TIGER Discretionary Grant FY 2016

Capitol Region Opportunity Corridor

First Mile | Last Mile Connections to Transit

APPENDIX D

Benefit-Cost Analysis Technical Paper

Connecting Communities | Strengthening Active Transportation and Transit | Improving Access to Education, Employment & Services

BENEFIT-COST ANALYSIS

Capitol Region Opportunity Corridor

TIGER FY 2016 Grant Application

Prepared By:

The Capitol Region Council of Governments
and the
City of Hartford
Department of Development Services

April 2016

Executive Summary

The following benefit-cost analysis was prepared for the Capitol Region Opportunity Corridor grant application for the TIGER Discretionary Grant (TIGER FY 2016) federal grant program. Under this program, a benefit-cost analysis is required by the USDOT in accordance with the Federal Register 59 FR 4233 and in order to present a comprehensive analysis that monetizes and quantifies the full range of costs and benefits associated with the proposed TIGER project. The intent of this benefit-cost analysis is to meet this requirement and to demonstrate that the potential benefits of the Capitol Region Opportunity Corridor Project will outweigh, on a net present value basis, the incurred costs associated with the project.

The estimated benefit-cost ratio for the proposed project was calculated for both the 7% and 3% discount rate scenarios. Under the 7% scenario, the benefit-cost ratio was 1.89 while the 3% scenario resulted in a ratio of 2.70. The net present value for the 7% scenario was $18.4 million and the NPV for the 3% scenario was $39 million.

This TIGER submittal builds upon the ongoing transformative change spearheaded by communities sharing the CT***fastrak*** corridor and a TIGER IV project secured by the City of Hartford. Uniformly the elements support continued growth in pedestrian and bicycle trips, increased transit usage, and safer vehicular maneuvers all while enhancing the corridor's quality of life and access to jobs, education and services. Three (3) of the existing CT***fastrak***'s eleven (11) stations will realize direct benefits from this project.

The following summarizes the key connected elements of the TIGER application:

- Element 1: Hartford: North Neighborhood Intermodal – Includes enhancements aimed at constructing complete streets and improving linkages between existing TIGER project and the North Hartford Promise Zone.
- Element 2: West Hartford: Complete Streets Improvements – Includes strengthening connection between CT***fastrak*** Flatbush Station and destinations along New Park Avenue.
- Element 3: New Britain: Complete Streets Network – Includes placemaking enhancements that improve pedestrian connections to/from the CT***fastrak*** Downtown New Britain station over an expressway.

Current Baseline & Problem to be Addressed	Change to Baseline/ Alternatives	Type of Impact	Population Affected by Impact	Economic Benefit	Results Summary (2016 $)	Page Reference in BCA
Incomplete linkages to transit and neighborhoods	Additional sidewalks/ bicycle lanes	Reduction in auto use	All drivers in study region and society	State of good repair in terms of reduced vehicular pavement damage	$326,955	13
Incomplete linkages to transit and neighborhoods	Additional sidewalks/ bicycle lanes	Reduction in auto use	Society	Economic competitiveness in terms of reduced fuel consumption, reduced operating expense	$7,197,769	12
Incomplete linkages to transit and neighborhoods	Additional sidewalks/ bicycle lanes	Reduction in auto use	Society and surrounding communities	Noise reduction	$37,024	17
Incomplete linkages to transit and neighborhoods	Additional sidewalks/ bicycle lanes	Reduction in auto use	Society and surrounding communities	Emissions reduction	$496,903	17
Travel time delays due to infrastructure deficiencies	Improved intersections and traffic signals	Reduction in travel time	Travelers in the study area	Travel time reduction	$42,856,072	12
Level of roadway crashes adjacent due to dangerous intersections and streets	Complete streets/ intersection improvements	Safer roadways, accident reductions	Society	Safety in terms of reductions in crashes	$34,559,500	18
Incomplete bicycle and pedestrian linkages	Additional sidewalks/ bicycle lanes	Improved health and increased mobility	Society and surrounding communities	Enhanced livability in terms of improved health, increased mobility, and recreation	$5,241,507	16
Incomplete linkages to transit and neighborhoods	Additional sidewalks/ bicycle lanes	Reduction in auto use	Global	Global warming reduction	$832,182	18

CAPITOL REGION OPPORTUNITY CORRIDOR PROJECT COMPONENT COST SUMMARY	
TIGER Application Components	**Component Cost**
1. Hartford North - Neighborhood Intermodal	***$11,550,820***
Main Street (Gold Street to Morgan Street)	*$5,900,000*
Albany Avenue/Main Street Intersection	*$5,650,820*
2. West Hartford Completed Streets	***$2,370,000***
New Park Avenue (Talcott Road to Flatbush Avenue)	*$2,370,000*
3. New Britain Complete Streets	***$10,473,350***
Beehive Bridge	*$7,160,000*
Myrtle Street and East Main Street	*$3,313,350*
TOTAL ESTIMATED PROJECT COST *	**$24,394,170**

* Includes Design, Construction, and ROW costs

Benefit-Cost Evaluation

A standard NPV function in Microsoft Excel was used to calculate the net present value of the total net project benefits. The summary tables of calculations for both the 7% discount rate and the 3% discount rate scenarios are included on the following page. As these tables show, the proposed project would generate a net present value, discounted at 7%, of $18,398,815 and a net present value, discounted at 3%, of $39,029,705. These figures include an accounting for a total estimated project cost of $24,394,170 and an estimated $492,096 over the life of the project for operations and maintenance.

Year	Project Costs	O&M	Total Costs	Life Cycle	Vehicle Operating Costs	Noise	Emissions	CO2	Active Health Benefits	Time Savings	Accident Costs	TOTAL BENEFITS	NET	Discount Rate	PVC	PVB	NPV
2016	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7%	$0	$0	$0
2017	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7%	$0	$0	$0.00
2018	-$9,025,843	$0	-$9,025,843	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$9,025,843	7%	-$7,883,520.74	$0	-$7,883,520.74
2019	-$15,368,327	$0	-$15,368,327	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$15,368,327	7%	-$20,428,654	$0	-$20,428,653.53
2020	$0	-$24,605	-$24,605	$14,849	$326,889	$1,681	$23,579	$31,558	$238,045	$1,946,322	$1,727,975	$4,310,898	$4,286,293	7%	-$20,447,424	$3,288,763	-$17,158,660.99
2021	$0	-$24,605	-$24,605	$14,997	$330,158	$1,698	$23,814	$31,874	$240,425	$1,965,785	$1,727,975	$4,336,727	$4,312,122	7%	-$20,464,967	$6,380,790	-$14,084,177.32
2022	$0	-$24,605	-$24,605	$15,147	$333,459	$1,715	$24,053	$33,431	$242,829	$1,985,443	$1,727,975	$4,364,053	$4,339,448	7%	-$20,481,363	$9,288,743	-$11,192,619.81
2023	$0	-$24,605	-$24,605	$15,299	$336,794	$1,732	$24,293	$34,391	$245,258	$2,005,297	$1,727,975	$4,391,039	$4,366,434	7%	-$20,496,685	$12,023,261	-$8,473,424.06
2024	$0	-$24,605	-$24,605	$15,452	$340,162	$1,750	$24,536	$35,366	$247,710	$2,025,350	$1,727,975	$4,418,301	$4,393,696	7%	-$20,511,005	$14,594,753	-$5,916,252.79
2025	$0	-$24,605	-$24,605	$15,606	$343,564	$1,767	$23,398	$36,358	$250,187	$2,045,604	$1,727,975	$4,444,458	$4,419,854	7%	-$20,524,389	$17,012,243	-$3,512,145.25
2026	$0	-$24,605	-$24,605	$15,762	$346,999	$1,785	$23,632	$37,365	$252,689	$2,066,060	$1,727,975	$4,472,268	$4,447,663	7%	-$20,536,897	$19,285,718	-$1,251,179.05
2027	$0	-$24,605	-$24,605	$15,920	$350,469	$1,803	$23,868	$39,040	$255,216	$2,086,721	$1,727,975	$4,501,012	$4,476,407	7%	-$20,548,586	$21,424,116	$875,529.66
2028	$0	-$24,605	-$24,605	$16,079	$353,974	$1,821	$24,107	$40,088	$257,768	$2,107,588	$1,727,975	$4,529,399	$4,504,795	7%	-$20,559,511	$23,435,223	$2,875,712.31
2029	$0	-$24,605	-$24,605	$16,240	$357,514	$1,839	$24,348	$41,153	$260,346	$2,128,664	$1,727,975	$4,558,077	$4,533,473	7%	-$20,569,721	$25,326,663	$4,756,942.23
2030	$0	-$24,605	-$24,605	$16,402	$361,089	$1,857	$24,591	$41,884	$262,949	$2,149,950	$1,727,975	$4,586,698	$4,562,093	7%	-$20,579,263	$27,105,464	$6,526,200.72
2031	$0	-$24,605	-$24,605	$16,566	$364,700	$1,876	$24,837	$42,303	$265,579	$2,171,450	$1,727,975	$4,615,285	$4,590,681	7%	-$20,588,181	$28,778,256	$8,190,074.66
2032	$0	-$24,605	-$24,605	$16,732	$368,347	$1,895	$25,085	$44,082	$268,235	$2,193,164	$1,727,975	$4,645,515	$4,620,910	7%	-$20,596,516	$30,351,852	$9,755,336.81
2033	$0	-$24,605	-$24,605	$16,899	$372,030	$1,914	$25,336	$45,208	$270,917	$2,215,096	$1,727,975	$4,675,375	$4,650,771	7%	-$20,604,305	$31,831,957	$11,227,651.66
2034	$0	-$24,605	-$24,605	$17,068	$375,750	$1,933	$25,590	$46,352	$273,626	$2,237,247	$1,727,975	$4,705,541	$4,680,936	7%	-$20,611,585	$33,224,156	$12,612,571.82
2035	$0	-$24,605	-$24,605	$17,239	$379,508	$1,952	$25,845	$47,514	$276,363	$2,259,619	$1,727,975	$4,736,016	$4,711,411	7%	-$20,618,388	$34,533,704	$13,915,316.15
2036	$0	-$24,605	-$24,605	$17,411	$383,303	$1,972	$26,104	$48,695	$279,126	$2,282,216	$1,727,975	$4,766,802	$4,742,197	7%	-$20,624,746	$35,765,536	$15,140,789.94
2037	$0	-$24,605	-$24,605	$17,585	$387,136	$1,991	$26,365	$50,608	$281,917	$2,305,038	$1,727,975	$4,798,616	$4,774,011	7%	-$20,630,689	$36,924,465	$16,293,776.00
2038	$0	-$24,605	-$24,605	$17,761	$391,007	$2,011	$26,629	$51,834	$284,737	$2,328,088	$1,727,975	$4,830,042	$4,805,437	7%	-$20,636,242	$38,014,669	$17,378,426.41
2039	$0	-$24,605	-$24,605	$17,939	$394,917	$2,031	$26,895	$53,079	$287,584	$2,351,369	$1,727,975	$4,861,790	$4,837,185	7%	-$20,641,433	$39,040,248	$18,398,815.47
TOTAL	**-$24,394,170**	**-$492,096**	**-$24,886,266**	**$326,955**	**$7,197,769**	**$37,024**	**$496,903**	**$832,182**	**$5,241,507**	**$42,856,072**	**$34,559,500**	**$91,547,912**	**$75,687,489**	7%	**-$20,641,433**	**$39,040,248**	**$18,398,815**

Year	Project Costs	O&M	Total Costs	Life Cycle	Vehicle Operating Costs	Noise	Emissions	CO2	Active Health Benefits	Time Savings	Accident Costs	TOTAL BENEFITS	NET	Discount Rate	PVC	PVB	NPV
2016	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3%	$0	$0	$0
2017	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3%	$0	$0	$0
2018	-$9,025,843	$0	-$9,025,843	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$9,025,843	3%	-$8,507,722.59	$0	-$8,507,722.59
2019	-$15,368,327	$0	-$15,368,327	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$15,368,327	3%	-$22,571,918.96	$0	-$22,571,919
2020	$0	-$24,605	-$24,605	$14,849	$326,889	$1,681	$23,579	$31,558	$238,045	$1,946,322	$1,727,975	$4,310,898	$4,286,293	3%	-$22,593,780.00	$3,830,177	-$18,763,603
2021	$0	-$24,605	-$24,605	$14,997	$330,158	$1,698	$23,814	$31,874	$240,425	$1,965,785	$1,727,975	$4,336,727	$4,312,122	3%	-$22,615,004.32	$7,571,076	-$15,043,928
2022	$0	-$24,605	-$24,605	$15,147	$333,459	$1,715	$24,053	$33,431	$242,829	$1,985,443	$1,727,975	$4,364,053	$4,339,448	3%	-$22,635,610.45	$11,225,902	-$11,409,709
2023	$0	-$24,605	-$24,605	$15,299	$336,794	$1,732	$24,293	$34,391	$245,258	$2,005,297	$1,727,975	$4,391,039	$4,366,434	3%	-$22,655,616.41	$14,796,218	-$7,859,398
2024	$0	-$24,605	-$24,605	$15,452	$340,162	$1,750	$24,536	$35,366	$247,710	$2,025,350	$1,727,975	$4,418,301	$4,393,696	3%	-$22,675,039.66	$18,284,066	-$4,390,974
2025	$0	-$24,605	-$24,605	$15,606	$343,564	$1,767	$23,398	$36,358	$250,187	$2,045,604	$1,727,975	$4,444,458	$4,419,854	3%	-$22,693,897.19	$21,690,373	-$1,003,524
2026	$0	-$24,605	-$24,605	$15,762	$346,999	$1,785	$23,632	$37,365	$252,689	$2,066,060	$1,727,975	$4,472,268	$4,447,663	3%	-$22,712,205.48	$25,018,160	$2,305,955
2027	$0	-$24,605	-$24,605	$15,920	$350,469	$1,803	$23,868	$39,040	$255,216	$2,086,721	$1,727,975	$4,501,012	$4,476,407	3%	-$22,729,980.51	$28,269,787	$5,539,806
2028	$0	-$24,605	-$24,605	$16,079	$353,974	$1,821	$24,107	$40,088	$257,768	$2,107,588	$1,727,975	$4,529,399	$4,504,795	3%	-$22,747,237.82	$31,446,616	$8,699,379
2029	$0	-$24,605	-$24,605	$16,240	$357,514	$1,839	$24,348	$41,153	$260,346	$2,128,664	$1,727,975	$4,558,077	$4,533,473	3%	-$22,763,992.49	$34,550,445	$11,786,453
2030	$0	-$24,605	-$24,605	$16,402	$361,089	$1,857	$24,591	$41,884	$262,949	$2,149,950	$1,727,975	$4,586,698	$4,562,093	3%	-$22,780,259.16	$37,582,793	$14,802,534
2031	$0	-$24,605	-$24,605	$16,566	$364,700	$1,876	$24,837	$42,303	$265,579	$2,171,450	$1,727,975	$4,615,285	$4,590,681	3%	-$22,796,052.05	$40,545,169	$17,749,117
2032	$0	-$24,605	-$24,605	$16,732	$368,347	$1,895	$25,085	$44,082	$268,235	$2,193,164	$1,727,975	$4,645,515	$4,620,910	3%	-$22,811,384.94	$43,440,101	$20,628,716
2033	$0	-$24,605	-$24,605	$16,899	$372,030	$1,914	$25,336	$45,208	$270,917	$2,215,096	$1,727,975	$4,675,375	$4,650,771	3%	-$22,826,271.25	$46,268,780	$23,442,508
2034	$0	-$24,605	-$24,605	$17,068	$375,750	$1,933	$25,590	$46,352	$273,626	$2,237,247	$1,727,975	$4,705,541	$4,680,936	3%	-$22,840,723.98	$49,032,789	$26,192,065
2035	$0	-$24,605	-$24,605	$17,239	$379,508	$1,952	$25,845	$47,514	$276,363	$2,259,619	$1,727,975	$4,736,016	$4,711,411	3%	-$22,854,755.75	$51,733,673	$28,878,917
2036	$0	-$24,605	-$24,605	$17,411	$383,303	$1,972	$26,104	$48,695	$279,126	$2,282,216	$1,727,975	$4,766,802	$4,742,197	3%	-$22,868,378.83	$54,372,935	$31,504,556
2037	$0	-$24,605	-$24,605	$17,585	$387,136	$1,991	$26,365	$50,608	$281,917	$2,305,038	$1,727,975	$4,798,616	$4,774,011	3%	-$22,881,605.13	$56,952,427	$34,070,822
2038	$0	-$24,605	-$24,605	$17,761	$391,007	$2,011	$26,629	$51,834	$284,737	$2,328,088	$1,727,975	$4,830,042	$4,805,437	3%	-$22,894,446.19	$59,473,190	$36,578,744
2039	$0	-$24,605	-$24,605	$17,939	$394,917	$2,031	$26,895	$53,079	$287,584	$2,351,369	$1,727,975	$4,861,790	$4,837,185	3%	-$22,906,913.24	$61,936,619	$39,029,705
TOTAL	**-$24,394,170**	**-$492,096**	-$24,886,266	**$326,955**	**$7,197,769**	**$37,024**	**$496,903**	**$832,182**	**$5,241,507**	**$42,856,072**	**$34,559,500**	**$91,547,912**	**$66,661,646**	**3%**	**-$22,906,913.24**	**$61,936,619**	**$39,029,705**

Non- Quantified Economic Benefits and Costs

Economic Development

The Capitol Region Opportunity Corridor project will strengthen first / last mile connections to transit, providing access to a jobs, education and community services. There are currently over 86,000 jobs within half a mile of the CT***fastrak*** corridor; this number increases to 115,900 job when circulator buses are factored into the service shed. Educational institutions such as Central Connecticut State University (CCSU) and Capital Community College are core destinations accessible by transit and walking / biking. In addition to enhancing access for expected users within the opportunity corridor, property reinvestment and increased investment in TOD sites are being realized.

Livability

Perhaps the most powerful long-term benefit from the development of the proposed project would be the increased attractiveness of living in the region due to an improved transit system, greater pedestrian and non-motorized vehicular access and connectivity, and a more competitive economic environment. Already, the region's transit and complete streets investments are generating growth. Hartford, New Britain, and West Harford are all in the process of beginning transit-oriented development projects near their CT***fastrak*** stations. When the Hartford Line rail project comes online, CRCOG expects the pace of development to increase. Providing non-automotive options for getting to and from these transit amenities will improve their accessibility and increase the attractiveness of the region.

Sustainability

In addition to the various sustainability benefits quantified as part of the benefit-cost analysis, the proposed development and implementation of "complete streets" and roadway/streetscape infrastructure components will have the ancillary benefit of reducing environmental impacts, particularly in terms of reducing stormwater run-off. Appropriate green design and LID best management practices will yield significant improvements through more permeable surfaces, context-sensitive stormwater capture, retention and distribution methods, and enhanced landscaping elements. While difficult to quantify and monetize these potential benefits at this stage of the proposed project the fact that such benefits will be ultimately realized must be a considered as part of the benefit-cost analysis.

Regional Land Value

It is likely that the realization of improved transit efficiencies and easier and quicker means of commutation will spur transportation-oriented development on vacant or underutilized parcels near transit services in the three communities. Other parcels along the routes of improved streetscaping and greenscaping would also likely see modest increases in property values. The

multimodal nature of transportation in the project area will also make the entire region more attractive as place to live and work. However, these possibilities require further detailed studies that are beyond the scope of this BCA.

Improved Economic Productivity

Travel time savings and better access to transportation networks and jobs are likely to make residents and commuters more economically productive. However, no attempt has been made to assess productivity increases due to the extensive amount of labor market analysis that would be required to provide a complete and accurate assessment.

Transportation Choice

Clearly, the presence of the new transportation infrastructure and improved pedestrian and bicycle connections throughout the project corridor will offer commuters and residents enhanced transportation choices. However, the quantification of option demand benefits and other potential benefits stemming from increased transportation choice are beyond the scope of this BCA and have not been conducted.

Project Description

Element 1: Hartford North Neighborhood Intermodal: Pedestrian and Bicycle Enhancements and Complete Street Network

The Hartford North Neighborhood Intermodal Element will leverage recent investments including CT***fastrak*** and the Intermodal Triangle Project (TIGER IV project) improvements, and continue the region's efforts to put a greater focus on pedestrian, bicycle and transit mobility. This element also supports other upcoming initiatives including the ***CTrail*** Hartford Line commuter rail service at Union Station with connections between New Haven, Hartford and Springfield Ma, construction of a new ballpark in the emerging mixed-use Downtown North district ("DoNo"), and the opening of downtown campuses by both UConn and Trinity College. In addition to the 6,000 seat baseball stadium, DoNo redevelopment is proposed to include over one million square feet of gross floor area mixed use development, over 800,000 square feet of residential in addition to retail, recreational, and light industrial uses.

Proposed improvements in Hartford will work to remove barriers for pedestrians and cyclists that exist in the low-income, economically distressed neighborhood that lays immediately north of Downtown Hartford – Clay Arsenal. It directly supports the goals of the recently HUD-designated North Hartford Promise Zone (NHPZ) by providing transit, walk and bike connectivity to education, training, job opportunities and medical services on the City's principal north-south transportation spine, divided by Interstate 84.

Improvements will occur on Main Street at the Albany Avenue / High Street / Ely Street intersection south to Pleasant Street and between Morgan and Gold Streets. The segment of Main

Street between Pleasant Street and Morgan Street will be improved under the City's new baseball park construction. The project will aim to calm traffic, increase pedestrian visibility and safety, improve bicycle safety, and provide for safer vehicular movement.

Element 2: West Hartford Complete Streets

This element focuses on strengthening the transit, pedestrian and bicycle connections to / from CT***fastrak***'s Flatbush Station, and to / from the future rail station planned at Flatbush Avenue for the Hartford Line. It entails the application of complete street enhancements and associated traffic signal improvements along roughly 0.7 miles of New Park Avenue, while ensuring vehicular safety and movement is optimized.

Access to and from the CT***fastrak*** stations is heavily dependent on pedestrian and bicycle traffic. To help address these demands, a multi-use trail was constructed alongside CT***fastrak***'s alignment from New Britain to Newington, providing multi-modal access to five of its stations. Unfortunately, due to right-of-way constraints, the trail was not extended to serve the six CT***fastrak*** stations in northern Newington, West Hartford, and Hartford. To address this need, the Capitol Region Council of Governments has been working with municipalities and local stakeholders to conceptually define potential walking and bicycling connections north of the current trail's terminus, with the goal of eventually providing multi-modal connections to all stations and the East Coast Greenway in Hartford. Initial planning has been completed along many of the remaining underserved segments, however this element focuses exclusively on the section in West Hartford where reconstruction of New Park Avenue to a complete street is proposed.

New Park Avenue runs parallel to CT***fastrak*** in the southeastern portion of the Town of West Hartford, and within West Hartford provides access to the Elmwood and Flatbush stations. Average daily traffic volumes range between 13,100 and 17,500. The corridor serves a variety of commercial services, auto-related repair garages, small machine shops and storage yards, and retail development. Also, within this area are significant industrial employment centers, major commercial employers, a "Home Design District," well established dense single and multi-family residential neighborhoods and community amenities. The vision of CT***fastrak*** stimulating Transit-Oriented Development in this corridor is already being realized. "616 New Park", a 54-unit transit-oriented development located just north of CT***fastrak***'s Elmwood Station, is expected to start construction this fall. The multi-modal demand is anticipated to increase even further upon completion of ongoing upgrades to the Hartford rail line, including a proposed new rail station at Flatbush Avenue that is currently being designed (and awaits construction funding).

The long term goal is for the New Park Avenue corridor to evolve into a more mixed-use, pedestrian and bicycle friendly neighborhood with the characteristics that support transit ridership growth. To this end, the Town is currently performing a New Park Avenue Transit Area Complete Streets Study, funded by the state through a Transit-Oriented and Development (TOD) Planning Grant and scheduled for completion by July 2016. The study's aim is to refine how best to

implement complete streets design features along the entire length of New Park Avenue in West Hartford form New Britain Avenue to Prospect Street. Where applicable, a main focus will be on implementing a road diet that will modify the existing four lane roadway to a single travel lane in each direction, a two way turn lane in the center, and bike lanes in each direction.

The element includes the reconstruction of New Park Avenue to implement complete street between its intersections with Talcott Road and Flatbush Avenue. The Town of West Hartford plans to similarly reconstruct the remaining portion of New Park Avenue from New Britain Avenue to Talcott Road. The implementation of complete streets measures along New Park in West Hartford will to improve multimodal connections to CT***fastrak*** Elmwood, CT***fastrak*** Flatbush Station, and the future CT***rail*** Hartford Line Flatbush Rail Station. The measures will also improve access between the stations and the existing Trout Brook multi-use trail, expand access for proposed TOD, nurture additional TOD efforts, and build towards the goal of providing multi-modal improvements between all stations, including the eventual connection to the East Coast Greenway.

Element 3: New Britain Complete Streets Network

The New Britain Complete Streets Element will improve pedestrian and bicycle access to Downtown New Britain and its CT***fastrak*** station, reconnecting neighborhoods that were cut off from downtown by Route 72. The improvement will also create new opportunities for TOD by increasing access to and from underutilized land adjacent to downtown. These improvements will build upon recently completed investments such as CT***fastrak***, as well as ongoing projects like the implementation of New Britain's Complete Streets Master Plan, which this project partially implements and extends.

Improvements will occur on the Main Street Overpass, and East Main Street and Myrtle Street. By themselves, these improvements provide critical linkages between downtown and surrounding neighborhoods. When seen in the context of the larger TIGER submission, as well as New Britain's Complete Streets Master Plan, these improvements greatly enhance mobility for the residents of New Britain.

The following summarizes key improvements of Element 3:

- Rebuild portions of East Main Street, Myrtle Street, and Main Street as complete streets, including: wider sidewalks with brick treatments; street trees; bump-outs at appropriate intersections; narrower travel lanes; bike lanes; upgraded traffic signals; and landscaped medians.
- Transform the Main Street Overpass into a signature bridge for the City of New Britain, creating a more inviting atmosphere.
- Perform road diets on East Main Street, Myrtle Street, and Main Street.
- Define a policy framework for 'transit signal priority'. After a clear assessment of the

framework for traffic signal priority, traffic signals and the supporting infrastructure will be upgraded to accommodate transit signal priority.

Key Analytical Assumptions

Real Discount Rate

All benefits and costs quantified in this analysis are provided in constant 2016 dollars. Many of these figures were originally expressed in dollar values for other years. Annual average data from the Bureau of Labor Statistics' Consumer Price Index for Urban Consumers (CPI-U) was utilized to "cost forward" these dollar values into 2016 dollars. Since no CPI-U annual average is yet available for 2016, the March 2016 figure was utilized for 2016 dollar values.

The guidance provided by the Federal Register 59 FR 4233, the TIGER Benefit-Cost Analysis (BCA) Resource Guide, and OMB Circulars A-4 and A-94 requires the use of a discount rate of 7% for this benefit-cost analysis. Additionally, applicants may provide an alternative analysis using a discount rate of 3%, particularly in the case where the alternative use for dedicated funds would be for other public expenditures, as in the case of this proposed project. This benefit-cost analysis has utilized both 7% and 3% discount rates to compare the net benefits of the proposed project.

Evaluation Period

For the proposed project, a twenty (20) year design life was assumed for the proposed infrastructure improvements. With construction proposed to begin in 2018 and be completed by 2020, the period of 2020 to 2039 was used as the evaluation period of benefits. Capital expenditures at the outset of the project are assumed to be incurred in 2018 and 2019, with the twenty year operational period beginning in 2020. All other costs and benefits are assumed to occur at the end of each year for simplicity of analysis.

Study Region Defined

This project is located within Connecticut's 1st and 5th Congressional Districts. Improvement elements are adjacent to CT***fastrak*** stations within the Cities of Hartford and New Britain as well as the Town of West Hartford. All towns fall within the Capitol Region Council of Governments (CRCOG) regional planning boundary which consists of 38 municipalities, 1,046 square miles, and approximately 975,000 people. Within the Capitol Region there are more than 528,000 jobs, over 20% of which fall within reach of CT***fastrak*** and the proposed elements. Ten percent of the population within the region does not have access to a vehicle and just over 33% of the Region's population identifies with an ethnic or racial minority group.

ADT and VMT Assumptions

New Ridership – Local Bus Service

One of the benefits resulting from the proposed project will be in the form of increased bus transit ridership due to efficiencies realized in the existing system operations. These efficiencies manifest themselves in time savings for bus routes traveling through each project area, and in improved access to and from bus stops along each route, including improved access to and from CT***fastrak*** stations adjacent project areas.

In Hartford, Main Street within the project area comprises the north-south axis of the main transfer hub for the entire region's CT***transit*** system. As such, most buses that travel into Downtown Hartford from the north and south are currently dropping off and picking up passengers in various locations within the project area. When combined with the existing improvements being made in bus route efficiencies and availability along the east-west axis of the transfer hub as part of the TIGER IV grant program funding, economies of scale will be realized for all Hartford transit passengers as, perhaps for the first time in its history, the transit system will function effectively as an integrated whole. Doing so will make all bus routes passing through Hartford more convenient for commuters and will likely induce additional commuters to shift modes from single occupancy vehicles to transit ridership.

Likewise the proposed operations and accessibility improvements to New Park Avenue in West Hartford, and Main Street, Myrtle Street, and East Main Street in New Britain will improve efficiency for CT***transit*** Routes 31, and 33, and New Britain Transportation bus Routes O and S. Additionally, accessibility will be improved to and from CT***fastrak***'s Flatbush Avenue station in West Hartford, and the downtown New Britain station.

Per 2013 transit ridership and station data, the routes and stations referenced above account for over 8,194 transit trips daily. This current ridership figure is logically expected to increase with improved transit system efficiencies. Several years ago, the City of New York had been testing and implementing the concept of "select service" bus service, with the results indicating that bus ridership on select service routes has increased by over 10% due to the improved efficiency and faster commute times offered by these routes[1]. The increase varied throughout the analysis period. The 25th percentile of the observed increase was 4.5%. The improvements to efficiencies and system reliability that would be realized from the various components of this project will likely have similar impacts on the ridership levels on bus routes in the project area. Conservatively, a projected increase in ridership of 4.5% above existing levels has been estimated.

As a result, a projected increase of 369 daily transit trips was assumed to occur as part of this project. This is assumed to represent a correspondingly equal reduction of 369 SOV trips.

[1] http://www.nyc.gov/html/brt/downloads/pdf/201111_1st2nd_progress_report.pdf

Table 1 Automobile ADTs Reduced - Local Bus Ridership			
	Transit Trips	%Increase	**ADTs Reduced**
Bus Transit Service	8,194	4.5%	**369**

Source: CT***transit*** 2013 Ridership Counts; NYCDOT "+selectbusservice M15 on First and Second Avenues: Progress Report" http://www.nyc.gov/html/brt/downloads/pdf/201111_1st2nd_progress_report.pdf

Mode Split – Bicyclists & Pedestrians

Additional reductions in ADTs will be realized as a result of the implementation of complete streets, streetscape improvements and pedestrian improvements as part of the proposed project. The presence of pedestrian-friendly streets and infrastructure such as bike lanes has been shown to increase the number of trips by bicyclists and pedestrians. According to the results of a "road diet" project in Orlando, Florida, bicycle volumes increased by 30% and pedestrian volumes increased by 23%; other communities have experienced even greater increases in bicycle and pedestrian traffic after implementing Complete Streets elements.[3]

The Capitol Region Council of governments collected 2 hour bicycle and pedestrian counts along project roadways in 2015. This count data served as the basis for calculating bike and pedestrian ADTs for each roadway utilizing the National Bicycle and Pedestrian Documentation (NBPD) adjustment factors. Within the project limits, the resulting ADT's were calculated as 240 bicycles and 4,508 pedestrians along Main Street in Hartford, 24 bikes and 396 pedestrians along New Park Avenue in West Hartford, and 98 bikes and 1,208 pedestrians along Main Street in New Britain. In order to project increases in bicycle and pedestrian traffic resulting from the proposed project areas, the previously cited 23% increase in pedestrian traffic and a 30% increase in bicycle traffic were utilized. The projected percentage increases were applied to these respective figures and are aggregated in Table 2, which shows a total increase of 1,592 daily non-vehicle trips and a corresponding reduction of 1,592 vehicle trips.

Table 2 Automobile ADTs Reduced - New Bicycle and Walking Trips			
	Baseline Trips	%Increase	ADTs Reduced
Bicycle	380	30%	114
Walking	6,424	23%	1,477
Total	**6,804**		**1,592**

Source: CRCOG Annual Bike/Ped Count Project and National Bike-Ped Documentation Project Adjustment Factors.

Forecast Assumptions

CRCOG maintains a system wide travel demand model which currently estimates traffic growth in the vicinity of 1% per year. Therefore, a standard assumption of a 1% annual growth was

[3] http://www.completestreets.org/complete-streets-fundamentals/factsheets/change-travel-patterns/

utilized to project the number of daily vehicular trips reduced by the proposed project out to the year 2039.

Annualizing Factor

To annualize the number of trips reduced from the initial daily calculations, a factor of 300 was applied. This factor is a standard annualizing factor used in many traffic impact analyses. As a result of these calculations, the assumed reduction in ADTs would equal 1,960 per day in 2020, and would rise to 2,060 per day in 2025. Projecting out over the assumed 20 year life span of the proposed project, a total of more than 12.9 million ADTs would be reduced.

Table 3
Total ADTs Reduced

	ADTs	Annual Factor	Total	TOTAL, Eval. Period
ADTs Reduced, 2020	1,960	300	**588,104**	
ADTs Reduced, 2025	2,060	300	**618,103**	**12,949,456**

Trip Distances

In order to convert reduced ADTs into reduced vehicle miles travelled, the mean commuting time for Hartford County travel modes of 36.9 minutes for bus transit, and 16.9 minutes for bicyclists and pedestrians obtained from the 2010 Census data was utilized. For bus transit, an average travel speed of 15 mph was assumed due to traffic and regular stops. For cyclists and pedestrians, average travel speeds of 15 mph and 3 mph were utilized, respectively. The resulting mean commuting trip lengths of 9.2 miles for bus transit trips, 4.2 miles for bicycle trips, and 0.85 miles for pedestrian trips was determined. The reduced ADTs and corresponding trip distances were then utilized to convert ADTs reduced into VMTs reduced. VMT reduction calculations were completed for years 2020 through 2039. The 2020 calculations shown in Table 4 include ADT reductions attributable to increased bicycling and pedestrian activity, along with increased local bus ridership. The resulting reeducation of VMTs equals 1.5 million miles in 2020 and projects out to a total of over 33.9 million VMTs reduced over the assumed 20 year life span of the proposed project.

Table 4
Total VMTs Reduced, 2020

Mode	ADTs	Trip Distance (miles)	VMTs Reduced
Bus Transit Service	110,621	9.225	1,020,482
Bicycle	34,242	4.225	144,672
Walking	443,240	0.845	374,538
TOTAL	**588,104**		**1,539,692**

Economic Benefits – State of Good Repair

Life Cycle Cost Savings

The reduction in VMTs realized by the proposed project will result in fewer long-term maintenance impacts on the region's roadways (including pavement damage). The Federal Highway Administrations' Federal Highway Cost Allocation Study from 1997 indicated a marginal cost of road responsibilities of 0.65 cents per VMT. This data was CPI-U-adjusted from 1997 dollars to 2016 dollars, resulting in a marginal cost of 0.964 cents per VMT. The application of this marginal cost value resulted in an evaluation period life cycle cost savings of approximately $326,955.

Table 5
Life Cycle Benefits

	Cost per VMT			
	1997 $	**2016 $**	**VMTs Reduced**	**Net Benefit**
Life Cycle Benefits	0.0065	0.00964	33,902,488	**$326,955**

Source: Federal Highway Administration's 1997 Federal Highway Cost Allocation Study, Table 3.

Economic Benefits – Economic Competitiveness

Travel Time Savings

Significant travel time savings are likely to be realized as a result of the proposed project. The combination of multiple transportation modes with easy options for mode transfer and traffic signal replacements and optimizations will lead to reduced travel times for commuters. Also, the reduced number of VMTs may also lead to a reduction in roadway congestion, which will result in additional time savings for commuters.

To come up with a conservative estimate of travel time savings, CRCOG restricted its analysis to savings resulting from intersection improvements. Each of the subject intersections had previously been modeled using Synchro (version 9) traffic capacity analysis software. These models were obtained and analyzed by CRCOG. For consistency, CRCOG used PM peak results for each intersection as not every model included an AM peak. Each result was multiplied by four to adjust to the observed peak period of two hours in the morning and two hours in the afternoon. For West Hartford, the Synchro model's results were reported for the five intersection corridor. The number reported below has been adjusted to provide a per intersection average ADT to avoid double counting.

Table 6 Annual Travel Time Savings Benefits, 2020						
	Passengers Per Day at Peak Periods	**Annual Factor**	**Reduction of Delay (Seconds Per Peak Hour Vehicle)**	**Hours Saved**	**$ Value/ Hr. (2016)**	**Total Savings**
New Britain (Myrtle)	1,266	300	7	2,955	$13.29	$39,268
New Britain (Rte 72 On-ramp)	1,791	300	-7	-3,881	$13.29	($51,574)
Hartford	2,958	300	138	135,687	$13.29	$1,803,121
West Hartford*	1,829	300	19	11,702	$13.29	$155,506
Total	**7,845**		**157**	**146,463**		**$1,946,322**

Source: Travel time savings are based on Synchro models for each intersection. The West Hartford figure is an aggregate of all five intersections. Assumes four peak hours (two in the AM and two in the PM) based on observed conditions.

Tables 6 illustrates the results of the applicable calculations. As illustrated in the table, the most significant time savings are anticipated within the Hartford element which includes improvements to the currently failing Main Street/Albany Avenue (Route 44) five-leg intersection. This intersection serves State Route 44, which is one of the few east-west commuter routes that spans Talcott Mountain, a 13-mile long mountain ridge located 6 miles west of the city of Hartford. As such it is one of only a few commuter routes to Hartford for communities from the west. This busy intersection serves three leg that are federally classified as Urban Principal Arterials (Albany Avenue and two legs of Main Street), as well as an Urban Collector (High Street) and a local road (Ely Street). Adding to the intersection's significance is its location adjacent major pedestrian generators including CT***transit***'s main north-south transfer hub and the Capital Preparatory Magnet School. These traffic generators combine to overwhelm the intersection during both AM and PM peak periods, resulting in LOS's of "F" with significant delays that span multiple signal cycle lengths. The proposed improvements have been modelled to improve intersection operations to LOS "D" and "C" in the AM and PM peaks respectively, resulting in travel time savings for all commuters including riders on CT***transit*** Routes 40, 42, 44, 46, 50, 52, 54, and 58. Additional traffic signal and operational improvements are proposed at intersections within each of the three project area communities. These time savings have been modelled and result in a cumulative benefit of over $42.8 million over the duration of the project evaluation period.

Vehicle Operating Costs

Fuel-Related

To calculate the benefits related to reduced fuel costs, the Energy Information Administration's (EIA) Annual Energy Outlook 2015 was referenced for appropriate data on vehicle fuel efficiency. EIA projections extend to 2040. The average price of gasoline for 2017 was obtained from the Energy Information Administration Short Term Energy Outlook 2016. The average price was forecasted at $2.00 per gallon.

Table 7
Fuel Economy and Fuel Prices 2012-2037

	2012	2015	2037
Auto Fuel Economy (mpg)	33.4	35.9	54.3
Truck Fuel Economy (mpg)	6.7	6.8	7.8
Gasoline Price ($)	$2.000		

Source: Energy Information Administration's (EIA) Short Term Energy Outlook 2016; http://www.eia.gov/forecasts/steo/index.cfm

The application of this data resulted in an evaluation period reduction in fuel usage of nearly 1 million gallons.

Non-Fuel Related

Marginal costs for vehicle repair and maintenance, tires, and vehicle depreciation were calculated from the Barnes and Langworthy study at the University of Minnesota in 2003. The original figures were in 2003 dollars, and were adjusted to 2016 dollars using CPI-U data.

Table 8
Non-Fuel Benefit Factors

	2003 Cents per VMT	2016 Cents per VMT
Auto-Maintenance/Repair	3.8	4.9
Auto-Tires	0.9	1.2
Auto-Depreciation	7.4	9.6

Source: Barnes, G. and P. Langworthy (2003), p. 22.

The application of this data resulted in an evaluation period reduction in fuel and non-fuel related costs of over $7.1 million.

Table 9 Fuel & Non-Fuel Net Benefits	
	Total Value
Auto-Maintenance/Repair	$1,667,305
Auto-Tires	$394,888
Auto-Depreciation	$3,246,858
Fuel Savings	$1,888,718
TOTAL	**$7,197,769**

Economic Benefits – Livability

Active Life Benefits

Standard multipliers are available to calculate the benefits associated with active health based upon bike-miles and walk-miles generated by a proposed project. However, data on potential bike trips and pedestrian trips generated by the connectivity improvements is very difficult to quantify with any degree of accuracy. First, as discussed previously, the methodology used to project potential increases in bicycle and pedestrian traffic as a result of the proposed project involved an estimation of a 23% increase to the existing number of commuters by foot and a 30% increase to the existing number of commuters by bicycle in the project area. Second, it was assumed that each commuting trip by foot would average 0.85 miles and each commuting trip by bicycle would average 4.2 miles. Multiplying trip distance by number of commuters by mode provides an estimate of walk-miles and bike-miles per year as a result of the proposed project.

Tables 10 and 11 illustrate the calculations for active life benefits. These benefits are estimated to total over $5.2 million over the course of the project evaluation period.

Table 10 Bike-Miles and Walk-Miles per Year				
Mode	**ADT**	**Distance**	**Annualization Factor**	**Miles per Year**
Bicycle	114	4.225	300	144,672
Walking	1,477	0.845	300	374,538
TOTAL	**1,592**			**519,210**

Table 11 Total Active Life Benefits				
Mode	**Miles per Year**	**$/Mile**	**Total Health Benefit**	**Total, Eval. Period**
Bicycle	144,672	$0.218	$31,570	
Walking	374,538	$0.551	$206,475	
TOTAL	**519,210**		**$238,045**	**$5,241,507**

Source: Todd Litman, "Evaluating Public Transportation Health Benefits," Victoria Transport Policy Institute, 8 June 2011, p. 20.

Noise Pollution

This analysis utilized the NTHSA's 2010 figure of $0.001 per VMT reduced (adjusted to 2016 dollars) for noise pollution reduction benefits, resulting in a net evaluation period benefit of approximately $37,024. This benefit comes from the reduction of automobile noise that accompanies a reduction of VMT.

Table 12 Noise Reduction Benefits				
	Cents per VMT			
	2010	2016	VMTs	Net Benefit
Noise Reduction	0.001	0.00109	33,902,488	**$37,024**

Source: NTHSA (2009) p. viii-60.

Economic Benefits – Environmental Sustainability

Emissions

This analysis utilized the emissions factors provided in the California Department of Transportation's Life-Cycle Benefit-Cost Analysis Model (Cal B/C) to estimate the grams per VMT generated for carbon monoxide (CO), nitrogen oxide (NOx), fine particulate matter (PM10), sulfur oxides (SOx) and volatile organic compounds (VOC). In addition, this analysis utilized the economic values per short ton for these emissions included as part of the TIGER Benefit-Cost Analysis (BCA) Resource Guide (inflated from 2015 to 2016 dollars) to estimate the economic benefits associated with reductions in these emissions. The total grams per VMT were converted into short tons per VMT, and the appropriate economic values provided in the Resource Guide were applied.

Tables 13 through 15 illustrate the data and results of these calculations. Based upon these calculations, the proposed project would generate approximately $496,903 in economic benefits over the course of the evaluation period due to reduced emissions.

Table 13 Value of Emissions (per short ton)		
Emissions Category	**2015**	**2016**
Nitrogen Oxide (NOx)	$7,266	$7,313
Particulate Matter (PM10)	$332,405	$334,559
Sulfur Oxide (SOx)	$42,947	$43,225
Volatile Organic Compounds (VOCs)	$1,844	$1,856

Source: TIGER Benefit-Cost Analysis (BCA) Resource Guide, p. 6.

Table 14 Emissions Factors From Cal B/C Model (g/VMT)					
Autos @ 35 mph	**CO_2**	**NO_X**	**PM10**	**SO_X**	**VOC**
2015	385.6	0.22799	0.03491	0.00392	0.20276
2025	382.4	0.10342	0.03582	0.00382	0.11391
2050	381.7	0.0883	0.036	0.0038	0.1015

Source: California Department of Transportation's Life-Cycle Benefit-Cost Analysis Model

Table 15 Net Benefit of Emissions Reductions					
	NO_X	**PM10**	**SO_X**	**VOC**	**TOTAL**
Tons Reduced	4.94	1.33	0.14	5.03	**11.44**
Economic Benefit	$36,151	$445,215	$6,208	$9,328	**$496,903**

CO2 and Global Warming

A similar methodology was utilized to calculate the economic benefits of reduced CO_2 emissions related to global warming. Data regarding the social cost of carbon from the TIGER BCA Resource Guide was utilized to complete these calculations. This data was provided for a 3% discount rate out to the year 2050. For this analysis, in compliance with the TIGER Benefit-Cost Analysis (BCA) Resource Guide recommendation, the 3% discount rate data was used for both the 7% discount rate scenario and for the 3% discount rate scenario. The 3% discount rate scenario results in a benefit of $832,182.

Table 16 Net Benefit of CO_2 Emissions Reductions		
	Tons Reduced	**Benefit - 3%**
CO2	13,016	**$832,182**

Source: TIGER BCA Resource Guide, p. 7.

Economic Benefits – Safety

Accident Cost Savings

To estimate the number of automobile crashes (including bicycle and pedestrian) that will be avoided due to the intersection and complete streets improvements being implemented, CRCOG analyzed three years of crash data (2012-2014) provided by the Connecticut Department of Transportation. This data was provided in the KABCO scale of severity and converted to AIS levels using factors provided by the National Highway Traffic and Safety Administration and quoted in the U.S. DOT's TIGER guidance (see Table 17). Dollar values were adjusted to 2016 dollars.

Table 17 Accident Severity, Economic Cost and Rate of Incidence				
AIS Level	**Severity**	**Fraction of VSL**	**Unit Value**	**% Total Injuries**
AIS 1	Minor	0.003	$28,826	76.0%
AIS 2	Moderate	0.047	$451,614	19.0%
AIS 3	Serious	0.105	$1,008,926	3.5%
AIS 4	Severe	0.266	$2,555,945	0.1666%
AIS 5	Critical	0.593	$5,698,028	0.1666%
Fatality	Unsurvivable	1	$9,608,815	0.1666%

Source: TIGER Benefit-Cost Analysis (BCA) Resource Guide, p. 3.; Adjusted to 2016 dollars.

Based an analysis performed by the Federal Highway Administration Office of Safety[2], we assume a 28% reduction in crashes for these complete streets projects. A 28% reduction was assumed for all crash types. The result of the analysis was an overall reduction of 190 crashes over the analysis period, which includes two fatalities. This equates to over $34.5 million over the 20 year period.

Table 18 Accident Reduction Net Benefit			
AIS Level	**Accidents**	**Unit Value (2016 $)**	**Total Value**
AIS 1	169	$28,826	**$4,885,633**
AIS 2	15	$451,614	**$6,659,578**
AIS 3	3	$1,008,926	**$3,114,233**
AIS 4	1	$2,555,945	**$1,335,526**
AIS 5	0	$5,698,028	**$628,075**
Fatality	2	$9,608,815	**$17,936,455**
TOTAL	**190**		**$34,559,500**

It should be noted that this analysis is limited to the benefits of complete streets infrastructure and does not include an estimate of crash reductions that will result from improvement intersections.

Property Damage Savings

In addition to a reduction in injuries, the reduction in crashes will also lead to a reduction in property damage costs associated with vehicle accidents. To calculate the savings associated with a reduction in property damage, the total number of property damage only (AIS 0) accidents projected per year was taken and the economic value of $3,927, adjusted to 2016 dollars as provided in the TIGER Benefit-Cost Analysis (BCA) Resource Guide, was applied. As a result, the reduction of 29 property damage only crashes over the course of the evaluation period would lead to $117,012 in net benefit.

[2] Federal Highway Administration office of Safety. (2009). *Safety Benefits of Walkways, Sidewalks, and Paved Shoulders*.

Table 19 Property Damage Savings				
	Cost per Accident			
	2013 $	2016 $	# of Accidents	Net Benefit
Property Damage	$3,927	$4,014	29	**$117,012**

Source: TIGER Benefit-Cost Analysis (BCA) Resource Guide, p. 4.

Economic Costs

Initial Project Investment Costs

The initial project investment costs for the proposed project are $24,394,170. These costs include design, construction, and contingencies. CRCOG and its partners have prepared these cost estimates based upon construction industry standards and detailed knowledge of the transportation system. The costs are assumed to begin being expended in 2018 and continue through 2019.

Operations and Maintenance Costs

The maintenance for the streetscaping, traffic signals, and pedestrian improvements was assumed to be $2 per linear foot per year, which when multiplied by the approximately 12,302 linear feet of new infrastructure results in $24,605 per year in maintenance costs. The 20 year total is $492,096.

Alternatives

A "No Build" alternative was considered as part of this analysis. However, the "No Build" scenario generates no real net benefits and only has the potential to incur economic costs in the form of lost transportation efficiencies and decreased economic competitiveness. Under such a scenario, the CT***fastrak*** busway and the CT***rail*** Hartford Line commuter rail service would be neither as efficient nor as effectively leveraged as they would be with the realization of the proposed project. These two transportation initiatives include a combined $1.21 billion in funding and represent major investments in both Downtown Hartford and the greater Hartford regional transportation system. In a "No Build" environment, the three communities would miss out on economic competitiveness benefits that will result from increased connectivity and reduced travel time. The three communities will also miss out on the reduction of crashes that are predicted.

Benefit- Cost Ratio

The estimated benefit-cost ratio for the proposed project was calculated for both the 7% and 3% discount rate scenarios. Under the 7% scenario, the benefit-cost ratio was 1.89 while the 3% scenario resulted in a ratio of 2.70.

Sensitivity Analysis

Two tests were conducted to understand how sensitive the results are to the underlying assumptions. Large portions of the benefits, specifically those that fall under economic competitiveness, are based on time savings and mode shifts away from personal automobiles. These tests were undertaken to understand how resilient the underlying value proposition is to a future where estimated impacts are worse than is currently expected. The first sensitivity test ("Zero Mode Shift" in Table 20) was run where the street improvements resulted in no mode shift from automobile to transit, cycling, and walking. The second sensitivity test ("Zero Time Savings" in Table 20) was run where the street improvements resulted in no speed improvements along the corridor for automobiles and bus passengers. The NPV's for these tests, under both discount rates, are positive.

Table 20
Benefit-Cost Analysis Summary

Scenario	NPV	B/C Ratio	NPV/K
Build, 7%	$18,398,815	1.89	0.75
Build, 3%	$39,029,705	2.70	1.60
Zero Mode Shift, 7%	$12,431,946	1.60	0.51
Zero Mode Shift, 3%	$29,510,805	2.29	1.21
Zero Time Savings, 7%	$3,306,071	1.16	0.14
Zero Time Savings, 3%	$14,986,903	1.65	0.61

Benefits by Category