Benefit Cost Analysis for the Linden Green Line

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Executive Summary

The Linden Green Line (LGL) is a proposed off-road trail, approximately 7 miles in length on a former rail line that the City of Columbus has purchased. The project will include a paved, bi-directional trail that crosses vehicle traffic at 12 intersections. Safety countermeasures ranging from high-visibility crosswalks to a pedestrian bridge are included in the design and respond to the traffic context of each intersection. Notably, the project also includes 15 east-west access points to make it easy for trail users to get on and off the trail at key locations. Some of the access points tie directly to schools, parks, apartment buildings, and commercial districts, while others serve residential neighborhoods and restore east-west connectivity.

This BCA adheres to guidance in the U.S. Department of Transportations (USDOT's) Benefit-Cost Analysis Guidance for Discretionary Grant Programs (February 2024) and pulls from relevant research as necessary to articulate and measure the project's benefits. Measured benefits include:

- **Safety:** The value of reduced crashes due to the installation of the shared use path, which creates a safer environment for active transportation users and results in fewer short vehicle trips.
- **Health:** Reduced mortality as a result of greater access to physical activity.
- **Reduced Pavement:** Fewer vehicle trips resulting in less wear and tear on road.
- **Emissions:** Fewer vehicle trips resulting in improved air quality and tree planting.

Many important benefits of the project are not measured in the BCA, including the benefit the trail will have for students, low-income households without vehicles, and people with disabilities who currently must navigate a built environment without high-quality infrastructure for pedestrians or bicyclists. Unquantified benefits are listed at the end of the document.

Part 1: Key Assumptions

The BCA relies on a number of key assumptions related to construction timeline, impact area, and scenarios.

Construction Timeline. The BCA assumes that capital costs will incur in 2026 and 2027, and the trail will open to the public in January 2028. The first year of benefits is 2028, with no ramp up in benefits prior.

Project Impact Area. A one-mile buffer around the LGL was used to represent the estimated impact area of the project for various calculations used in the BCA. For Census

and demographic data, the study area included Census Tracts where at least ten residential properties were within one mile of the LGL to capture neighborhoods most impacted by the trail. We assume that the LGL will attract trail users from areas outside of this study area, but those users are not measured in this analysis. Figure 1 shows the one mile buffer and LGL trail alignment.

Evaluated Scenarios. The BCA analyzes two scenarios in accordance with USDOT guidance: no-build and build. While there are many planned projects the City and other partners are pursuing in the study area, these projects are not considered in the scenarios. Network improvements and connections between the LGL and future active transportation projects are expected but not measured in this BCA.

No-Build Scenario. The no-build scenario is a baseline that assumes the LGL is not constructed, and no similar alternative is constructed. Benefits associated with the trail project are not calculated, including the health benefits, crash reduction, and mobility benefits the trail would provide. People walking and biking today have little to no supportive infrastructure and those interested in walking or biking have few active transportation options to consider for their trips.

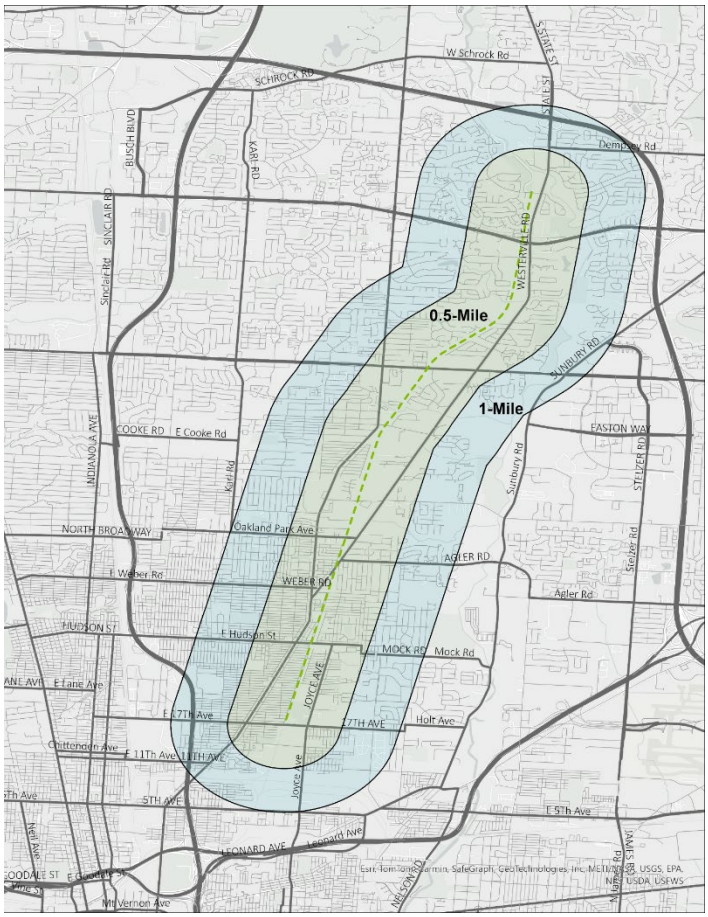

Figure 1. Proposed Project Impact Area

Build Scenario. The build scenario assumes that the LGL project is constructed as proposed, and incorporates benefits and costs associated with the project. These benefits include health benefits from increased access to physical activity, trips shifting to the LGL from other roads in the study area, and more people choosing to walk or bike instead of driving for short trips on parallel routes. As a result, the project will reduce crashes for people walking, biking, and driving and will reduce emissions. Trees are an additional source of emissions reduction. See Table 1 on the following page for an overview of scenario assumptions.

Characteristics	No-Build Scenario	Build Scenario
Population	The population is expected to continue to grow.	The population is expected to continue to grow.
Active Transportation Users	People bike and walk on roads in the study area, often with little to no supportive infrastructure.	When the trail opens, some people who bike and walk will shift to using the trail instead of other facilities. Some people who drive for short distances on parallel routes will walk or bike on the LGL instead.
Construction costs	None	Project construction cost
Operation and Maintenance Costs	Illegal dumping and hazardous trees are present on the abandoned rail line. These will need to be removed to maintain a state of good repair and avoid hazards to the public.	Once the trail is open, operational and maintenance costs will keep it functioning and maintained.

Table 1. Scenario Comparison

Analysis Period. The analysis period for the LGL BCA is 30 years. This analysis period was chosen to reflect the durability of the project's pedestrian bridge, a significant feature of the project's design. The City of Columbus has a commitment to building a connected low-stress bike network of which the LGL is an important piece. The City expects to maintain the LGL well beyond the analysis period.

Inflation and Discounting Adjustments. All benefits and costs are estimated in 2022 dollars based on USDOT guidance. A 3.1% real discount rate is assumed throughout the period of analysis unless otherwise noted.

Part 2: Population and Demand Estimation

The Mid-Ohio Regional Planning Commission (MORPC) produces population forecasts at various scales, including the Census Tract level. These were used to develop population forecasts for the study area. MORPC's population forecasts are available in 5-year increments, beginning in 2025 through 2050. The analysis period for this BCA is 30 years, the 2049-2050 growth rate was interpolated and apply to years 2050 through 2057 as shown in User Volumes (see Excel). In the build scenario, there are two sources of demand: locally originating active transportation trips that will divert trips to the trail and motorists that will shift to biking or walking on the trail for some trips.

Facility Shift (Active Transportation Trips shifting to the LGL)

StreetLight is a big data source that the Ohio Department of Transportation allows local communities to access for no cost via its statewide subscription. The data primarily comes from cell phone aggregators and is available at the Census Tract level and for select corridors and trail segments. StreetLight is inclusive of all types of trips and accounts for seasonality in its annual averages based on actual usage.

For the Census Tracts in the study area, StreetLight data indicates that 4.5% of all trips were conducted by walking in 2022, and 0.82% of all trips were conducted by biking.[1] StreetLight also estimates that there were around 205,600 trips daily originating in the study area across all modes, equating to approximately 9,252 walking trips and 1,694 biking trips.

Alum Creek Greenway Comparison. When the LGL is constructed, some of today's active transportation trips will shift to the LGL. To estimate this number of trips, StreetLight data for Alum Creek Greenway, a comparable trail in Columbus, was used. Alum Creek Trail is a greenway that has neighborhood connections in the City of Columbus, and shares a number of characteristics with the proposed LGL. At the time of this analysis, recent trail counts were not available for the BCA on the Alum Creek Trail or any regional trails. Instead, the team used StreetLight data to estimate the share of trips in the Census Tracts near the trail that use the trail over the course of a year. On average, in 2021, StreetLight data shows that there were **1,487 pedestrian trips** and **215 bicycle trips** each day in the Census Tracts within one-mile of the 1.6 mile section of the Alum Creek Greenway available for analysis in StreetLight. The same Census Tract selection criteria was used (tract boundary within one mile of the trail and with at least 10 residential properties within one mile). The year 2021 was used to gather Alum Creek Greenway data as the trip length by segment was not available for 2022. The 1.6 miles of trail is divided into 17 individual trail segments in Streetlight, each of which has some transportation data available.

Pedestrian Assessment: On average, there were 152 pedestrian trips on the most-used segment of the Alum Creek Greenway in 2021, and 14 trips a day on the lowest-used segment. This would account for between 1 and 10% of all active transportation activity in the study area if all trips originated in the Alum Creek Greenway Study Area. But, we know that there are long-distance pedestrian trips included in the data. Because the Study Area includes 1.6 miles of trail and a 1-mile radius around the trail, we can surmise that just trips up to three miles in length are likely to have originated in the Census Tracts around Alum Creek. For the most-used segment, this included 104 local trips per day, or 7% of the pedestrian trips in the study area (Table 2). Keeping the low estimate as-is of one percent, we can assume that between 1 and 7 percent of all pedestrian trips in the Study Area used the Alum Creek Greenway in 2021.

Trip Length (Up to)	Pedestrian Trips
1 mile	19
2 miles	52
3 miles	33
4 miles	25
5 miles	10
More than 5 Miles	13
Total	152

[1] StreetLight data was pulled using the Active Transportation feature for the Census Tracts in the study area, then selected by mode and volume for 2022. 2022 was selected as it is the most recent full year of data available and is less impacted by COVID-19 than prior years.

Table 2. Pedestrian Trips by Length for Typical Alum Creek Greenway segment, 2021

Bicyclist Assessment: There were 182 bike trips on the most-used segment (out of those available for StreetLight analysis) on the Alum Creek Greenway in 2021, and 11 trips a day on the lowest-used segment. This would account for between 5% and 85% of all bike activity in the Alum Creek Greenway Study Area, if all trips originated in the study area. We know that long-distance bike trips are common on trails. Just as in the Pedestrian Assessment, we assumed that just trips up to three miles in length originated in the Alum Creek Greenway Study Area. For the most-used trail segment totaling 182 trips, this includes 22 out of 182 trips, of about 12% (Table 3). Keeping the low estimate as-is of five percent, we can assume that between 5 and 12 percent of all bike trips in the Study Area used the Alum Creek Greenway in 2021.

Trip Length (Up to)	Bicyclist Trips
1 mile	2
2 miles	13
3 miles	7
4 miles	7
5 miles	6
6 miles	10
7 miles	12
More than 7 Miles	124

Table 3. Bicyclist Trips by Length for Typical Alum Creek Greenway segment, 2021

Alum Creek Greenway Comparison Findings

Data on trip length, Alum Creek Greenway trail trips, and the number of local active transportation trips near the trail was used to develop an estimate of local trail use on the LGL. Table 4 shows estimates for each mode.

	Pedestrian Trips	Bicyclist Trips
Alum Creek Local Use Estimate (Range)	1% to 7%	5% to 12%
Daily Active Trips near LGL	9,252	1,694
Estimates Daily Use of the LGL	92 to 648	85 to 203

Table 4. Alum Creek Local Use Estimates applied to Linden Green Line Study Area

Using this logic, we anticipate that between **177 and 851 active transportation trips a day** on the LGL will originate locally from the study area. The study area of the LGL is significantly larger than the Alum Creek Greenway Trail study area, and has significant and dedicated access to schools, high-density housing (mobile home park, apartments, and traditional neighborhoods), parks, and businesses. American Community Survey 2018-2022 5-year estimates show that there are 780 commuters that bike or walk to work without the use of the LGL. It seems likely that due to the lack of comfortable bike and pedestrian facilities on parallel North-South roads, and the new East-West connectivity the trail creates, many of these commuters will divert at least part of their trip to the Linden Green Line. For these above reasons, we use the high-range estimate from the Table 4 for the

demand estimation, and assume that **851 daily active transportation trips in the study area** will convert to active modes if the trail opened in 2022.[2]

Mode Shifts(Vehicle Trips Converted to Active Transportation). Once the trail is constructed, we anticipate that some vehicle trips will convert to active transportation modes, based on trip length and parallel routing. The mode shift percentages are likely to vary based on overall trip length, and not every future trail user will use all 6.8 miles of the trail. To estimate mode shift conversion conservatively, we limited mode shift to a percentage of short vehicle trips on two north-south routes that parallel the LGL, Cleveland Avenue; and Joyce Avenue to Westerville Road.
These are the largest and closest parallel routes to the proposed trail. Because of the number of new access points, there are a number of short east-west trips that will be practical for active transportation once the trail is constructed, but these are not included in the analysis.

According to StreetLight's Corridor Analysis data, the stretch of Cleveland Avenue that parallels the LGL averaged between 11,226 and 22,212 vehicle trips in 2022, depending on the segment analyzed. This is consistent with the Ohio Department of Transportation's 2022 count of 23,303 vehicles on the segment north of Republic Avenue.[3] StreetLight's trip length data for one segment with about average traffic volumes (15,118 vehicles per day) and centrally located (just south of Morse Road) are shown in Table 5. Just trip lengths under 5.1 miles are shown.

Joyce Avenue and Westerville Road (north of Joyce) together form a parallel north-south route to the corridor. On the segments available for analysis in StreetLight, Joyce Avenue had between 3,149 and 5,313 average daily vehicle trips, while Westerville Road had between 13,336 and 13,628 average daily vehicle trips. StreetLight's trip length data for two segments (one typical for each road) are shown in Table 6, which is normalized by the overall detour extent.

	Cleveland Avenue		Joyce Avenue (Windsor to Agler)		Westerville Road (Agler to Cooper)	
Trip Length (up to)	# of Vehicle Trips	% of all Vehicle Trips	# of Vehicle Trips	% of all Vehicle Trips	# of Vehicle Trips	% of all Vehicle Trips
1 mile	91	0.6%	26	0.5%	41	0.3%
2 miles	484	3.2%	174	3.3%	355	2.6%
3 miles	1,134	7.5%	300	5.7%	519	3.8%
4 miles	1,451	9.6%	363	6.9%	751	5.5%
5 miles	1,527	10.1%	479	9.1%	902	6.6%
Detour Extent (% Parallel with LGL)	100% (6.8 miles)		30% (2.2 miles)		65% (4.6 miles)	

Table 5. Parallel Route Vehicle Trip Lengths, 2021
Source: StreetLight

[2] This analysis may also be conservative because it does not account for any long-distance recreational travel outside originating outside of the immediate study area. New trails, especially those that connect to other low-stress facilities, will attract bicyclists and long-distance runners from non-local origins. These trips are expected but not calculated for the Linden Green Line given available data.
[3] Traffic Count Database System (TCDS) - Detail (ms2soft.com)

Table 6 shows the National Household Travel Survey's 2022 data on trip length by mode share, for similar MSA's to the Columbus region. East North Central MSA/CMSA's with at least one million people were used as the basis for this analysis. This estimate is likely conservative for the LGL for several reasons. First, many of the peer MSAs are further north than Columbus and have harsher winter conditions, likely reducing the percentage of mode shift for the group overall. Secondly, this information is at the MSA-scale which includes suburban contexts as well as urban.

Trip Length	Walking	Biking	Total
< 0.5 mile	57.3%	6.4%	63.6%
1 mile	20.1%	1.4%	21.5%
2 miles	3.5%	0.1%	3.6%
3 miles	1.6%	0.5%	2.2%
4 miles	0.4%	1.0%	1.4%
5 miles	0.4%	0.5%	0.9%
6 to 10 miles	0.1%	0.0%	0.1%

Table 6. Mode Share by Trip Length for Peer MSA's
Source: National Household Travel Survey, 2022

Estimated trip diversion by trip length is shown in Table 7. As trips between 0.1 and 0.5 miles were not distinguishable from trips under 1 mile in length in StreetLight, the assumptions for trips up to 1 mile in length were used to estimate activity (20.1% and 1.4% for walking and biking respectively). Because some people already bike and walk on these parallel routes and are captured in the facility diversion, the percentages were halved as shown in Table 7 to represent new trips attracted to active modes. Lastly, Table 7 does not show trips longer than 5.1 miles, as mode diversion was dropped to 0.0% for both modes for trips longer than 5 miles. The number of total trips diverted in Table 7 must be multiplied by the percent of the route that parallels the Linden Green Line, to gain a realistic estimate of trips that might reasonably use the project. Table 8 shows the calculation that results in 60 additional daily active transportation trips, drawn from parallel routes.

Trip Length (Up to)	Mode Diversion		Cleveland Avenue (Windsor to Young)			Joyce Avenue (Windsor to Agler)			Westerville Road (Agler to Cooper)		
	% Walking	% Biking	# Vehicle trips	Walking Trips Diverted	Biking Trips Diverted	# Vehicle trips	Walking Trips Diverted	Biking Trips Diverted	# Vehicle trips	Walking Trips Diverted	Biking Trips Diverted
1 mile	10.10%	0.70%	91	9	1	26	3	0	41	4	0
2 miles	1.80%	0.00%	484	9	0	174	3	0	355	6	0
3 miles	0.20%	0.30%	1,134	2	3	300	1	1	519	1	2
4 miles	0.20%	0.50%	1,451	3	7	363	1	2	751	2	4
5 miles	0.20%	0.30%	1,527	3	5	479	1	1	902	2	3
Total Trips Diverted				26	16		8	4		15	8

Table 7. Trip Diversion, 2021
Source: StreetLight, Note Trips rounded to nearest whole

	# Diverted Walking Trips	# Diverted Biking Trips	% of Route Parallel to Linden Green Line	# New Walking Trips	# New Biking Trips	Reduced Vehicle Trip Total
Cleveland	26	16	100%	26	16	42
Joyce	8	4	30%	2	1	3
Westerville	15	8	65%	10	5	15
				38	22	60

Table 8. Diversion Totals
Source: Streetlights, Note Trips rounded to nearest whole

Forecasting Demand. The annual estimate of trail users is shown in User Volumes (Excel). Seasonality was captured by multiplying the daily maximum mode shift increase by 250 days per year, in accordance with the approximate number of appropriate weather days for short walking and biking trips in Columbus. Seasonality is already captured in StreetLight's average daily active transportation trip data, as the number of daily trips in the study area in 2022 was captured based on actual usage (fluctuations due to seasonality are reflected). So, the number of trips expected to divert from various facilities was multiplied by 365 to create an annual estimate. Combined, these values equal daily expected trail trips. The increase each year from year to year was based on the regional population growth estimate (provided by MORPC) for trips due to facility shift. For trips based on mode shift, the increase from year to year was based on the projected rate of increase in VMT (provided by MORPC), because the mode shift calculation is based on traffic on parallel roads.

Part 3: Benefit Calculations

USDOT guidelines were followed to quantity several key benefits.

Value of Reduced Crashes. The LGL project is in an area that experiences significant crashes, especially for people walking. Between 2018 and 2022, 17 pedestrians were killed. Many of the roads, despite the urban context with dense homes and business, lack sidewalks, lighting, and marked crosswalks. The value of reduced crashes is a significant benefit of the LGL. 5-years of most recent crash data (2018-2022) was downloaded from the Ohio Department of Transportation's GCAT tool for the study area. Crash severity was organized into the KABCO scale by the Ohio Department of Transportation. Crash reductions were measured for bicyclists and pedestrians in part using a CMF (crash modification factor) described below.

Crash Modification. The 6.8-mile LGL will be on an independent right of way, far from parallel traffic. The trail will require users to cross traffic at up to 12 locations, one of which will be an above-grade pedestrian and bicyclist bridge. The intersections, their current configuration, and proposed crossing treatments are shown in Table 9. The project also introduces 15 paved east-west access points connecting directly to community destinations and residential developments like parks, a mobile home park, schools, an apartment complex, etc. The east-west connections will be paved with a total of 1,900 additional feet of trail and 720 feet of widened sidewalk.

Intersection	Current Configuration	Proposed Crossing Style
17th	AADT 4,410, 35 MPH 2 travel lanes with center turn lane; 32 feet wide	High Visibility Crosswalk, Advanced Yield Signs, Advanced Pavement Markings
East Hudson Street	AADT 21,564, 35 MPH 2 travel lanes; 30 feet wide	High Visibility Crosswalk, Advanced Yield Signs, Advanced Pavement Markings, RRFB
Genessee Ave	AADT 1,535, 25 MPH 2 travel lanes; on-street parking; 26 feet wide	High Visibility, Raised Crosswalk
Denune Ave	25 MPH 2 travel lanes; on-street	High Visibility, Raised Crosswalk, Advanced Yield Signs, Advanced Pavement Markings, RRFB
Westerville Road	AADT 13,251, 35 MPH 3 lanes	High Visibility Crosswalk, Advanced Yield Signs, Advanced Pavement Markings, Rectangular Rapid Flashing Beacon (RRFB)
Oakland Park	AADT 6,010, 35 MPH 2 Lanes, TWLTL	High Visibility Crosswalk, Advanced Yield Signs
Innis Road	AADT 19,204, 35 MPH 2 Travel Lanes	High Visibility Crosswalk, Advanced Yield Signs, Pedestrian Hybrid Beacon
Ferris	AADT 11,072, 35 MPH 2 travel lanes	High Visibility Crosswalk, Raised Median Island
Morse	AADT 28,916, 45 MPH 6 lanes, TWLTL	Grade Separated Pedestrian Bridge
Minerva Lake Road	25 MPH 2 lanes, on-street parking	High Visibility, Raised Crosswalk
Old Dublin-Granville	35 MPH 2 lanes	High Visibility Crosswalk, Advanced Yield Signs
Cooper	AADT 8,315, 45 MPH 2 lanes	High Visibility Crosswalk, Advanced Yield Signs, Advanced Pavement Markings, RRFB

Table 19. Intersection Configurations and Crossing Treatments
Note: AADT provided by Ohio Department of Transportation, not available for all roads.

The nearest signalized crossings to each trail crossing today are typically on roads that lack dedicated bike facilities, marked crosswalks, and other pedestrian countermeasures. Many roads in the study area lack sidewalks. Therefore, the "no-build" scenario is assumed to be reflected in the 2018-2022 crash data for pedestrians and bicyclists. In other words, if the trail is not built, unsafe conditions will continue and the high number of bicyclist and pedestrian crashes will persist.

CMF ID 9250 resulted in a CMF of .75 for shared use paths and is available for reference in the Crash Modification Factor Clearinghouse.[4] Trails included in the study were installed in a variety of contexts, many of which can be assumed to have better "no-build" conditions than the area around the LGL today. The trails included in the study also had a range of crossing conditions, many with less supportive crossings than what is proposed for the LGL. Lastly, because the study measured the impact to all traffic crashes after trails were

[4] https://www.cmfclearinghouse.org/detail.php?facid=9250

installed, it accounts for some degree of facility shift. Because of the comprehensive nature of the study, no other CMF's were applied to the LGL crash reduction estimates.

Bike and Pedestrian Crash Reduction. The LGL is in an integral location central to the community it serves. With 15 dedicated access points to neighborhoods and 12 crossings with City streets, the project will dramatically increase connectivity between homes and key destinations with new east-west and north-south conditions. The measured expected VMT reduction, as discussed in the next section, is relatively low, due to the conservative estimates of mode shift (drawing only from parallel streets and not anticipating these east-west connections). Table 10 shows the value of crash reductions by applying a 25% reduction to pedestrian and bicyclist crashes in the study area per the Crash Reduction Factor. Because the number of fatalities and serious injuries is high in the study area, the value of the reductions is also high. Although population is expected to grow, this BCA remains conservative by not applying today's crash rate to future population estimates for biking and walking crashes.

Crash Severity	5-YEAR TOTAL CRASHES	CRASHES PER YEAR	Predicted Annual Crash Reduction	Value of Crashes Reduced
O - No Injury	21	4.20	1.05	$ 5,250.00
C - Possible Injury	57	11.40	2.85	$ 318,345.00
B - Non-Incapacitating	176	35.20	8.80	$ 2,057,440.00
A - Incapacitating	56	11.20	2.80	$ 3,326,960.00
K - Killed	17	3.40	0.85	$ 10,625,000.00

Table 10. Bike and Pedestrian Crash Reduction Value, 2022 dollars

VMT Reduction Calculation. Vehicle crash reductions were calculated using an estimate of VMT reduction. To calculate VMT reduction, the number of annual pedestrian and bike trips expected due to mode shift were multiplied by average trip lengths of 0.93 and 2.46, respectively, based on results from the 2022 National Household Travel Survey. National data was used as it is more conservative than results for the Columbus peer group of East North Central Region MSA's. This estimate accounts for seasonality by assuming a person shifting to an active mode would do so for 250 days of the year. The rate change between VMT in 2022 and 2057 was used to create an annual crash reduction as shown in Table 11. Because VMT is expected to rise based on MORPC's traffic model for the study area, the vehicle crash reduction does account for growth, unlike the bike and pedestrian crash reduction.

Crash Severity	5-YEAR TOTAL CRASHES	CRASHES PER YEAR	Predicted Annual Crash Reduction	Value of Crashes Reduced
O - No Injury	6490	1,298.00	5.64	$28,185.27
C - Possible Injury	1159	231.80	1.01	$112,446.02
B - Non-Incapacitating	1425	285.00	1.24	$289,378.89
A - Incapacitating	199	39.80	0.17	$205,376.19
K - Killed	26	5.20	0.02	$282,286.97

Table 11. Vehicle Crash Reduction

Total crash reduction benefits are shown in Table 12.

	2028 (Opening Year)	Over Project Life Cycle (2028-2057)	
		In Constant Dollars	Discounted
Reduced Costs	$ 17,305,033	$523,101,566	$289,286,845

Table 12. Total Crash Reduction Benefit

Reduced Pavement Maintenance

The LGL project is an area that will experience a reduction in vehicle miles traveled due to mode shifts. This will have positive benefits on pavement maintenance costs as there will be less vehicles on nearby roads. Reduced pavement maintenance was calculated by multiplying the VMT reduction (explained previously in the Safety Benefit section) and the cost per mile traveled value, which is discussed below.

Cost Traveled Per Mile. The value for cost per mile traveled comes from the 1997 Federal Highway Cost Allocation Study: Final Report.[5] It was estimated that the marginal pavement cost in 2000 is $0.1 for autos/urban interstate. The Consumer Price Index Inflation Calculator was used to inflate the marginal cost to 2022 dollars. January 2000 was used as the starting point and was inflated to January 2022 dollars.[6] The result was $0.17 per mile traveled.

Total reduced pavement maintenance benefits are shown in Table 13.

	2028 (Opening Year)	Over Project Life Cycle (2028-2057)	
		In Constant Dollars	Discounted
Reduced Costs	$ 4,041	$138,189	$75,077

Table 13. Total Crash Reduction Benefit

[5] 1997 federal highway cost allocation study : final report (bts.gov)
[6] CPI Inflation Calculator (bls.gov)

Emissions

The Emissions category was calculated in two parts: emissions reduction from reduced VMT and air quality improvements from tree planting.

Emissions Reductions. The first part of this benefits calculation was the emissions reduction from the VMT reduction (discussed previously). According to the EPA, the average passenger vehicle emits about 400 grams of CO_2 per mile, which is 0.0004 metric tons.[7] To convert the annual VMT reduction to CO_2 emissions, the annual VMT reduction values were multiplied by the conversion factor of 0.0004. The annual value of CO_2 emissions was then multiplied by the recommended value per USDOT guidance, which is $0.124 per mile in 2022 dollars for all vehicles - urban CO_2 emissions. Total reduced pavement maintenance benefits are shown in Table 14.

		Over Project Life Cycle (2028-2057)	
	2028 (Opening Year)	In Constant Dollars	Discounted
Reduced Costs	$ 1.18	$40	$27

Table 14. Emissions Reduction Value from Reduced VMT

Air Quality Improvements from Tree Planting. The LGL project is planting 2,000 native, hardwood trees alongside the creation of the trail. The makeup of these 2,000 trees include: 750 hardwood at 3" DBH (diameter at breast height), 750 hardwood at 5" DBH, and 500 hardwood at 6" DBH.

The i-Tree Planting Calculator was used to calculate the benefits of CO_2 sequestration for air quality improvements. This calculation provided numbers for each type of tree and the total number of all three types. All totals calculated of CO_2 sequestered were for the full project lifecycle of 20 years (2037-2057) to account for tree maturity during the first ten years (2027-2037).

Total air quality improvements from tree planting benefits are shown in Table 15.

	Over Project Life Cycle (2037-2057)	
	In Constant Dollars	Discounted
Reduced Costs	$84,251	$28,942

Table 15. Tree Planting Benefit

Health & Mortality

[7] Greenhouse Gas Emissions from a Typical Passenger Vehicle: Questions and Answers – Fact Sheet (EPA-420-F-23-014, June 2023)

The LGL project will attract more people to walk and bike, due to mode shift. These new active transportation users will experience health benefits from physical activity. To quantify this benefit, a reduction in mortality risk was calculated by multiplying the number of induced trips meeting criteria and the cost per induced trip. The cost per induced trip comes from USDOT Guidance: $7.63 per induced walking trip and $6.80 per induced cycling trip. The induced trips meeting criteria is explained below.

Induced Trips Meeting Criteria. The first part of this criteria is that only new users from mode shift can be included in this measurement. New users from other facilities already experience these health benefits and cannot be included for that reason. The numbers for mode shift are discussed in Part 2: Population and Demand Estimation.

However, there are specific age ranges for the walking and cycling calculations, per USDOT Guidance. Only those between ages 20 and 74 can be included in the calculation for walking. Only those between ages 20 and 64 can be included in the calculation for cycling. To determine this percentage new users from mode shift, the study area demographics were analyzed. Using American Community Survey 2018-2022 5-year estimates, 65% and 59% of the study area meets that criteria for walking and biking, respectively. These percentages were factored into the numbers of new users from mode shift to calculate the number of induced trips meeting criteria. Total health benefits from reduced mortality are shown in Table 16.

	2028 (Opening Year)	Over Project Life Cycle (2028-2057)	
		In Constant Dollars	Discounted
Reduced Costs	$ 73,521	$2,514,557	$1,366,079

Table 16. Health Benefit

Part 4: Unquantified Benefits

The LGL has many benefits beyond what is calculated in this BCA. Some of these include:

- Utility and Stormwater Benefits- the LGL will reduce localized flooding and utility costs for nearby buildings, due to increased tree plantings
- Travel Time Savings- as this project is in a residential area interspersed with parks and community destinations, and near several business districts, the mix of trip purposes is likely very diverse, making it impractical to estimate travel time savings.
- Connectivity to other multi-modal projects- the City of Columbus' low-stress bike network is growing rapidly, and a number of projects are planned and funded today that will connect the LGL into this network. Network increases are associated with more ridership, but this benefit was not calculated in the BCA.
- Benefits for Environmental Justice Communities- Communities of Concern/Interest and Environmental Justice Areas are present in the study area. These areas have high concentration of children, families living in poverty, and households without access to vehicles. Each of these will benefit from the trail above and beyond what is calculated in the BCA.

- Long distance recreational trips - The number of recreational trips originating outside of the study area was not estimated. But, the LGL will work to connect the Columbus Greenways together by filling a critical gap in the network and bring low-stress biking networks closer to parks and to downtown Columbus, likely resulting in more use than comparable trails in the City.
- Amenity Benefits- The quality of separated infrastructure for people walking and biking had a large impact on the BCA's safety benefit. To avoid double counting benefits, this analysis did not estimate amenity benefits separately. The amenity calculations also rely on per person benefits, but as this BCA uses new forms of estimating trip volumes (StreetLight activity data), per person volume would have been difficult to ascertain without exaggerating the values.
- Land Value- As the City is working to build affordable housing and other equitable land use strategies into the project, the estimated increase in value of nearby private properties was not included in this BCA.

Part 5: BCA Totals

The final BCA result is shown in Table 17 below.

Category	Value
Total Discounted Benefits	$292,942,767
Total Discounted Costs	$15,959,200
Net Present Value	$276,983,567
Benefit Cost Ratio	18.36