Benefit-Cost Analysis Supplementary Documentation

TIGER Discretionary Grant Program

32nd Street Corridor Improvements

USDOT TIGER BCA Results

City of Joplin, MO

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Benefit-Cost Analysis Supplementary Documentation

1. Executive Summary

The City of Joplin is addressing the safety and capacity of the regionally critical 32nd Street corridor with multiple capital projects aimed at improving the movement and safety of people in the community. These projects will improve traffic operations, reduce crashes, and generate community and environmental benefits. The improvements include:

- West 32nd Street Widening;
- 32nd Street Rail-Grade Separation;
- Main Street Northbound Right Turn Lane;
- Roadway repaving between the intersections at Main Street and Interstate 44; and
- 32nd Street Sidewalk and ADA Improvements.

The period of analysis used in the estimation of benefits and costs corresponds to 24 years, including four years of planning and construction and 20 years of operation. The total project capital costs are 26.5 million dollars and are expected to be financed by Federal, State, local and private funds according to the distribution shown in Table ES-1.

1. **Table ES-1: Summary of Project Costs and Anticipated Funding Sources, in Millions of Dollars of 2016**

Funding Partner	Funding Amount (millions $)	Funding Percent
MoDOT	$3.09	11.7%
City of Joplin	$11.00	41.5%
Joplin Area Transportation Study Organization (STP funds)	$0.15	0.6%
Kansas City Southern Railway	$0.28	1.1%
TIGER request	$11.97	45.2%
TOTAL	**$26.49**	**100.0%**

A summary of the relevant data and calculations used to derive the benefits and costs of the project are shown in Table ES-2 (in dollars of 2016). Based on the analysis presented in the rest of this document, the project is expected to generate 29.8 million dollars in discounted benefits and 23.5 million dollars in discounted costs, using a 7 percent real discount rate. Therefore, the

project is expected to generate a Net Present Value of 6.3 million dollars and a Benefit/Cost Ratio of 1.27.

Table ES-2: Summary of Pertinent Data, Quantifiable Benefits and Costs

Calendar Year	Project Year	7% Discounted Costs	7% Discounted Benefits	7% Discounted Net Benefits (2016$)
2017	1	$3,537,383	$0	($3,537,383)
2018	2	$7,090,867	$0	($7,090,867)
2019	3	$6,422,904	$0	($6,422,904)
2020	4	$5,117,755	$0	($5,117,755)
2021	5	$121,208	$2,087,868	$1,966,661
2022	6	$113,278	$2,014,597	$1,901,319
2023	7	$105,867	$1,943,351	$1,837,484
2024	8	$98,942	$1,873,946	$1,775,005
2025	9	$92,469	$1,806,461	$1,713,992
2026	10	$86,419	$1,740,911	$1,654,491
2027	11	$80,766	$1,677,255	$1,596,489
2028	12	$75,482	$1,600,765	$1,525,283
2029	13	$70,544	$1,541,472	$1,470,928
2030	14	$65,929	$1,484,099	$1,418,170
2031	15	$61,616	$1,428,648	$1,367,032
2032	16	$57,585	$1,374,967	$1,317,383
2033	17	$53,818	$1,323,044	$1,269,226
2034	18	$50,297	$1,272,799	$1,222,502
2035	19	$47,006	$1,224,270	$1,177,263
2036	20	$43,931	$1,177,383	$1,133,452
2037	21	$41,057	$1,132,102	$1,091,044
2038	22	$38,371	$1,088,439	$1,050,068
2039	23	$35,861	$1,046,409	$1,010,548
2040	24	$33,515	$1,005,732	$972,217
Total		**$23,542,870**	**$29,844,519**	**$6,301,649**

The monetized benefits presented in Table ES-2 are part of the justification of the selection criteria elements. These criteria are also justified with other benefits that have not been

monetized at this time. The following are the key benefits in the justification of the project for the primary selection criteria.

The state of good repair benefits from this project are primarily from the reduced vehicle operating costs. This includes operating cost savings for vehicles on West 32nd street from Schifferdecker Ave to Central City due to improved free flow speed and efficiency. The idling time operating cost savings from the wait time at the rail-grade crossing also contributes to the state of good repair. Non-monetized state of good repair benefits are reduced operating costs from reduced wait times on at the right turn from Main Street northbound at 32nd Street.

Economic competitiveness benefits are travel time savings for passengers on west 32nd Street from Schifferdecker Ave to Central City due to improved free flow speeds. There are also travel time savings due to a reduction in wait time at the rail-grade crossing which are monetized. Travel time savings due to a reduction in wait time at the northbound right turn lane of Main Street has not yet been monetized.

Community and environmental benefits are generated via a reduction in emissions and CO2 from vehicles on West 32nd street from Schifferdecker Ave to Central City as well as eliminating idling time emissions and CO2 cost savings from the wait time at the rail-grade crossing.

Safety benefits are calculated related to the reduction in accidents along West 32nd street from Schifferdecker Ave to Central City, the reduction in accidents due to the removal of the at-grade rail crossing, and the reduction in accidents due to the northbound right turn lane of Main Street.

2. Introduction

This document provides detailed technical information on the economic analyses conducted in support of the Grant Application for the Joplin 32nd Street Corridor Improvements project.

Section 3, Methodological Framework, introduces the conceptual framework used in the Benefit-Cost Analysis (BCA). Section 4, 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 the types of effects that the Joplin 32nd Street Corridor Improvements project is expected to generate. Section 5, General Assumptions, discusses the general assumptions used in the estimation of project costs and benefits, while estimates of travel demand and traffic growth can be found in Section 6, Demand Projections. Specific data elements and assumptions pertaining to the long-term outcome selection criteria are presented in Section 7, Benefits Measurement, Data and Assumptions, along with associated benefit estimates. Estimates of the project's Net Present Value (NPV), its Benefit/Cost ratio (BCR) and other project evaluation metrics are introduced in Section 8, Summary of Findings and BCA Outcomes. Additional data tables are provided in Section 9, Supplementary Data Tables, including annual estimates of benefits and costs, as well as intermediate values to assist DOT in its review of the application.[1]

3. Methodological Framework

Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies in monetary terms as many of the costs and benefits of a project as possible. Benefits are broadly defined. They represent the extent to which people impacted by the project are made better-off, as measured by their own willingness-to-pay. In other words, central to BCA is the idea that people are best able to judge what is "good" for them, what improves their well-being or welfare.

BCA also adopts the view that a net increase in welfare (as measured by the summation of individual welfare changes) is a good thing, even if some groups within society are made worse-off. A project or proposal would be rated positively if the benefits to some are large enough to compensate the losses of others.

Finally, BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life-cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns.

The specific methodology developed for this application was developed using the above BCA principles and is consistent with the TIGER 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 five long-term outcomes identified in the Notice of Funding Opportunity (NOFO);

[1] While the models and software themselves do not accompany this appendix, greater detail can be provided, including spreadsheets presenting additional interim calculations and discussions on model mechanics and coding, if requested.

- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using DOT 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 the DOT (7 percent, and 3 percent for sensitivity analysis); and
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

4. Project Overview

The city of Joplin is seeking funding to improve the 32nd Street Corridor in Joplin, MO. The corridor improvements are a combination of several projects described in detail in Chapter 2.2 of the application:

- Grade Separation at 32nd Street near Davis Boulevard;
- West 32nd Street Widening from Schirfferdecker Avenue to Central City Road;
- Northbound 32nd and Main Street Right Turn Lane;
- Roadway repaving between the intersections at Main Street and Interstate 44; and
- 32nd Street Sidewalk Improvements and ACA upgrades.

4.1 Base Case and Alternatives

In the base case, the city of Joplin would have to maintain current conditions along 32nd Street. Without these improvements there is expected to be an increase in travel time and reduced safety in the long run. The base case shows moderate traffic growth along West 32nd Street and at the grade separation. There would continue to be safe travel speed limitations along West 32nd Street and long delays from the hourly train crossings near Davis Boulevard.

The improvements suggested would minimize the negative impacts at each project area. The grade separation will reduce delays at the rail crossings. The widening project will increase the safe free flow speed along the west end of the corridor. A right turn lane at 32nd and Main will reduce the number of cars waiting at the intersection. The repaving with reduce public roadway maintenance costs recued wear vehicle using the road. Lastly the sidewalk improvements are intended to improve pedestrian mobility along the corridor.

4.2 Types of Impacts and Affected Population

The 32nd Street Corridor is one of the primary east-west transportation corridors for the City of Joplin, providing access to industrial complexes, commercial centers, and health care facilities as well as thousands of jobs in the region. Joplin is a regional employments center; significantly growing in population.

The widening improvements along 32nd Street can be expected to:

- Reduce travel times and operating costs for drivers and passengers along the corridor;
- Decrease the rate of accidents along the corridor; and
- Provide Joplin citizens with uninterrupted travel to employment, recreational, and medical facilities.

The grade separation efforts will:

- Reduce transportation wait times and vehicle idling costs;
- Provide the community a safer rail crossing for both vehicles and pedestrian; and
- Provide and continuous connection across the community, no longer periodically severed each time a train passes through town.

The side walk and ACA improvements will be expected to provide safe and efficient facilities for bicyclists and pedestrians. As a whole, the project will provide a job-creating project in an economically depressed area and contribute to a regional economy dependent on trade and commerce.

4.3 Project Cost and Schedule

The cost estimates for the Grade Separation at 32nd Street near Davis Boulevard include a four year planning and construction effort. This project will cost approximately $9.5 million. It will require a $95,000 commitment in annual maintenance.

West 32nd Street Widening from Schirfferdecker Avenue to Central City Road construction is expected to be completed by fall of 2020. These improvements will cost an estimated $13 million with an expected annual maintenance of $65,000.

The 32nd and Main Street Right Turn Lane project will cost $0.5 million dollars over two years of construction work. There is an estimated required $5000 per year in annual maintenance with this project.

Sidewalk and ADA Improvements will take about two years to implement the improvements from 2017 to 2019. This sidewalk improvement will cost about $3.48 million. The project will cost an estimated $5000 per year in maintenance.

Table 1: Cost Summary by Project

	West 32nd Street Widening	32nd Street Rail-Grade Separation	Main Street Northbound Right Turn Lane	32nd Street Sidewalk and ADA Improvements
Construction and Planning Costs	$13,000,000	$9,500,000	$500,000	$3,480,000
Total Operations and Maintenance Costs	$1,300,000	$1,900,000	$100,000	$100,000

4.4 Effects on Long-Term Outcomes

The main benefits associated with the project are mapped into the five long-term outcome criteria set forth by the DOT in the table below.

Table 2: Expected Effects on Long-Term Outcomes and Benefit Categories

Long Term Outcomes	Benefit Categories	Description	Monetized	Quantified	Qualitative
State of Good Repair	**Vehicle Operating Cost Savings vehicles on West 32nd street from Schifferdecker Ave to Central City**	West 32nd Street Widening	Yes	Yes	
	Idling Time Operating Cost Savings from the wait time at the rail-grade crossing	32nd Street Rail-Grade Separation	Yes	Yes	
Economic Competitiveness	**Travel time savings for passengers on west 32nd Street from Schifferdecker Ave to Central City**	West 32nd Street Widening	Yes	Yes	

Long Term Outcomes	Benefit Categories	Description	Monetized	Quantified	Qualitative
	Travel time savings due to a reduction in wait time at the rail-grade crossing	32nd Street Rail-Grade Separation	Yes	Yes	
	Travel time savings due to a reduction in wait time at 32nd and Main.	Main Street Northbound Right Turn Lane			Yes
	Travel time savings due to improved pedestrian mobility	32nd Street Sidewalk and ADA Improvements			Yes
Safety	**Reduction in accidents along West 32nd street from Schifferdecker Ave to Central City**	West 32nd Street Widening	Yes	Yes	
	Reduction in accidents due to the removal of the at grade rail crossing	32nd Street Rail-Grade Separation	Yes	Yes	
	Reduction in accidents at 32nd and Main.	Main Street Northbound Right Turn Lane			Yes
Sustainability	**Reduction in Emissions and CO2 from vehicles on West 32nd street from Schifferdecker Ave to Central City**	West 32nd Street Widening	Yes	Yes	
	Idling Time Emissions and CO2 Cost Savings from the wait time at the rail-grade crossing	32nd Street Rail-Grade Separation	Yes	Yes	

5. General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction and including 20 years of operations.

The monetized benefits and costs are estimated in 2016 dollars with future dollars discounted in compliance with TIGER requirements using a 7 percent real rate, and sensitivity testing at 3 percent.

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

- Input prices are expressed in 2016 dollars;
- The period of analysis begins in 2016 and ends in 2040. It includes project development and construction years (2016 - 2020) and 20 years of operations (2020 - 2040);
- A constant 7 percent real discount rate is assumed throughout the period of analysis. A 3 percent real discount rate is used for sensitivity analysis; and
- Opening year demand is an input to the BCA and is assumed to be fully realized in Year 1 (no ramp-up).

6. Demand Projections

The traffic projections are identified in the long term project plans for the Joplin area, or more specifically identified in the JATSO 2036 Metropolitan Transportation Plans. These demand projections show moderate traffic growth projections between 2013 and 2024. The traffic growth rates are assumed to be constant between the two data points and to continue to grow at this rate in the subsequent years. For the rail grade crossing, the Federal Railway Administration (FRA) grade crossing database[2] was used to get basic information on the crossing.

6.1 Methodology

The Grade Separation at 32nd Street near Davis Boulevard portion of the project will measure the benefits from the reduced idling time with the at grade crossing to having no idling time with the overpass.

The benefits to the West 32nd Street Widening from Schirfferdecker Avenue to Central City Road aspect from the project will be measured on the improved free flow travel conditions, including speed and safety. The improved travel efficiency will provide vehicle operating cost savings and reduced vehicle emissions.

The city of Joplin provided information that the delays to turn right off of Main Street on to 32nd Street can range from 30 to 60 second per car accounting for the 130 second cycle of the light At the time of analysis there was limited available information regarding the traffic volumes for the northbound 32nd and Main Street right turn lane, so rather than having a traffic count done, the analysis recognizes that benefits are under quantified here.

[2] http://safetydata.fra.dot.gov/webaps/default.aspx

For the 32nd Street Sidewalk Improvements and ACA upgrades there is limited data measuring the likely safety benefits. Therefore, the analysis acknowledges the difficulty in measuring these benefits and does not try to force the measurement of benefits to justify this portion of the project. Thus, benefits are under estimated again.

6.2 Assumptions

The basic assumptions in estimating the impact of grade separation involve the estimation of average train length and speed for use in the accident prediction model. The FRA crossing data provides much of the information needed, and the City of Joplin estimates that the gate closures are about 8 minutes. Given this information, and the lead and lag time of 0.6 minutes, the analysis uses a 10,000 foot train traveling at 16 mph to approximate a 7.7 minute delay per crossing. This delay estimate and the number of trains per day are assumed to be constant throughout the study period. The analysis also assumes that the percentage of blockage time impacting vehicles stopped at the crossing is only 50%.

Accident statistics for the 32nd street corridor are tabulated from the City of Joplin's police reports. These reports include all accidents along the full length of 32nd street. As a simple method to identify the share along the improvement corridor, the analysis assumes there will be an equal distribution of accidents along all 15.2 miles of 32nd street.

Table 3: Assumptions Used in the Estimation of Demand

Variable Name	Unit	Value	Source
Train Length	Feet	10,000	Estimated based on the City of Joplin information that there is an 8 minute delay. 12,000 feet is the longest in the US limited by AAR Standard S-4200.
Train Speed	Mph	16	This is the speed required to achieve an approximate 8 minute delay with a 10,000 foot long train.
Percentage of Average Blockage Time Impacting Vehicles Waiting	%	50	HDR Estimate
Percent of Trucks	%	8	http://safetydata.fra.dot.gov/webaps/default.aspx

6.3 Demand Projections

The resulting projections for traffic at the West 32nd Street Widening section and the 32nd Street Rail-Grade Separation Section are presented in the table below.

Table 4: Annual Demand Projections

Calendar Year	West 32nd Street Widening Forecasted ADT	32nd Street Rail-Grade Separation Forecasted ADT
2013	12,000	14,800
2014	12,375	15,203

Calendar Year	West 32nd Street Widening Forecasted ADT	32nd Street Rail-Grade Separation Forecasted ADT
2015	12,750	15,672
2016	13,126	16,140
2017	13,501	16,609
2018	13,876	17,078
2019	14,251	17,547
2020	14,626	18,015
2021	15,001	18,484
2022	15,377	18,953
2023	15,752	19,421
2024	16,127	19,890
2025	16,502	20,359
2026	16,877	20,827
2027	17,253	21,296
2028	17,628	21,765
2029	18,003	22,234
2030	18,378	22,702
2031	18,753	23,171
2032	19,128	23,640
2033	19,504	24,108
2034	19,879	24,577
2035	20,254	25,046
2036	20,629	25,514
2037	21,004	25,983
2038	21,380	26,452
2039	21,755	26,921
2040	22,130	27,389

7. Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each benefit or impact category identified in Table 2 (Expected Effects on Long Term Outcomes and Benefit Categories) and provides an overview of the associated methodology, assumptions, and estimates.

7.1 State of Good Repair

To quantify the benefits associated with maintaining the existing transportation network in a state of good repair, the reduced vehicle operating costs are estimated based on improved travel speed and reduced waiting time that will arise due to the project. For the 32nd Street Widening section, the state of good repair benefits are only related to savings from more efficient fuel consumption due to faster speeds. For the 32nd Street Rail-Grade Separation portion of the project, the elimination of wait time from the crossing reduces the vehicle operating costs from idle time.

Table 5: Estimates of [State-of-Good-Repair] Benefits, 2016 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
West 32nd Street Widening	$106,921	$3,711,840	$1,433,785
32nd Street Rail-Grade Separation	$37,614	$1,525,472	$567,294

7.2 Economic Competitiveness

The proposed project would 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, the measure of mobility presented is: travel time savings. Travel time savings for the West 32nd Street Widening is related to the improved free flow speed from 30 to 40 miles per hour as estimated by the City of Joplin. This change in free flow speed creates nearly 2 million person hours of travel time savings. Travel time savings for the 32nd Street Rail-Grade Separation arise from the elimination of wait time for when train crossings occur. With no train crossings impacting traffic, over 1.1 million person hours saved due to the Rail-Grade Separation. These person hours are monetized in Table 6.

Table 6: Estimates of Travel Time and Out-of-Pocket Cost Savings, 2016 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
West 32nd Street Widening	$860,863	$33,122,261	$12,515,085

32nd Street Rail-Grade Separation	$491,226	$19,278,052	$7,234,580

7.3 Environmental Sustainability

Environmental sustainability comes from reduced CO_2 emissions. The higher free flow speed for the West 32nd Street Widening will produce a savings of nearly 10,000 tons of CO_2 while the elimination of the wait time at the 32nd Street Rail-Grade Separation will lead to a reduction of about 2,000 tons of CO_2. This translates monetarily into the impacts shown in Table 7.

Table 7: Estimates of Environmental Sustainability Benefits, 2016 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
West 32nd Street Widening	$32,952	$760,221	$327,088
32nd Street Rail-Grade Separation	$6,126	$151,772	$93,059

7.4 Safety

The West 32nd Street Widening project will have significant safety improvements. Installing center two-way left-turn lanes on two-lane roads improves safety on the roads. FHWA publications[3] indicate that there will be a crash reduction factor of 79.7%. This is a cumulative number from the combination of improvements over several states. This will lead to a reduction in accidents over a 20 year period including less than one fatal crash, nearly 27 injury only crashes, and 120 property damage crashes are not expected to occur in this updated road.

The 32nd Street Rail-Grade Separation project has safety benefits from removing the rail crossing. The assumption used in this benefit calculation is that all of the accidents that have been captured in the FRA statistics for the crossing will no longer occur if the crossing is no longer at-grade since the road vehicles will no longer cross the railroad tracks. This will result in avoiding nearly one fatal accident, 2.8 injury only accidents and 5.4 property damage accidents over 20 years. Table 8 shows the monetary value of public benefits of these projects.

Table 8: Estimates of Safety Benefits, 2016 Dollars

	In Project Opening Year	Over the Project Lifecycle	
		In Constant Dollars	Discounted at 7 Percent
West 32nd Street Widening	$302,173	$10,490,144	$4,052,064
32nd Street Rail-Grade Separation	$249,993	$9,607,888	$3,621,564

[3] Publication Number: FHWA-HRT-08-042. Date: March 2008. Safety Evaluation of Installing Center Two-Way Left-Turn Lanes on Two-Lane Roads

8. Summary of Findings and BCA Outcomes

The tables below summarize the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (20 years). As stated earlier, construction is expected to be completed by 2040. Benefits accrue during the full operation of the project.

Table 9: Overall Results of the Benefit Cost Analysis, Millions of 2016 Dollars*

Project Evaluation Metric	7% Discount Rate	3% Discount Rate
Total Discounted Benefits	$29,844,519	$50,529,222
Total Discounted Costs	$23,542,870	$26,735,107
Net Present Value	$6,301,649	$23,794,115
Benefit / Cost Ratio	1.27	1.89
Internal Rate of Return (%)	9.6%	
Payback Period (years)	9 Years	

Considering all monetized benefits and costs, the estimated internal rate of return of the project is 9.6 percent. With a 7 percent real discount rate, the $23.5 million investment would result in $29.8 million in total benefits and a Benefit/Cost ratio of approximately 1.27.

With a 3 percent real discount rate, the Net Present Value of the project would increase to $23.8 million, for a Benefit/Cost ratio of 1.89.

Table 10: Benefit Estimates by Long-Term Outcome for the Full Build Alternative

Long Term Outcomes	Benefit Categories	7% Discount Rate	3% Discount Rate
State of Good Repair	**Vehicle Operating Cost Savings vehicles on West 32nd street from Schifferdecker Ave to Central City**	$1,433,785	$2,404,795
	Idling Time Operating Cost Savings from the wait time at the rail-grade crossing	$567,294	$971,825
Economic Competitiveness	**Travel time savings for passengers on west 32nd Street from Schifferdecker Ave to Central City**	$12,515,085	$21,252,050
	Travel time savings due to a reduction in wait time at the rail-grade crossing	$7,234,580	$12,331,180

Safety	Reduction in accidents along West 32nd street from Schifferdecker Ave to Central City	$4,052,064	$6,796,264
	Reduction in accidents due to the removal of the at grade rail crossing	$3,621,564	$6,157,542
Sustainability	Reduction in Emissions and CO2 from vehicles on West 32nd street from Schifferdecker Ave to Central City	$327,088	$516,144
	Idling Time Emissions and CO2 Cost Savings from the wait time at the rail-grade crossing	$93,059	$99,422

9. Supplementary Data Tables

This section breaks down all benefits associated with the long-term outcome criteria (State of Good Repair, Economic Competiveness, Environmental Sustainability, and Safety) in annual form for the improvements to the 32nd Street Corridor. Supplementary data tables are also provided for some specific benefit categories. For example, tables providing estimates of annual emission reductions (in tons) are provided under Environmental Sustainability.

Table 11: Annual Estimates of Total Project Benefits and Costs

Calendar Year	Project Year	Total Undiscounted Costs	Total Undiscounted Benefits	Undiscounted Net Benefits	7% Discounted Net Benefits (2016$)	3% Discounted Net Benefits (2016$)
2017	1	$3,785,000	$0	($3,785,000)	($3,537,383)	($3,674,757)
2018	2	$8,118,333	$0	($8,118,333)	($7,090,867)	($7,652,308)
2019	3	$7,868,333	$0	($7,868,333)	($6,422,904)	($7,200,640)
2020	4	$6,708,333	$0	($6,708,333)	($5,117,755)	($5,960,267)
2021	5	$170,000	$2,927,297	$2,757,297	$1,966,661	$2,378,468
2022	6	$170,000	$3,022,060	$2,852,060	$1,901,319	$2,388,556
2023	7	$170,000	$3,118,982	$2,948,982	$1,837,484	$2,397,792
2024	8	$170,000	$3,217,874	$3,047,874	$1,775,005	$2,406,020
2025	9	$170,000	$3,318,873	$3,148,873	$1,713,992	$2,413,349
2026	10	$170,000	$3,422,062	$3,252,062	$1,654,491	$2,419,840
2027	11	$170,000	$3,527,436	$3,357,436	$1,596,489	$2,425,483
2028	12	$170,000	$3,601,899	$3,431,899	$1,525,283	$2,407,065
2029	13	$170,000	$3,711,017	$3,541,017	$1,470,928	$2,411,260
2030	14	$170,000	$3,822,650	$3,652,650	$1,418,170	$2,414,832
2031	15	$170,000	$3,936,954	$3,766,954	$1,367,032	$2,417,865
2032	16	$170,000	$4,053,850	$3,883,850	$1,317,383	$2,420,287
2033	17	$170,000	$4,173,369	$4,003,369	$1,269,226	$2,422,104
2034	18	$170,000	$4,295,428	$4,125,428	$1,222,502	$2,423,254
2035	19	$170,000	$4,420,331	$4,250,331	$1,177,263	$2,423,904
2036	20	$170,000	$4,548,030	$4,378,030	$1,133,452	$2,424,009
2037	21	$170,000	$4,678,595	$4,508,595	$1,091,044	$2,423,592
2038	22	$170,000	$4,812,327	$4,642,327	$1,050,068	$2,422,795
2039	23	$170,000	$4,949,433	$4,779,433	$1,010,548	$2,421,699
2040	24	$170,000	$5,089,183	$4,919,183	$972,217	$2,419,912
Total		**$29,880,000**	**$78,647,650**	**$48,767,650**	**$6,301,649**	**$23,794,115**

Table 12: State of Good Repair - Annual Benefit Estimates (2016 $)

Calendar Year	Project Year	7% Discounted West 32nd Street Widening	7% Discounted 32nd Street Rail-Grade Separation	7% Discounted Benefits (2016$)
2017	1	$0	$0	$0
2018	2	$0	$0	$0
2019	3	$0	$0	$0
2020	4	$0	$0	$0
2021	5	$106,921	$37,614	$144,535
2022	6	$102,425	$36,361	$138,786
2023	7	$98,060	$35,180	$133,240
2024	8	$93,828	$34,059	$127,887
2025	9	$89,730	$32,979	$122,708
2026	10	$85,766	$31,947	$117,713
2027	11	$81,937	$30,932	$112,869
2028	12	$78,242	$29,969	$108,211
2029	13	$74,680	$29,041	$103,720
2030	14	$71,249	$28,144	$99,393
2031	15	$67,947	$27,313	$95,259
2032	16	$64,772	$26,561	$91,333
2033	17	$61,722	$25,829	$87,551
2034	18	$58,794	$25,072	$83,865
2035	19	$55,984	$24,363	$80,347
2036	20	$53,291	$23,665	$76,957
2037	21	$50,711	$22,980	$73,690
2038	22	$48,240	$22,353	$70,593
2039	23	$45,875	$21,784	$67,659
2040	24	$43,613	$21,147	$64,760
Total		**$1,433,785**	**$567,294**	**$2,001,079**

Table 13: Economic Competitiveness - Annual Benefit Estimates (2016 $)

Calendar Year	Project Year	7% Discounted West 32nd Street Widening	7% Discounted 32nd Street Rail-Grade Separation	Total Person Hours Saved - West 32nd Street Widening	Total Person Hours Saved - 32nd Street Rail-Grade Separation	7% Discounted Benefits (2016$)
2017	1	$0	$0			$0
2018	2	$0	$0			$0
2019	3	$0	$0			$0
2020	4	$0	$0			$0
2021	5	$860,863	$491,226	78,308	44,772	$1,352,089
2022	6	$832,912	$474,683	80,266	45,743	$1,307,596
2023	7	$805,390	$458,697	82,224	46,736	$1,264,087
2024	8	$778,335	$443,250	84,183	47,751	$1,221,585
2025	9	$751,782	$428,322	86,141	48,787	$1,180,105
2026	10	$725,760	$413,898	88,100	49,846	$1,139,658
2027	11	$700,292	$399,959	90,058	50,928	$1,100,251
2028	12	$675,398	$386,489	92,017	52,033	$1,061,888
2029	13	$651,094	$373,473	93,975	53,163	$1,024,568
2030	14	$627,392	$360,896	95,934	54,317	$988,288
2031	15	$604,301	$348,742	97,892	55,496	$953,043
2032	16	$581,827	$336,997	99,851	56,700	$918,824
2033	17	$559,973	$325,648	101,809	57,931	$885,621
2034	18	$538,741	$314,681	103,767	59,188	$853,422
2035	19	$518,129	$304,084	105,726	60,473	$822,212
2036	20	$498,134	$293,843	107,684	61,785	$791,977
2037	21	$478,753	$283,947	109,643	63,126	$762,700
2038	22	$459,979	$274,385	111,601	64,497	$734,364
2039	23	$441,805	$265,144	113,560	65,896	$706,949
2040	24	$424,223	$256,215	115,518	67,327	$680,438
Total		**$12,515,085**	**$7,234,580**	**1,938,257**	**1,106,494**	**$19,749,666**

Table 14: Environmental Sustainability - Annual Benefit Estimates (2016 $)

Calendar Year	Project Year	7% Discounted West 32nd Street Widening	7% Discounted 32nd Street Rail-Grade Separation	CO2 Emissions Saved - West 32nd Street Widening	CO2 Emissions Saved - 32nd Street Rail-Grade Separation	7% Discounted Benefits (2016$)
2017	1	$0	$0			$0
2018	2	$0	$0			$0
2019	3	$0	$0			$0
2020	4	$0	$0			$0
2021	5	$32,952	$6,126	473	106	$39,078
2022	6	$31,845	$5,807	485	106	$37,651
2023	7	$30,760	$5,617	497	106	$36,377
2024	8	$29,697	$5,365	509	105	$35,062
2025	9	$28,659	$5,140	521	105	$33,799
2026	10	$27,645	$4,943	532	105	$32,588
2027	11	$26,657	$4,770	544	105	$31,427
2028	12	$10,939	$4,620	423	104	$15,559
2029	13	$10,618	$4,429	432	105	$15,047
2030	14	$10,303	$4,333	441	105	$14,636
2031	15	$9,993	$4,322	450	106	$14,315
2032	16	$9,689	$4,255	459	107	$13,944
2033	17	$9,392	$4,206	468	108	$13,597
2034	18	$9,100	$4,173	477	109	$13,273
2035	19	$8,815	$4,150	486	110	$12,965
2036	20	$8,536	$4,136	495	112	$12,672
2037	21	$8,264	$4,129	504	114	$12,393
2038	22	$7,998	$4,132	513	116	$12,130
2039	23	$7,739	$4,198	522	118	$11,937
2040	24	$7,486	$4,209	531	121	$11,695
Total		**$327,088**	**$93,059**	**9,759**	**2,172**	**$420,147**

Table 15: Safety - Annual Benefit Estimates

Calendar Year	Project Year	7% Discounted West 32nd Street Widening	7% Discounted 32nd Street Rail-Grade Separation	Fatal Accidents Saved - West 32nd Street Widening	Injury Only Accidents Saved - West 32nd Street Widening	PDO Accidents Saved - West 32nd Street Widening	Fatal Accidents Saved - 32nd Street Rail-Grade Separation	Injury Only Accidents Saved - 32nd Street Rail-Grade Separation	PDO Accidents Saved - 32nd Street Rail-Grade Separation	7% Discounted Benefits (2016$)
2017	1	$0	$0							$0
2018	2	$0	$0							$0
2019	3	$0	$0							$0
2020	4	$0	$0							$0
2021	5	$302,173	$249,993	0.0	1.1	4.8	0.0	0.1	0.2	$552,166
2022	6	$289,467	$241,096	0.0	1.1	5.0	0.0	0.1	0.2	$530,564
2023	7	$277,131	$232,517	0.0	1.1	5.1	0.0	0.1	0.2	$509,647
2024	8	$265,170	$224,242	0.0	1.2	5.2	0.0	0.1	0.2	$489,412
2025	9	$253,588	$216,262	0.0	1.2	5.3	0.0	0.1	0.2	$469,850
2026	10	$242,386	$208,566	0.0	1.2	5.5	0.0	0.1	0.2	$450,952
2027	11	$231,565	$201,144	0.0	1.2	5.6	0.0	0.1	0.3	$432,708
2028	12	$221,122	$193,986	0.0	1.3	5.7	0.0	0.1	0.3	$415,107
2029	13	$211,054	$187,082	0.0	1.3	5.8	0.0	0.1	0.3	$398,137
2030	14	$201,358	$180,425	0.0	1.3	5.9	0.0	0.1	0.3	$381,782
2031	15	$192,026	$174,004	0.0	1.3	6.1	0.0	0.1	0.3	$366,030
2032	16	$183,054	$167,812	0.0	1.4	6.2	0.0	0.1	0.3	$350,866
2033	17	$174,434	$161,840	0.0	1.4	6.3	0.0	0.1	0.3	$336,274

Calendar Year	Project Year	7% Discounted West 32nd Street Widening	7% Discounted 32nd Street Rail-Grade Separation	Fatal Accidents Saved - West 32nd Street Widening	Injury Only Accidents Saved - West 32nd Street Widening	PDO Accidents Saved - West 32nd Street Widening	Fatal Accidents Saved - 32nd Street Rail-Grade Separation	Injury Only Accidents Saved - 32nd Street Rail-Grade Separation	PDO Accidents Saved - 32nd Street Rail-Grade Separation	7% Discounted Benefits (2016$)
2034	18	$166,159	$156,080	0.0	1.4	6.4	0.0	0.1	0.3	$322,239
2035	19	$158,219	$150,526	0.0	1.4	6.5	0.0	0.2	0.3	$308,745
2036	20	$150,608	$145,169	0.0	1.5	6.7	0.0	0.2	0.3	$295,777
2037	21	$143,315	$140,003	0.0	1.5	6.8	0.0	0.2	0.3	$283,318
2038	22	$136,331	$135,021	0.0	1.5	6.9	0.0	0.2	0.3	$271,352
2039	23	$129,648	$130,216	0.0	1.6	7.0	0.0	0.2	0.3	$259,864
2040	24	$123,256	$125,582	0.0	1.6	7.2	0.0	0.2	0.3	$248,838
Total		**$4,052,064**	**$3,621,564**	**0.5**	**26.6**	**120.0**	**0.8**	**2.8**	**5.4**	**$7,673,628**