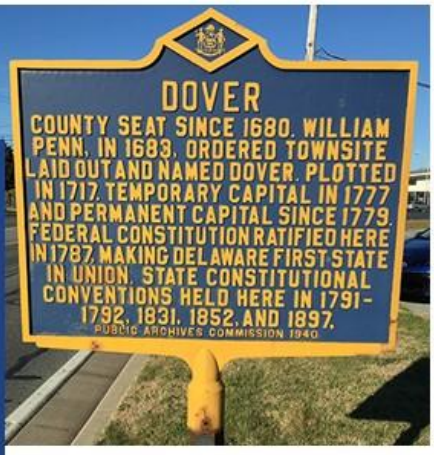
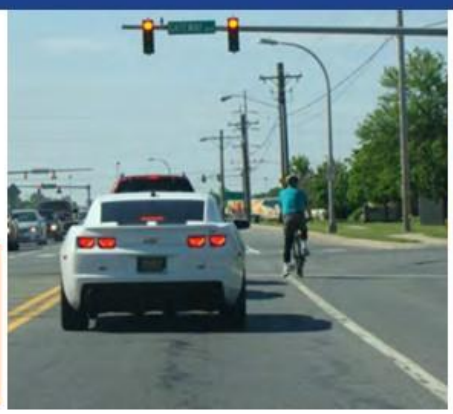
US Department of Transportation
Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant 2024

# CREATING CONNECTIONS:

## MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector



## BENEFIT COST ANALYSIS NARRATIVE

Submitted February 28, 2024 Delaware Department of Transportation

# BENEFIT COST ANALYSIS NARRATIVE

## PROJECT DESCRIPTION AND SCOPE

The purpose of this grant application is to fund the construction of bicycle and pedestrian improvements along South Little Creek Road, MLK Boulevard and where they intersect Bay Road and US13.

Known as the **MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector,** this project was identified as a priority in the 2015 and 2020 City of Dover Bicycle and Pedestrian Plans, which the Dover/Kent County Metropolitan Planning Organization assisted in developing. Once complete, it will provide a primary east-west bicycle and pedestrian route connecting central Dover to the residential and commercial areas on the eastern limits of the city.

The project will include the installation of approximately 1.2 miles of 10-foot-wide shared-use path with a 3-foot buffer on the north side of South Little Creek Road, from Horsepond Road to the intersection of Bay Road. The path will continue for approximately 250 feet northbound on Bay Road and will stop at an existing sidewalk utilized by shoppers walking or bicycling to the Target store.

Also included in this project are improvements to where South Little Creek Road, MLK Boulevard and the two 4-lane highways of Bay Road and US13 intersect. These improvements will include signalized crosswalks, median refuge islands, median fencing, and ADA-compliant curb ramps. A shared use path approximately 400 feet in length will also be installed on the northside of MLK Boulevard in between Bay Road and US13. The path will then connect to an existing pathway on the southern side of MLK Boulevard. This existing pathway is part of the Capital City Trail and other bicycle and pedestrian trail networks that connect to various places within the City of Dover including government buildings, shopping centers, parks, museums, a transit center, schools, etc.

To accommodate the width of a new shared-use pathway, the curb of the existing road must be relocated, triggering the reconstruction and expansion of the closed drainage system along South Little Creek Road. A culvert in poor condition (bridge #BR2-067B) near Horsepond Road must also be reconstructed to fit the shared use pathway and to help mitigate nuisance flooding on the roadway.

## BASELINE: NO-BUILD

The current Baseline No-Build Condition of South Little Creek Road will be assessed from the perspective of people walking and biking. The proposed project is not anticipated to have any meaningful benefits or detrimental impacts to automobile traffic, and therefore it will not be detailed or accounted for in this Benefit Cost Analysis (BCA).
From the pedestrian perspective, South Little Creek Road has 4-5’ sidewalks along the majority of the street, with critical gaps in the sidewalk which require people to walk in the shoulder or on the grass adjacent to the street. The sidewalks end at Barrister Place, leaving two large mobile home communities disconnected from the sidewalk network, accounting for approximately 290

mobile home units. The sidewalks on South Little Creek Road were constructed incrementally, installed by land developers along their frontage or small DelDOT and City of Dover projects since the 1990s. This has led to sidewalks and curb ramps which are not compliant with the Americans with Disabilities Act (ADA), and substandard by contemporary DelDOT Pedestrian Access Standards (PAS). Some of the older segments of sidewalk are significantly deteriorated and in poor condition. **Figure 1** shows a map of sidewalks, shared-use pathways, and curb ramps within the project area. **Figure 2** shows deteriorated sidewalks on South Little Creek Road.


**Figure 1:** A map showing segments of sidewalk, shared-use pathway, and curb ramps along state-maintained roads, and their designation as Compliant or Non-Compliant by ADA standards.

**Figure 2:** a picture showing the condition of some sidewalks on South Little Creek Road.

Currently, there are only east-west signalized pedestrian crosswalks for crossing Bay Road and US13 on the south side of Bay Road and the north side of US13. There are no east-west

signalized pedestrian crossings on the north side of Bay Road or the south side of US13, as shown in **Figure 3**.

To safely cross this system of intersections at signalized pedestrian crosswalks, people walking must cross between three to five separate pedestrian crossing phases, zig-zagging their way across this intersection, experiencing a significant amount of delay, and increasing their exposure to the danger of crossing high-volume, high-speed roadways. It takes about 9 minutes for an able-bodied person to cross from the north side of South Little Creek Road to south side of MLK Boulevard and requires one to walk across about 475' of active travel ways which, depending on the leg being crossed, may have conflicting turning movements sharing time with the pedestrian crossing phase.


**Figure 3:** An aerial view of the intersection of US13, Bay Road, South Little Creek Road, and MLK Boulevard

From the perspective of those bicycling or using micro-mobility devices, South Little Creek Road typically falls within the Bicycle Level of Traffic Stress 3 (LTS3) category; with an AADT of 5775 vehicles per day, an estimated free flow speed around 40 mph (based on State Fleet Vehicle GPS data), and typically a shoulder between 5-12' wide.

There are segments of the street where the shoulder transitions to a right-turn lane with no dedicated or advisory space for bikes, which elevate the street to Level of Traffic Stress 4 (LTS4) conditions. While there are 5' 'pocket bike lanes' on the approach to Bay Road, there are no bike lanes between Bay Road and US13 – transitioning to 3 travel lanes in each direction with no shoulders. This is a very stressful and potentially dangerous segment of roadway for vulnerable road users. This pinch point in the bike network limits the effective utility of this corridor for traveling into Dover to those who are comfortable cycling on LTS4 roadway conditions –

creating a physical, perceptual, and social barrier to those considering or required to travel without a car.

While Babb Drive and Levy Court Lane offer alternate ways to get into Dover without crossing this intersection, the effective detour of these routes is staggering. For example, a trip towards central Dover to Legislative Avenue would require an additional detour of 200% to take Levy Court Drive and Public Safety Boulevard and a detour of 50% to take Babb Drive and Loockerman Street. These alternatives are not without high-stress pinch points in the cycling network as well.

Bicycling and using micro-mobility devices on the sidewalk and ad-hoc crossing between gaps in traffic is not uncommon on South Little Creek Road and the Bay Road/ US13 intersection, as there is an obvious mismatch in facilities for the typical bike rider on this roadway. The lack of a coherent, direct way to travel along South Little Creek Road and across US13 and Bay Road leads people to operate their bicycles in whatever manner feels most safe and expedient – at times straddling the legal guidelines of the motor vehicle code and exposing them to higher levels of risk for injury and conflict with automobile drivers.

For people living on South Little Creek Road, the lack of a direct, safe, and comfortable route to walk, cycle, or use other micro-mobility devices to cross the US13/Bay Road intersection is a massive barrier to safely traveling to jobs, shopping, family and friends, and community resources in the City of Dover. For many, this lack of a coherent and safe-feeling route across these intersections will result in choosing to drive for short local trips (if that is an available option), not taking a trip they might have otherwise taken, or in the case of those who cannot afford to drive or miss their trip, exposure to onerous detour or potentially dangerous, unsignalized crossings of these arterial roads.

It is evident by the volume of unsignalized mid-block crossings of US13 that have been documented between South Little Creek Road and East Loockerman Street that the current configuration of the roadway and these intersections is not working for residents and that it is leading to high-risk behavior, degrading the quality of life for those traveling without a car, and potentially leading to a suppression in mobility for a vulnerable population.

## SOLUTION: BUILD

Under the Build Scenario, the proposed improvements of this project will be implemented within the project limits. This includes the construction of a 10’ wide hotmix shared use pathway with a 3’ grass buffer along the westbound side of South Little Creek Road from US13 to Horsepond Road, construction of 5-6’ concrete sidewalks to fill missing gaps along the eastbound side of the road, and the reconfiguration of many intersections along South Little Creek Road to reduce speeds for automobile turning movements which conflict with the shared use pathway crossings. An example of this improvements can be seen in **Figure 4**.

Build Scenario improvements also include the installation of a signalized east-west pedestrian crosswalk on the north side of Bay Road and the south side of US13. This would fulfill DelDOT’s long-term goal of providing a signalized pedestrian crossing on all sides of these two

intersections. This would also create a direct crossing on the north side of this intersection where the predominant walking and bicycling desire-line lies. Improvement to the Bay Road/ US13 intersection can be seen in **Figure 5.**

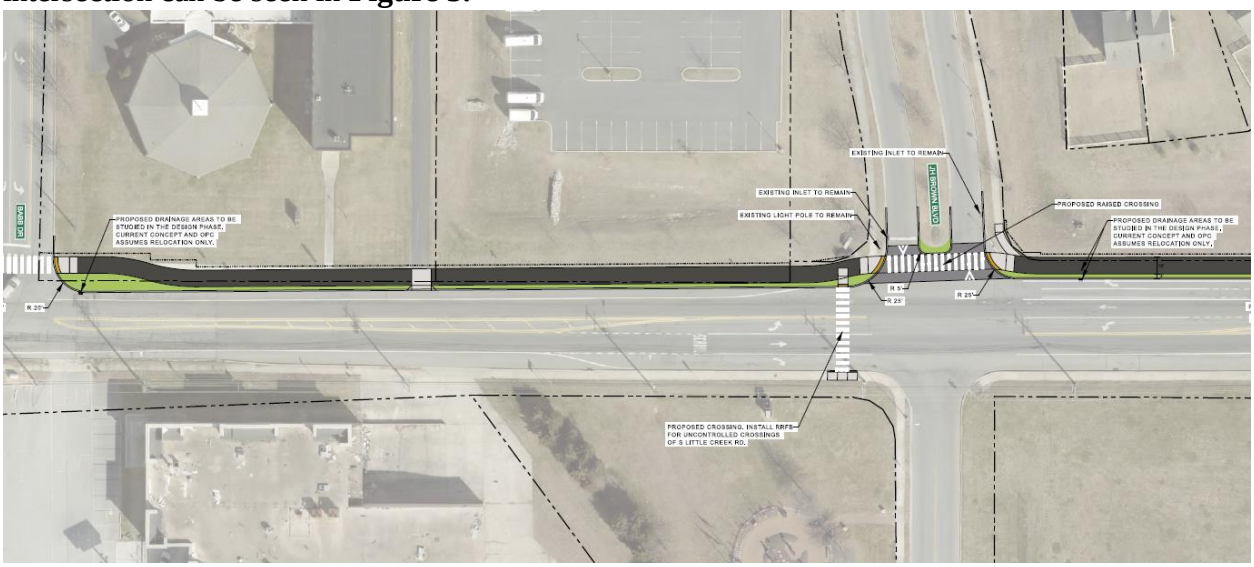



**Figure 4:** Example of the Build Scenario Improvements along South Little Creek Road.

**Figure 5:** Example of the Build Scenario Improvements at the intersection of Bay Road and US13

By adding a pedestrian crossing on the north-side desire line and reducing the crossing distance via curb relocations and median islands, the full pedestrian crossing maneuver described in the No-Build section above (which required people to walk across about 475' active travel-way pavement, an unnecessary risk exposure), reduces the distance walked in a high-speed, high-volume roadway to less than 250'. It is too early in design to estimate Build Scenario pedestrian crossing times for this intersection.

The Build Scenario Improvements also include the installation of median barrier fencing along Bay Road and US13 between South Little Creek Road and East Loockerman Street, as proposed in the DelDOT's 2019 US13 Pedestrian Safety Audit. The median barrier fencing would be designed to limit the utility of unsignalized mid-block crossings between South Little Creek

Road and Loockerman Street and reduce exposure to this high-risk crossing maneuver, which has a tragic history of pedestrian injuries and fatalities throughout this corridor.

Additional improvements which will be addressed in the Build Scenario include the replacement of bridge #2-067B – a state-maintained bridge which is in poor condition which will be expanded to fit the shared use path on South Little Creek Road, and right sized to reduce flooding for local home owners and business owners, reducing nuisance flooding of Horsepond Road, a critical industrial corridor and access point to the Dover Airforce Base Civil Air Terminal. While this improvement is requisite to fulfill the primary pedestrian/bicyclist mobility and safety goals of this project, it will have other environmental and travel time reliability benefits for surrounding businesses and residents which were not accounted for in the BCA.

## PROJECT ANALYSIS PERIOD

The analysis period for the **MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector** project begins in year 2028 when the project is expected to open to the public and ends in year 2043. This period includes a 25-year operational period. The 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs (BCA Guidance) was used to develop each section of the BCA.

## BICYCLE AND PEDESTRIAN VOLUME ESTIMATION AND VALIDATION PROCESS

To assess and monetize the benefits of the proposed improvements as part of this project, a model of existing and proposed walking and bicycling trips within the project area was developed. This model was based on data derived from Replica, a data-as-a-service platform which provides in-depth mobility data modeled from a variety of unique data sources. Data related to walking and biking were exported from Replica and verified against peak-hour pedestrian turning movement counts collected in 2019 at the intersection of MLK Boulevard and US13 as part of the US13 Pedestrian Safety Audit conducted by DelDOT.

Pedestrian and bicycle trip data, as well as traveler demographic data, were exported from a Replica Study modeling typical weekday travel, utilizing a Select Link Analysis of a roadway segment of South Little Creek Road, directly east of Bay Road (see **Figure 6**). This segment (Replica network ID = 837674455047433000, referred to as the Analysis Segment) was chosen because a large proportion of the walking trips on South Little Creek Road will concentrate at this location, and it will provide a representative sample of the corridor's non-motorized users. Total trips modeled on this link are shown in **Table 1**.

According to bicycle and pedestrian trip data from Replica, this segment of South Little Creek Road has daily bicycle and pedestrian volumes in the 95$^{th}$ percentile of all roadway segments in the City of Dover.

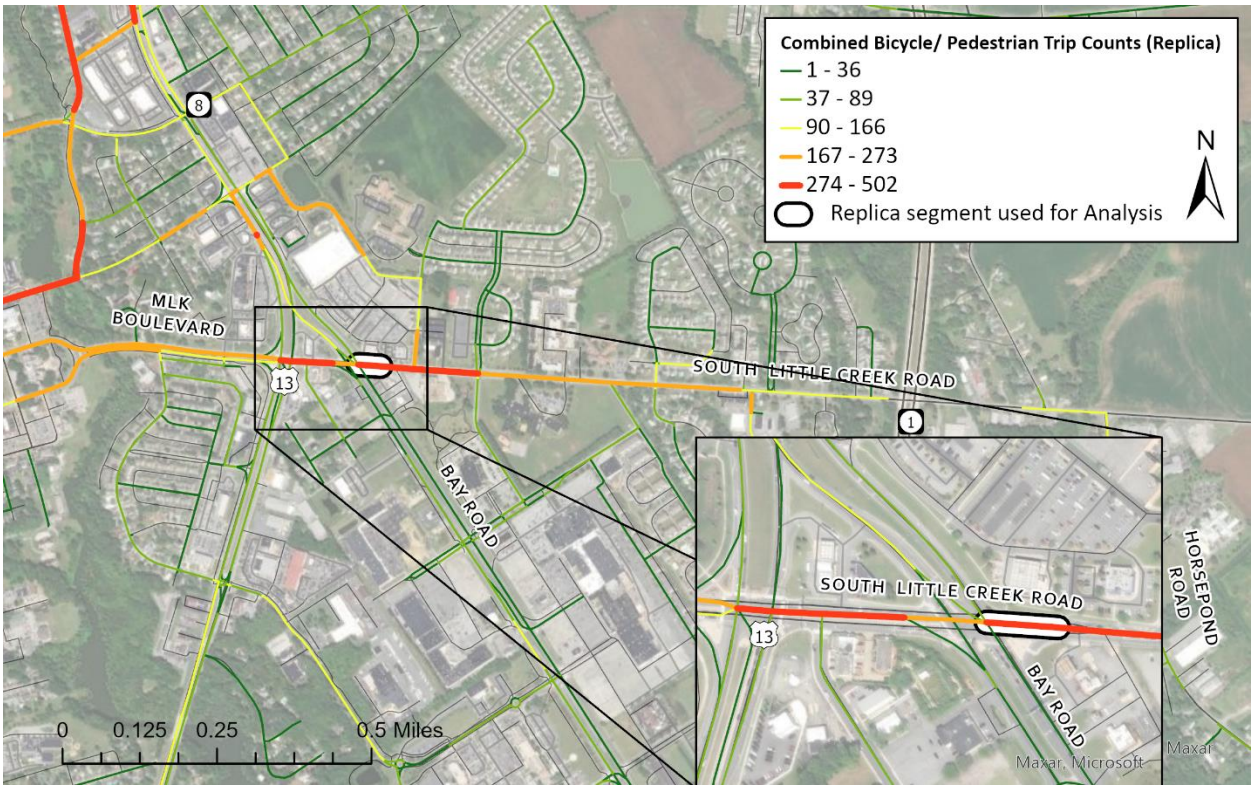



**Figure 6:** A map showing the network segment used for Select-Link analysis in the Replica platform.

| Existing Select-Link Analysis Daily Traffic Volumes from Replica | | | |
|---|---|---|---|
| **Year** | **Walking** | **Biking** | **Combined** |
| **2023 (No Build, Replica Value)** | 209 | 130 | 339 |

**Table 1:** The volume of daily Walking and Bicycling trips predicted by the Replica platform from the Select-Link Analysis on the analysis segment.

From the Analysis Segment, detailed travel data exported from the Replica platform. A trip time distribution of pedestrian-only trips was developed to determine peak-hour pedestrian volumes, shown in **Figure 7**. The Replica trip time distribution was diurnal, matching expectations of pedestrian travel behavior in this land use and demographic context. Peak hours were 8:00am and 2:00pm with 33 and 31 pedestrian counts, respectively.

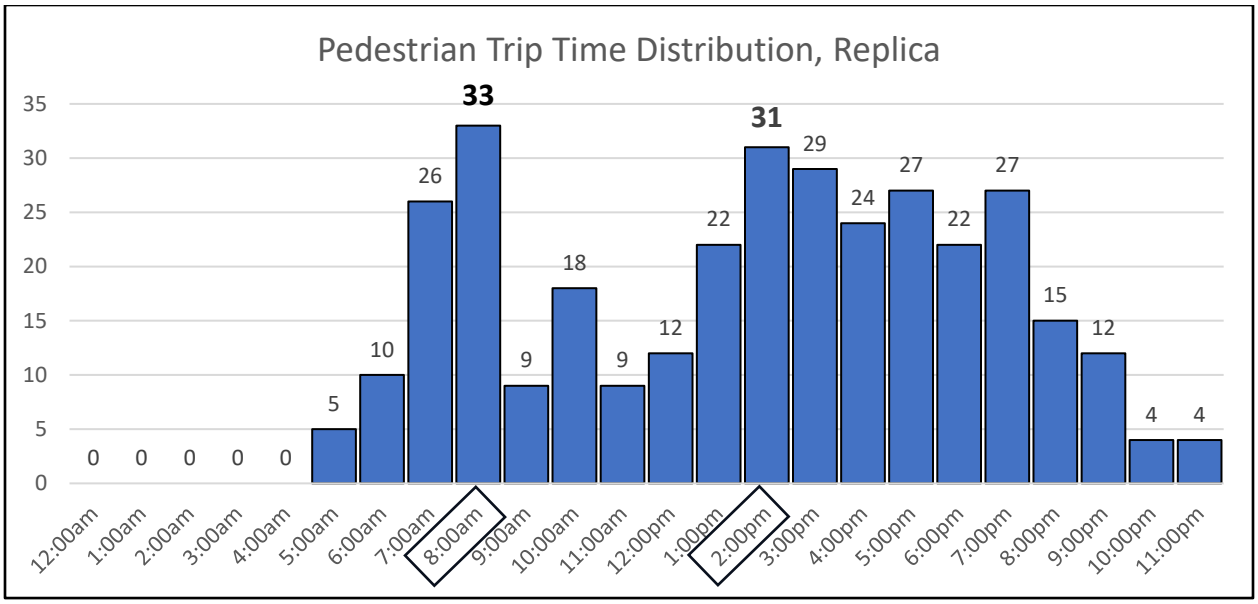



**Figure 7:** A histogram showing the hourly distribution of Pedestrian trips predicted by the Replica platform on the analysis segment.

To validate this data, the Replica daily peak hour pedestrian volumes were compared against the turning movement counts collected from DelDOT's 2019 Pedestrian Safety Audit, shown in **Figure 8.** Pedestrians observed crossing US13/Bay Road to or from the east, were summed and are shown in a table in **Figure 8**. Pedestrian mid-block crossings at unsignalized locations were included in this count, assuming that most of these trips were tributary to South Little Creek Road or may have otherwise used that signalize crossing if it is a more expedient or higher utility option. Replica only models trips along a GIS roadway network model, so assumptions about the spatial allocation of these mid-block trips must be made.


**Figure 8:** A map from the 2019 DelDOT US 13 Pedestrian Safety Audit, showing pedestrian movements at the US13 and MLK Boulevard intersection, as well as a table summarizing the number of crossing movement.

Total pedestrians observed crossing US13 at South Little Creek Road totaled to 32 pedestrians per hour, at peak hour. The study conducted counts at AM, PM, and Mid-day peak hours, but did not specify which count interval the data presented in **Figure 8** came from. Comparing this observed count of 32 pedestrians per hour at peak hour against the two peak-hour counts from Replica of 31 and 33, the alignment of the Replica data to the field observation is very accurate.

While this only represents one location and one time slice of validation, modeling network-level pedestrian and cycling volumes is generally a high-error analysis, so data alignment with this level of accuracy provides justification to confidently accept the volume estimates at this location and utilize the other rich demographic data that Replica builds into their model. Thus, demographic information about trip takers provided by Replica will be used for this BCA, as it provides a more context-sensitive application of Census, ACS, and other data sources towards walking and bicycling trips.

## PROJECTED GROWTH

To understand how population growth will affect bicycle and pedestrian volumes along this corridor throughout the duration of the Analysis Period, projected population growth rates were developed from data provided by the Delaware Population Consortium at the Traffic Analysis Zone (TAZ) level. The two TAZs which comprise all residential land uses along South Little Creek Road were chosen to develop growth rates for each decade between 2020 and 2050.

Growth rates were assumed constant within each decade. These growth rates are shown on **Table 2.** The growth rates were applied to the Replica-derived pedestrian and bicycle peak hour volume data to estimate start-of-analysis period No-Build bicycle and pedestrian travel volumes in 2028, as shown in **Table 3.**

| Projected Population Growth Rate in Adjacent TAZs | | | | |
|---|---|---|---|---|
| **Year** | | | | |
| **TAZ** | **671** | **773** | **Combined** | **Yearly Growth Rate** |
| **2020** | 2985 | 382 | 3367 | |
| **2030** | 3025 | 420 | 3445 | 0.23% |
| **2040** | 3614 | 619 | 4233 | 2.29% |
| **2050** | 3765 | 645 | 4410 | 0.42% |

**Table 2:** The projected population growth of adjacent Traffic Analysis Zones (TAZs) and the composite annual growth rates, by decade, applied to walking and bicycling trips used in this BCA.

| Existing Select Link Volumes from Replica , Projected Growth to 2027 | | | |
|---|---|---|---|
| **Year** | **Walking** | **Biking** | **Combined** |
| **2023 (No Build, Replica Value)** | 209 | 130 | 339 |
| **2028 (No Build, Replica Value, TAZ Growth Rate)** | 212 | 132 | 344 |
| **Proportion** | 61.6% | 38.34% | 100.00% |

**Table 3:** The daily volume of walking and bicycling trips from the Replica analysis segment, population growth adjusted from the Replica Analysis year of 2023 to the beginning BCA Analysis year of 2028 to represent the No-Build Scenario.

To develop estimates of how many bicycle and walking trips may be induced by the construction of this project, the Methodology for Assessing the Benefits of Active Transportation Projects (Trust for Public Land 2016) was utilized. This method is typically used by DelDOT to develop estimates of emissions offsets associated with Active Transportation Projects for Congestion Mitigation and Air Quality (CMAQ) funding justification. This method estimates Primary Trips only, not accounting for any recreational trips which may be induced by the construction of this facility. The results of this analysis are shown in **Table 4**. The proportion of the induced trips categorized as bicycle or pedestrian trips was assumed from the modal split observed in the Replica data shown in **Table 3.** Breakdown of assumed mode-choice for the induced trips is shown in **Table 4,** and the analysis-year (2028) Build Scenario daily peak hour bicycle and pedestrian traffic volumes are shown in **Table 5**.

| Build-Scenario Daily Induced Trips (Trust for Public Land 2016 Method) | | | |
|---|---|---|---|
| | **Total Induced** | **Assumed Walking** | **Assumed Biking** |
| No. of Primary Trips Shifted from Vehicular to Bike-Ped Travel | 143 | 55 | 88 |

**Table 4:** Total number of daily induced walking and bicycling trips estimated based on the construction of the proposed project (Trust for Public Land 2016 Method), and assumed modal split based on proportion of total walking and bicycling trips from the Replica Select-Link analysis.

| Build-Scenario Estimated Bicycle and Pedestrian Volumes | | | |
|---|---|---|---|
| **Year** | **Walking** | **Biking** | **Combined** |
| 2028 (Build) | 300 | 187 | 487 |

**Table 5:** The daily volume of walking and bicycling trips adjusted to the BCA Analysis year of 2028 with the induced walking and bicycling trips proportionally allocated to each mode to represent the daily volumes associated with the Build-Scenario.

The 2028 Build Scenario daily peak hour bicycle and pedestrian traffic volumes shown in **Table 5** will be used throughout the BCA. The data and all computations made are presented in detail in the Benefit Cost Analysis Calculations Workbook that accompanies this BCA Narrative (hereinafter referred to as the BCA Workbook).

## PROJECT BENEFITS

### SAFETY BENEFITS

The proposed **MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector** and all improvements proposed in the Project Build Scenario are expected to improve safety for people walking and biking in three critical ways: the construction of a continuous shared use pathway along South Little Creek Road which will better facilitate the volume and trip types currently being taken, the construction of median barrier fencing along US13 and Bay Road which will significantly reduce the likelihood of pedestrians, or people bicycling, from making unsignalized, mid-block crossings (which currently make up a large proportion of the total pedestrian crossings in this area – 40% according to the Pedestrian Turning Movement Counts collected in 2019 as shown in **Figure 8**), and the construction of a pedestrian crossing signal and

crosswalk on the north side of the Bay Road intersection, and the south side of the US13 intersection.

For this safety analysis, injury, fatality, and property damage only crash data involving a pedestrian or a bicyclist were extracted within a 0.5-mile buffer around the proposed improvements. The analysis crash data were restricted to crashes which occurred in the last four years (2020-2023), and annual crash rates were developed for each crash severity category. This data is summarized in **Table 6**.

The buffer distance around the project limits was reduced from the BCA Guidance of 0.86 miles for average pedestrian trips to avoid inclusion of crashes which were not likely to be relevant to the Build Scenario Improvements. The location of bicycle and pedestrian involved crashes outside of the 4-year analysis window is presented in **Figure 9**, as there is a long history of pedestrian injury crashes within this corridor and an additional fatality on the north side of the project limits and south of the limits on US13 which were not included in the analysis.

| Bicycle / Pedestrian Injury and Fatal Crashes within 0.5 mile (2020-2023) | | | | | |
|---|---|---|---|---|---|
| **Year** | **Injury (U)** | **Fatal (K)** | **Property (PDO)** | **Total Bike** | **Total Pedestrian** |
| **2023** | 3 | 0 | 1 | 4 | 0 |
| **2022** | 4 | 1 | 1 | 1 | 5 |
| **2021** | 3 | 0 | 2 | 2 | 3 |
| **2020** | 4 | 0 | 0 | 0 | 4 |
| **Total** | 14 | 1 | 4 | 7 | 12 |
| **Annual Crash Rate** | 3.5 | 0.25 | 1 | 1.75 | 3 |

**Table 6:** Bicycle and Pedestrian involved crashes and annual crash rate, by severity, between 2020 and 2023.

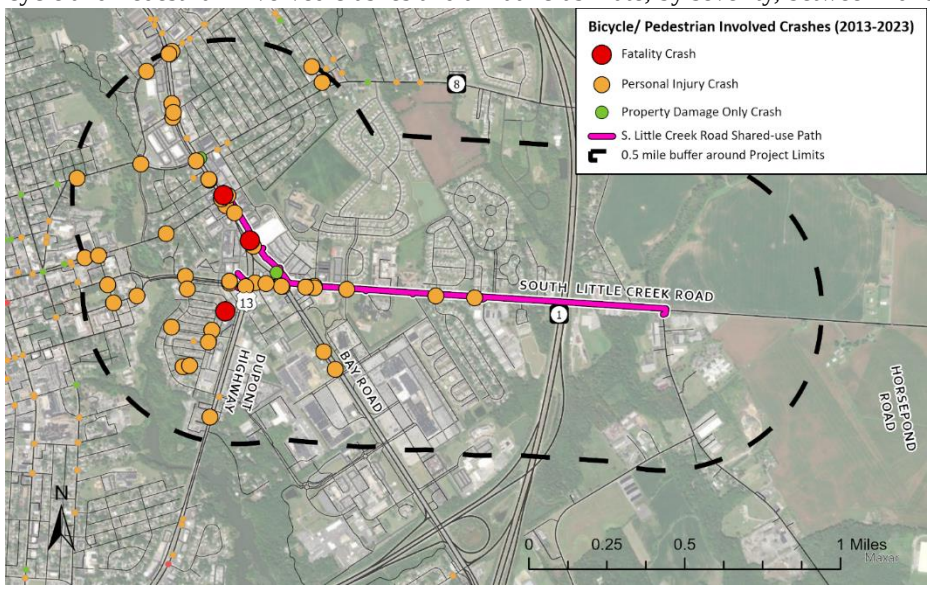



**Figure 9:** Proposed project limits and all Bicycle and Pedestrian-Involved crashes within 0.5-mile buffer between 2013 and 2023.

The annual crash rates presented in **Table 6,** were used to estimate the reduction in annual crash rates using Crash Modification Factors (CMFs) for the proposed improvements. Of the three primary safety benefits described in the beginning of this section, only two of the improvements presented are represented by meaningful and applicable CMFs. CMFs used in this analysis are CMF 9250, "Install Shared Path", and CMF 9123, "Median Treatment for Ped/ Bike Safety". CMFs and CMF IDs are presented in **Table 7**.

| Relevant Crash Modification Factors for Proposed Project | | | | |
|---|---|---|---|---|
| **CMF Name** | **CMF** | **Relevant Crashes** | **CMF ID** | **URL** |
| Install Shared-Use Path | **0.75** | All, Bike | 9250 | CMF Clearinghouse |
| Median Treatment for Ped/ Bike Safety | 0.14 | Fatal, Ped + Bike | 9123 | CMF Clearinghouse |

**Table 7:** Relevant Crash Modification Factors (CMFs) used in this analysis.

CMF 9250, "Install Shared-use Path", can be relevant to Major Collectors and Minor Arterials (South Little Creek Road and Bay Road, respectively), and has a minimum traffic volume threshold of 5700 AADT (South Little Creek Road is 5,778 AADT and Bay Road is 22,371 AADT per 2022 traffic counts), making this an appropriate CMF for this context. This CMF has a crash modification factor of 0.75 for all Vehicle/ Bike crashes and was applied to the Vehicle/ Bicycle crash types for Injury, Fatality, and Property Damage Only crashes included in the analysis.

CMF 9123, "Median Treatment for Ped/ Bike Safety", is appropriate for median divided, urban roadways and applies to both bicycle and pedestrian crashes, but only applies to fatal crashes. This CMF has a crash modification factor of 0.14 and was applied to the one fatal crash in the analysis, a mid-block bicycle crash at the interchange of US13 and Bay Road in 2022.

Application of both CMFs led to a reduction in the Annual Crash rates within the project limits, as shown in **Tables 8**. These reductions in the Annual Crash Rate were monetized using the values provided in the **2024 BC Guidance** and provide us with the Annual Safety Benefit associated with the proposed improvements, amounting to $3,217,011 in undiscounted 2022 dollars in Analysis Year 2028, and **a discounted cost benefit of $48,805,156** over the analysis period, in 2022 dollars.

| Bicycle and Pedestrian Crash Rates (2020-2023) | | | |
|---|---|---|---|
| | **Injury** | **Fatal** | **Property** |
| **Total** | 14 | 1 | 4 |
| **Annual Crash Rate** | 3.5 | 0.25 | 1 |
| **Improved Crash Rate** | 3.25 | 0.03 | 0.88 |
| **Annual Crash Rate Reduction** | 0.25 | 0.22 | 0.13 |
| **% Reduced** | 7.14% | 89.50% | 12.50% |

| | | | |
|---|---|---|---|
| **Monetized Annual Safety Benefit** | $78,250.00 | $3,137,623.88 | $1,137.50 |

**Table 8:** Bicycle and Pedestrian involved annual crash rate, by severity, between 2020 and 2023, the improvements in crash rates associated with the relevant CMFs, and the monetization of improvement in annual crash rates.

## EMISSIONS REDUCTION BENEFITS

Using the induced bicycle and pedestrian Trips estimate provided by the Methodology for Assessing the Benefits of Active Transportation Projects (Trust for Public Land 2016), the annual reduction in Vehicle Miles Traveled (VMT) associated with this mode-shift was estimated and is shown in **Table 15**. These VMT reduction figured were used as inputs for the CMAQ Emissions Calculator Toolkit and estimates of the daily and annual reductions in a variety of pollution emissions were developed, shown in **Table 9**.

| Emissions Reductions Associated with Induced Bicycling and Walking Trips | | | | |
|---|---|---|---|---|
| Pollutant | Daily Emissions Reduction (kg/day) | Daily Emissions Reduction (mt/day) | Annual Emissions Reduction (mt/ yr) | Monetized Value in 2028 (2022 Dollars) |
| CO | 1.073 | 0.001073 | 0.3863 | 0 |
| PM2.5 | 0.004 | 0.000004 | 0.0014 | $1,457.14 |
| PM10 | 0.013 | 0.000013 | 0.0047 | 0 |
| Nox | 0.069 | 0.000069 | 0.0248 | $521.64 |
| VOC | 0.063 | 0.000063 | 0.0227 | 0 |
| CO2 | 109.22 | 0.10922 | 39.319 | $9,639.82 |

**Table 9:** Emissions reductions estimated for the Induced walking and bicycling trips (CMAQ Emissions Calculator).

Of the emissions modeled as part of this toolkit, the BCA Guidance only monetizes the value of $NO_x$, $PM_{2.5}$, and $CO_2$. CO, $PM_{10}$ and VOC emission reductions are shown in **Table 9** as well but are not explicitly monetized in this calculation. The emissions reductions associated with the induced trips estimated for this project were converted to metric tons and monetized using the **BCA guidance**, amounting to $11,796 in undiscounted 2022 dollars in Analysis Year 2028, and **a discounted cost benefit of $293,358** over the analysis period, in 2022 dollars.

## FACILITY AMENITY IMPROVEMENT BENEFITS

Facility Amenity Benefits for the proposed project were monetized using three types of Facility Amenity Improvements, as described in the 2024 BCA Guidance – Expand Sidewalk, Install Signal for Pedestrian Crossing on a Roadway with Volumes > 13,000 Vehicles per Day, and Cycling Path with At-Grade Crossings.

These Facility Amenity Benefits were estimated by developing a model of typical bicycle and pedestrian trip lengths using the Replica trip data, the Build Scenario daily peak hour bicycle and pedestrian volumes, the estimated induced bicycle and pedestrian trips, as well as the annual growth rates shown in **Table 3**. Bicycle and pedestrian trip lengths were exported from the

Replica trip-tables and are plotted as histograms in **Figure 10** and **Figure 11**, with the estimated induced trips proportionally allocated to each trip-length bin.

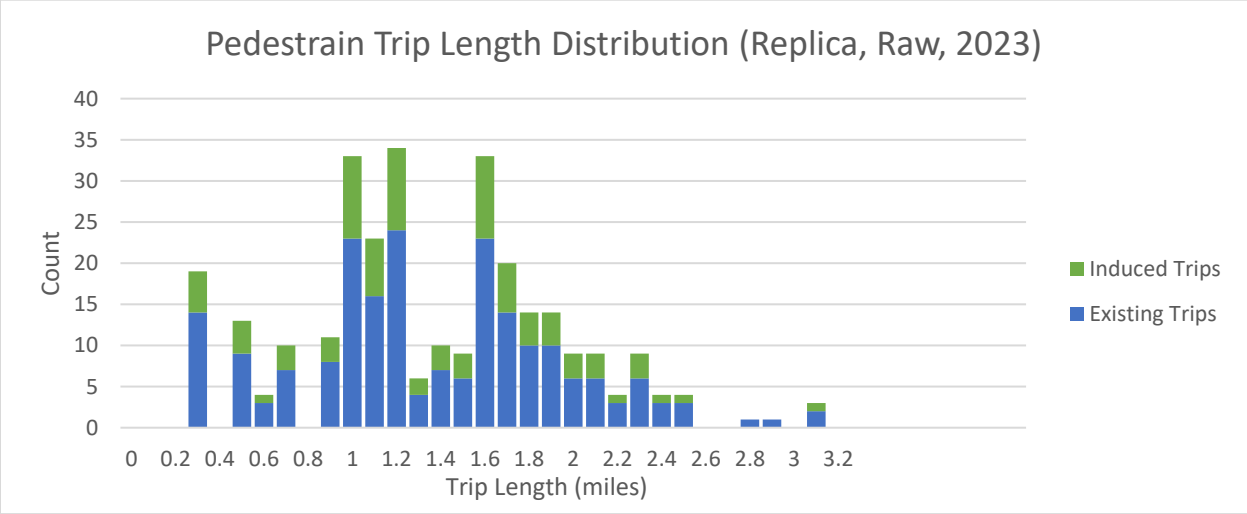



**Figure 10:** Pedestrian trip-length distribution from the Replica Select-Link analysis, with induced trips proportionally allocated to each trip-length bin.

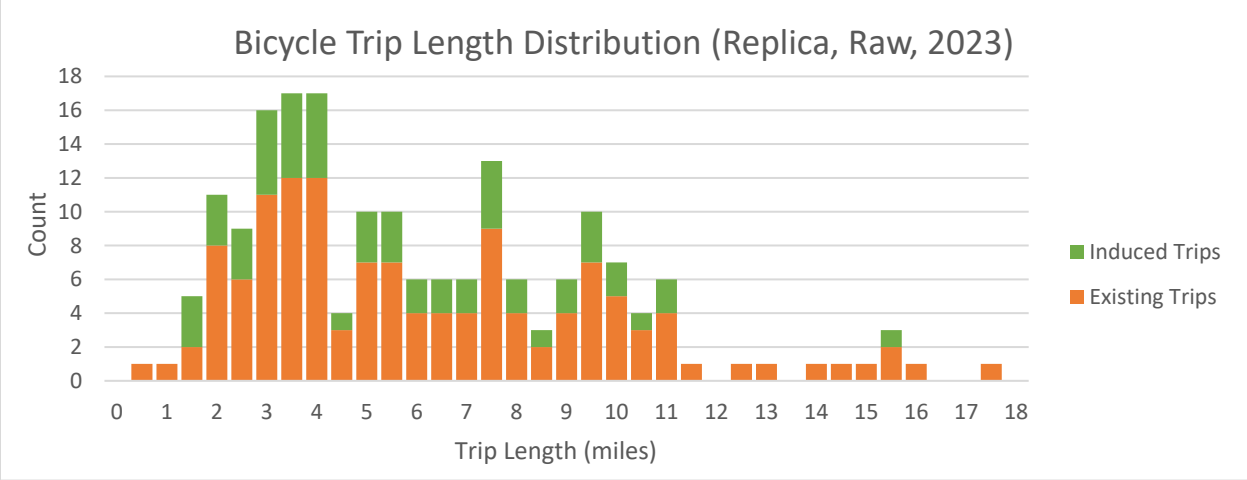



**Figure 11:** Bicycle trip-length distribution from the Replica Select-Link analysis, with induced trips proportionally allocated to each trip-length bin.

Per the guidance provided in the 2024 BCA Guidance, the modeled trip lengths for bicycle trips were limited to 2.4 miles and modeled trip lengths for pedestrians were limited to .86 miles (rounded to 0.9 due to less precise significant figures provided in Replica). All trips above these thresholds were counted as 2.4 miles and 0.9 miles respectively. The raw Replica data was also adjusted from 2023 to the first Analysis Year of 2028. The revised Trip Length Distribution Histograms are shown in **Figure 12** and **Figure 13**.

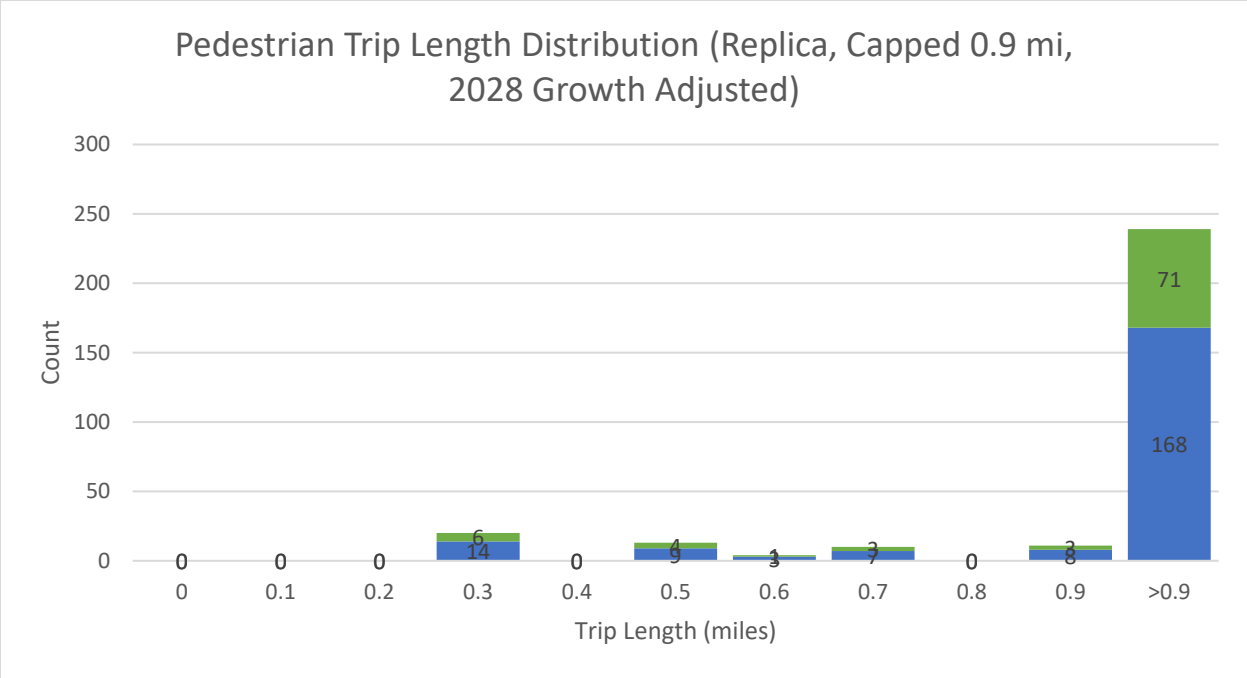



**Figure 12:** Pedestrian trip-length distribution adjusted to account for the 0.86-mile trip-length cap in the monetization of pedestrian trips. Rounded to 0.9 miles to match significant figures of Replica data.

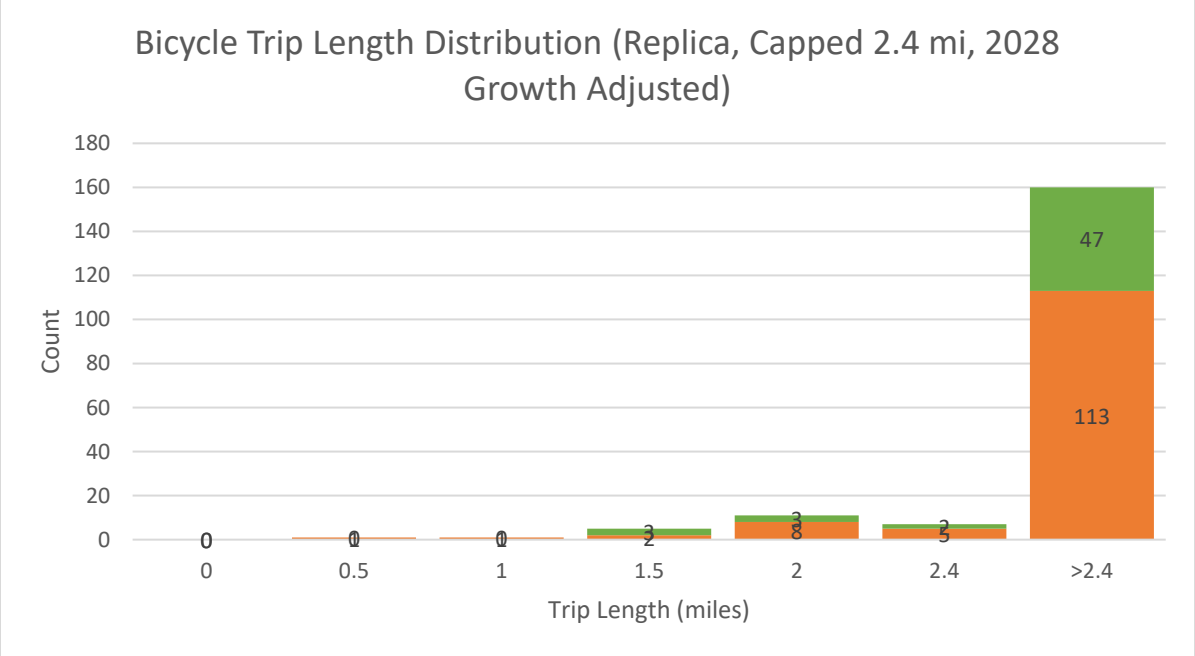



**Figure 13:** Bicycling trip-length distribution adjusted to account for the 2.4-mile trip-length cap in the monetization of bicycling trips.

From these adjusted trip lengths and frequencies, an estimate for Annual Person-Miles Walked (PMW) and Person-Miles Biked (PMB) was developed. For bicycle trips, trip purpose was exported from Replica and analyzed to isolate the number of recreational trip types, which may be affected by seasonal climatic factors. For cycling, 4% of trips on this corridor were modeled to be recreation and for walking, there were no modeled recreational trips. Of these 4% of total

bicycle trips, a typical recreational cycling season of March 1st to November 1st was assumed – accounting for 67% of the year. As such, the Annual PMB figure was adjusted to 97.32% of total PMB to account for out-of-season recreational trips.

For the Expand Sidewalk Facility Amenity Benefit, a sidewalk expansion of 6' beyond the existing sidewalk width was chosen to represent the construction of a shared use pathway. The assumed existing sidewalk width was averaged to 4' wide. The benefits of widening the sidewalk were monetized based on the annual PMW estimate. This amounted to $60,128.64 in undiscounted 2022 dollars.

For the Install Signal for Pedestrian Crossing on a Roadway with Volumes > 13,000 Vehicles per Day improvement, a pedestrian crossing utilization rate for the northern and southern sides of the US13/Bay Road intersection was assumed based on the proportion of pedestrians using the north and south side of the intersection from the 2019 Pedestrian Turning Movement Counts (87.5% on the north side and 12.5% on the south side, as shown in **Figure 8**). This utilization rate was applied to the estimated annual number of pedestrian trips, so a value can be applied to the install of each pedestrian signal. The value for these pedestrian crossing signals were monetized per the 2024 BCA Guidance and totaled to $55,8458.51 in undiscounted 2022 dollars.

For the Cycling Path with At-Grade Crossings improvement, the Seasonally Adjusted PMB figure was used to monetize the benefits for cycling facilities, which amounted to $243,633.18 in undiscounted 2022 dollars.

| Bicycle and Pedestrian Facility Amenity Benefits | | | | |
|---|---|---|---|---|
| **Improvement Type** | **Additional sidewalk Width** | **Value ($/ PMW)** | **Annualized, Seasonally Adjusted Person - Miles Walked (2028)** | **Annual Benefit** |
| **Expand Sidewalk (per foot of added Width)** | 6 | $0.11 | 91104 | **$60,128.64** |
| **Improvement Type** | **Ratio of Utilization (from Ped Audit Count)** | **Value ($/trip)** | **Annual Trips (2028)** | **Annual Benefit** |
| **Install Signal for Pedestrian Crossing on Roadway with Volumes > 13,000 Vehicles per Day (North Side, Bay Road)** | 0.875 | $0.51 | 95813 | **$48,864.63** |
| **Install Signal for Pedestrian Crossing on Roadway with Volumes > 13,000 Vehicles per Day (South Side, US13 Road)** | 0.125 | $0.51 | 13688 | **$6,980.88** |
| **Improvement Type** | | **Value ($/PMB)** | **Annualized, Seasonally Adjusted Person - Miles Biked (2028)** | **Annual Benefit** |
| **Cycling Path with At-Grade Crossings** | | $1.57 | 155199.4802 | **$243,663.18** |

In total, Facility Amenity Benefits amounts to $359,637.73 in undiscounted 2022 dollars in Analysis Year 2028, and **a discounted cost benefit of $6,394,469** over the analysis period, in 2022 dollars.

## MORTALITY REDUCTION/HEALTH BENEFITS

The Health and Mortality Benefits for the proposed project were based on the age distribution of the induced bicycle and pedestrian Trips. For each mode, a distribution of the age of travelers was exported from Replica as shown on **Table 10** and **Table 11**. For induced pedestrian trips, the target age range is 20-74, while for bicycling trips, the target age range is 20-64. The Induced Bicycle and Pedestrian Trips were proportionally distributed to across this age distribution.

| Age Distribution of Replica and Induced Pedestrian Trips | | | | |
|---|---|---|---|---|
| Age | Existing Trips | Proportion | Induced Trips | Total Build Trips (Growth adjusted 2027) |
| Age 1-19 | 73 | 34.93% | 31 | 105 |
| Age 20-74 | 132 | 63.16% | 55 | 188 |
| Age > 74 | 4 | 1.91% | 2 | 6 |
| Total | 209 | 100.00% | 88 | 299 |

**Table 10:** Age distribution of pedestrian trips from the Replica analysis, categorized to show the relevant age range (20-74) for monetization of health benefits for induced walking trips.

| Age Distribution of Replica and Induced Bicycle Trips | | | | |
|---|---|---|---|---|
| Age | Existing Trips | Proportion | Induced Trips | Total Build Trips (Growth adjusted 2027) |
| Age 1-19 | 24 | 18.46% | 19 | 43 |
| Age 20-64 | 93 | 71.54% | 35 | 128 |
| Age >64 | 13 | 10.00% | 1 | 14 |
| Total | 130 | | 55 | 185 |

**Table 11:** Age distribution of bicycling trips from the Replica analysis, categorized to show the relevant age range (20-64) for monetization of health benefits for induced bicycling trips.

Using the monetization values in the **2024 CBA Guidelines,** the Health Benefits of these induced bicycle and pedestrian trips within the target age demographics were monetized at $255,540 in 2022 dollars in the 2028 Analysis Year and **a discounted cost benefit of $4,541,253** over the analysis period, in 2022 dollars.

## OPERATION AND MAINTENANCE COST

To estimate the Maintenance and Operations Costs and Benefits associated with the proposed improvements, annual maintenance, and operations costs, as well as costs for a future replacement and rehabilitation project were estimated for both the Build Scenario and the No-Build Scenario. This allows us to compare both annual maintenance and long-term asset replacement costs for the Build and No-Build scenarios.

The proposed hotmix shared use pathway has an expected useable service life of 25 years before requiring a replacement and rehabilitation project. Based on two open-end maintenance contracts managed by DelDOT in 2018, consisting of five work orders which resurfaced several 8-10' wide shared-use pathways, a cost per linear foot was estimated for resurfacing the proposed shared-use path and other incidental project items and costs. The estimated replacement cost was $44 per linear foot, adjusted to 2022 dollars. Preconstruction Engineering (PE) and Construction Engineering (CE) costs were also assumed at 30% and 25% respectively, for a total estimated project cost of $547,305.

A breakdown of these costs is shown in **Table 12.** The total replacement and rehabilitation project cost was depreciated linearly over the 25-year expected service life of the pathway. A key assumption of this cost estimate is that the replacement and rehabilitation project is managed in an open-end contract which may have lower contract administration overhead and reduced mobilization costs.

| 10' Hotmix Shared Use Pathway Rehabilitation/ Replacement Costs Estimate (Build Scenario) | | | | | |
|---|---|---|---|---|---|
| **Proposed Length of Shared Use Path (ft)** | **Unit cost to resurface 10' hotmix SUP, adj to 2022 dollars ($/LF)** | **Rehab/ Replace Project Construction Costs** | **PE Costs (30%)** | **CE Costs (25%)** | **Total (2022 Dollars)** |
| 8025 | $44.00 | $353,100.00 | $105,930.00 | $88,275.00 | $547,305.00 |

**Table 12:** Breakdown of the planning-level cost estimate for replacement and rehabilitation project for the existing 4' sidewalks on South Little Creek Road.

The existing concrete sidewalk has an expected usable service life of 40 years. It is assumed that the average age of the existing sidewalk is 22 years, based on documentation of several projects along the corridor. Some segments are much older and in poor condition, but for the purposes of the analysis, a single value was assumed. This leaves an additional 15 years of remaining service life at the beginning of the 2028 Analysis Year. The cost of a replacement and rehabilitation project was estimated based on costs for removing the existing sidewalk, widening to contemporary DelDOT Pedestrian Access Standards (5' wide sidewalk, or 6' wide if against back of curb), and adjusting to meet Americans with Disability Act (ADA) standards.

The rehabilitation and replacement project costs were estimated based on observed project costs from DelDOT's Pedestrian Access routes (PAR) program, which is tasked with managing the Department's ADA Transition Plan. This program has extensive experience with replacing and rehabilitating sidewalks across a variety of contexts state-wide. Based on average costs associated with and incidental to replacing sidewalks, a cost per linear foot to widen sidewalk to 5' was estimated at $24 per square foot ($120 per linear foot), adjusted to 2022 dollars. Given the length of existing sidewalk and PE/ CE costs, the total estimated project cost is $4,803,450. A breakdown of these costs is shown in **Table 13.**

Given that there will be 15 years of expected service life remaining at the beginning of the 2028 analysis year, the total costs of a replacement project will be fully depreciated over the first 15 years of the analysis period between 2028 and 2043. After the anticipated 2038 replacement and

rehabilitation project, the costs of another replacement and rehabilitation project will be linearly depreciated over the following 40 years of expected service life.

| Existing Concrete Sidewalk Rehabilitation/ Replacement to Current Standards Cost Estimate (No-Build Scenario) | | | | | |
|---|---|---|---|---|---|
| **Existing Length of Sidewalk (ft)** | **Unit costs to replace sidewalk to 5' standard (SF), adj to 2022 dollars ($/LF)** | **Rehab/ Replace Project Construction Costs** | **PE Costs (30%)** | **CE Costs (25%)** | **Total (2022 Dollars)** |
| 5165 | $120.00 | $3,099,000.00 | $929,700.00 | $774,750.00 | $4,803,450.00 |

**Table 13:** Breakdown of the planning-level cost estimate for replacement and rehabilitation project for the proposed 10' wide hot-mix Shared-use pathway on South Little Creek Road

Costs associated with annual maintenance for sidewalks and shared-use paths were estimated by DelDOT's Maintenance and Operations (M&O) Division at approximately $2000 per mile per year. These costs include vegetation removal, debris clearing, general facility maintenance, and complaint response for sidewalks and other pedestrian facility equipment. A cost estimate was also developed for snow removal associated with shared-use pathways. DelDOT's snow removal policy includes snow removal from shared-use pathways on state-maintained roads but does not cover snow removal from sidewalks. M&O provided costs for snow removal from shared-use pathways observed in the snow events in the winter of 2023. This cost was provided as a per-mile cost and accounts for one mobilization per year. These costs were adjusted to 2022 dollars and are shown in **Table 14**.

| Annual Maintenance and Operations Expenditures | |
|---|---|
| **Sidewalk/ Shared Use Path Annual General Operational Maintenance ($/mi, 2022 Dollars)** | $2,000 |
| **Shared Use Path Annual Snow Removal cost per mile ($/mi, 2022 Dollars)** | $2,764 |

**Table 14:** Estimate of annual costs to DelDOT for maintenance and operation of sidewalks and shared-use pathways along state-maintained roadways.

A key observation from this analysis is that the No-Build Scenario also bears significant Maintenance and Operations expenses when the cost of an incremental replacement and rehabilitation project of the existing sidewalk is accounted for. Based on recent contracts associated with shared-use pathway and sidewalk maintenance and replacement, the relative cost of resurfacing a shared-use pathway is significantly lower over the life cycle of the asset. This amounts to an annual savings of $293,053 until the anticipated 2042 sidewalk replacement and rehabilitation project, and an annual savings of $92,909 for the remainder of the analysis period. This totals to **a discounted cost benefit of $3,551,240** over the analysis period, in 2022 dollars. A large source of this cost benefit is offsetting the capital expense of rehabilitating the existing deteriorated sidewalk.

## AVOIDED HIGHWAY USE EXTERNALITIES

Based on the estimated induced bicycle and pedestrian Trips presented in the Bicycle and Pedestrian Volume Estimation and Validation section of this BCA, the reduction in annual VMT associated with these trips is presented in **Table 15**. This annual reduction in VMT was monetized per the guidance in the 2024 BCA Guidelines and amounts to $23,075 in undiscounted 2022 dollars in Analysis Year 2028, and **a discounted cost benefit of $409,808** over the analysis period, in 2022 dollars.

| Reduced VMT Associated with Induced Bicycling and Walking Trips | | |
|---|---|---|
| | Daily | Annual |
| No. of Primary Trips Shifted from Vehicular to Bike-Ped Travel (1) | 143 | 52195 |
| Induced VMT Reduction (2) | 359 | 131035 |

**Table 15:** An estimate of annual Vehicle- Miles-Traveled (VMT) reduction associated with the annual included bicycling and walking trips (Trust for Public Land 2016 Method).

## BENEFIT-COST SUMMARY

An estimate of the total capital costs for the **MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector** was developed by the project design team. The total capital cost estimate includes construction costs, right-of-way acquisition, construction engineering, and contingency, as shown in the Engineers Estimate in the **Budget Section**. Preliminary Engineering (PE) design costs are also included in the total capital cost used for the BCA but are not shown in the Engineers Estimate. PE costs will be funded by DelDOT if the grant is awarded, and are approximately $1 million as shown in the Detailed Cost Estimate in **Appendix X**. The Total Capital Cost in constant 2022 dollars is $11,367,286, with a discounted cost of $9,822,379. Given total discounted benefits of $54,172,905 through the analysis period, the Benefit Cost Ratio (BCR) of the **MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector is 6.52**, as seen in **Table 16.**

**Benefit Cost Analysis Results**

| Category | Value |
|---|---|
| Total Discounted Benefits | $63,995,283 |
| Total Discounted Costs | $9,822,379 |
| Net Present Value | $54,172,905 |
| Benefit Cost Ratio | 6.52 |

**Table 16:** Summary table of discounted Benefit Cost Analysis for the MLK Boulevard/South Little Creek Road Bicycle and Pedestrian Connector.