Viaduct Greenway:
A Rails-to-Trail Conversion
RAISE Grant
APPENDIX F. COST BENEFIT ANALYSIS NARRATIVE

SUBMITTED BY: CENTER CITY DISTRICT
Location: Philadelphia, PA
RAISE GRANT Request: $24,000,000
Date: February 2024

Executive Summary

The Center City District (CCD) is planning the development of the Viaduct Greenway, which will convert an abandoned elevated rail corridor into a greenway trail. With the construction of this greenway trail, residents will have the option to use infrastructure that is unaffected by surface street hazards and supports safe and low-cost modes of transportation. Additionally, this trail will become a newly accessible green space that will offer new recreational amenities as well as improved access to existing parks for a growing number of families with children in the area. These improvements represent expansions of access to residents and workers in the area and will generate benefits through increased transportation safety for a wide range of users, including pedestrians, cyclists, and drivers travelling on or near the Viaduct. The project will reduce the need for vehicle miles traveled by residents and visitors by making walking and biking more appealing, improve safety for all travel modes in the project area, support neighborhood businesses by making them more accessible, promote active recreation and health, increase property values, and improve factors impacting quality of life for people in nearby communities. Overall, the project generates benefits well exceeding its costs. The quantified value of each of the benefits described below represents the economic value lost by failing to implement the planned improvements.

Table 1 – Benefit Summary Table

Long-Term Outcome	Associated Benefit Types
Safety	Reduced Traffic Injuries Pedestrian and Cyclist Crash Reduction Reduction in Crime Risk
Environmental Sustainability	Car Air Pollution Reduction - Reduced VMT Green Design Impacts - Air Quality Soil Remediation CO2 Reduction Benefit
Quality of Life	Recreation Benefits – New Users Recreation Benefits – Current Users Reduced Noise Pollution Improved Experience
Mobility and Community Connectivity	Pedestrian Journey Quality and Comfort Cycling Journey Quality and Comfort
Economic Competitiveness and Opportunity	Health Benefits - New Users Property Value Increase Reduced Congestion Job Creation
State of Good Repair	Reduced VMTs - Road Maintenance Costs Reduced Car Accidents - Property Damage Deferred Maintenance Stormwater Cost Savings - Water Treatment Stormwater Cost Savings - Energy Savings

Background

The Center City District (CCD) is pursuing funds through the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant program for the development of the Viaduct Greenway. The

project will convert an abandoned elevated railway into a high-quality greenway trail for an area spanning north of Vine Street, east of North 12th Street, south of Mount Vernon Street, and west of North 8th street. The Greenway will consist of an elevated active transportation trail to facilitate movement throughout the area and enhance cohesion of Poplar, Callowhill and the surrounding area. Instead of loud, difficult to cross, and complex of surface roads, the Viaduct Greenway will provide a safe and accessible trail for pedestrians and cyclists. Additionally, it will rehabilitate the aging and overgrown viaduct, transforming infrastructure that has long divided the area into an asset.

The planned improvements are expected to return the viaduct to a state of good repair and generate significant benefits for safety, quality of life, and health outcomes, among others. This analysis identifies and quantifies the benefits in their natural units (travel time savings, for example) and values the benefits in dollar terms. We then discount the benefits by 3.1 percent and calculate the Benefit-Cost ratio. The detailed Benefit-Cost Analysis indicates that quantifiable benefits are 4.7 to 8.0 times the total costs of the project, as shown in Table 1.

Table 2 - Benefit Cost Summary

Metric	Nominal Sum	Present Value (3.1%)
Present Value of Benefits	$565,920,356	$300,860,308
Present Value of Costs	$71,164,383	$63,959,926
Net Present Value	**$494,755,973**	**$236,900,382**
Benefit / Cost Ratio	**8.0**	**4.7**

Baseline Assumptions

The BCA compares the proposed project against the baseline over a span of thirty years. The focus of this BCA is the construction of the Viaduct Greenway relevant to this RAISE application. Geographically, the project area covers tracts 131, 132, and 376. This area is bounded by Poplar Street to the north, by North 6th Street to the east, by Vine Street to the south, and by North Broad Street to the west. In the baseline scenario, the construction of the Viaduct Greenway is not undertaken.

Project Costs

Project costs relevant to this application are $71.2 million. The present value of the project cost is $64.0 million when discounted at 3.1 percent. Construction is modeled to take place over a total of two years. Once complete, operations and maintenance of the Viaduct is expected to cost $1.5 million per year. This cost was subtracted from the total benefits.

Capture Period for Benefits

The construction period of the project is estimated to last from 2025 to 2026. We assume that the project begins to generate full benefits in 2027. We calculate the benefits of the project over 30 years ending in 2057.

1. Safety

The proposed project confers safety benefits through direct roadway design improvements as well as the marginal shift of travel from vehicular modes to pedestrian, cyclist, and public transit

usage. Transfer away from vehicular travel reduces the overall likelihood of crashes on the roadway. The addition of an elevated path through the area will address safety issues that motorists, pedestrians and cyclists currently face in the project area. Due to traffic volumes and relatively unsafe conditions for both pedestrians and motorists, the project area has experienced a high crash rate in recent years; 742 crashes have occurred in the project area within the last five years, including three fatal crashes. [1] The addition of a path grade-separated from the dangers of the surface road will reduce crash rates for the surrounding area, which will generate additional benefits in the form of avoided property damage. The project will also reduce the risk of crime, including violent crime, by improving area cohesion, community presence, and physical factors including lighting.

Reduced Traffic Crashes – Injuries and Fatalities

The reduction in vehicle miles traveled (VMT) reduces traffic crashes, effectively reducing injuries and deaths. Using specific crash information for the project area, and valuation guidance from USDOT, VMT reduction can be translated to the expected value of avoided crashes. The separation of pedestrian and cyclist traffic from vehicular traffic will directly reduce risk to travelers in vehicles. The remediation of the structure and adjoined infrastructure will also marginally improve conditions across the area roadways. Based on those calculations, we estimate that these improvements will result in annual benefits of $762,631 per year.

Reduced Pedestrian and Bicycling Crashes

Improvements to the project area will decrease the risk of pedestrian and cyclist-related crashes. The inclusion of extensive new pedestrian and cyclist paths separated from the roadway will significantly decrease the risk of collision or other incidents. This is a particularly important benefit for this area due to the high proportion of residents who report walking to work.[2] We estimate pedestrian and cyclist crash reductions to generate $6,745,306 in safety benefits each year.

Reduction in Crime Risk

The proposed project will include many factors that will reduce crime risk and increase public safety. Improved lighting, visibility, pedestrian movement, and significant place-making improvements will all lead to reductions in crime in the area.

Recent studies show that in addition to direct improvements such as lighting and multiple pedestrian paths, placemaking and maintenance have a significant effect on crime risk mitigation. Thorough maintenance and development of a space, including signage, cohesive design, and amenities, helps to "establish ownership" which can greatly deter criminal activity. With proper implementation, improvements like these can mitigate crime risk by 45% or more.[1] Crime generates substantial costs to society at the individual, community, and national levels. Investments that directly or indirectly reduce or prevent crime can generate substantial economic benefits by reducing the crime-related costs incurred by the victim, communities, and criminal justice system. The combined effects of the improvements in this project, accounting for the urban nature of the surrounding area, are conservatively estimated to reduce crime in the project area by 5%. Using per-crime social cost figures, this effect is valued at $2,998,060 per year.[2]

[1] Review of study area tracts. Pennsylvania Department of Transportation.
[2] U.S. Census Bureau. See equity analysis included in application.

Table 3 – Safety Benefit Cost Analysis

Safety	Average Annual Value	Nominal Value	3.1% Discount Value
Reduced Car Crashes - Injuries and Fatalities	$762,631	$26,692,089	$15,041,150
Pedestrian and Bicycling Crash Reduction	$6,745,306	$236,085,697	$133,035,684
Reduction in Crime Risk	$2,998,060	$104,932,106	$59,129,861
Subtotal	**$10,505,997**	**$367,709,892**	**$207,206,695**

2. Environmental Sustainability

This project is aligned with the goals of the RAISE program and its goal to support projects that "reduce greenhouse gas emissions and are designed with specific elements to address climate change impacts".[3] The project is directly aimed at reducing the reliance on motor vehicles, encouraging pedestrian activity, supporting the use of public transit of individual vehicles, and reducing the overall emissions profile of the project area.

Air Pollution Reduction – VMT Reduction

The reduced VMTs and the associated reduction in fuel usage will reduce the emissions of a number of air pollutants, including nitrogen oxide, nitrous oxide, volatile organic compounds, carbon dioxide, and particulate matter. With the proposed project improvements, we estimate that the emission reductions will generate $24,756 in benefits per year.

Green Design Impacts - Air Quality

The proposed project will renovate a structure with limited existing stormwater infrastructure and unmanaged foliage. Improved stormwater management and the planting and maintaining of native plants, is conservatively estimated to reduce the presence of harmful emissions. Trees, open space, and other assets cut down emissions through direct uptake, reduced reliance on electricity, and reduce overall smog. Reduced emissions yield incremental savings estimated at $44,163 per year.

Soil Remediation

The proposed project would seek to remediate the soil and pollutants associated with the existing, aging viaduct. Environmental review indicates the need for soil remediation along the rail park. Reviews of the area have shown levels of PCBs, lead, and arsenic present in the soil. Soil pollution has severe impacts on both environmental conditions and human health. Further, the direct devaluation of contaminated properties stunts economic development, and the perception of disuse and disrepair can further deter nearby residential and commercial development. As pollutants affect groundwater and bodies of water, further impacts to ecological functions can occur, both in the immediate area and further away as the pollutants travel through the water. According to information from the EPA, soil

[3] Notice of Funding Opportunity for the Department of Transportation's National Infrastructure Investments (i.e., the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Program) under the Infrastructure Investment and Jobs Act ("Bipartisan Infrastructure Law"), Amendment No. 1. Department of Transportation. 2024

contamination negatively impacts human health through cancer and poison risks, harms wildlife and surrounding ecology, and negatively impacts tourism, productivity, and other economic functions. [4]

Soil pollution impacts can be vast and diverse, as such it is difficult to assign a conclusive value to those damages. A well-established method of estimating the magnitude of remediation impacts is to observe nearby property values before and after remediation efforts. By isolating the effect of soil remediation on property values, the net value of each benefit mentioned above (heath risk reductions, improved ecological health, improved land productivity, etc.) can be observed. One often used approach is to measure what individuals affected by the damage would be willing to pay to remove it. When studying impacts such as pollution from localized contaminants (e.g. soil contamination) these "willingness-to-pay" models are often studied and expressed in terms of property values. Using analyses from various studies, we estimate that the total value to nearby residents and businesses of soil remediation is to be 0.5% of nearby property value. Studies suggest this value could be considerably higher.[5] This analysis employs a considerably reduced soil remediation value to account for other factors influencing property value, and to avoid double-counting with other benefits in this analysis. These benefits yield one-time incremental savings estimated at $337,948.

Carbon Dioxide Emission Reduction

Each of the emission reduction benefits discussed above will also result in the reduction of carbon dioxide emissions. Following guidance from the USDOT, carbon dioxide emissions are calculated separately, and discounted with a 2% discount rate. Combining each of the effects above, carbon dioxide emission reductions are valued at $31,422 per year.

Table 4 – Environmental Sustainability Benefit Cost Analysis

Environmental Sustainability	Average Annual Value	Nominal Value	3.1% Discount Value
VMT reduction - Air pollution	$24,756	$866,458	$487,428
Green Design Impacts - Air Quality	$44,163	$1,545,690	$909,637
Soil Remediation	$9,656	$337,948	$290,106
CO2 Reduction Benefit - 2% Discount	$31,422	$938,266	$938,266
Subtotal	$109,997	$3,688,361	$2,625,437

3. Quality of Life

Quality of life benefits for this project are generated primarily through the value of recreation and exercise assets, and through the marginal reduction in noise pollution from decreased vehicle traffic. However, the presence of these assets, and the attention to design, aesthetics, and community, will

[4] Handbook on the Benefits, Costs, and Impacts of Land Cleanup, EPA (2011)

[5] Handbook on the Benefits, Costs, and Impacts of Land Cleanup, EPA (2011); Combining Revealed And Stated Preference Data To Estimate Preferences For Residential Amenities: A Generalized Method of Moments (GMM) Approach, Phaneuf (2010); Assessing the Impacts of Soil Degradation – Final Report, Gorlach (2004)

bring additional experiential benefits, specifically to residents. The presence of these factors will increase the general happiness of community members, employees, and visitors.

Recreation Benefits

Safe accessible biking and pedestrian infrastructure is an amenity for local residents, visitors, and general users. The extension of safe pedestrian and cyclist access and the connection to public space will enable many users in the area to engage in pedestrian and cyclist activity. In addition to the health benefits associated with exercise, recreation users have a direct value for space to exercise safely, which is commonly measured by a user's willingness-to-pay (WTP) for a public good. Exercise, recreation, and walkability are often studied topics in willingness-to-pay research, and are show to be highly demanded and valued resources. Using information from the Army Corp of Engineers and other sources on willingness-to-pay for recreational assets, total benefits from recreation users are $296,258 per year from new users, and $542,513 per year from increased participation among current users.

Reduced Noise Pollution

The proposed improvements will reduce noise pollution in the area. The reduction in overall vehicle miles traveled through the area will marginally reduce traffic-related noise. Noise pollution is an aesthetic "disamenity" and can be harmful in high levels. The marginal decrease in vehicle activity will reduce the level of associated noise, conferring benefits to those in the area. Following guidance from the Department of Transportation, noise pollution reduction is estimated to generate $991 in benefits each year.

Improved Experience

Quality of life benefits accrue to nearby residents as well as individuals that frequent or pass through the project area. Each of these groups are impacted by quality of the infrastructure and public space they interact with. The Viaduct Greenway will impact millions of trips through the area from pedestrians, cyclists, and motorists. Each of these users have a willingness-to-pay for these improvements and the effect the improvements have on their experience.[6] These benefits, though small for any one individual, when taken in the aggregate for all visitors to the area achieve a substantial value. On average, we estimate that the visitors and residents in the area have a willingness-to-pay of $0.076 for the proposed Viaduct Greenway. This results in a total improved experience value of $441,200 per year.

Table 5 – Quality of Life Benefit Cost Analysis

Quality of Life	Average Annual Value	Nominal Value	3.1% Discount Value
Recreation Benefits – Current Users	$542,513	$558,470	$593,374
Recreation Benefits - New Users	$296,258	$304,972	$324,033
Reduced Noise Pollution	$991	$1,020	$1,084
Improved Experience- All Riders	$441,200	$454,176	$482,562
Subtotal	**$1,280,962**	**$1,318,638**	**$1,401,052**

[6] Falzarano, S. & Hazlett, R. "Evaluating the Effects of Transit Station and Access Improvements", Resource Systems Group and City of Chicago Department of Transportation, 2000

4. Mobility and Community Connectivity

The proposed improvements will make travel by non-vehicular modes much more pleasant and more preferrable. By expanding and improving pedestrian and cyclist infrastructure, specifically in an area with a key corridor, will better connect businesses, employees, and residents through a better-connected multi-modal system. The improvements will encourage additional pedestrian, and cyclist travel through improvements to each of those modes. Beyond the benefits to safety, health, and recreation benefits already calculated in this analysis, the improvements to mobility and connectivity will confer additional benefits in the form of convenience, comfort, and enjoyment for the users of those travel methods.

Pedestrian Journey Quality and Comfort

The new elevated pathway increases the separation between pedestrians and vehicle traffic and provide more comfortable and spacious pathways. Increasing sidewalk size or overall pedestrian facilities improves the quality, convenience, and comfort of pedestrian travel. This impact is directly valuable to the residents, employees, visitors, and others using the pedestrian infrastructure. Using guidance from the Department of Transportation, these pedestrian facility improvements are estimated to generate $73,099 in benefits each year.

Cyclist Journey Quality and Comfort

The Viaduct will also be open to cyclists. Comfortable cyclist pathways distanced from vehicle traffic confer considerable benefits to users by making travel more comfortable, more enjoyable, and less stressful than many alternative design styles. These improvements to the quality and comfort of cycling journeys are valuable to users. Using guidance from the Department of Transportation, these pedestrian facility improvements are estimated to generate $55,259 in benefits each year.

Table 6 – Mobility and Community Connectivity Benefit Cost Analysis

6. - Mobility and Community Connectivity	Average Annual Value	Nominal Value	3.1% Discount Value
Pedestrian Journey Quality and Comfort	$73,099	$2,558,460	$1,441,707
Cyclist Journey Quality and Comfort	$55,259	$1,934,051	$1,089,849
Subtotal	$128,357	$4,492,511	$2,531,556

5. Economic Competitiveness and Opportunity

This project will help enhance the region's economic competitiveness by improving transportation efficiency through reducing congestion throughout the region. The project will also create positive health impacts through increased exercise activity. The significant improvements to connectivity and access to local trails, public spaces, and other assets will also increase nearby property values.

Health Benefits

The proposed improvements will expand infrastructure for pedestrian and cyclist travel. This will provide a considerable number of residents with greater access to the area's pedestrian and cyclist infrastructure, and will encourage residents to exercise more, which has extensive proven health benefits. These health benefits include reduced direct and indirect healthcare costs, direct and indirect workers compensation costs, and lost productivity costs. Using guidance and data from the Department

of Transportation on valuing health benefits of walking and cycling, we estimate that these incremental savings will amount to $900,690 per year.

Property Value Increase

Building out multimodal infrastructure has direct and indirect value to the residents and businesses of Philadelphia. Walkability in communities is a heavily researched topic, and a significant body of literature exists that quantifies the marginal increase in home values associated with nearby improvements to walkability.[7] Studies have observed property value increases due to trail proximity of a wide range. Access to reliable, safe, attractive walkability would be heavily valued by residents in the area. Increasing walkability and accessibility for nonvehicular travel increases economic opportunity for residents and businesses.[8] These effects have significant value among community members. That value can be represented by the increase in home values from these improvements.

These effects are also felt by the tourists and visitors to the area. For commercial properties, in addition to the direct factors mentioned above, the relative attractiveness of Philadelphia as a destination will promote economic vitality in the area. The more attractive, safe, and improved the transportation infrastructure throughout the area, the more economic opportunity will spread. Increased economic activity for residents and businesses brings an entire host of beneficial effects. While the magnitude of each individual effect is not easily quantified, these effects together will be reflected in increased property values. As such, property value effects are used as a proxy for the value of these social benefits. Using research on the impact of green space on nearby property, we estimate a property value increase of 7 percent to nearby commercial and residential properties. To maintain conservative estimates and account for the current existence of public assets in the area, we assume only 85 percent of commercial and 75 percent of residential value is conferred through the planned improvements. Overall, residential, and commercial property value is expected to see a one-time $3,820,061 increase after the project is completed.

Reduced Congestion

The reduction in VMT per year reduces the congestion on local roads and improves the overall efficiency of goods movement and commuter movement. This decongestion is quantified through factors such as reduced travel delay, improved fuel efficiency, and experiential improvements. These savings are above and beyond the savings experience by commuters switching away from vehicle travel. As those users drive less, overall road congestion declines. As congestion declines, all motorists in the area experience improvements in their commutes. These incremental savings are valued at $29,916 in benefits each year.

Table 7 – Economic Competitiveness and Opportunity Benefit Cost Analysis

Economic Competitiveness and Opportunity	Average Annual Value	Nominal Value	3.1% Discount Value
Health Benefits - New Users	$900,690	$927,181	$985,130
Property Value Increase	N/A	$3,820,985	$3,280,061
Reduced Congestion	$29,916	$30,796	$32,721
Subtotal	$930,607	$4,778,962	$4,297,912

[7] See for instance: Economic Benefits of Trails, Pennsylvania Land Trust Association (2011)

[8] The Business of Trails: A Compilation of Economic Benefits, American Trails (2008). Craft, S. (2014, June 1). The Economic Impact of PLACEMAKING. Placemaking.

Job Creation

The development of infrastructure covered by this project will involve substantial construction and related work in the short-term. While not included in the overall benefit cost analysis, construction activity and additional supported economic activity originating from development of the project has been modeled for Philadelphia County.

Total project costs are estimated to be $71.2 million.[9] Construction is estimated to take place over two years. Using IMPLAN economic modeling software, total economic activity supported by this development is estimated. For each year of development, the project is estimated to support 129 direct jobs, earning $13.8 million in labor income. That direct economic activity in turn supports additional activity in the region.[10] Within Philadelphia County, construction activity is estimated to support an additional 96 jobs per year, earning $7.5 million in labor income each year. These impacts represent the additional activity going to local vendors and suppliers through business purchases, as well as to retail establishments, restaurants, and other businesses supported by spending from employees.

Table 8 – Economic Impacts from Construction per Year

Impact	Employment	Labor Income ($M)	Output ($M)
Direct Impacts	129	$13.8	$35.6
Indirect Impacts	50	$4.1	$10.1
Induced Impacts	46	$3.4	$8.8
Total Impacts	**226**	**$21.4**	**$54.4**

After the project is constructed, operations and maintenance of the park is estimated to be $1.5 million annually, which will support on average 20 to 30 full-time equivalent jobs each year. These jobs represent park maintenance, landscaping, safety, and other functions necessary to operate the park. As with construction, direct operations of the park will support additional economic activity each year. In addition to the 20 to 30 jobs referenced above (average of 25 jobs each year), operation of the Viaduct Greenway will support an additional 5 jobs and $400,000 in labor income each year.

Table 9 – Economic Impacts from Construction per Year

Impact	Employment	Labor Income ($M)	Output ($M)
Direct Impacts	25	$0.8	$1.5
Indirect Impacts	3	$0.2	$0.7
Induced Impacts	2	$0.2	$0.5
Total Impacts	**30**	**$1.2**	**$2.6**

[9] For modeling purposes, the total development budget is estimated to be comprised of $71.2 million in hard construction costs (e.g. the materials and labor directly associated with constructing the infrastructure in the project) and $11.0 million soft costs (e.g. architecture and design work, planning, and other efforts beyond the physical construction of the project)

[10] For additional information on economic modeling see Appendix A

The new park space and increased options for travel and recreation will continue to support the economic health of Philadelphia and of the area. Repairing and updating the aging viaduct will replace a blighting element in the neighborhood with an asset. This will increase economic opportunity in the area, strengthen local businesses, and support sustained economic growth. The economic growth supported by the investment will potentially lead to job growth, supporting expanded employment in the area. The improvements in this application will also provide ongoing support to the residents of Philadelphia in accessing that economic opportunity. The impact to quality of life and economic competitiveness discussed here is partially valued in the property value impacts discussed above. The corresponding job growth is not directly calculated here, or included as a benefit, but it is an important impact to Philadelphia and the region as a whole.

6. State of Good Repair

The existing rail viaduct was formally abandoned in 1983. This infrastructure is aging and requires substantial work to promote the integrity of the structure, control the expense of maintaining it, and improve the efficiency of stormwater management. Additionally, the project is expected to reduce the vehicle miles traveled (VMT) by people travelling through the area, alleviating some of the wear and tear on local roads.

Avoided Road Maintenance (Reduced VMT)

The reduction in vehicle miles traveled due to an increase in the use of other travel modes reduces future road maintenance costs along the surrounding roads. Using estimates for roadway maintenance per vehicle mile traveled[11], and the VMT savings above, these incremental savings are estimated at $5,574 per year.

Reduced Car Crashes – Property Damage

The reduction in VMT will also result in a concomitant reduction in car crashes. More significantly, the improvements to roadway conditions, pedestrian separation, and other improvements in the project area will directly reduce the prevalence of crashes. These effects together will reduce property damage costs incurred by the avoided crashes. Using cost information from DOT guidance regarding car crashes, these incremental savings are estimated at $55,733 per year.

Deferred Maintenance

The project scope includes the repair and rehabilitation of the viaduct, which is aging and in poor repair. Sidewalk infrastructure within the project area is in need of repair. These necessary sidewalk repairs (which would otherwise be addressed in the proposed project) have been valued at $6.8 million dollars, and are considered reasonably overdue.[12] Without proper mitigation and coverage efforts, failing infrastructure poses a potential danger to people and vehicles passing underneath. In turn, avoiding these dangerous conditions requires additional interim costs in the form of spot work, coverage such as netting, and other work. Alternatively, the full removal of the viaduct may be necessary, which would require significant investment. The cost and viability of removal for the current viaduct is estimated to be $110 million.[13] Despite the sizeable cost, the continued degradation of the structure along with the

[11] Transportation Cost and Benefit Analysis II – Roadway Costs, VTPI (2020)
[12] Value for sidewalk repair provided by the Center City District of Philadelphia
[13] Value for viaduct removal provided by the Center City District of Philadelphia

presence of soil contaminants mentioned above may necessitate removal in the absence of proper investment like the proposed project. Repairing this infrastructure elements now will avoid future increases in maintenance and repair costs, and other related detriments. The deferred maintenance is estimated at a nominal sum of $116,800,000 or a present value (at a 3.1 percent discount) of $46,125,136 over the 30-year horizon.

Stormwater Cost Savings – Water Treatment

Green stormwater design can effectively manage almost all rainfall outside of major storm events. New green infrastructure and best practices in the planned improvements will collect excess storm water, which would otherwise be collected and treated. At an average cost of 30 cents per gallon to treat, total savings from water captured by green infrastructure is estimated to be approximately $1,033,889 annually.

Stormwater Cost Savings – Energy Savings

Beyond water treatment savings, green stormwater design reduces energy uses through a number of vectors. Planted trees and other greenery minimizes temperature variations, provides shade, and positively impacts landscape conditions to reduce energy requirements. Using EPA data on impacts per planted trees, the energy savings from the project stormwater design is estimated to be $6,267 per year.

Table 10 – State of Good Repair Benefit Cost Summary

State of Good Repair	Average Annual Value	Nominal Value	3.1% Discount Value
Reduced VMTs - Road Maintenance Costs	$5,574	$195,074	$109,925
Reduced Car Accidents - Property Damage	$55,733	$1,950,671	$1,099,214
Differed Maintenance	$3,337,143	$116,800,000	$46,125,136
Stormwater Cost Savings - Water Treatment	$1,033,889	$36,186,125	$20,391,095
Stormwater Cost Savings - Energy Savings	$6,267	$219,340	$123,599
Subtotal	**$4,438,606**	**$155,351,209**	**$67,848,970**

Results of the Benefit-Cost Analysis

As outlined above, the proposed project will provide significant long-term benefits for the Poplar and Callowhill area and for Philadelphia overall. On the basis of the benefit-cost analyses presented above, the City of Philadelphia estimates that the benefits of the proposed improvements will be approximately $300.9 million and the total costs will be $64.0 million over the useful life of the project. These benefits and costs are the present values of future benefits and costs and are discounted at 3.1 percent. The Net

Present Value (NPV) of the project, calculated as benefits minus costs, is approximately $236.9 million, and the benefit-cost ratio is 4.7. The project has an Internal Rate of Return (IRR) of 19 percent.

Table 11 – Benefit Cost Summary

Metric	Nominal Sum	Present Value (3.1%)
Present Value of Benefits	$565,920,356	$300,860,308
Present Value of Costs	$71,164,383	$63,959,926
Net Present Value	**$494,755,973**	**$236,900,382**
Benefit / Cost Ratio	**8.0**	**4.7**

Appendix A

Overview

Economic impact estimates are generated by utilizing input-output models to translate an initial amount of direct economic activity into the total amount of economic activity that it supports, which includes multiple waves of spillover impacts generated by spending on goods and services and by spending of labor income by employees. This section summarizes the methodologies and tools used to construct, use, and interpret the input-output models needed to estimate this project's economic impact.

Input-Output Model Theory

In an inter-connected economy, every dollar spent generates two spillover impacts:

- First, a portion of that expenditure which goes to the purchase of goods and services gets circulated back into an economy when those goods and services are purchased from local vendors. This is the "indirect effect," and reflects the fact that local purchases of goods and services support local vendors, who in turn require additional purchasing with their own set of vendors.
- Second, a portion of that expenditure which goes to labor income gets circulated back into an economy when those employees spend some of their earnings on various goods and services. This is the "induced effect," and reflects the fact that some of those goods and services will be purchased from local vendors, further stimulating a local economy.

The role of input-output models is to determine the linkages across industries in order to model out the magnitude and composition of spillover impact to all industries of a dollar spent in any one industry. Thus, the total economic impact is the sum of its own direct economic footprint plus the indirect and induced effects generated by that direct footprint.

Input-Output Model Mechanics

To model the impacts resulting from the direct expenditures, Econsult Solutions, Inc. developed a customized economic impact model using the IMPLAN input/output modeling system. IMPLAN represents an industry standard approach to assess the economic and job creation impacts of economic development projects, the creation of new businesses, and public policy changes within its surrounding area. IMPLAN has developed a social accounting matrix (SAM) that accounts for the flow of commodities through economics. From this matrix, IMPLAN also determines the regional purchase coefficient (RPC), the proportion of local supply that satisfies local demand. These values not only establish the types of goods and services supported by an industry or institution, but also the level in which they are acquired locally. This assessment determines the multiplier basis for the local and regional models created in the IMPLAN modeling system. IMPLAN takes the multipliers and divides them into 536 industry categories in accordance to the North American Industrial Classification System (NAICS) codes.

The IMPLAN modeling system also allows for customization of its inputs which alters multiplier outputs. Where necessary, certain institutions may have different levels of demand for commodities. When this

occurs, an “analysis-by-parts” (ABP) approach is taken. This allows the user to model the impacts of direct economic activity related to an institution or industry with greater accuracy. Where inputs are unknown, IMPLAN is able to estimate other inputs based on the level of employment, earnings, or output by an industry or institution.

Employment and Wages Supported

IMPLAN generates job estimates based on the term “job-years”, or how many jobs will be supported each year. For instance, if a construction project takes two years, and IMPLAN estimates there are 100 employees, or more correctly “job-years” supported, over two years, that represents 50 annual jobs. Additionally, these can be a mix of a full and part-time employment. Consequently, job creation could feature more part-time jobs than full-time jobs. To account for this, IMPLAN has a multiplier to convert annual jobs to full-time equivalent jobs.

Income to direct, indirect, and induced jobs is calculated as employee compensation. This includes wage and salary, all benefits (e.g., health, retirement) and payroll taxes (both sides of social security, unemployment taxes, etc.). Therefore, IMPLAN’s measure of income estimates gross pay opposed to just strictly wages.