



Delhi Pike Trail Economic Return on Investment

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MOUNT ST. JOSEPH'S UNIVERSITY

Summer Hamilton - Student Director of Orientation and Students Affairs

Janet Cox - Dean of Students

Warren Grove - Assistant Dean for Student Engagement and Leadership

BAYLEY

Steven Breidenich - Director of Gift Planning

Acknowledgments

Thank you to all of the organizations and individuals who committed their time and energy to this study. Your dedication to the Delhi community is appreciated.

Executive Summary

The purpose of the *Delhi Avenue Trail Economic Return on Investment Study* is to define and assess the factors that contribute to the benefits of a proposed 1.1-mile-long parallel, asphalt multi-use trail facility extending from Mt. St. Joseph University at Neeb Road to the central business district at Anderson Ferry Road (Figure 2). The benefits and costs of the trail were estimated to the horizon year of 2045 to determine the overall return on investment that the community can expect from this project.

Economic Impacts of Trails

Trails have a multitude of potential positive impacts for the surrounding community, including increases in recreation, health, transportation, ecological, aesthetics, and economic value. This report attempts to monetize these benefits in order to estimate the overall impact of the Delhi Avenue Trail. To understand the potential economic impacts, twenty-nine comparable trails in Ohio were identified and studied. Common factors that maximized economic impacts in the areas surrounding the trail included coordinated community and business participation, broader economic revitalization planning efforts, and the connection of residential, recreational, and commercial areas.

Stakeholder Outreach

In April 2017, telephone interviews were conducted with key stakeholders to better understand the specific and unique potential economic impacts of the trail in the Delhi community. Through these interviews several themes were identified, including exercise and health; community attractiveness to new businesses and residents; and linking Mount Saint Joseph’s University with the business district. These themes, along with discussions with Township staff, were used to inform the benefit categories analyzed.

Cost Estimate

A cost estimate of \$1.59 million for the trail was based on prior unit estimates for similar work, and included several improvements along the corridor such as curb ramps, bike racks, landscaping, pedestrian signals, and crosswalks, as well as a 10% design fee and a 30% fee for contingencies. Additional costs may be incurred as a result of more detailed design efforts, potentially including right-of-way acquisition.

Benefit Estimation

Based on stakeholder interviews and the most recent literature on the economic benefits of trails, the benefits of the Delhi Avenue Trail were estimated for several categories: Pollution Reduction, Crash Reduction, Construction & Maintenance Impacts, Health Benefits, and Property Valuation. The benefits in each category were monetized to reflect potential economic impacts of the trail. Pollution reduction benefits were calculated as a reduction in mobile source emissions from lower crash-related delays and conversion of automobile trips to walking and biking trips. Crash reduction benefits were derived from the cost of fatalities and injuries reduced by the presence of certain design features on the trail, including lighting, improved crossings, and pedestrian signals. Construction and maintenance benefits were estimated based on the wages from construction jobs created by the project. Health benefits were monetized by calculating the value of additional years of life gained through active use of the trail. Finally, property valuation benefits were calculated using estimates for increased premiums for properties located in close proximity to the trail. The total cumulative benefits in each category through 2045 are listed in the table below.

Category	Benefit
Pollution Reduction	\$53,116
Crash Reduction	\$542,202
Construction and Maintenance Impacts	\$958,021
Health Benefits	\$45,688,910
Property Valuation	\$7,535,815

1 | Table: Cumulative Benefits Estimate

Return on Investment Evaluation

The overall benefit cost-ratio for the projects is positive (19.6:1), with a modified internal rate of return (MIRR, with a conservative assumption for public return on investment of 75%) of 77% and a payback period of less than a year at a 3% discount rate of return. For a 7% discount rate of return is also positive, at 14.1:1, with an MIRR of 76% and a payback period of less than a year.

Infrastructure investment projects can have a range expected benefits. Because of this uncertainty, a benefit-cost analysis was also conducted for two additional scenarios: pessimistic and optimistic. These scenarios help to define a range of return-on-investment values that the Township may expect to see from the trail. At a 3% discount rate, the benefit cost-ratio ranged from 5.0:1 (pessimistic) to 27.2:1 (optimistic).



2 | Figure: Proposed Location of Delhi Avenue Trail

Economic Impacts of Trails

The benefits of greenways trails and greenways are numerous; these investments can increase recreation, health, transportation, ecological, aesthetic, and economic value within a community.

With the construction of the Delhi Avenue Trail, other economic benefits can also be anticipated based on experience in addition to the safety and convenience potentially afforded to the University student and staff population, Protected bicycle lanes and trails provide economic enhancements to communities in at least four ways, according to the Urban Land Institute:

1. Fuel redevelopment
2. Improve health and productivity of workers
3. Help attract Millennial and Generation X employees
4. Increase retail opportunities and sales

These projects, particularly when they are "signature" projects that become community landmarks or when they are combined to create a network that contributes to a recognition as a "walkable" community, can be used help to promote the community to residents, visitors, and businesses alike.

...
52% of people in the U.S. want to live where they don't always need to use a car (Urban Land Institute)

...
30% of trail users on the American Tobacco Trail report making retail, restaurant, or grocery purchases related to their use of the trail (Institute for Transportation Research and Education)

...
50% decline in retail vacancy after the opening of the Pinella Trail in Dunedin, Florida (Urban Land Institute)

...
35% lower risk of obesity for people who live in neighborhoods where they can walk to shops and retail establishments (American Journal of Preventative Medicine)

IMPACTS BY THE NUMBERS

Maximizing Impacts: Comparable Trail Study

To better understand potential impacts of the Delhi Avenue Trail, several comparable trails in Ohio were identified for further study (see Appendix A for detailed list of trails). These trails were selected based on similar construction (asphalt or concrete surface), length (less than ten miles), and presence of a commercial area within a half-mile to represent similar land uses to that of the Delhi Avenue Trail. Parcel, corridor, and regional level data was used to compare commercial real estate and job growth in the trail corridors compared to the surrounding regions. The features of trails that performed better after trail construction were compared to those that lagged behind in order to explore how location, accessibility, socioeconomic/demographic, and destination characteristics may contribute to the success of certain trails. In-depth examination revealed that trails with the largest economic benefits had three common characteristics:

1. Coordinated community and business participation



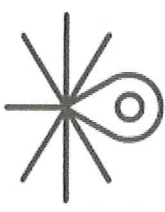
In the trail case studies, involvement of community organizations and the business community was a key factor for economic success. This started with the trail planning stages, and continued forward, where community groups and businesses can play a prominent role in events, programming, and trail promotion. Delhi Township can take advantage of its many active community groups and institutions, including Mount Saint Joseph University, the Sisters of Charity, Boyley, and the Delhi Business Association, to ensure that the trail is meeting the community's needs and having the greatest impact possible.



2. Broader economic revitalization planning efforts

Trails in and of themselves are often not enough to maximize potential economic benefits. In the comparable trail case studies, trails that were included in larger, coordinated revitalization efforts, such as the Mill Creek Greenway in Cincinnati, or the Morgand Run Trail in Cleveland, saw the greatest economic impacts in the retail sector. In 2015, Delhi Township adopted *Plan the Pike*, a strategic redevelopment plan for the Delhi Pike business district. The Delhi Avenue Trail will be a key element of the Plan's guiding principle of connectivity, which aims to connect the Mount Saint Joseph University and residences to key amenities via bicycle and pedestrian pathways.

3. Connection of residential, recreational, and commercial areas



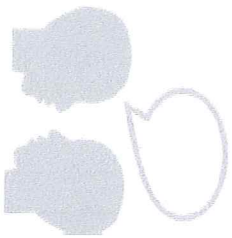
Trails that provided access to a wide variety of destinations, including parks, schools, universities, commercial districts, workplaces, and community centers, in addition to residential areas, saw some of the greatest economic growth. The Delhi Avenue Trail plans to connect a mix of land uses, with community and educational institutions (including Mount Saint Joseph University, Sisters of Charity, and Boyley) and Delhi's central business district at the trail termini, while passing through a primarily single-family residential area. Additionally, continuing east on Delhi Avenue, residents will be able to reach Delhi Park, the Township's premier community greenspace.

Stakeholder Outreach

In April 2017, Stantec and Delhi Township conducted eight phone interviews with several community members to better understand the potential economic impacts of the trail. This is what we heard.

Interviewees

- Ted Hubbard, Hamilton County Engineer
- Travis Curd, President, Delhi Business Association
- Sister Georgia Kitt, Director of Communications, Sisters of Charity
- Summer Hamilton, Student Director of Orientation and Student Activities, Mount Saint Joseph University
- Janet Cox, Dean of Students, Mount Saint Joseph University
- Warren Grove, Assistant Dean for Student Engagement and Leadership, Mount Saint Joseph University
- Steven Briedenich, Director of Gift Planning, Bayley
- Rose Stertz, President, Delhi Board of Trustees



Who currently uses this route?

University students to get to the business corridor • Families • Only drivers • Local route for motorists • People who work at Mount Saint Joseph, Bayley, and Sisters of Charity • Residents accessing the business district • Churchgoers • Groceries and gas stations

Who would like to use this route?

People who want to exercise • Students to get to businesses on Delhi Pike • Active retirees at Bayley • Employees at Mount Saint Joseph, Bayley, and Sisters of Charity • Cyclists • Runners • University students who don't have cars • Families on outings

What is keeping people from using this route more?

Safety • Not a reasonable path to travel by walking or biking • Tough to see cars coming around bends • Could cause a major accident • No attractiveness or variety in walking environment • Drivers aren't used to looking out for people walking or biking • Blind spots • Lack of sidewalks • Lack of destinations

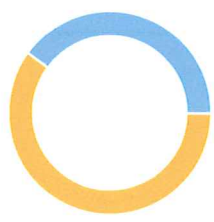
“The Township wants to connect students to business and recreation opportunities, and we want to make it convenient and safe for you to get there.”

- Travis Curd, President, Delhi Business Association

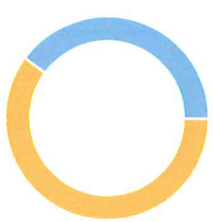
How would the proposed path impact your business or organization?

● 1 (negative impact) ● 2 ● 3 (no impact) ● 4 ● 5 (positive impact)

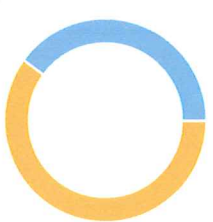
Ease of walking and biking through the corridor



Attractiveness to new visitors, students, customers, etc.



Amount of foot traffic or bicycle travel



Traffic congestion and overall mobility

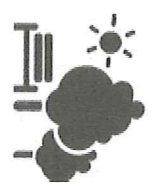


What trail design features would have the most benefit for your business or organization?

Least Impact Most Impact



Security
measures like call boxes, maintenance, and litter removal



Benches, trees, and streetscaping improvements



Improved safety features to get people to cross roads safely



Pedestrian-level lighting

KEY COMMUNITY AND ECONOMIC BENEFITS

- Provide natural greenspace and access to Delhi Park
- Cosmetic improvements make community more attractive
- Morale boost for community
- Community walking groups
- Encourage social interaction
- Improve attitudes about exercise and health
- Support business for existing restaurants and stores
- Attract new businesses
- Commercial core has a direct link to university
- Show that Delhi is investing in trend of walkable/bikeable communities

Cost Estimate

The benefit-cost information depends heavily on the denominator of that pairing; in fact, the cost estimate is the more influential of the two (monetized benefits being the other factor) on the final estimate of the benefit-cost ratio (BCR).

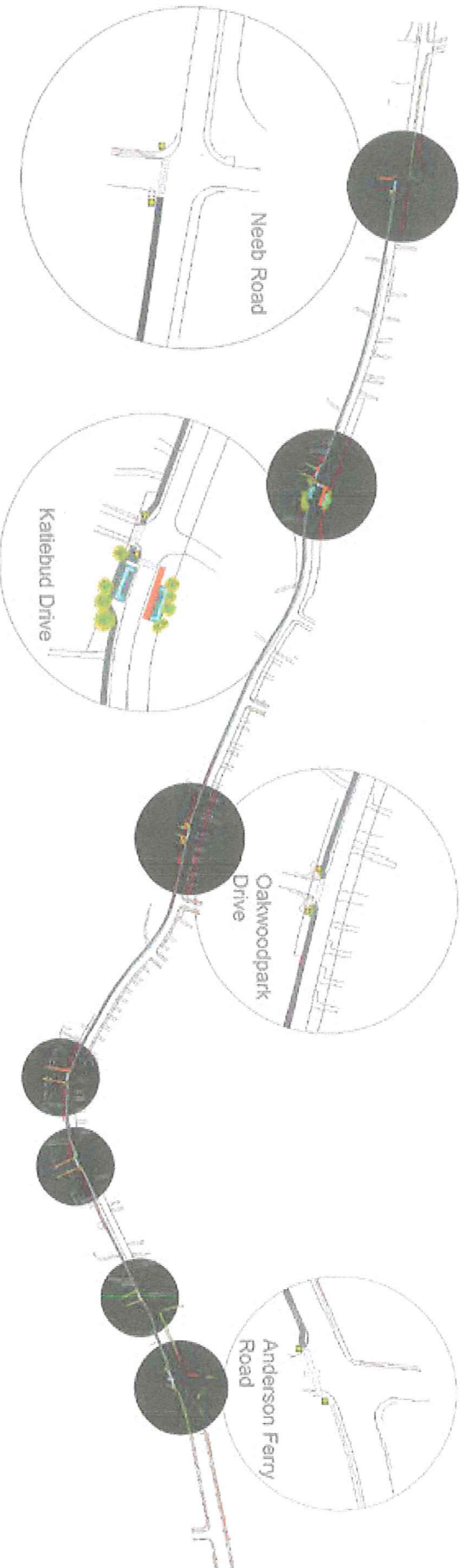
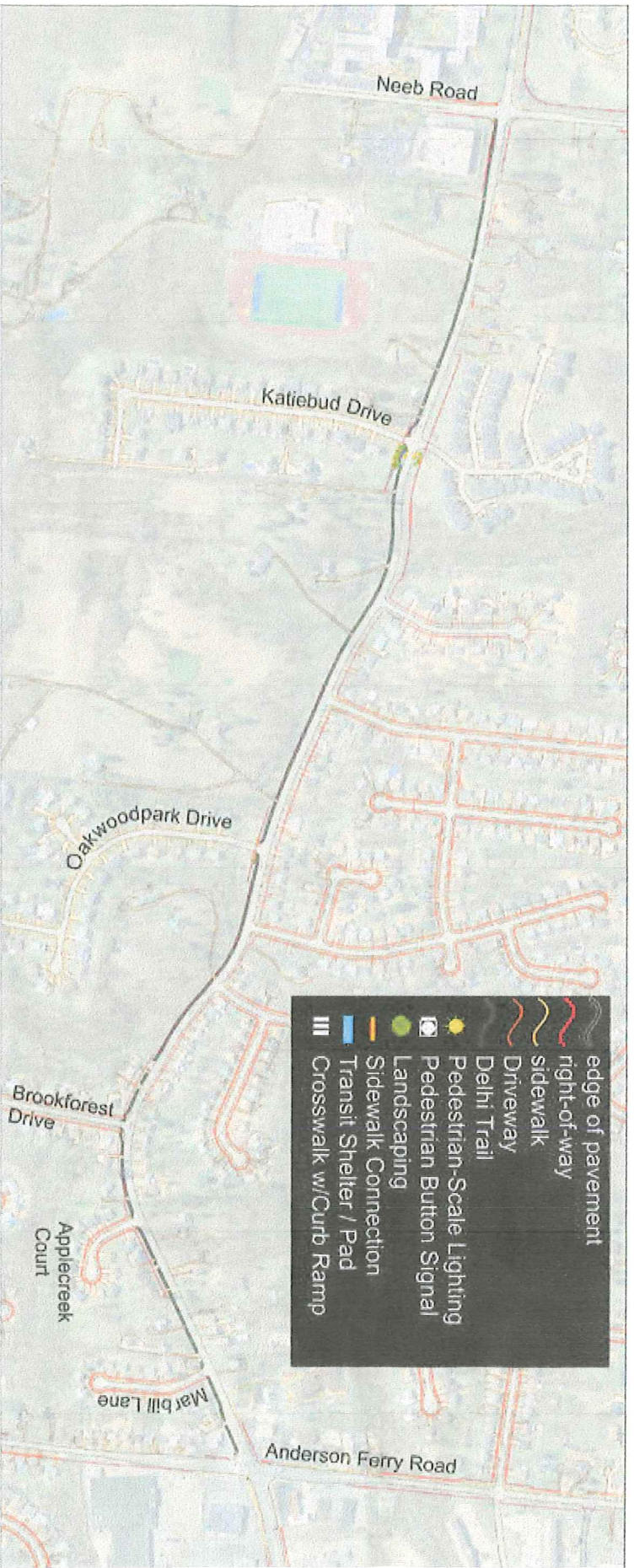
The unit costs used for the cost estimate are based on recent bid tabulations and prior unit estimates gathered by Stantec. Quantities were derived from the base design graphic and numbers of individual elements such as curb ramps as well as linear feet (or square yards of material).

The total estimated cost for the project is \$1.589 million, which includes a 10% design fee and a 30% fee for contingencies and mobilization. Features like pedestrian-scale lighting at street crossings; two improved transit stops at Katiebud Drive (with bike racks); and high-visibility crosswalks were included, as was the necessity of constructing retaining walls in two locations (refer to Figure 4 on the opposite page).

It is important to note that the estimated cost for the project does not include right-of-way acquisition or the cost of additional topography issues that may be identified during the detailed engineering design phase of the project.

Element	Unit	Unit Cost	Quantity	Extended Cost
10'-12' Asphalt Greenway/Multi-Use Trail	linear foot	\$161	5,808.00	\$932,800
Sidewalk Installation	linear foot	\$181	70	\$12,648
ADA Ramp (ea.)	each	\$1,272	9.00	\$11,448
Bike Racks (Inverted U, 2 bicycles)	each	\$371	2.00	\$742
Pedestrian Signal (2-wy)	each	\$2,014	1.00	\$2,014
Tree (landscaping)	each	\$530	13.00	\$6,890
Lighting, Pedestrian-Scale	each	\$1,590	12.00	\$19,080
Crosswalk (Tape, Transverse Lines)	each	\$106	2.00	\$212
Crosswalk (Tape, Ladder, ea. 12' lane)	each	\$318	20.00	\$6,360
Remove Concrete	square yard	\$15.21	213.89	\$3,253
Shelter w/Concrete Pad	each	\$12,720	2.00	\$25,440
Bench	each	\$1,060	2.00	\$2,120
Trash Receptacle	each	\$530	2.00	\$1,060
Retaining Wall	square foot	\$30	2,840.00	\$85,200
Brick column/marker	each	\$1,000	2.00	\$2,000
subtotal				\$1,111,267
design fee				\$111,127
mobilization+contingency				\$366,718
opinion of probable cost (total)				\$1,589,112

3 | Table: Opinion of Probable Costs



4 | Figure: Location of Delhi Avenue Trail Project, and key features at intersections

Benefit Estimation

Based on stakeholder interviews and the most recent literature on the economic benefits of trails and greenways, the benefits of the Delhi Avenue Trail were estimated for several categories: Pollution Reduction, Crash Reduction, Construction & Maintenance Impacts, Health Benefits, and Property Valuation. Each of these categories is described below; detailed inputs used to estimate benefits in each category are included in Appendix B.

Pollution Reduction

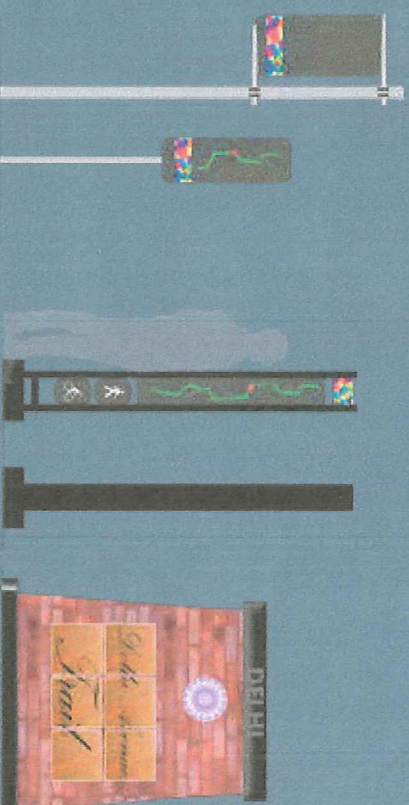
Mobile source emissions represent about 50% of all toxics emitted into the air including volatile organic compounds (VOCs) and Nitrogen Oxide (NOx); the number increases to 75% of carbon monoxide and is even higher in urbanized areas like Delhi.¹ While everyone is at an increased risk of cardiovascular disease, respiratory illness, cancer and diabetes as a result of airborne toxins, those most at risk are children, elderly, lower socioeconomic classes, and people living near (500' to 600') a major roadway.^{2,3} Mobile source pollution can be reduced when more people shift from single-person automobile travel to biking and walking forms of transportation.

The Delhi Avenue Trail will reduce some automobile travel by making walking and biking trips more attractive for both commuting and other travel purposes. Benefits were calculated as a reduction in mobile source emissions from reductions in crash-related delays as well as conversion of automobile trips to walking and biking trips, using the cost of emissions described in the 2016 TIGER BCA Resource Guide. Currently only 1.5% of the population walks or bikes to work in Delhi.⁴ However, as more people choose these active modes over single-person automobile use, the amount of mobile source emissions will be reduced. The total discounted pollution reduction benefits of the project were estimated to be \$53,116 through 2045.

Crash Reduction

From 2009 to 2013, there was one bicycle or pedestrian crash along the Delhi Avenue corridor.⁵ Economic impacts from crashes include increased congestion, increased pollution from stop-and-go traffic, and most importantly, the costs of injuries and fatalities.

The construction of an off-road trail can help reduce crashes on a roadway based on certain design elements. During stakeholder interviews, community members identified the need for improved pedestrian crossings and lighting along the trail; these features have been incorporated into the base design graphic used for the project cost estimate. Pedestrian signals, improved crossings, and lighting are all factors which can reduce crashes along a roadway. Based on these design elements, we have estimated that the construction of the Delhi Avenue Trail can help reduce crashes along the corridor by approximately 10%.⁶ The total net crash reduction benefits of the project were estimated to be \$542,202.



Great wayfinding signage is about placement, legibility, and connections back to the materials and images reminiscent of Delhi.

Construction & Maintenance Impacts

Construction and maintenance benefits were estimated in an approximate fashion based on the 2016 TIGER BCA Guidance multiplied by construction worker wages over a one-year period.⁷ The construction of the project is estimated to create approximately 20 construction jobs in Delhi, which has the potential to stimulate further spending in the area. The total net construction and maintenance wage benefits of the project were estimated to be \$958,021. Note: in addition to the costs of construction, annualized maintenance costs were accounted for in the benefit-cost analysis.

Health Benefits

Through stakeholder interviews, it was clear that there is interest in using the Delhi Avenue Trail for recreation and fitness. These benefits, while typically considered somewhat intangible, have also been quantified and included in the economic benefit-cost analysis.

Changes in the design of the built environment can have an impact on people's travel behaviors. With the construction of the Delhi Avenue Trail, we can expect to see an approximately 6% increase in the number of walking trips within a half-mile of the study area (which is equivalent to approximately a ten-minute walk to the trail). These additional walking trips translate to health benefits: people

who walk one hour per day are more likely to live longer and have lower medical costs.⁸ The value of extended life from walking in the community has been monetized for this analysis using the statistical value of a life based on Federal Highway Administration guidance (i.e. additional years of life multiplied by the annual statistical value of a life). Based on these calculations, the total net health benefits of the project were estimated to be \$45,688,910.

Property Valuation

Given trails' unique value as both open recreation space and a means of travel, research in this area pulls from the study of property value impacts of both transportation infrastructure and parks and open space. Proximity to trails has been shown to have an effect on property value premiums for commuting and recreational purposes and access to greenspace. Increases in property values were estimated to be 6% within a quarter-mile of the proposed trail, which is the approximate distance from the trail that is expected to see impacts.^{9,10} Using this percentage and the assessed dollar values of properties in the trail corridor, the one-time property value increase in the trail corridor was estimated to be \$7,535,815, applied as a one-time value-added figure based on typical Federal Highway Administration practices. The benefit was applied in year six to allow for sufficient time for value increases to occur.

¹ USEPA, "Cars, Trucks, Buses, and "Non-Road" Equipment," Guide to the Clean Air Act, accessed May 8, 2015 (web: www.epa.gov/airquality/peg_caaq/carstrucks.html).

² John Wango, Ph.D., et al. "The Harmful Effects of Vehicle Exhaust," Environment and Human Health, Inc., 2006 (web: www.ehhi.org/reports/exhaust/exhaust06.pdf).

³ USEPA, "Near Roadway Air Pollution and Health," Office of Transportation and Air Quality, date unknown (web: www.epa.gov/otaq/nearroadway.htm).

⁴ American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision.

⁵ OKI Bicycle and Pedestrian Crash data, 2009-2013 (web: <http://www.oki.org/portfolio-items/bike-pedestrian-crashes/>)

⁶ FHWA, Desktop Reference for Crash Reduction Factors. (web: <http://safety.fhwa.dot.gov/tools/crf/fresources/fhwasc08011/>)

⁷ Bureau of Labor Statistics, "May 2016 State Occupational Employment and Wage Estimates, Ohio," (web: https://www.bls.gov/oes/current/oes_oh.htm#47-0000)

⁸ Masato Nagai, et al., Impact of walking on life expectancy and lifetime medical expenditure: the Ohsaki Cohort Study, September, 2011 (web: <http://bmjopen.bmj.com/content/1/1/2/bmjopen-2011-000240.full>)

⁹ Nicholls, S., and J. Crompton, 2005, "The Impact of Greenways on Property Values: Evidence from Austin, Texas," Journal of Leisure Research 37(3): 321-341.

¹⁰ Campbell, Harrison S, and Darla K. Monroe, 2007, "Greenways and Greenbacks: The Impact of the Catawba Regional Trail on Property Values In Charlotte, North Carolina." Southeastern Geographer 47: 118-137.

Operation Year	Years	Pollution Reduction Benefits	Crash Reduction Benefits	Construction Wage Benefits	Construction + Maintenance Costs	Health Benefits	NPV	One-Time Property Value Added	Total Discounted Benefits - Costs (3%)	Total Discounted Benefits - Costs (7%)
0	2017-2019	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	0		\$0.00	\$0.00
0	2020	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	3		\$0.00	\$0.00
0	2021	\$0.00	\$0.00	\$493,162.01	-\$794,556.00	\$0.00	4		-\$266,821.93	-\$425,052.06
0	2022	\$1,530.62	\$18,418.79	\$493,162.01	-\$794,556.00	\$804,880.30	5		\$449,492.07	\$676,858.03
1	2023	\$1,598.67	\$18,737.32	\$2,068.20	-\$3,332.18	\$861,221.92	6		\$733,260.21	\$1,043,957.58
2	2024	\$1,647.57	\$19,061.36	\$2,068.20	-\$3,332.18	\$921,245.87	7		\$760,062.06	\$1,023,348.71
3	2025	\$1,697.69	\$19,391.01	\$2,068.20	-\$3,332.18	\$985,191.60	8		\$787,674.87	\$1,003,161.86
4	2026	\$1,749.04	\$19,726.36	\$2,068.20	-\$3,332.18	\$1,053,314.12	9		\$816,127.46	\$983,401.05
5	2027	\$1,801.66	\$20,067.51	\$2,068.20	-\$3,332.18	\$1,125,885.03	10	\$7,525,814.55	\$6,395,166.78	\$3,650,033.40
6	2028	\$1,855.58	\$20,414.56	\$2,068.20	-\$3,332.18	\$1,203,193.58	11		\$875,671.79	\$945,164.58
7	2029	\$1,887.67	\$20,767.60	\$2,068.20	-\$3,332.18	\$1,285,547.82	12		\$906,809.72	\$926,672.09
8	2030	\$1,943.87	\$21,126.76	\$2,068.20	-\$3,332.18	\$1,373,275.81	13		\$938,928.29	\$908,622.75
9	2031	\$2,025.41	\$21,492.13	\$2,068.20	-\$3,332.18	\$1,466,726.96	14		\$972,060.50	\$891,010.05
10	2032	\$2,084.81	\$21,863.81	\$2,068.20	-\$3,332.18	\$1,566,273.38	15		\$1,006,209.56	\$873,800.22
11	2033	\$2,145.43	\$22,241.92	\$2,068.20	-\$3,332.18	\$1,672,311.36	16		\$1,041,426.98	\$857,003.45
12	2034	\$2,207.76	\$22,626.57	\$2,068.20	-\$3,332.18	\$1,785,262.96	17		\$1,077,750.00	\$840,614.31
13	2035	\$2,271.60	\$23,017.88	\$2,068.20	-\$3,332.18	\$1,905,577.67	18		\$1,115,216.59	\$824,626.40
14	2036	\$2,336.99	\$23,415.95	\$2,068.20	-\$3,332.18	\$2,033,734.20	19		\$1,153,866.10	\$809,032.93
15	2037	\$2,403.97	\$23,820.91	\$2,068.20	-\$3,332.18	\$2,170,242.37	20		\$1,193,739.12	\$793,826.73
16	2038	\$2,472.56	\$24,232.86	\$2,068.20	-\$3,332.18	\$2,315,645.16	21		\$1,234,877.56	\$779,000.31
17	2039	\$2,570.29	\$24,651.95	\$2,068.20	-\$3,332.18	\$2,470,520.80	22		\$1,277,338.74	\$764,554.29
18	2040	\$2,642.70	\$25,078.28	\$2,068.20	-\$3,332.18	\$2,635,485.16	23		\$1,321,138.97	\$750,463.33
19	2041	\$2,716.85	\$25,511.98	\$2,068.20	-\$3,332.18	\$2,811,194.11	24		\$1,366,338.60	\$736,728.29
20	2042	\$2,793.83	\$25,953.19	\$2,068.20	-\$3,332.18	\$2,998,346.15	25		\$1,412,971.68	\$723,334.01
21	2043	\$2,841.06	\$26,402.02	\$2,068.20	-\$3,332.18	\$3,197,685.19	26		\$1,461,114.53	\$710,286.45
22	2044	\$2,919.86	\$26,858.62	\$2,068.20	-\$3,332.18	\$3,410,003.50	27		\$1,510,804.00	\$697,569.83
23	2045	\$3,000.81	\$27,323.11	\$2,068.20	-\$3,332.18	\$3,636,144.85	28		\$1,562,092.71	\$685,175.94
Total Benefit-Cost		\$53,116.29	\$542,202.44	\$1,033,892.67	-\$1,665,752.03	\$45,688,909.87		\$7,525,814.55	\$31,103,316.98	\$22,473,194.52
Benefit/Cost Ratio									19.57276579	14.14198277
MIRR (@75% Reinvestment Rate)									77%	76%
Payback Period (Years)									0.37	0.39

5 | Table: Summary of Costs and Benefits for Delhi Avenue Trail Project, Most Likely Scenario

Return-On-Investment Evaluation

Benefit-Cost: Most Likely Scenario

The final step in this process was to prepare a benefit-cost analysis to weigh the monetized benefits of the trail project against its costs. Using the most likely costs and benefits outlined in the previous sections, Table 5 on the opposite page shows a detailed summary of the benefit-cost ratio analysis at 3% and 7% discount rates, which is the standard requirement for past rounds of USDOT grant funding under the TIGER program.

The overall benefit cost-ratio for the projects is positive (19.6:1), with a modified internal rate of return (MIRR, with a conservative assumption for public return on investment of 75%) of 77% and a payback period of less than a year at a 3% discount rate of return. For a 7% discount rate of return is also positive, at 14.1:1, with an MIRR of 76% and a payback period of less than a year.

Benefit-Cost Ratio: The amount returned for each dollar of investment (e.g., a 5:1 BCR returns five dollars for each dollar of investment). A higher ratio is better, with a value greater than 1.0:1 indicating a positive return on the community investment.

Modified Internal Rate of Return: A measure of the project's effectiveness, useful for ranking against other projects. A higher percentage is better.

Payback Period: The amount of time, in years, that is required for a project's financial returns to exceed the cost of construction and maintenance. A smaller number is better.

Pessimistic and Optimistic Scenarios

Infrastructure investment projects can have a range expected benefits. Because of this uncertainty, a benefit-cost analysis was also conducted for two additional scenarios: pessimistic and optimistic. These scenarios help to define a range of return-on-investment values that the Township may expect to see from the trail. Table 6 below shows the range of return-on-investment metrics that may be expected based on the three scenarios.

Based on available literature on the economic benefits of trails and possible construction scenarios, the pessimistic scenario includes lower crash reduction rates, fewer additional biking and walking trips, and lower property value increases in the trail corridor, 1.5% higher construction costs, and three-year delay in construction start date. The optimistic scenario includes a greater number of new bike and walking trips, higher property value increases, lower maintenance costs, and 15% lower construction costs. It is important to note that in order to make the optimistic benefits a reality, the Township will need to invest in landscaping and amenities, including transit stops, lighting, and improved crossings, in order to maximize trail usage. The detailed input and output tables for these scenarios are included in Appendix C.

	Pessimistic		Most Likely		Optimistic	
	3%	7%	3%	7%	3%	7%
Total Benefit-Cost	\$9,092,243	\$5,901,576	\$31,103,316	\$22,473,194	\$36,716,607	\$26,397,278
Benefit/Cost Ratio	4.98	3.23	19.57	14.14	27.18	19.54
MIRR (@7% Reinvestment Rate)	59%	58%	77%	76%	79%	78%
Payback Period (Years)	0.87	0.88	0.37	0.39	0.28	0.92

6 | Table: Summary of Return-on-Investment Scenarios

Appendix A: Comparable Trails

Trail	CBSA	CBSA Type	Year	Length (mi)	Surface	Pop. Density (per sq. mile)	Average Median Household Income	Active Commute Mode Share	Schools in Corridor	Univer-sites in Corridor	Parks in Corridor	Trail Connections	Trail-heads	Parking
4C Bicentennial Trail	Wilmington	Micro	2004	1.3	Asphalt	557.4	\$ 46,489.63	19.3%	N	Y	Y	Y	2	2
Canal Feeder Trail	Sidney	Micro	2007	2.4	Asphalt	409.4	\$ 61,988.02	1.5%	N	N	N	N	0	2
Canal Winchester Trail System	Columbus	Metro	2007	4.8	Asphalt	1190.6	\$ 87,985.34	1.2%	Y	Y	Y	N	1	1
Chippewa Inlet Trail	Cleveland	Metro	2002	4	Asphalt, crushed stone	349.8	\$ 66,516.02	1.2%	N	N	Y	N	3	4
Chippewa Rail Trail	Cleveland	Metro	2009	2.4	Asphalt	423.5	\$ 64,775.75	1.8%	N	N	N	N	1	1
County Line Trail	Wooster	Micro	2010	6.8	Asphalt	524.0	\$ 63,582.23	1.8%	Y	N	Y	N	4	4
Dr. Richard D. Ruppert Rotary Trail	Toledo	Metro	2009	2.4	Asphalt	4952.0	\$ 24,654.44	5.1%	Y	N	Y	N	0	1
Fairfax Bike Trail	Cincinnati	Metro	2009	0.8	Asphalt	4279.7	\$ 61,435.56	4.2%	Y	N	Y	N	0	0
Fairfield Heritage Trail	Columbus	Metro	2009	9.5	Asphalt	2381.5	\$ 43,420.15	4.2%	Y	Y	Y	N	4	8
Foor Leisure Path	Columbus	Metro	2009	1.3	Asphalt	849.3	\$ 78,789.03	0.6%	Y	N	Y	Y	0	1
Franklin Township Greenway Trail	Celina	Micro	2006	6.5	Asphalt	151.8	\$ 53,138.34	1.4%	Y	N	Y	N	0	2
Garrett Wonders Bike Trail	Youngstown	Metro	2010	3.2	Asphalt	2348.6	\$ 29,543.39	1.6%	Y	N	Y	Y	0	1
Genoa Trail	Columbus	Metro	2009	4	Asphalt	1286.7	\$ 102,296.98	0.1%	Y	N	Y	Y	4	1
Greenville Creek Trail	Greenville	Micro	2005	0.5	Asphalt	2589.7	\$ 29,232.36	1.6%	Y	N	Y	N	0	2

7 | Table: Summary of Comparable Trails

Trail	CBSA	CBSA Type	Year	Length (mi)	Surface	Pop. Density (per sq. mile)	Average Median Household Income	Active Commute Mode Share	Schools in Corridor	Universities in Corridor	Parks in Corridor	Trail Connections	Trail-heads	Parking
Hydraulic Canal Run	Dayton	Metro	2003	2.3	Asphalt	2074.7	\$ 52,578.56	1.9%	Y	N	Y	Y	0	3
Iron Horse Trail	Dayton	Metro	2009	7.6	Asphalt	2889.8	\$ 54,316.80	0.6%	Y	Y	Y	Y	0	1
Lake to Lake Trail	Cleveland	Metro	2009	2.4	Asphalt, boardwalk	1290.3	\$ 61,415.27	15.0%	Y	Y	Y	N	0	2
Lebanon Countryside YMCA Trail	Cincinnati	Metro	2005	8.2	Asphalt	1070.7	\$ 96,222.40	2.4%	Y	N	Y	Y	1	1
Loudonville Pedestrian and Bicycle Pathway	Ashland	Micro	2006	1.5	Asphalt	338.0	\$ 41,170.32	8.3%	Y	N	Y	N	0	2
Lowie's Drive Trail	Wilmington	Micro	2005	0.7	Asphalt	360.1	\$ 42,425.85	4.0%	Y	N	Y	N	0	0
Marietta River Trail	Marietta	Micro	2005	3.4	Asphalt	1690.6	\$ 27,075.67	13.7%	Y	Y	Y	N	0	3
Mill Creek Greenway Trail	Cincinnati	Metro	2009	3	Asphalt, concrete	3448.9	\$ 27,353.56	0.7%	Y	Y	Y	N	0	3
Morgana Run Trail	Cleveland	Metro	2007	2.1	Asphalt	4163.3	\$ 22,917.04	3.2%	Y	N	Y	N	0	0
Nickelplate Trail	Canton	Metro	2004	2.5	Asphalt, crushed stone	898.6	\$ 52,939.56	0.9%	Y	N	Y	N	0	2
Roberts Pass Trail	Columbus	Metro	2007	6.5	Asphalt	260.9	\$ 53,697.79	6.2%	Y	N	Y	Y	0	1
Steel Mill Trail	Cleveland	Metro	2008	2	Asphalt	1100.7	\$ 46,620.14	0.6%	Y	N	Y	Y	2	2
Tecumseh Trail	Springfield	Metro	2010	2.4	Asphalt	1247.2	\$ 56,664.50	1.8%	Y	N	Y	N	1	3
Union City Gateway Trail	Greenville	Micro	2008	0.7	Asphalt	277.7	\$ 23,965.85	5.4%	N	N	N	Y	0	1
Wellston Bike Path	Jackson	Micro	2003	1.8	Asphalt	444.1	\$ 31,747.33	3.1%	Y	N	Y	N	0	0

Appendix B: Benefit-Cost Inputs

Key Input Factors	Source(s)
Project Length (mi.):	Delhi Township
Current Year:	Delhi Township
Operational Year:	Delhi Township
Benefit Horizon Year:	Delhi Township
Cost Estimate (\$2017):	Cost Estimate by Stantec based on recent bid tabulations and prior unit estimates, quantities derived from base design graphic
Cost of Travel (\$2017):	2015 BLS Median hourly wage in Ohio https://www.bls.gov/oes/current/oes_oh.htm#00-0000
Mean Travel Time to Work (2015, hours)	American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T147)

Key Input Factors: Pollution Reduction Benefits	\$/short ton	Average Emissions / Mile (tons)	Source(s)
VOC Benefit	\$1,916	0.000001126	TIGER BCA Resource Guide, updated 3.1.2016; USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf ;
NOx Benefit	\$7,550	0.000000778	TIGER BCA Resource Guide, updated 3.1.2016; USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf ;
PM Benefit	\$345,394	0.000000009	TIGER BCA Resource Guide, updated 3.1.2016; USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf ;
SO2 Benefit	\$44,625	0.000000005	TIGER BCA Resource Guide, updated 3.1.2016; USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf ;
CO2 Benefit	Varies	0.000415066	TIGER BCA Resource Guide, updated 3.1.2016; USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf ;

Key Input Factors: Crash Reduction Benefits	Crashes in Vicinity of Greenway	Number of Crashes per Year in Vicinity of Greenway:	Source(s)
Transportation Demand Annual Increase:	1	1.7%	OKI Bicycle and Pedestrian Crash data, http://www.ohio.gov/portfolios-items/bike-pedestrian-crashes/
Delay Caused by Crashes (hours per crash):	0.6	10%	Average annual rate of increase from 2013 to 2015 - Ohio DOT DVMT for urban roads in Hamilton County: https://www.dot.state.oh.us/Divisions/Planning/TechServ/trffc/Pages/DVMT.aspx
Estimated Crash Reduction:			Mark Hallenbeck, et al. "Incident Response Evaluation Phase 3." Washington State DOT, February 2011 (web: http://www.wsdot.wa.gov/research/reports/fullreports/751.1.pdf)
			FHW4, Desktop Reference for Crash Reduction Factors: Estimate of 10% related to off-road improvements, ped signals, improved crossings, and lighting (http://safety.fhwa.dot.gov/tools/crf/resources/fhw4s08011/)

Key Input Factors: Greenway Benefits	Percent People Walking or Biking to Work:	Number of Residents within 1/2-mile of Greenway (2015 est.):	Jobs within 1/2-mile of Greenway (2014):	Number of New Bike/Walk Users of Trail:	Auto Miles Reduced in One Year:	Source(s)
	1.5%	5,858	2,289	86	1,248	American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T128)
						ACS 2015 estimates for census block groups: 39061 - 0213021, 0213033, 0213041, 0213042, 0214012, 0213044, 0214211, 0214212, 0213043, 0213413, 0104001. Apportioned by area to trail buffer
						LEHD / Bureau of Labor Statistics, 2014
						Number Residents + Number Workers x .7 reduction factor for people who live/work in area
						Assuming average commute of 25 minutes (American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T147) at average speed of 35mph)

Key Input Factors: Construction Benefits	Construction Investment to Create One Job (\$2017):	Average Construction Worker Wage for One Year (\$2017):	Source(s)
	\$78,823	\$48,923	TIGER BCA Resource Guide, updated 3.1.2016
			May 2016 State Occupational Employment and Wage Estimates, Ohio, Bureau of Labor Statistics (web: https://www.bls.gov/oes/current/oes_oh.htm#47-0000)

Key Input Factors: One-Time Property Value Added Benefits Greenway	Increase of Property Values within 1/4-mile of Greenway:	Total Market Property Values within 1/4-mile (\$2017):	Fair Market Property Value Increase with Greenway (\$2017):	Source(s)
	6%	\$170,092,404	\$10,205,544.24	Nicholls, S., and J. Crompton. 2005. "The Impact of Greenways on Property Values: Evidence from Austin, Texas." <i>Journal of Leisure Research</i> 37(3): 321-341. Research conducted on comparable trails in Ohio indicated conservative property value increases.
				Hamilton County Planning and Development
				Hamilton County Planning and Development; Asaber, P. and F. Huffman. 2009. "The relative impacts of trails and greenbelts on home price." <i>The Journal of Real Estate Finance and Economics</i> 38(4): 408-419.

8 | Table: Benefit-Cost Inputs for Most Likely Scenario

Key Input Factors: Health-Related Benefits from Walking and Biking

Trips Reliant on Walking within 1/2 mile of Study Area	86
Population Growth per annum	0.50%
Additional Walking Trips within 1/2mile of Study Area	6%
Additional Life Accrued to More Physical Activity	1.27
Statistical value of one year of life (\$2017)	120,434.47

Maintenance Cost Factors

Cost per mile (Greenway or trail) (\$2017):	\$3,029
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Source(s)

American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T128), Number Residents + Number Workers x .7 reduction factor for people who live/work in area
 Census Bureau Estimates (<http://www.bizjournals.com/cincinnati/news/2015/03/26/how-much-has-greater-cincinnati-grown-in.html>)
 Based on Elasticity of .06 from changes in density, diversity and design of built environment (The Louis Berger Group, Inc., Emissions Benefits of Land Use Planning Strategies, FHWA-TOPR-29December 20, 2004.
 Based on greater number of people walking at least one hour per day (Masato Nagai, et al., Impact of walking on life expectancy and lifetime medical expenditure: the Ohaki Cohort Study, September, 2011:
 2016 TIGER Guidance: Lewis, Kristen and Burd-Sharps, Sarah, American Human Development Report: The Measure of America 2013-2014, page 17 (web: www.measuredforamerica.org/wp-content/uploads/2013/06/MOA-III.pdf)

Source(s)

"Draft Milwaukee County Trails Network Plan," 2007, Milwaukee County Dept. of Parks, Recreation, and Culture, estimate for asphalt trail maintenance (web: <http://www.americantrails.org/resources/ManageMaintain/MilwaukeeCost.html>)

Appendix G: Scenarios

Key Input Factors		Source(s)
Project Length (mi.):	1.1	Delhi Township
Current Year:	2017	Delhi Township
Operational Year:	2022	Delhi Township
Benefit Horizon Year:	2045	Delhi Township
Cost Estimate (\$2017):	\$1,589,112	Cost Estimate by Stantec based on recent bid tabulations and prior unit estimates, quantities derived from base design graphic
Cost of Travel (\$2017):	\$17.19	2016 BLS Median hourly wage in Ohio https://www.bls.gov/oes/current/oes_oh.htm#00-0000
Mean Travel Time to Work (2015, hours)	0.42	American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T147)

Key Input Factors: Pollution Reduction Benefits		Source(s)
VOC Benefit	\$/shortton \$1,916	Average Emissions / Mile (tons) 0.000001126 TIGER BCA Resource Guide, updated 3.1.2016: USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf
NOx Benefit	\$/shortton \$7,550	0.000000778 TIGER BCA Resource Guide, updated 3.1.2016: USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf
PM Benefit	\$/shortton \$345,394	0.000000009 TIGER BCA Resource Guide, updated 3.1.2016: USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf
SO2 Benefit	\$/shortton \$44,625	0.000000005 TIGER BCA Resource Guide, updated 3.1.2016: USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf
CO2 Benefit	Varies	0.000415066 TIGER BCA Resource Guide, updated 3.1.2016: USEPA, https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf

Key Input Factors: Crash Reduction Benefits		Source(s)
Crashes in Vicinity of Greenway	1	OKI Bicycle and Pedestrian Crash data, http://www.oki.org/portfolio-items/bike-pedestrian-crashes/
Number of Crashes per Year in Vicinity of Greenway:	1.7%	Average annual rate of increase from 2013 to 2015 - Ohio DOT DIVMT for urban roads in Hamilton County: https://www.dot.state.oh.us/Divisions/Planning/TechServ/Traffic/Pages/DIVMT.aspx
Transportation Demand Annual Increase:	0.6	Mark Hellenbeck, et al, "Incident Response Evaluation Phase 3," Washington State DOT, February 2011 (web: http://www.wsdot.wa.gov/research/reports/fullreports/751.1.pdf)
Delay Caused by Crashes (hours per crash):	10%	FHWA, Desktop Reference for Crash Reduction Factors. Estimate of 10% related to off-road improvements, ped signals, improved crossings, and lighting (http://sdgfy.fhwa.dot.gov/tools/crf/resources/fhwass08011/)

Key Input Factors: Greenway Benefits		Source(s)
Percent People Walking or Biking to Work:	1.5%	American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T128)
Number of Residents within 1/2-mile of Greenway (2015 est.):	5,858	ACS 2015 estimates for census block groups: 39061 - 0213021, 0213033, 0213041, 0213042, 0214012, 0213044, 0214211, 0214212, 0213043, 0213413, 0104001, Apportioned by area to trail buffer
Jobs within 1/2-mile of Greenway (2014):	2,289	LEHD / Bureau of Labor Statistics, 2014
Number of New Bike/Walk Users of Trail:	86	Number Residents + Number Workers x .7 reduction factor for people who live/work in area
Auto Miles Reduced in One Year:	1,248	Assuming average commute of 25 minutes (American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision (SE T147)) at average speed of 35mph

Key Input Factors: Construction Benefits		Source(s)
Construction Investment to Create One Job (\$2017):	\$78,823	TIGER BCA Resource Guide, updated 3.1.2016
Average Construction Worker Wage for One Year (\$2017):	\$48,923	May 2016 State Occupational Employment and Wage Estimates, Ohio, Bureau of Labor Statistics (web: https://www.bls.gov/oes/current/oes_oh.htm#47-0000)

Key Input Factors: One-Time Property Value Added Benefits Greenway		Source(s)
Increase of Property Values within 1/4-mile of Greenway:	6%	Nicholis, S., and J. Crompton, 2005. "The Impact of Greenways on Property Values: Evidence from Austin, Texas" <i>Journal of Leisure Research</i> 37(3): 321-341. Research conducted on comparable trails in Ohio indicated conservative property value increases.
Total Market Property Values within 1/4-mile (\$2017):	\$170,092,404	Hamilton County Planning and Development
Fair Market Property Value Increase with Greenway (\$2017):	\$10,205,544.24	Hamilton County Planning and Development; Asabere, P. and F. Huffman, 2009. "The relative impacts of trails and greenbelts on home price." <i>The Journal of Real Estate Finance and Economics</i> 38(4): 408-419.

9 | Table: Benefit-Cost Inputs, Pessimistic Scenario

Operation Year	Years	Pollution Reduction Benefits	Crash Reduction Benefits	Construction Wage Benefits	Construction + Maintenance Costs	Health Benefits	NPV	One-Time Property Value Added	Total Discounted Benefits - Costs (3%)	Total Discounted Benefits - Costs (7%)
0	2017-2019	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	0		\$0.00	\$0.00
0	2020	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	3		\$0.00	\$0.00
0	2021	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	4		\$0.00	\$0.00
0	2022	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	5		\$0.00	\$0.00
0	2023	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	6		\$0.00	\$0.00
0	2024	\$0.00	\$0.00	\$567,136.32	-\$913,739.40	\$0.00	7		-\$280,049.34	-\$377,053.10
0	2025	\$1,212.63	\$9,695.51	\$567,136.32	-\$913,739.40	\$389,054.27	8		\$41,820.02	\$53,265.11
1	2026	\$1,249.31	\$9,863.18	\$2,068.20	-\$3,332.18	\$408,506.99	9		\$318,046.85	\$383,236.63
2	2027	\$1,286.90	\$10,033.75	\$2,068.20	-\$3,332.18	\$428,844.80	10		\$323,656.54	\$369,069.43
3	2028	\$1,325.41	\$10,207.28	\$2,068.20	-\$3,332.18	\$450,107.59	11		\$329,307.82	\$355,444.57
4	2029	\$1,348.33	\$10,383.80	\$2,068.20	-\$3,332.18	\$472,337.02	12		\$334,990.69	\$342,331.35
5	2030	\$1,388.48	\$10,563.38	\$2,068.20	-\$3,332.18	\$495,576.66	13	\$2,747,443.10	\$2,189,833.39	\$1,049,581.31
6	2031	\$1,446.72	\$10,746.06	\$2,068.20	-\$3,332.18	\$519,872.00	14		\$346,526.03	\$317,635.93
7	2032	\$1,489.15	\$10,931.91	\$2,068.20	-\$3,332.18	\$545,270.61	15		\$352,358.50	\$305,994.14
8	2033	\$1,532.45	\$11,120.96	\$2,068.20	-\$3,332.18	\$571,822.17	16		\$358,239.86	\$294,803.40
9	2034	\$1,576.97	\$11,313.29	\$2,068.20	-\$3,332.18	\$599,578.62	17		\$364,171.80	\$284,046.91
10	2035	\$1,622.57	\$11,508.94	\$2,068.20	-\$3,332.18	\$628,594.24	18		\$370,155.69	\$273,708.08
11	2036	\$1,669.28	\$11,707.97	\$2,068.20	-\$3,332.18	\$658,925.73	19		\$376,193.01	\$263,770.86
12	2037	\$1,717.12	\$11,910.45	\$2,068.20	-\$3,332.18	\$690,632.37	20		\$382,285.23	\$254,219.73
13	2038	\$1,766.11	\$12,116.43	\$2,068.20	-\$3,332.18	\$723,776.08	21		\$388,433.83	\$245,039.63
14	2039	\$1,835.92	\$12,325.97	\$2,068.20	-\$3,332.18	\$758,471.58	22		\$394,650.32	\$236,222.02
15	2040	\$1,887.64	\$12,539.14	\$2,068.20	-\$3,332.18	\$794,636.51	23		\$400,915.98	\$227,740.41
16	2041	\$1,940.60	\$12,755.99	\$2,068.20	-\$3,332.18	\$832,491.53	24		\$407,242.46	\$219,587.64
17	2042	\$1,974.17	\$12,976.59	\$2,068.20	-\$3,332.18	\$872,060.52	25		\$413,621.59	\$211,745.67
18	2043	\$2,029.33	\$13,201.01	\$2,068.20	-\$3,332.18	\$913,420.64	26		\$420,074.29	\$204,212.04
19	2044	\$2,085.61	\$13,429.31	\$2,068.20	-\$3,332.18	\$956,652.56	27		\$426,592.19	\$196,969.27
20	2045	\$2,143.44	\$13,661.55	\$2,068.20	-\$3,332.18	\$1,001,840.56	28		\$433,176.95	\$190,005.73
Total Benefit-Cost		\$34,528.16	\$242,992.49	\$1,175,636.67	-\$1,894,122.30	\$13,712,423.04		\$2,747,443.10	\$9,092,243.68	\$5,901,576.77
Benefit/Cost Ratio									4.975293654	3.229354437
MIRR (@75% Reinvestment Rate)									59%	58%
Payback Period (Years)									0.87	0.88

10 | Table: Summary of Costs and Benefits, Pessimistic Scenario

Key Input Factors		2017	2022	2045	Cost Estimate (\$2017):	Mean Travel Time to Work (2015, hours)
Project Length (mi.):	1.1					
Current Year:	2017					
Operational Year:	2022					
Benefit Horizon Year:	2045					
Cost Estimate (\$2017):	\$1,350,745					
Cost of Travel (\$2017):	\$17,19					
Mean Travel Time to Work (2015, hours)	0.42					

Key Input Factors: Pollution Reduction Benefits		\$/Shortton	Average Emissions / Mile (tons)
VOC Benefit	\$1,916	0.000001126	
NOx Benefit	\$7,550	0.000000778	
PM Benefit	\$345,594	0.000000009	
CO2 Benefit	\$44,625	0.000000005	
	Varies	0.000415066	

Key Input Factors: Crash Reduction Benefits		Crashes in Vicinity of Greenway
Number of Crashes per Year in Vicinity of Greenway:	1	
Transportation Demand Annual Increase:	1.7%	
Delays Caused by Crashes (hours per crash):	0.6	
Estimated Crash Reduction:	10%	

Key Input Factors: Greenway Benefits		Percent of People Walking or Biking to Work:
Number of Residents within 1/2-mile of Greenway (2015 est.):	5,858	
Jobs within 1/2-mile of Greenway (2014):	2,289	
Number of New Biker/Biwalk Users of Trail:	98	
Auto Miles Reduced in One Year:	1,426	

Key Input Factors: Construction Benefits		Construction Investment to Create One Job (\$2017):
Average Construction Worker Wage for One Year (\$2017):	\$78,823	
	\$46,923	

Key Input Factors: One-Time Property Value Added Benefits Greenway		8%
Increase of Property Values within 1/4-mile of Greenway:	\$170,292,404	
Total Market Property Values within 1/4-mile (\$2017):	\$13,607,292.32	
Fair Market Property Value Increase with Greenway (\$2017):		

Key Input Factors: Health-Related Benefits from Walking and Biking		Trips Reliant on Walking within 1/2 mile of Study Area
Population Growth per annum	0.50%	
Additional Walking Trips within 1/2mile of Study Area	6%	
Additional Life Accrued to More Physical Activity	1.27	
Statistical value of one year of life (\$2017)	120,434.47	

Cost per mile (greenway or trail) (\$2017):	\$2,491.78
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11 | Table: Benefit-Cost Inputs, Optimistic Scenario

Source(s)
 Delhi Township
 Delhi Township
 Delhi Township
 Delhi Township
 Cost Estimate by Stantec based on recent bid tabulations and prior unit estimates, quantities derived from base design graphic
 2016 BIS Median hourly wage in Ohio https://www.bls.gov/oes/current/oes_oh.htm00-0000
 American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision [SE 1747]

Source(s)
 TIGER BGA Resource Guide, updated 3.1.2016, USEPA, <https://www.transportation.gov/sites/gov/files/oes/BGA%20Resource%20Guide%202016.pdf>
 TIGER BGA Resource Guide, updated 3.1.2016, USEPA, <https://www.transportation.gov/sites/gov/files/oes/BGA%20Resource%20Guide%202016.pdf>
 TIGER BGA Resource Guide, updated 3.1.2016, USEPA, <https://www.transportation.gov/sites/gov/files/oes/BGA%20Resource%20Guide%202016.pdf>
 TIGER BGA Resource Guide, updated 3.1.2016, USEPA, <https://www.transportation.gov/sites/gov/files/oes/BGA%20Resource%20Guide%202016.pdf>
 TIGER BGA Resource Guide, updated 3.1.2016, USEPA, <https://www.transportation.gov/sites/gov/files/oes/BGA%20Resource%20Guide%202016.pdf>

Source(s)
 Oxi Bicycle and Pedestrian Crash Data, <http://www.ohio.gov/portals/items/bike-pedestrian-crashes/>
 Average annual rate of increase from 2013 to 2015 - Ohio DOT DMVT for urban roads in Hamilton County:
<https://www.dot.state.oh.us/Divisions/Planning/TrafficServ/TrafficPages/DMVT.aspx>
 Mark Hollenbeck, et al. "Incident Response Evaluation Phase 3." Washington State DOT, February 2011. (web): <http://www.wsdot.wa.gov/research/reports/subreports/RS11.1.pdf>
 FHWA, Desktop Reference for Crash Reduction Factors. Estimate of 10% related to off-road improvements, ped signals, improved crossings, and lighting <http://safety.fhwa.dot.gov/tools/crf/resources/fhwes080111>

Source(s)
 American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision [SE 1728]
 ACS 2015 estimates for census block groups: 39061 - 0213021, 0213033, 0213041, 0213042, 0213044, 0214012, 0213044, 0214211, 0214212, 0213043, 0213413, 0100001.
 LEHD / Bureau of Labor Statistics, 2014
 Number Residents + Number Workers x 8 reduction factor for people who live/work in area
 Assuming average commute of 25 minutes (American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision [SE 1747]) at average speed of 35mph

Source(s)
 TIGER BGA Resource Guide, updated 3.1.2016
 May 2016 State Occupational Employment and Wage Estimates, Ohio Bureau of Labor Statistics (web): https://www.bls.gov/oes/current/oes_oh.htm#7-0000

Source(s)
 Aabere, P. and F. Huffman, 2009. "The relative impacts of trails and greenbelts on home price." *The Journal of Real Estate Finance and Economics* 38(4): 408-419.
 Hamilton County Planning and Development
 Hamilton County Planning and Development
 Hamilton County Planning and Development
 Estate Finance and Economics 38(4): 408-419.

Source(s)
 American Community Survey, 2015 Five-Year Estimate for Delhi Township Hamilton County Subdivision [SE 1728], Number Residents + Number Workers x .78 reduction factor for people who live/work in area
 Census Bureau Estimates <http://www.bizjournals.com/cincinnati/news/2015/03/26/how-much-has-greater-cincinnati-grown-in.html>
 Based on Elasticity of .05 from changes in density, diversity and design of built environment (The Louis Berger Group, Inc., Emissions Benefits of Land Use Planning Strategies, FHWA-TRP-20December 20, 2004.
 Based on a greater number of people walking at least one hour per day (Kistner Nagel, et al., Impact of walking on life expectancy and lifetime medical expenditure: the Orsaki Cohort Study, September, 2011: <http://bmjopen.bmj.com/content/1/2/bmjopen-2011-000240.full>)
 2015 TIGER Guidelines, Lewis, Kristen and Burd-Sharps, Sarah, American Human Development Report: The Measure of America 2013-2014, page 17 (web): <http://www.measuringamerica.org/wp-content/uploads/2013/06/MOA-111.pdf>

Source(s)
 "Draft Milwaukee County Trails Network Plan", 2007, Milwaukee County Dept. of Parks, Recreation, and Culture, estimate for asphalt trail maintenance (web): <http://www.americantrails.org/resource/Management/MilwaukeeMaincast.html>

Operation Year	Years	Pollution Reduction Benefits		Crash Reduction Benefits		Construction Wage Benefits		Construction + Maintenance Costs		Health Benefits		NPV Year	One-Time Property Value Added	Total Discounted Benefits - Costs	
		Reduction Benefits	Reduction Benefits	Reduction Benefits	Reduction Benefits	Construction Wage Benefits	Maintenance Costs	Health Benefits	Health Benefits	(3%)	(7%)				
0	2017-2019	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	0		\$0.00	\$0.00
0	2020	\$0.00	\$0.00	\$0.00	\$0.00	\$419,187.71	-\$675,372.60	\$0.00	\$0.00	\$0.00	\$0.00	3		\$0.00	\$0.00
0	2021	\$0.00	\$18,418.79	\$18,418.79	\$419,187.71	-\$675,372.60	\$919,863.20	\$0.00	\$0.00	\$0.00	\$0.00	4		-\$226,798.64	-\$361,293.81
0	2022	\$1,749.28	\$18,737.32	\$18,737.32	\$1,701.25	-\$2,740.96	\$984,253.62	\$0.00	\$0.00	\$0.00	\$0.00	5		\$587,242.16	\$884,284.99
1	2023	\$1,827.06	\$19,061.36	\$19,061.36	\$1,701.25	-\$2,740.96	\$1,052,852.42	\$0.00	\$0.00	\$0.00	\$0.00	6		\$836,119.21	\$1,190,399.51
2	2024	\$1,882.94	\$19,391.01	\$19,391.01	\$1,701.25	-\$2,740.96	\$1,125,933.25	\$0.00	\$0.00	\$0.00	\$0.00	7		\$866,769.27	\$1,167,018.86
3	2025	\$1,940.21	\$19,726.36	\$19,726.36	\$1,701.25	-\$2,740.96	\$1,203,787.57	\$0.00	\$0.00	\$0.00	\$0.00	8		\$898,346.05	\$1,144,109.11
4	2026	\$1,998.90	\$20,067.51	\$20,067.51	\$1,701.25	-\$2,740.96	\$1,286,725.75	\$0.00	\$0.00	\$0.00	\$0.00	9		\$930,882.49	\$1,121,675.63
5	2027	\$2,059.04	\$20,414.56	\$20,414.56	\$1,701.25	-\$2,740.96	\$1,375,078.38	\$0.00	\$0.00	\$0.00	\$0.00	10	\$10,034,419.40	\$8,364,035.52	\$4,681,008.20
6	2028	\$2,120.66	\$20,767.60	\$20,767.60	\$1,701.25	-\$2,740.96	\$1,469,197.51	\$0.00	\$0.00	\$0.00	\$0.00	11		\$998,971.26	\$1,078,248.32
7	2029	\$2,187.34	\$21,126.76	\$21,126.76	\$1,701.25	-\$2,740.96	\$1,569,458.07	\$0.00	\$0.00	\$0.00	\$0.00	12		\$1,034,576.37	\$1,057,236.57
8	2030	\$2,221.56	\$21,492.13	\$21,492.13	\$1,701.25	-\$2,740.96	\$1,676,259.39	\$0.00	\$0.00	\$0.00	\$0.00	13		\$1,074,302.10	\$1,036,723.24
9	2031	\$2,314.75	\$21,863.81	\$21,863.81	\$1,701.25	-\$2,740.96	\$1,790,026.72	\$0.00	\$0.00	\$0.00	\$0.00	14		\$1,109,186.17	\$1,016,701.46
10	2032	\$2,382.64	\$22,241.92	\$22,241.92	\$1,701.25	-\$2,740.96	\$1,911,212.98	\$0.00	\$0.00	\$0.00	\$0.00	15		\$1,148,232.25	\$997,133.11
11	2033	\$2,451.92	\$22,626.57	\$22,626.57	\$1,701.25	-\$2,740.96	\$2,040,300.53	\$0.00	\$0.00	\$0.00	\$0.00	16		\$1,188,499.19	\$978,030.33
12	2034	\$2,523.15	\$23,015.95	\$23,015.95	\$1,701.25	-\$2,740.96	\$2,177,803.05	\$0.00	\$0.00	\$0.00	\$0.00	17		\$1,230,029.57	\$959,387.34
13	2035	\$2,596.12	\$23,415.95	\$23,415.95	\$1,701.25	-\$2,740.96	\$2,324,267.66	\$0.00	\$0.00	\$0.00	\$0.00	18		\$1,259,563.55	\$931,360.47
14	2036	\$2,670.85	\$23,820.91	\$23,820.91	\$1,701.25	-\$2,740.96	\$2,480,277.00	\$0.00	\$0.00	\$0.00	\$0.00	19		\$1,317,055.74	\$923,452.63
15	2037	\$2,747.39	\$24,232.86	\$24,232.86	\$1,701.25	-\$2,740.96	\$2,646,451.61	\$0.00	\$0.00	\$0.00	\$0.00	20		\$1,362,642.90	\$906,145.70
16	2038	\$2,825.78	\$24,651.95	\$24,651.95	\$1,701.25	-\$2,740.96	\$2,823,452.35	\$0.00	\$0.00	\$0.00	\$0.00	21		\$1,409,676.13	\$889,268.19
17	2039	\$2,937.47	\$25,078.28	\$25,078.28	\$1,701.25	-\$2,740.96	\$3,011,983.04	\$0.00	\$0.00	\$0.00	\$0.00	22		\$1,458,220.93	\$872,821.15
18	2040	\$3,020.23	\$25,511.98	\$25,511.98	\$1,701.25	-\$2,740.96	\$3,212,793.27	\$0.00	\$0.00	\$0.00	\$0.00	23		\$1,508,295.96	\$856,775.88
19	2041	\$3,104.97	\$25,953.19	\$25,953.19	\$1,701.25	-\$2,740.96	\$3,426,681.31	\$0.00	\$0.00	\$0.00	\$0.00	24		\$1,559,970.17	\$841,133.63
20	2042	\$3,158.66	\$26,402.02	\$26,402.02	\$1,701.25	-\$2,740.96	\$3,654,497.36	\$0.00	\$0.00	\$0.00	\$0.00	25		\$1,613,282.47	\$825,877.32
21	2043	\$3,246.93	\$27,323.11	\$27,323.11	\$1,701.25	-\$2,740.96	\$3,897,146.86	\$0.00	\$0.00	\$0.00	\$0.00	26		\$1,668,320.09	\$811,014.00
22	2044	\$3,336.98	\$27,740.96	\$27,740.96	\$1,701.25	-\$2,740.96	\$4,155,594.11	\$0.00	\$0.00	\$0.00	\$0.00	27		\$1,723,125.16	\$796,525.85
23	2045	\$3,429.50	\$28,184.57	\$28,184.57	\$1,701.25	-\$2,740.96	\$4,419,419.40	\$0.00	\$0.00	\$0.00	\$0.00	28		\$1,783,757.78	\$782,403.69
Total Benefit-Cost		\$60,704.33	\$519,184.57	\$877,504.12	-\$1,413,787.23	\$52,215,897.00							\$10,034,419.40	\$36,703,303.84	\$26,387,441.38
Benefit/Cost Ratio														27.1726318	19.53546929
MIRR (@75% Reinvestment Rate)														79%	78%
Payback Period (Years)														0.28	0.29

12 | Table: Summary of Costs and Benefits, Optimistic Scenario

