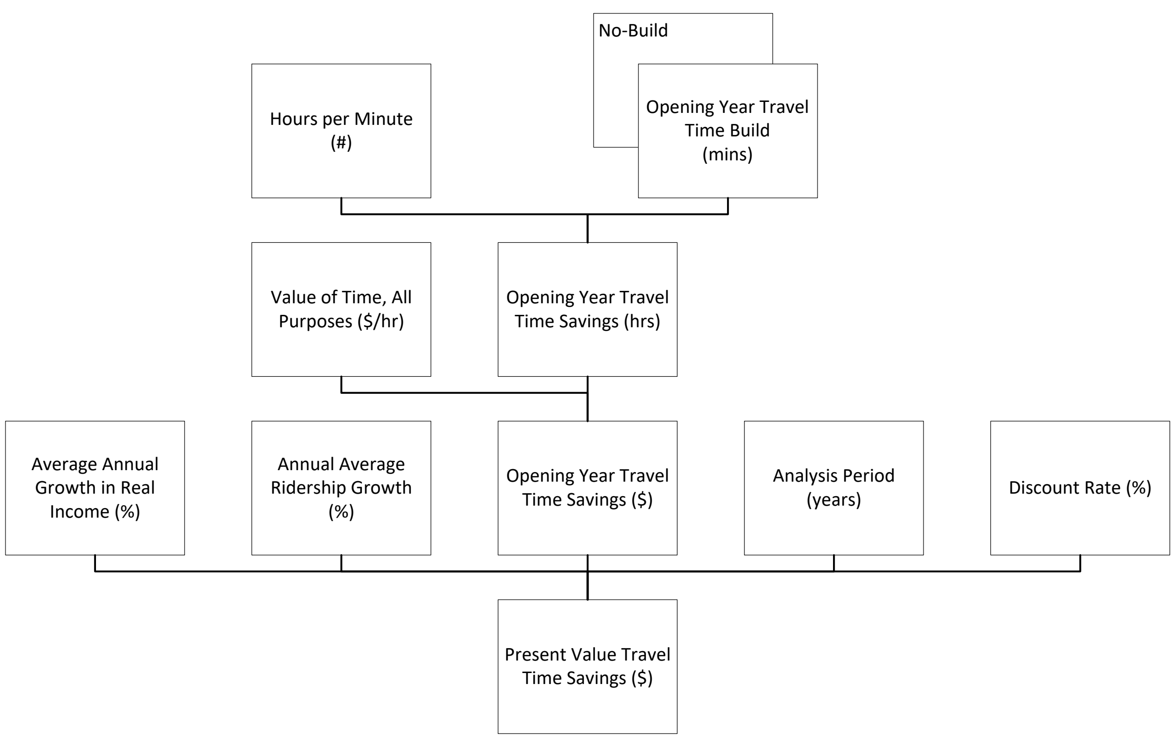


Figure 4: Structure and Logic Diagram - Travel Time Savings



Generalized travel cost has two components: travel time cost and out-of-pocket transportation costs. Travel time savings for travelers are dependent on their value of time (VOT) and the reduction of time spent on traveling (travel time).

Once the project is complete, some car drivers will experience a reduction in travel time as a result of less congestion. Travelers who divert from autos to buses might also experience a reduction in travel time depending on their origin and destination. VOT is then applied to each reduction in travel time to estimate the reduction in travel time costs. Assumptions applied are reported in Table 8.

Out-of-pocket costs are composed of four vehicle operating costs: fuel, oil, tires, maintenance and depreciation. The consumption rates for these costs are derived from average vehicle speed and combined with unit cost estimates to derive total out-of-pocket costs per mile and per trip. The out-of-pocket costs are combined with parking cost to estimate the total out-of-pocket cost per trip for auto users. The decrease in out-of-pocket costs in the build scenario represents out-of-pocket cost savings for remaining auto users. For travelers who divert from auto to BRT, the out-of-pocket savings are estimated by subtracting fare payments from out-of-pocket costs. Assumptions applied are reported in Table 9.

Table 8: Assumptions Used in the Estimation of Travel Time Savings

Variable Name	Unit	Value	Source
Travel Time Cost – Personal Travel	Dollar per Hour	$15.20	USDOT, BUILD Benefit-Cost Analysis Resource Guide, updated 2020
Travel Time Cost – Business Travel	Dollar per Hour	$27.10	
Weighted Average Travel Time Cost	Dollar per Hour	$16.60	
Real Annual Growth Rate of Value of Time	Percent	0.0%	

Table 9: Assumptions Used in the Estimation of Out-of-Pocket Cost Savings

Variable Name	Unit	Value	Source
Ownership and O&M Cost – Automobiles	Dollars per Mile	$0.42	American Automobile Association, Your Driving Costs – 2018 Edition (2018).
Parking Cost	Dollar per Day	$13.50	Eugene Downtown Daily Parking Rates
Average Bus Fare	Dollar per Trip	$1.75	Lane Transit District

Table 10 presents the monetized benefit estimates for travel time and vehicle operating cost savings over the life of the project. The cost savings for this project total $52.5 million in discounted 2018 Dollars.

Table 10: Estimates of Travel Time and Out-of-Pocket Cost Savings, 2018 Dollars

	In Project Opening Year	Over the Project Lifecycle	
Mode	**2025**	**Non-Discounted**	**Discounted @ 7%**
Auto	$356,417	$41,954,034	$11,612,031
BRT	$2,371,640	$141,782,573	$40,916,599
Total	$2,728,057	$183,736,607	$52,528,630

2) Safety

The project will convert two existing 4-legged signalized intersections into multi-lane roundabouts. The roundabouts are designed to reduce travelling speeds on approach and maintain reduced speeds on departure of the intersection. Several crash modification factors (CMF) have been determined for converting a signalized intersection to a roundabout. To estimate the crash reduction the proposed improvements, a 0.81 CMF was used. Between 2016 and 2018, a total of 15 crashes occurred at either Franklin Boulevard and Walnut Street or Franklin Boulevard and Moss Street, with 11 resulting in injuries and 4 resulting in property damage only. Using the AADT between these years, a crash rate was determined for each crash type. The crash rate was then applied to the projected AADT for the Build and No Build alternatives to determine the overall reduction in crashes expected by converting the intersections of Franklin Boulevard and Walnut Street and Franklin Boulevard and Moss Street to roundabouts.

Additional safety enhancements include enhanced pedestrian crosswalks. The proposed project will install pedestrian actuated rectangular flashing beacons and raised crosswalks to enhance the visibility of pedestrians to vehicular drivers. Pedestrians will also experience a reduction in exposure to conflicting vehicles by reducing the roadway width that is required for them to cross Franklin Boulevard. Our approach to estimating the value of transit environmental impacts relies on existing crash rates from the City of Eugene and City of Springfield. We apply a CMF of 0.81, or a 19 percent reduction in all crash types from Clearinghouse to the no-build scenario for the accident rates in the build scenario. The estimates of the economic cost of crashes taken from USDOT's Guidance are presented in Table 11.

Table 11. Safety Benefits Assumptions

Variable Name	Unit	Value	Source
Crash Modification Factor	Percent	81%	CMF Clearinghouse for Roundabouts and Signals Improvements. CMF ID4194 http://www.cmfclearinghouse.org/detail.cfm?facid=4194#commentanchor
Fatality	Dollar per Fatality	$9,600,000	USDOT, BUILD Benefit-Cost Analysis Resource Guide, updated 2020
Injury	Dollar per Injury	$110,988	
Property Damage Only (PDO)	Dollar per Damaged Vehicle	$4,400	
Annual Growth in Accident Cost	Percent	0.0%	

The resulting benefits due to safety improvements amounts to $70,219, discounted over 20 years. It should be noted that although no fatalities were reported at these intersections between 2016 and 2018, a crash in December of 2019 at Franklin Boulevard and Walnut Street resulted in one fatality. However, since complete crash data for 2019 was unavailable, the crash reduction for crashes resulting in fatality is shown as zero. Based on the nature of the fatal crash and the speed at which the vehicle hit the pedestrians, pedestrians' chances of survival would have been increased if Walnut Street was a roundabout due to the reduction in approach speeds.

3) Environmental Sustainability

Reductions in emission volumes are derived based upon the reduction in VMT resulting from diversion to public transit and the improved travel times due to the proposed signal coordination. Emission rates for Shelby County were obtained from Motor Vehicle Emission Simulator (MOVES) – a tool provided by the U.S. Environmental Protection Agency (EPA). Per-unit emission costs are applied to the emission reduction volumes due to the reduction in VMT caused by modal shifts.

The assumptions used in the estimation of environmental sustainability benefits are summarized in the tables below. The breakdown of the $0.2 million emission reduction benefits are reported in Table 13.

Table 12: Assumptions used in the Estimation of Emissions Reductions Benefits

Variable Name	Unit	Value	Source
Cost of CO2 Emissions	Dollar per Metric Ton	Varies	USDOT, BUILD Benefit-Cost Analysis Resource Guide, updated 2020
Cost of VOC Emissions	Dollar per Metric Ton	$2,315	
Cost of PM2.5 Emissions	Dollar per Metric Ton	$9,480	
Cost of SO2 Emissions	Dollar per Metric Ton	$426,925	
Cost of NOx Emissions	Dollar per Metric Ton	$55,226	

Table 13: Emissions Reductions Benefits

	In Project Opening Year	Over the Project Lifecycle	
Variable Name	2025	Non-Discounted	Discounted @ 7%
Cost of Carbon Emissions	$20,880	$365,249	$148,902
Cost of SO2 Emissions	$0	$0	$0
Cost of PM2.5 Emissions	-$3,738	$229,721	$60,927
Cost of VOC Emissions	-$146	$4,115	$1,202
Cost of NOx Emissions	-$3,727	$42,577	$7,678
Total	$13,269	$641,663	$218,709

4) State of Good Repair

To estimate the operating and maintenance cost benefit the proposed improvements provide, the operating and maintenance cost of a similar project recently completed approximately three miles to the east of the project was analyzed. Prior to converting the signalized intersection of Franklin Boulevard and McVay Highway, the historical operating costs from 2000 through 2018 averaged $2,500 per year. This cost includes signal, lighting, street, sidewalk, and landscape maintenance. After converting the intersection of Franklin Boulevard and McVay Highway, the annual roadway O&M cost was reduced to $800, which includes lighting, signing, sidewalk, and landscape maintenance. Therefore, converting a signalized intersection into a roundabout results in a reduction in roadway O&M costs of $1,700 per intersection.

The proposed improvements convert two signalized intersections to roundabouts. The estimate O&M change is calculated as the difference between roadway maintenance costs in the no-build ($5,000) and the build ($800) scenarios. The difference amounts to $82,559 over the 20-year analysis (or $29,140 discounted).

The residual value of the project implies that infrastructure investments in the corridor will have significant value beyond the 20-year operation period within the BCA. It is calculated as a linear depreciation of construction costs ($26.4 million with 65 percent labor cost and contingency) and assuming no salvage value at the end of the project's useful life (30 years). After 20 years, the $3.1 million residual value is discounted to $0.5 million.

5) Quality of Life

Bicyclists are assumed to benefit from improved access/mobility on their daily commute trips. NCHRP research found that bicycle commuters are willing to spend 20.38 (M) extra minutes per trip to travel on an off-street bicycle trail when the alternative is riding on a street with parked cars. This willingness to pay also reflects users' perceived benefit of safety and appreciation for greenspace.

The value of time is estimated by the USDOT in the Revised Departmental Guidance on the Valuation of Travel Time in Economic Analysis. The value of time for personal travel is $16.60 per hour. The per-trip benefit is multiplied by the number of daily existing and induced commuters, and then doubled to include trips both to and from work. This results in a daily mobility benefit. NCHRP recommends multiplying the daily benefit by an annualization factor for the annual benefit.

Annual mobility benefit = M ·V/60 · (Existing Commuters + New Commuters) · 260 days · 2 trips per day

Where:

- M is the time commuters are willing to spend to travel to an off-street facility
- V is the value of time for commuters per hour (translated to minutes by dividing by 60).
- 260 equals the number of commuting days
- Two is the number of trips per day that the commuter spends time traveling to off street facility

For the project, the benefit amounts to $13.4 million (discounted). NCHRP does not recommend including user safety benefits in a quantitative analysis because the data is inconclusive. Bicycle safety data is difficult to analyze because stated preferences of cyclists are difficult to match with sparse collision data, especially on off-road facilities. Benefits for a reduction of pedestrian and cyclist accidents on the off-road facility are not quantified explicitly. Instead, the safety and comfort of the off-street facility is a factor of the total value for commuters and recreational users included in the mobility and recreational benefit.

As a sensitivity analysis, transit-oriented development (TOD) benefits of property value uplift from transit accessibility is included. Economic development of the community and appreciation of land and building values to nearby properties are associated with the amenity effect of the transit line. This induced property value appreciation is often referred to as transit premium.

For a new property near the transit alignment, its market price or rental rate at the time of purchase or lease is assumed to capture the expected lifecycle stream of benefits. The amount of transit premium is then realized by the property owner or lessee annually at an increasing rate to reflect growing certainty over time. As a result of these two assumptions, the transit premium rate (as a percentage of property value) is applied once to the price of new property only, and the dollar amount of benefits is spread over the analysis horizon, subject to time discounting.

There are five key components in estimating transit premium: property number and growth rate, property value and growth rate, and transit premium rate. The first four are derived through historic, current, and forecast (or planned) land use and property data of the impact area. These estimates are assumed to remain unchanged with or without transit. The last component, the transit premium rate, is estimated based on the property value impact study by Hodel and Ickler (2014) and Nelson and Ganning (2015).[6]

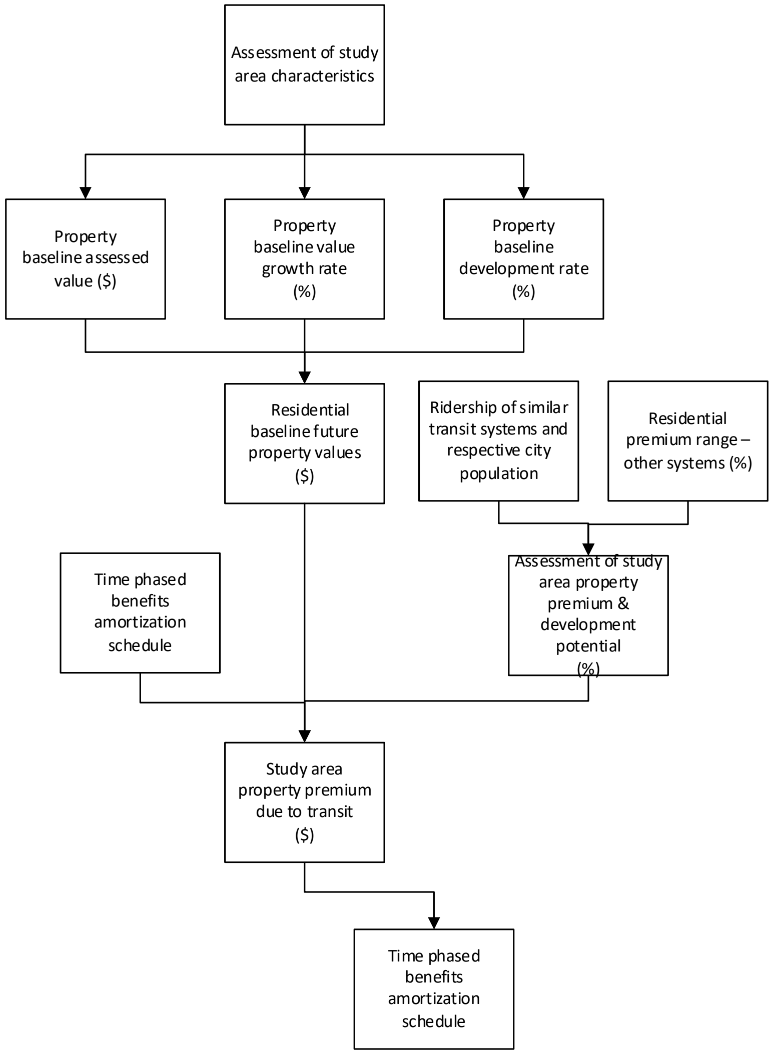
Property prices are multiplied by transit premium rates to compute the lifetime amount of value appreciation due to the project. For any property, it will take 30 years for all premiums to be realized, independent of this BCA's horizon. The rate at which the premium amount is realized over time is computed as shown in Table 14. The first ten years of service are assumed to be a ramp-up period and the ramp-up parameters (a and b) are chosen for formulation continuity.

Table 14: Economic Development Estimation

Time Horizon	Formulation
First Ten Years	a * Property Price* Transit Premium Rate / b + (1-a) Property Price* Transit Premium Rate / b *(Years of Service+1)/ (Years of Gradual Realization+1)
Rest of Realization Years (=20)	Property Price* Transit Premium Rate / b
Parameters: a=0.3, b=26.5	

[6] Peter Hodel and Megen Ickler. *"The Value of Bus Rapid Transit: Hedonic Price Analysis of the EmX in Eugene, Oregon."* http://economics.uoregon.edu/wp-content/uploads/sites/4/2014/07/Hodel_Ickler_LTD-EMX.pdf. And Art Nelson and Joanna Ganning. "*National Study of BRT Development Outcomes*." http://t4america.org/wp-content/uploads/2016/01/NATIONAL-STUDY-OF-BRT-DEVELOPMENT-OUTCOMES-11-30-15.pdf Accessed March 25, 2020.

Figure 5: Structure and Logic Diagram - TOD Benefits



The 2019 baseline property data obtained from Lane County was mapped to the study area using a 0.5-mile buffer from the route using ERSI ArcGIS Online. The analysis assume a construction rate of 2-3 percent based on a five-year absorption rate of existing vacant properties. The assumptions (reported in Table 15) yield $159,061 discounted benefits from residential properties and $18.0 million from commercial properties.

Table 15: TOD Benefits Assumptions

Assumptions	Property Type		
	Multifamily	Single-family	Commercial
Number of Properties in 2019	91	774	207
Average Property Value ($2018)	$4,011,645	$422,834	$917,366
Transit Premium Rate	0.1%		12.0%
Property Number Growth Rate	3.2%		2.3%
Property Value Growth Rate	3.2%		3.2%

VII. SUMMARY OF FINDINGS AND BCA OUTCOMES

Table 16 and Table 17 summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the project. As stated earlier, construction is expected to be completed by the end of year 2023. Benefits accrue during the full operation of the project.

Table 16: Overall Results of the Benefit Cost Analysis, Millions of 2018 Dollars

Project Evaluation Metric	7% Discount Rate	Undiscounted
Total Discounted Benefits (Millions of $2018)	$59.1	$204.7
Total Discounted O&M Costs (Millions of $2018)	*-$7.8*	*-$22.0*
Total Discounted Costs (Millions of $2018)	$25.8	$35.7
Net Present Value (Millions of $2018)	$33.3	$169.1
Benefit-Cost Ratio	2.29	5.74
Internal Rate of Return (%)	15.0%	
Payback Period (Year)	14	

Note: The internal rate of return is the discount rate that makes the net present value (NPV) of all cash flows from the project equal to zero. The payback period represents the number of years it would take for the cumulative discounted benefits to become equal to the cumulative discounted costs.

Table 17: Benefit Estimates for Build Alternative, 2018 Dollars

Long-Term Outcome	Benefit Category	7% Discount Rate
State of Good Repair	Pavement O&M Cost Savings	$29,140
	Residual Value	$496,296
	Incremental transit O&M	-$7,707,445
Economic Competitiveness	Travel Time Savings	$31,048,121
	Vehicle Operating Cost Savings	$21,480,509
Quality of Life	Bicyclists WTP	$13,441,567
Environmental Sustainability	Reductions in Air Emissions	$218,709
Safety	Reduction in Crashes	$70,219
Total Benefits		**$59,077,116**
Agency Benefits	Fare Revenue	$57,718

VIII. BCA SENSITIVITY ANALYSIS

The BCA outcomes presented in the previous sections rely on a large number of assumptions and long-term projections, both of which are subject to considerable uncertainty.

The primary purpose of the sensitivity analysis is to help identify the variables and model parameters whose variations have the greatest impact on the BCA outcomes: the “critical variables.”

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables – how much the final results would vary with reasonable departures from the “preferred” or most likely value for the variable; and
- Assess the robustness of the BCA and evaluate, in particular, whether the conclusions reached under the “preferred” set of input values are significantly altered by reasonable departures from those values.

The outcomes of the sensitivity analysis for the project are summarized in Table 18 and assume the same values as the base case for all parameters except for the parameter specified. The table provides the changes in project NPV associated with variations in variables or parameters (listed in row), as indicated in the column headers.

Table 18: Quantitative Assessment of Sensitivity, Summary

Parameters	Change in Parameter Value	New NPV ($ Millions)	% Change in NPV	New BCR	Source / Notes
Base results	Build (7% Discount Rate)	$33.3	-	2.29	No Change to the Model
Value of Travel Time	Lower Bound of Range Recommended by USDOT	$22.8	-31.5%	1.89	Automobile: $11.8. HDR Computation from BUILD BCA Guidance
	Upper Bound of Range Recommended by USDOT	$40.7	22.1%	2.58	Automobile: $20.0. HDR Computation from BUILD BCA Guidance
Capital Cost Estimate	25% increase	$20.7	-37.9%	1.53	25 percent increase chosen based on range displayed in the Summary of Cost Estimate.
O&M Cost Estimate	25% increase	$29.4	-11.6%	2.14	25 percent increase chosen based on range displayed in the Summary of Cost Estimate.
TOD Benefits	Include benefits	$51.4	54.4%	3.00	Included