MANNAKEE STREET

Complete Streets Feasibility

June 2024

Prepared For:
City of Rockville
Department of Public Works
111 Maryland Ave
Rockville, MD 20850

Emad Elshafei, Ph. D, PE, PTOE – Chief of Traffic and Transportation
Bryan Barnett-Woods, AICP – Principal Transportation Planner

Prepared By:
Kittelson & Associates, Inc.
100 M Street SE #910
Washington, D.C. 20003

Aditya Inamdar, AICP, LEED AP – Project Principal
Caitlin Mildner, AICP – Project Manager
Karen Phan, AICP – Project Analyst

In collaboration with

T3 Design Corporation
10340 Democracy Lane, Suite 305
Fairfax, Virginia 22030

Asma Ali, PE, PTOE, PMP, RSP2 – Senior Traffic Engineer
Deema Allan, MS, PE – Traffic Engineer

Project No. 29234

June 2024

CONTENTS

OVERVIEW **1**

Introduction 2

EXISTING CONDITIONS **5**

Existing Roadway Characteristics 7

Pedestrian Conditions 11

Bicycle Conditions 13

Transit Conditions 15

Curbside Activity 16

Safety 16

Traffic Operations 17

ISSUES & OPPORTUNITIES **21**

PUBLIC OUTREACH **22**

TOOLBOX OF STRATEGIES **25**

Corridor Strategies 25

Intersection Strategies 31

ALTERNATIVES **35**

Option 1: Traffic Calming 36

Option 2: Bicycle Corridor Improvements 42

Option 3: Multimodal Redesign 47

Intersection Recommendations 52

ALTERNATIVES EVALUATION **55**

Safety 55

Implementation Timeline 56

Travel Impacts 57

Cost 57

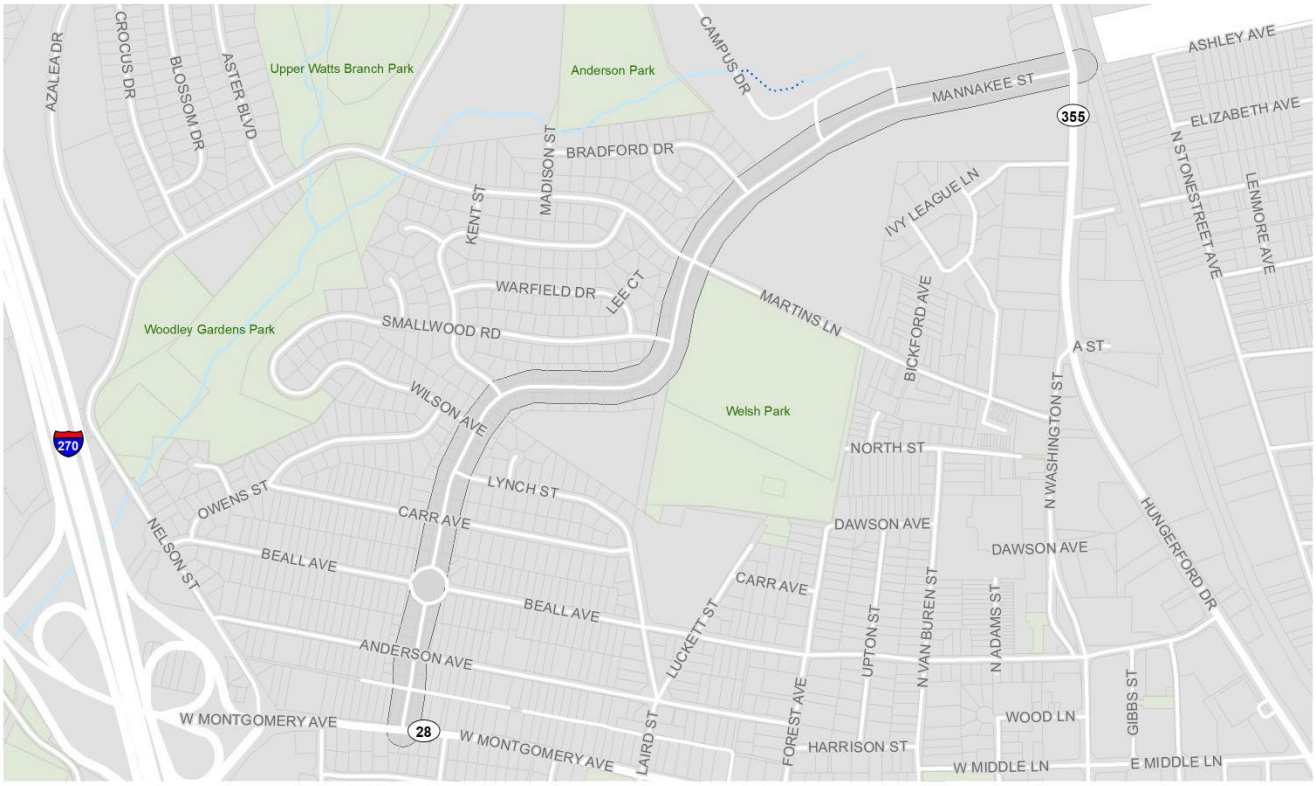
Summary of Alternatives Evaluation 57

NEXT STEPS **58**

OVERVIEW

Mannakee Street is owned and maintained by the City of Rockville and primarily runs north to south between Hungerford Drive (MD 355) and West Montgomery Avenue (MD 28) as shown in **Figure 1**. This corridor is approximately 1.25 miles in length and contains a mix of land uses and destinations, including the largest Montgomery College campus, Welsh Park, the Rockville Swim and Fitness Center, and residential properties. The mix of land uses and destinations along Mannakee Street invites pedestrian and bicycle activity, however, the street primarily serves vehicles and lacks protected bicycle facilities and comfortable pedestrian crossings. Mannakee Street is within a Metropolitan Washington Council of Governments (MWCOG) Equity Emphasis Area and an MWCOG regional activity center, making it a key candidate for safety enhancements. This Study will advance the City's multimodal network by connecting to a planned National Capital Trail Network trail, providing multimodal connections to the nearby Rockville Metro and MARC stations, and enhancing access to the future Flash BRT.

Figure 1 Study Area Map



Base Map
Mannakee Street
Complete Streets Feasiblity Study

KITTELSON & ASSOCIATES

This Complete Streets Feasibility Study (Study) aims to improve multimodal safety and comfort for all users on Mannakee Street by exploring corridor redesign alternatives that better accommodate all modes and incorporate Complete Streets design.

> *"Complete Streets is an approach to planning, designing, building, operating, and maintaining streets that enables safe access for all people who need to use them, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities." – Smart Growth America*

This Study was funded by MWCOG's Transportation Land-use Connections (TLC) program and is managed by the MWCOG and City of Rockville. Kittelson and Associates Inc. is collaborating with T3 Design Corporation to conduct the Study.

Introduction

Mannakee Street is classified as a Primary Residential Street (Class 2) within the City of Rockville, Maryland, which provides access to the Montgomery College campus, Welsh Park, the Rockville Swim and Fitness Center, and other key community, institutional, and residential sites.

This Study focuses on identifying intersection and corridor recommendations to create protected, comfortable, and low-stress pedestrian and bicycle facilities that align with the principles of Complete Street design. Mannakee Street is bordered by two state roads, W Montgomery Avenue (MD 28) and Hungerford Drive (MD 355). These intersections are owned by the Maryland State Highway Administration (SHA) and operated by Montgomery County Department of Transportation (MCDOT). Consequently, this Study will involve cross-jurisdictional collaboration between the City of Rockville, MCDOT, and MDOT SHA. Additional coordination and collaboration will include Montgomery College, Montgomery Public Schools, and RideOn as needed.

The approach for this Study builds on objectives that have been identified in the City's Comprehensive Plan, Bikeway Master Plan, Vision Zero Action Plan, and the Transportation Planning Board's R3-2021.

Mannakee Street runs north-south for 1.25 miles between Hungerford Drive (MD 355) and state-owned MD 28 (W. Montgomery Avenue). This Study will evaluate multimodal and Complete Streets-focused improvements. Mannakee Street runs through a mix of residential and institutional land uses, including Montgomery College at the north end. The corridor provides a key connection for students, residents, and employees in the area.

Mannakee Street has a pleasant walking environment throughout most of the corridor, with continuous sidewalks, street trees, pedestrian crosswalks and signage, and a raised crosswalk at Smallwood Road. Additionally, the region has been investing significantly in multimodal transportation. In the future, Mannakee Street will connect to the MD 355 Flash Bus Rapid Transit (BRT). The plans for BRT include enhanced pedestrian and bicycle facilities along MD 355 and will increase the demand for multimodal connectivity to MD 355.

However, the corridor lacks bicycle facilities and enhanced connections to transit. According to the American Community Survey in 2022, a small percentage of employees are commuting in Rockville by walking, biking, or transit, as shown in **Figure 2**. Residents on Mannakee Street and in the surrounding neighborhood have also indicated that motorists do not always yield to pedestrians crossing the street at crosswalks. Although Mannakee Street has transit service near Montgomery Community College, connected sidewalks, and nearby bike routes, transportation modes are not accommodated equally along Mannakee Street.

This Study recognizes commuter behavior changes that have occurred after the COVID-19 pandemic. American Community Survey data shows commute patterns in Rockville have shifted between 2019 and 2022, with more employees working from home in 2022 and fewer public transportation commuters. The percentage of the population biking and walking has remained relatively steady since 2019.

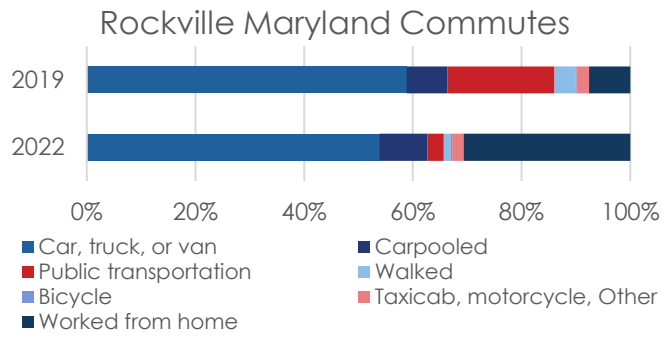


Figure 2. Census Commute Behavior in Rockville, Maryland

American Community Survey Data, 2019-2022

PREVIOUS PLANS AND STUDIES

The project team reviewed relevant plans, studies, and documents to understand the area's context and ongoing projects and plans adjacent to the study corridor.

Martins Lane Bicycle Lanes (Ongoing)

The Martins Lane Bicycle Lanes project is a feasibility and design study exploring bicycle facilities on Martins Lane between Mannakee Street and N. Washington Street. The Bikeway Master Plan proposes a bicycle lane on Martins Lane and the Vision Zero Action Plan directs staff to extend the safe bicycling network. Bicycle facilities on Martins Lane will connect to the separated bicycle lanes on N. Washington Street and provide better access to the Rockville Swim and Fitness Center for families. The City hosted a virtual public meeting in March 2024 to discuss design alternatives and will be finalizing design plans.

MD 355 Flash Bus Rapid Transit (Ongoing)

The Maryland 355 Flash BRT will transform driving and riding experiences on MD 355 by significantly enhancing accessibility and mobility options and providing safer and more reliable transit service between Bethesda and Clarksburg. This will help enhance transit connectivity and integration with other travel modes, improve bus speed and reliability, address current and future bus ridership demands, and more. MCDOT anticipates construction to begin in 2025.

The plan proposes BRT treatments along segments of MD 355, including mixed-traffic transit lanes, median-running dedicated transit lanes, and curbside dedicated transit lanes. Along MD 355 near Mannakee Street, the plans propose a northbound BRT and mixed travel lane and a dedicated curbside BRT transit-only lane in the southbound direction. The plans also propose BRT platforms just south of the intersection with Mannakee Street, providing BRT service to Montgomery College. **Figure 3** summarizes the proposed and future in-fill stations near Mannakee Street.

Figure 3. Flash BRT Proposed and Future In-fill Stations

Get On Board BRT MD 355 Corridor Summary Report, 2019

The plans propose a two-way cycle track on the west side of MD 355 and a pedestrian refuge island on the south intersection leg on Mannakee Street.

Comprehensive Plan of the City of Rockville, Maryland (2021)

The City of Rockville's transportation vision is to continue the transition to a more walkable and rollable community and to contribute to regional efforts to create safe, efficient, and environmentally sustainable mobility. Mannakee Street is located within the Rockville Town Center and the Montgomery College Area.

The City notes the key issues and opportunities identified in the Rockville Town Center include:

- Improved vehicular and pedestrian signage and wayfinding;
- Implementation of Vision Zero principles to provide a safe environment for pedestrians and bicyclists within the Town Center;
- Connections to the Town Center from nearby neighborhoods; and

/ More parks and open space for downtown residents and visitors.

The key issues identified in the Montgomery College Area include:

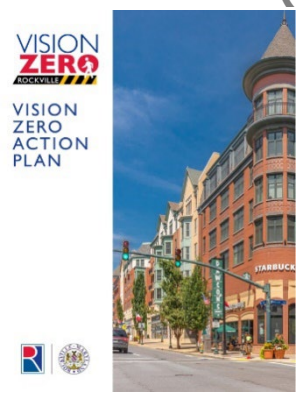
/ Accommodate future expansion of the Montgomery College Rockville campus and minimize its impact on the surrounding community;
/ Reduce traffic congestion at major intersections in and near the planning area related to Montgomery College;
/ Improve pedestrian and bicycle connections among Montgomery College, surrounding neighborhoods, and nearby shopping destinations; and
/ Enhance streetscape along MD-355 and WMATA/CSX tracks.

Within the study area of the Rockville Town Center, the City notes that redevelopment of property in the area should contribute to a pedestrian-oriented, urban-scale streetscape. Within the study area of the Montgomery College area, the City notes that opportunities to provide additional vehicular access to the college campus from the north will relieve traffic pressure on the intersection of East/West Gude Drive and MD 355. The plan also discusses opportunities to open or remove barriers to access the college by non-automobile travel modes and physical connections to surrounding areas, while considering community and college safety concerns.

One project note in the plan is located near the study area:

/ Project 3 in the Montgomery College Area seeks to improve pedestrian and bicycle access between the college, College Plaza Shopping Center, and Rockville Town Center. This includes significantly improving sidewalks and bicycle facilities on MD-355 and creating a potential new pedestrian path and bikeway connecting the properties owned by the College, MCPS, and the City of Rockville, to each other and to areas north and south.

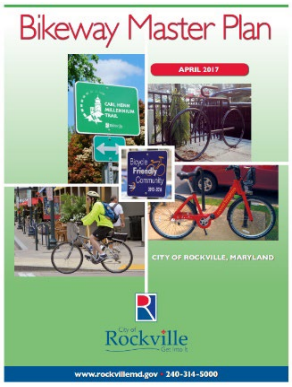
City of Rockville Vision Zero Action Plan (2018)



The Rockville Vision Zero Action Plan seeks to lay the foundation for a long-term strategy for reducing and eliminating transportation related crashes involving serious injuries and fatalities. Four key action areas were identified, including Enforcement, Engineering, Policy, and Education. The applicable action items spanning all four action areas include:

/ Conduct a crash analysis;
/ Evaluate crossings and unsignalized intersections;
/ Expand network of safe bicycle facilities; and
/ Review existing traffic safety programs and policies.

City of Rockville Bikeway Master Plan (2017)



The Rockville Bikeway Master Plan is a component of the City's Comprehensive Master Plan and provides a vision for a safe and efficient multimodal transportation system within the City of Rockville. Within the study area, there are no existing bikeway facilities on Mannakee Street.

The Bikeway Master Plan proposes:

/ A bike lane from 355 to Martins Lane;
/ A climbing bike lane between Martins Lane and the traffic circle; and
/ Shared roadways from the traffic circle to Montgomery Avenue.

EXISTING CONDITIONS

The project team reviewed the existing conditions along the corridor to understand transportation issues and opportunities. This section provides a summary of the study corridor, focusing on the following topics:

/ Roadway Characteristics
/ Pedestrian Conditions
/ Bicycle Conditions
/ Transit Conditions
/ Curbside Activity
/ Safety
/ Traffic Operations

While the typical section on Mannakee Street remains constant throughout the corridor, the land uses change from residential uses south of Bradford Drive to institutional uses north of Bradford Drive. The project team segmented Mannakee Street based on curb-to-curb widths, land uses, and curbside activity to better evaluate the existing conditions and later develop recommendations for the corridor based on the street segment's context and use.

The project team identified the following corridor segments to evaluate and review existing conditions:

1/ West Montgomery Avenue to Anderson Avenue
2/ Anderson Avenue to Henderson Circle
3/ Henderson Circle
4/ Henderson Circle to Bradford Drive
5/ Bradford Drive to Hungerford Drive

The project team conducted a field visit on December 7, 2023 to observe multimodal activity, take measurements of the sidewalks and lane widths, observe curbside activity, and discuss potential treatment options for the corridor. The team made several observations, summarized below:

/ The area is inviting to pedestrians throughout the corridor, with continuous sidewalks, street trees, pedestrian crosswalks and signage, and a raised crosswalk at Smallwood Road (**Figure 4**).
/ Sidewalks are available along both sides of Mannakee Street along most of the corridor (**Figure 5**).
/ A speed bump south of Welsh Park encourages drivers to slow down (**Figure 6**).
/ Parking restrictions vary along the corridor, and signage can create confusion (**Figure 7**).

Figure 4. Raised Crosswalk near Welsh Park on Mannakee Street

Kittelson and Associates, Inc.

Figure 5. Sidewalks near Welsh Park

Kittelson and Associates, Inc.

Figure 6. Speed Bump south of Welsh Park

Kittelson and Associates, Inc.

Figure 7. On-Street Parking Restrictions

Kittelson and Associates, Inc.

Existing Roadway Characteristics

The typical cross-section on Mannakee Street varies along the corridor, with curb-to-curb widths summarized in **Table 1**. The posted speed limit on Mannakee Street is 25 MPH. **Figure 8** through **Figure 12** depict the typical cross sections for each of the five segments along Mannakee Street.

Table 1 Curb to Curb Widths along Mannakee Street

Segment	Curb to Curb Width
MD 28 to Anderson Avenue	36 feet
Anderson Avenue to Henderson Circle	26 feet
Henderson Circle	22 feet
Henderson Circle to Bradford Drive	36 feet
Bradford Drive to MD 355	36 feet

Source: Kittelson and Associates, Inc, 2023

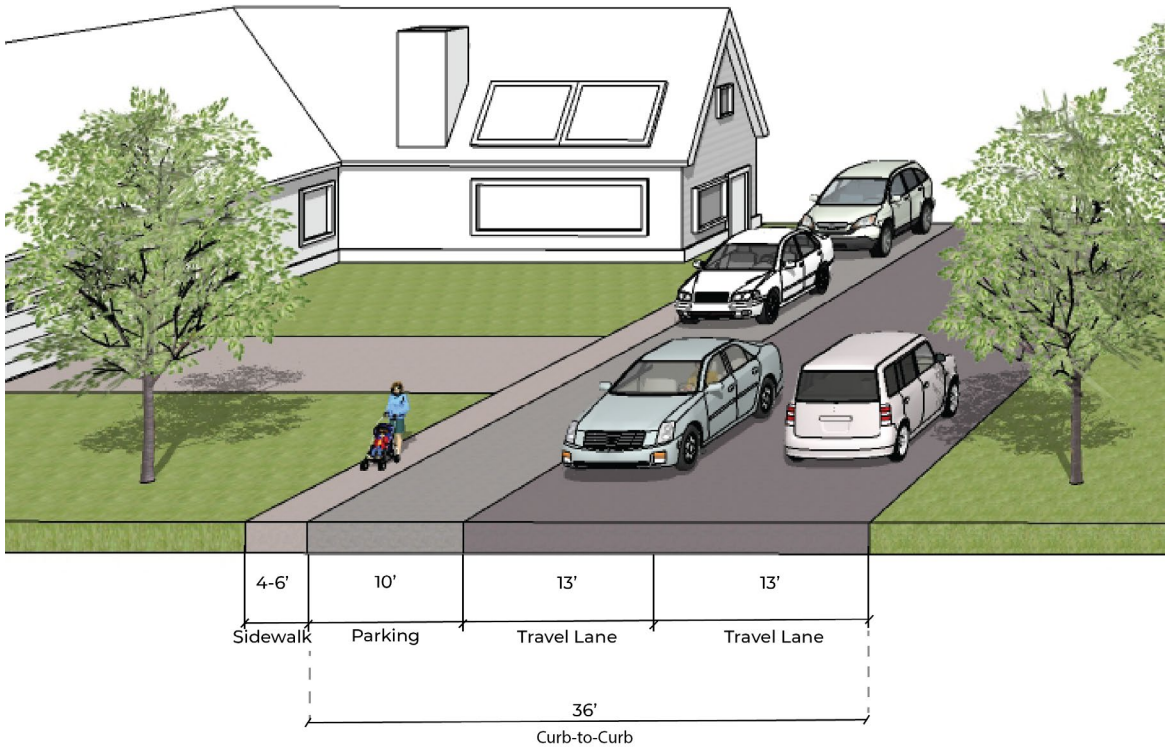


Figure 8. Segment 1: MD 28 to Anderson Avenue (facing north)

Kittelson and Associates, Inc.

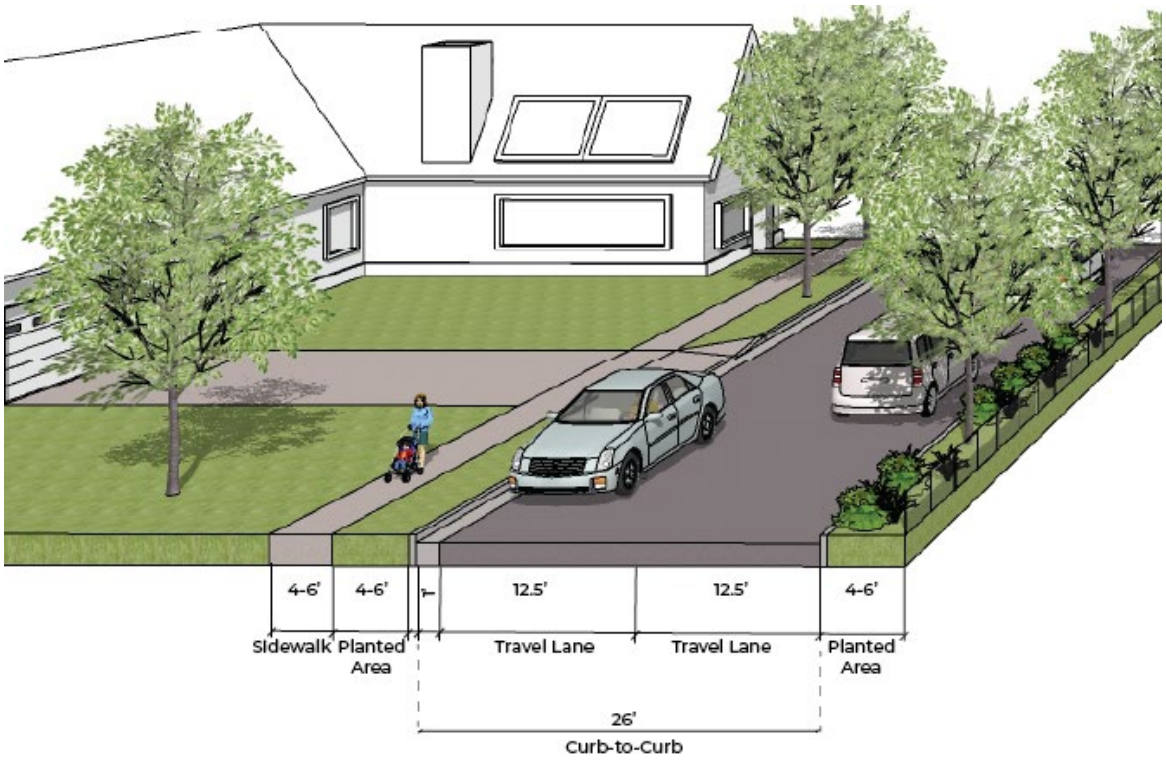


Figure 9. Segment 2: Anderson Avenue to Henderson Circle (facing north)

Kittelson and Associates, Inc.

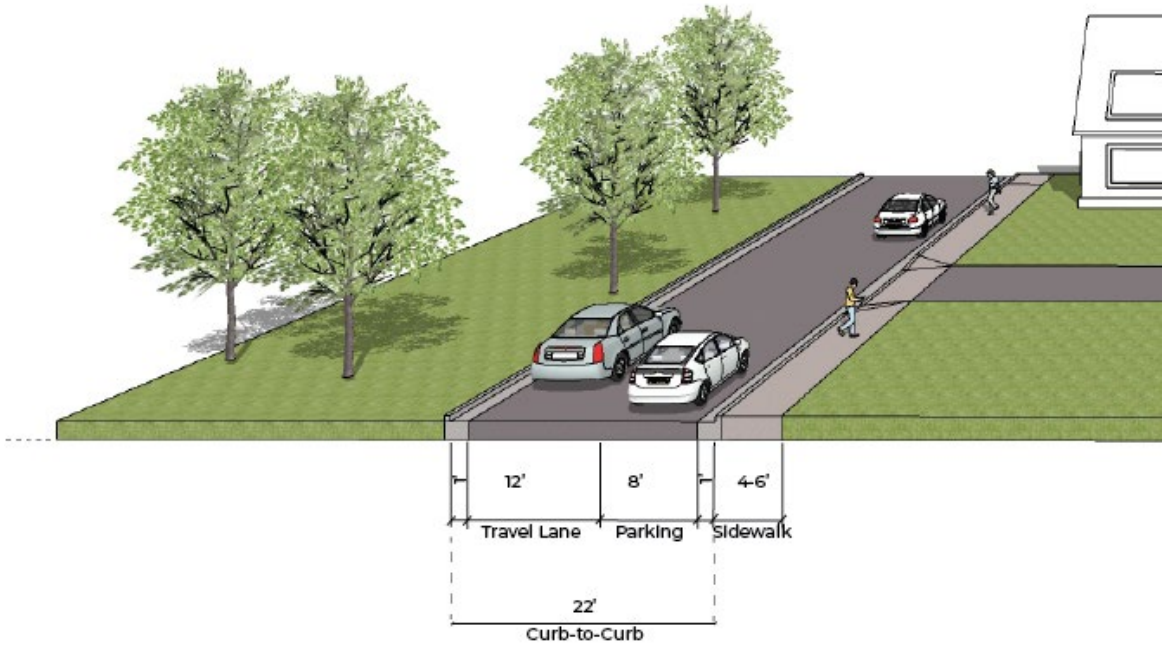


Figure 10. Segment 3: Henderson Circle

Kittelson and Associates, Inc.

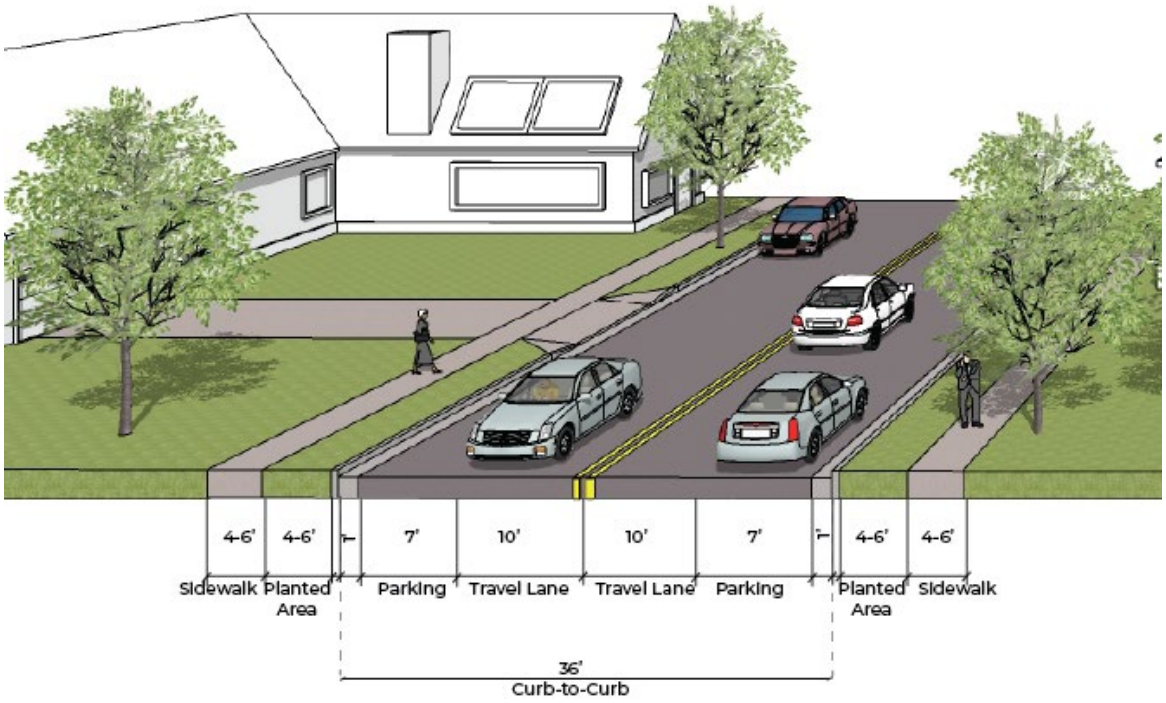


Figure 11. Segment 4: Henderson Circle to Bradford Drive (facing north)

Kittelson and Associates, Inc.

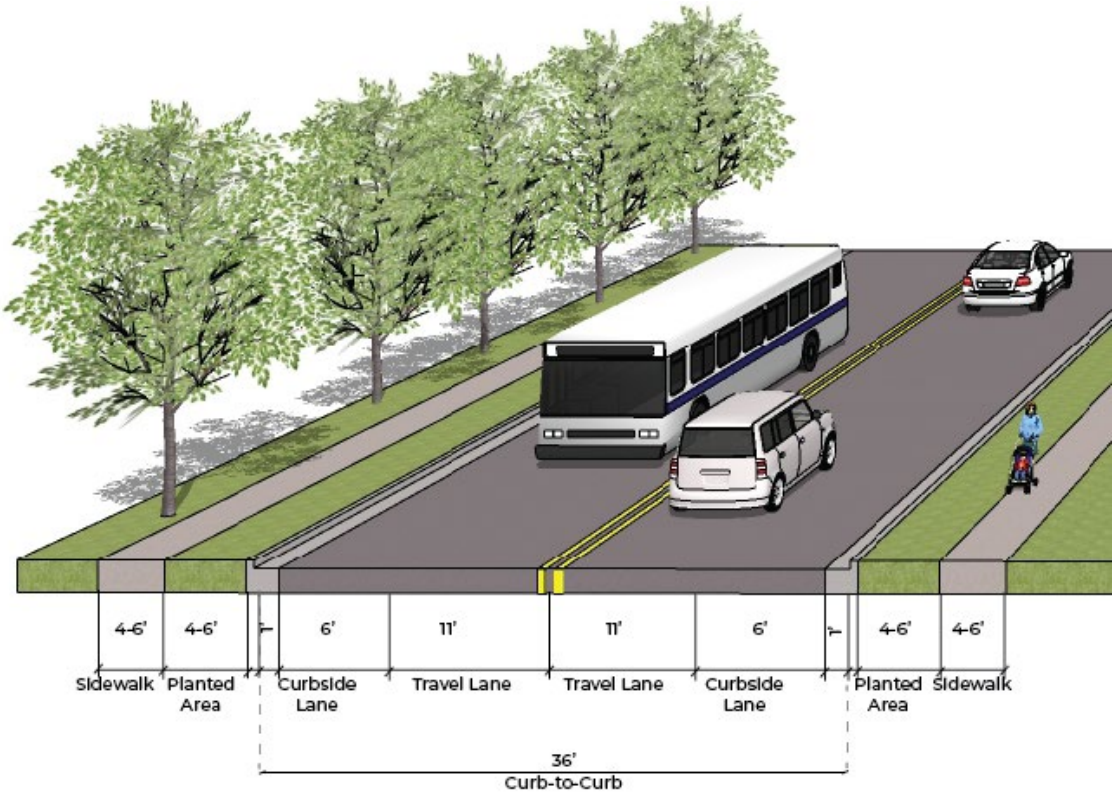


Figure 12 Segment 5: Bradford Drive to Hungerford Drive (facing north)

Kittelson and Associates, Inc.

There are no bicycle facilities along Mannakee Street, the on-street parallel parking varies, and the sidewalk network is mostly complete, with a missing connection on the east side of Mannakee Street from West Montgomery Avenue to Henderson Circle. **Table 2** summarizes the existing conditions observed along Mannakee Street for each street segment.

Table 2 Existing Conditions along Mannakee Street

Mannakee Street Segment	Sidewalk		Curbside Use		Curb to Curb Width	Transit Facilities
	West	East	West	East		
MD 28 to Anderson Avenue	Yes	No	Parking permitted	No parking permitted	36 feet	N/A
Anderson Avenue to Henderson Circle	Yes	No	No parking permitted		26 feet	N/A
Henderson Circle	Sidewalk available within Henderson Circle and outside of the Circle		Right side parking permitted (except from Mannakee St to Beall Ave)		22 feet	N/A
Henderson Circle to Bradford Drive	Yes	Yes	Parking permitted in most areas		36 feet	N/A
Bradford Drive to MD 355	Yes	Yes	Parking restrictions vary		36 feet	Ride On: 46, 55 WMATA: Q2, Q6

Source: Kittelson and Associates, Inc, 2023

Pedestrian Conditions

Mannakee Street has several comfortable and safe pedestrian facilities, including sidewalks that connect most of the corridor, trees that provide shade, speed humps and a raised crosswalk that encourage traffic calming, high visibility pedestrian crossing signage, and several opportunities for protected crossings. The team's review of existing conditions highlighted several gaps and opportunities to improve the existing pedestrian network and improve connections to other modes, as summarized in the following section.

Most of the corridor along Mannakee Street includes sidewalks that are approximately four to five feet wide. There are no sidewalks on the east side of Mannakee Street from MD 28 to Henderson Circle, as shown in **Figure 13**. Given the mix of residential and commercial land uses, as well as the proximity to several bus routes and nearby MARC and Rockville Metro stations, the corridor experiences primarily residential and college visitor pedestrian, bicycle, and scooter activity.

The City provided pedestrian counts that were collected at the following locations:

- MD 355 and Mannakee Street (October 2, 2014), shown in **Table 3**
- MD 28 and Mannakee Street (October 18, 2022), shown in **Table 4**

Figure 13. Missing Sidewalks on the East side of Mannakee Street north of MD 28

Google Streetview

Twenty-hour hour pedestrian activity at Mannakee Street and MD 355 and MD 28 are provided in **Table 3** and **Table 4**, respectively.

Table 3 24-Hour Pedestrian Volumes at MD 355

North	South	East	West	Total
23	4	-	114	141

Source: City of Rockville, 2023

Table 4 24-Hour Pedestrian Volumes at MD 28

North	South	East	West	Total
25	-	0	5	30

Source: City of Rockville, 2023

PEDESTRIAN CROSSINGS

Crosswalks allow pedestrians to safely cross the corridor. Vehicles must stop at crosswalks when pedestrians are in the crosswalk, which increases the visibility of pedestrians and improves overall safety. A crosswalk is the extension of a sidewalk across a street at an intersection and requires a curb ramp between the sidewalk and roadway. Crosswalks with high-visibility markings and/or signage further improve visibility and safety.

The City has made several investments in pedestrian safety along Mannakee Street. The list below summarizes the various pedestrian crossing treatments along the corridor:

Crosswalks across Mannakee Street vary between stop-controlled crosswalks, signalized crosswalks, and a midblock crosswalk by the Montgomery College.

There are 14 crosswalks across Mannakee Street, with the average spacing between crosswalks being 650 feet. The greatest distance between crosswalks is 1,650 feet between Smallwood Road and Lynch Street. Approximately half of the crosswalks are high-visibility and help to increase the visibility of crosswalks and crossing pedestrians. The study area has lighting approximately every 80 to 150 feet along Mannakee Street, helping to further increase pedestrian visibility.

There is a raised crosswalk located at Smallwood Road, which doubles as a traffic calming treatment to encourage slower vehicular speeds and a more comfortable pedestrian experience. Additionally, there is a Rectangular Rapid-Flashing Beacon (RRFB) located at the Mannakee Street/Parking Lot 13 intersection to help facilitate pedestrian crossings near Montgomery College, shown in **Figure 14**. There are several locations with missing crossings, including:

- Mannakee Avenue and Anderson Avenue – west leg
- Mannakee Street and Henderson Circle – north and south legs
- Beall Avenue and Henderson Circle – west leg
- Mannakee Street and Carr Avenue – west leg
- Mannakee Street and Lynch Avenue – east leg
- Mannakee Street and Wilson Avenue – west leg
- Mannakee Street and Goldsborough Drive – west leg
- Mannakee Street and Welsh Park Drive – east leg
- Mannakee Street and Smallwood Road – west leg
- Mannakee Street and Bradford Drive – west leg

The above listed missing crosswalks only include crossings that would connect sidewalks with curb ramps.

Figure 14. Rectangular Rapid-Flashing Beacon on Mannakee Street/Parking Lot 13 Entrance

Kittelson and Associates, Inc.

Bicycle Conditions

Mannakee Street does not have existing bicycle infrastructure. However, there is an existing Capital Bikeshare station located within the Montgomery College (**Figure 15**). **Figure 16** depicts existing bicycle facilities on surrounding streets, including a mix of shared use paths, bike lanes, and shared lanes.

Additionally, dockless e-bikes and e-scooters are available within the City. Bicycle parking along the study corridor is primarily located within Montgomery College.

The Rockville Bikeway Master Plan proposes a bike lane from MD 355 to Martins Lane, a climbing lane between Martins Lane and the traffic circle, and shared roadways from the traffic circle to Montgomery Avenue, as shown in **Figure 17**.

Figure 15 Capital Bikeshare Station at Montgomery College

Google Streetview

Figure 16. Bicycle Facilities in Rockville

Kittelson and Associates, Inc.

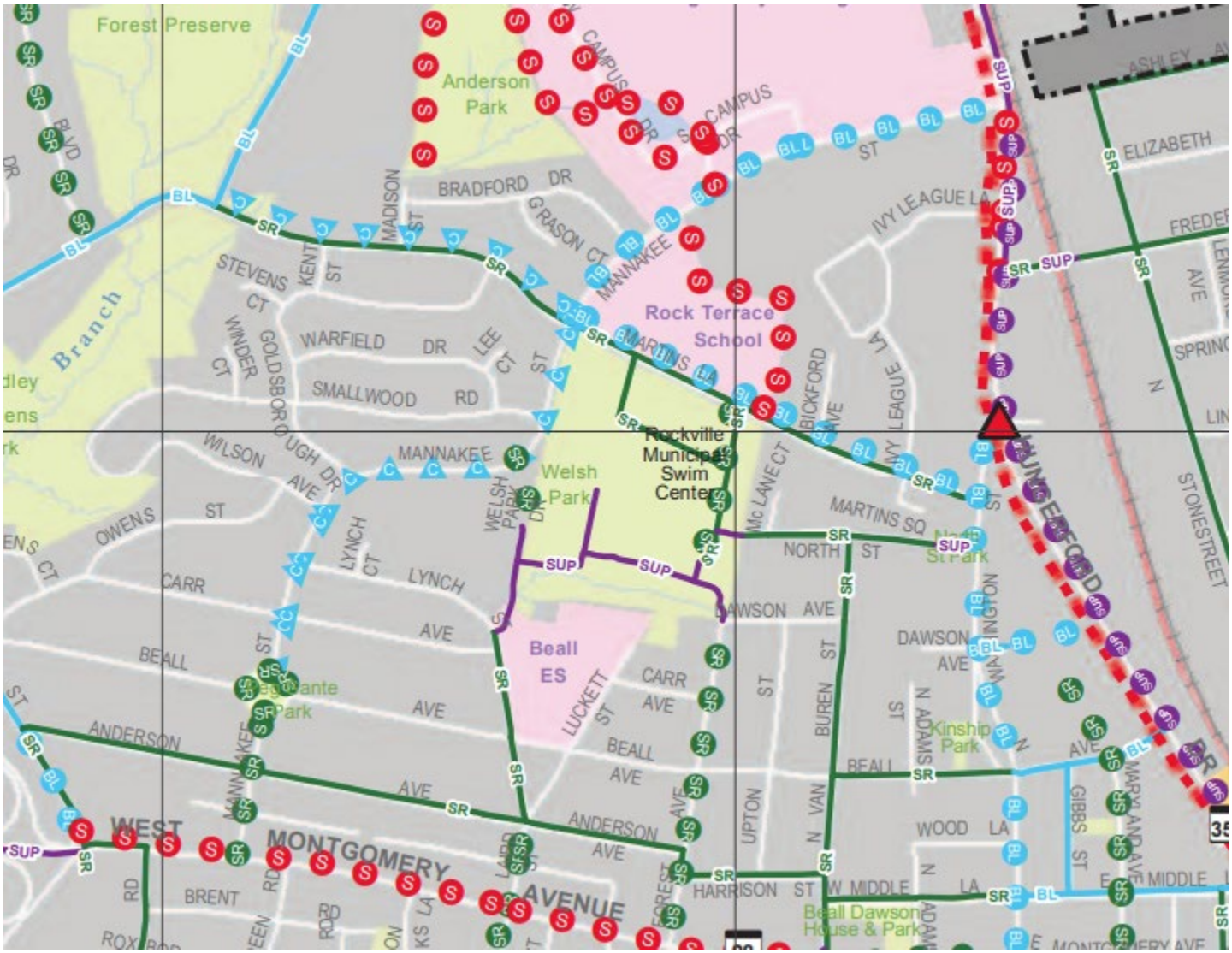


Figure 17. Proposed Bicycle Facilities in Rockville

City of Rockville Bikeway Master Plan, 2017

Anderson Avenue has shared lane markings and provides a lower-stress east-west bicycle connection than MD 28, as shown in **Figure 18**. Additionally, there is an ongoing project to evaluate the feasibility and design of bicycle facilities on Martins Lane.

The City has been making strides in advancing bicycle improvements, with separated bicycle lanes provided on N. Washington Street and E. Middle Lane. The City is actively reviewing other nearby corridors to evaluate safety improvements for people biking and walking, including improvements on Martins Lane and Mannakee Street. Mannakee Street serves as a critical connector in the City's bicycle network.

Figure 18. Shared Lane Markings on Anderson Lane

Kittelson and Associates, Inc.

Transit Conditions

Ride On and WMATA transit service is provided along a portion of Mannakee Street, near Montgomery Community College. WMATA's Metro Red Line service runs parallel to MD 355, with the Rockville Metro station located approximately one mile from Mannakee Street and MD 355.

There are two Metro Bus lines that service this area, including:

/ Metro bus Q2 and Q6 serve the neighborhoods in the west connecting to Shady Grove, Silver Spring, and Wheaton stations, as summarized in **Table 5**.

Table 5 WMATA Transit Service

Route	Headways	Service
Q2	16-30 mins	Serves Shady Groves station, Montgomery College, Rockville station, Wheaton station, Forest Glen station, and Silver Spring station.
Q6	16-30 mins	Serves Shady Grove station, Montgomery College, Rockville station, and Wheaton station.

Source: WMATA, 2023

Montgomery County transit service, Ride On, ensures connectivity within Rockville to adjacent towns. The Ride On routes that service Mannakee Street are shown in **Table 6** and include:

/ Ride-On Routes 46, 55, 101, detailed in **Table 6**.

Table 6 Ride On Transit Service

Route	Headways	Service
46	15-30 mins	Montgomery College to Southern Oakmont area
55	12-30 mins	Rockville station north to the Germantown area
101	10 mins	Gaithersburg area south to the North Bethesda area

Source: WMATA, 2023

Amenities at the nearby transit stations include shelters, benches, and wayfinding signage. The transit stop located near the Mannakee Street and MD 355, across from the Montgomery College, has wayfinding signage but lacks pedestrian-oriented amenities, such as seating and shade (**Figure 19**). The transit stops located within Montgomery College have shelters and benches (**Figure 20**).

Figure 19. Transit Stop near Mannakee Street and MD 355

Kittelson and Associates, Inc.

Figure 20. Transit Stops at Montgomery College

Google Streetview

Curbside Activity

The curbside activity along Mannakee Street varies throughout the corridor. On-street parking is provided in the more residential, southern portion of Mannakee Street whereas no on-street parking is provided near Montgomery College. **Table 7** details the curbside uses for each segment along Mannakee Street.

Table 7 Curbside Uses on Mannakee Street

Mannakee Street Segment	Curbside Use	
	West	East
West Montgomery Avenue to Anderson Avenue	Parking permitted	N/A
Anderson Avenue to Henderson Circle	N/A	
Henderson Circle	N/A	
Henderson Circle to Bradford Drive	Parking permitted in most areas	
Bradford Drive to Hungerford Drive	Parking is generally restricted along the segment	

Parking signs along Mannakee Street indicate parking restrictions along the corridor. No parking signage, as displayed in **Figure 21**, indicates where on-street parking is not permitted, typically near intersections. **Figure 22** notes parking restrictions, which vary along the corridor. The remainder of the corridor allows on-street parking without restrictions, as shown in **Figure 23**.

Figure 21. No Parking

Kittelson and Associates, Inc.

Figure 22. Restricted Parking

Google Streetview

Figure 23. No Restricted Parking

Kittelson and Associates, Inc.

Safety

The City provided crash data for Mannakee Street from 2018-2023, with 2023 data provided through October 31st. The project team reviewed this data to understand crashes and safety concerns along the corridor. The crash data presented in this section only accounts for crashes recorded in this dataset and should function as a reference.

Between 2018 and 2023, there were twenty-one crashes along Mannakee Street. In this five-year period, there were no fatal crashes or pedestrian crashes. **Figure 24** displays crash severity over the last five years.

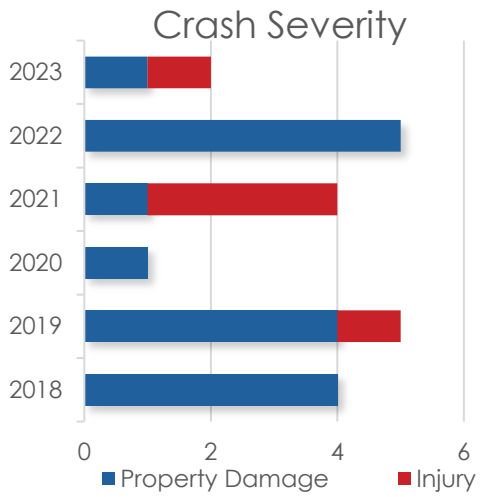


Figure 24. Crash Severity

Maryland Department of Transportation, 2023

Figure 25 displays the crashes by type. As shown, angle crashes, or crashes that include motorists turning left or right, accounted for approximately 40% of total crashes along Mannakee Street from 2018 to October 2023. Other crash types included collisions with fixed objects and parked vehicles.

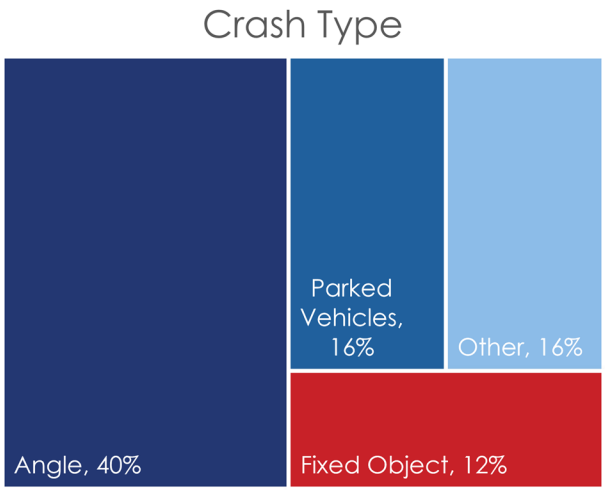


Figure 25. Crash Severity

Maryland Department of Transportation, 2023

Traffic Operations

This section provides an overview of the existing traffic operations observed and evaluated along Mannakee Street. The City provided turning movement counts and vehicular speed and volume data for analysis.

Additionally, the team conducted a field visit and observed traffic and operations.

EXISTING SPEED AND VOLUME ANALYSIS

The City of Rockville provided speed and volume data for the team to analyze to understand existing traffic operations along the corridor. The City provided turning movement counts at the following intersections:

- Mannakee Street and MD 28 (October 18. 2022)
- Mannakee Street and MD 355 (October 2, 2014)
- Mannakee Street and Martins Lane (September 20, 2023)

The City provided additional tube count data for vehicular speeds and volumes on Mannakee Street at the following locations:

- Mannakee Street between MD 28 and Anderson Avenue (April 22-29, 2019)
- Mannakee Street between Anderson Avenue and Mannakee Street (November 5-12, 2019)
- Mannakee Street between Lynch Street and Wilson Avenue (April 22-29, 2019)

Table 8 summarizes weekdays (Tuesday, Wednesday, Thursday) average daily traffic (ADT), average speeds, 85th percentile speeds, total vehicles exceeding the posted speed limit, and maximum speeds for the three different segments. The ADT along Mannakee Street varies between 3,827 to 6,344 vehicle per day (vpd) with the segment between Lynch Street and Wilson Avenue being most travelled with an ADT of 6,344 vpd.

Currently, Mannakee Street has a posted speed limit of 25 Miles per Hour (MPH). The project team observed that between 40.66 % to 67.83% of the total traffic travels at a speed higher than the posted speed limit. Additionally, vehicles traveling between Anderson Avenue and Mannakee Street generally travel at a higher speed in comparison with the other two segments, with the 85th percentile speed reported as 44.4 MPH.

It is expected that the proposed traffic calming measures in this study would help reduce high speed along the corridor and improve safety for pedestrians and cyclists.

Table 8 Mannakee Street Speed and Volume Analysis

Speed and Volume Data along Mannakee St (Both Directions)	Btw Lynch St and Wilson Ave	Btw W. Montgomery & Anderson Ave	Btw Anderson Ave & Beall Ave
Data Collection Period	From April 22 to April 29, 2019		From Nov 5 to Nov 12, 2019
Average Daily Traffic (ADT)	6,322 (VPD)	5,709 (VPD)	3,827 (VPD)
Average Speed	26.60 MPH	24.62 MPH	28.48 MPH
85th Percentile Speed*	30.77 MPH	29.29 MPH	44.40 MPH
Exceeding Posted Speed Limit (25 MPH)	4,290 (67.83%)	2,659 (46.57%)	1,499 (40.66%)
Maximum Speed	56.2 MPH	49.9 MPH	50.1 MPH

Source: City of Rockville, 2023

* 85th Percentile Speed is reported as the maximum over a 72-hour period.

EXISTING INTERSECTION OPERATIONS

The team evaluated existing intersection operations at the two signalized intersections along Mannakee Street, including MD 355 and Nelson Street/Martins Lane. A review of the turning movement counts at both intersections indicates the AM peak hour to be between 7:15 AM to 8:15 AM and the PM peak hour between 5:00 PM and 6:00 PM. **Figure 26** presents the AM and PM peak hour turning movement counts.

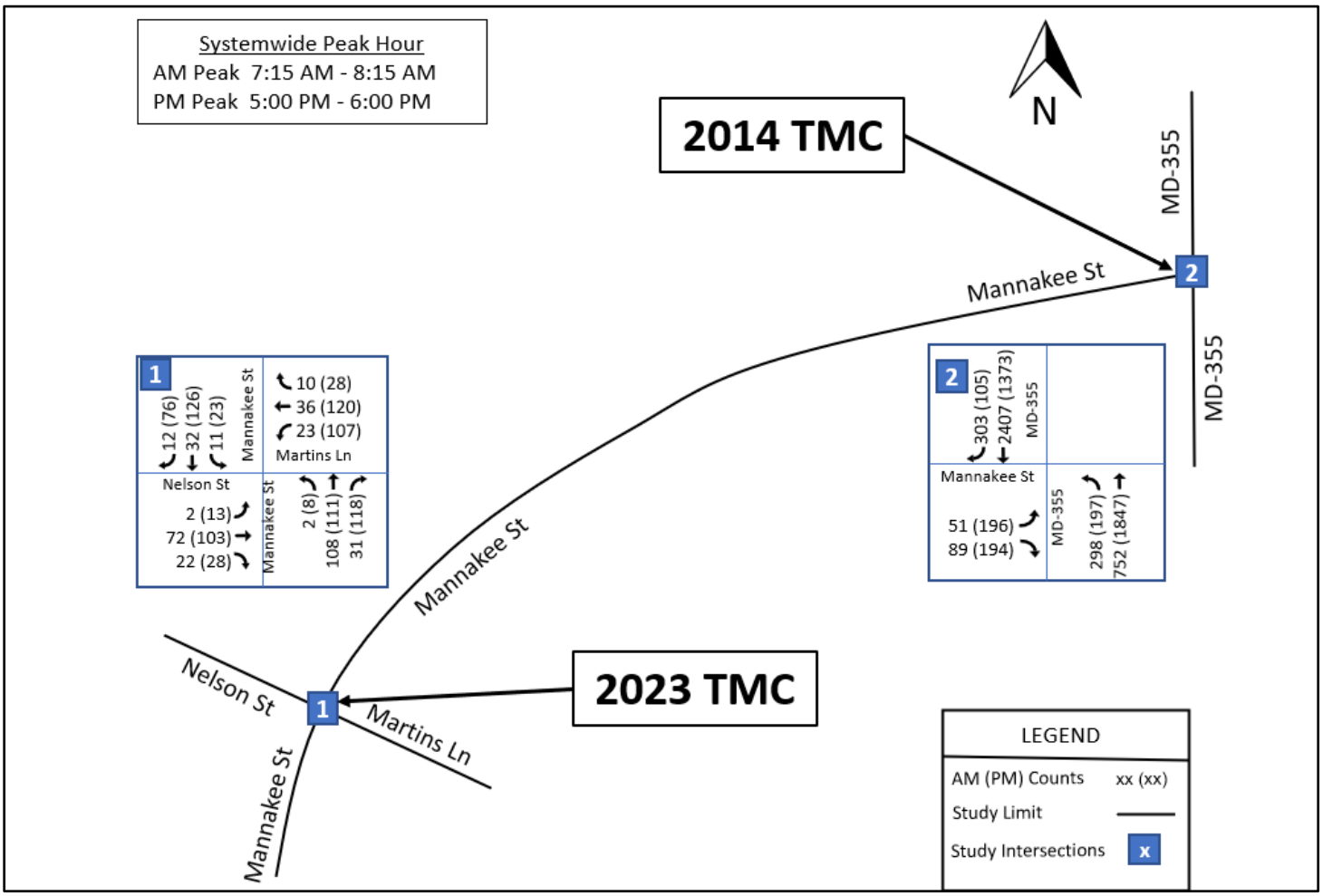


Figure 26. AM and PM Peak Hour Turning Movement Counts

Maryland Department of Transportation, 2023

Traffic Growth Rate

Due to the difference in data collection years for each signalized intersection, the project team calculated an annual growth rate to adjust the 2014 counts at MD 355 to better reflect existing 2023 volumes. The annual growth rate was calculated based on a 5-year historical Average Annual Daily Traffic (AADT) as shown in **Table 9**.

Table 9 Mannakee Street 5-year Historical AADT

Mannakee Street AADT				
Year	Between MD 28 and Beall Ave		Between MD 355 and Beall Ave	
	AADT	GR	AADT	GR
2015	4,293	2%	9,223	2%
2016	4,384	3%	9,404	2%
2017	4,495	-1%	9,635	-3%
2018	4,470	0%	9,330	0%
2019	4,471		9,331	
Average Growth Rate (GR)		1%		0%

Source: Maryland Department of Transportation, 2023

The traffic growth along Mannakee Street fluctuates throughout the 5-year study period, with a few years showing minimal growth. The overall average growth rate along Mannakee Street between MD 28 and Mannakee Street was 1% while there was no growth between Mannakee Street and MD 355. This is likely because the study area is mostly built-out and had little to no traffic growth during the 5-year study period. Based on the historical volumes review, 2014 volumes were used to evaluate the intersection of MD 355 and Mannakee Street without growing them to the year 2023. This approach was discussed and approved by the City.

Capacity Analysis – Existing Year Traffic Conditions

Synchro Professional (Version 11) was used to develop AM and PM peak hour existing conditions analysis models. Both peak hour models were prepared based on existing lane configuration, peak hour volumes shown in **Figure 26**, and traffic signal timings and phasing provided by the City of Rockville.

Control delay (seconds per vehicle) and Level of Service (LOS) are presented based on HCM 2000 methodologies.

The intersection delay and LOS results for the study intersections are presented in **Table 10**. The accompanying Synchro reports are provided in **Appendix A**. Levels of service (LOS) results of D or better are considered acceptable, and LOS E or F are considered unacceptable and are presented in red font and highlight.

The analysis results indicate that all movements at the intersection of Martins Lane/ Nelson Street and Mannakee Street operate at LOS C or better and the overall intersection operates at LOS B during both peak hours.

During the AM peak hour, the eastbound and southbound approaches at intersection of MD 355 and Mannakee Street, operate at LOS E and the overall intersection also operates at LOS E. During the PM peak hour, the eastbound approach operates at LOS E, but the overall intersection operates at LOS B.

Table 10 Capacity Analysis Results - Existing Year (2023) Conditions

Intersection/ Signalized	Approach Label	Approach/ Movement	AM Peak		PM Peak	
			Delay (veh/sec)	LOS	Delay (veh/sec)	LOS
MD 355 Hungerford Dr & Mannakee St	Mannakee St	EBL	70.5	E	73.1	E
		EBR	64.8	E	52.3	D
		EB Overall	66.9	E	62.8	E
	MD 355 (Hungerford Dr.)	NBL	49.6	D	25.5	C
		NBT	2.2	A	8.3	A
		NB Overall	15.6	B	9.9	A
	MD 355 (Hungerford Dr.)	SBLTR	75.1	E	18.0	B
		SB Overall	75.1	E	18.0	B
	Overall Intersection		55.9	E	19.2	B
Martins Ln./ Nelson St. & Mannakee St	Mannakee St	EBLTR	31.0	C	33.9	C
		EB Overall	31.0	C	33.9	C
	Mannakee St	WBT	25.2	C	30.7	C
		WBR	21.7	C	21.4	C
		WB Overall	24.4	C	27.6	C
	Martins Ln	NBL	6.0	A	7.9	A
		NBTR	6.0	A	7.6	A
		NB Overall	6.0	A	7.7	A
	Nelson St	SBTL	3.3	A	3.6	A
		SBR	3.3	A	3.8	A
		SB Overall	3.3	A	3.8	A
	Overall Intersection		19.0	B	18.9	B

Source: T3, 2023

ISSUES & OPPORTUNITIES

Based on the existing conditions analysis and field walk, the team identified key issues and opportunities that can be addressed within the scope of this Study. The issues and opportunities align with the project's vision to create protected, comfortable, and low-stress pedestrian and bicycle facilities along Mannakee Street to enhance connectivity, safety, and access for all modes and users. The team identified the following key issues:

- Focus on vehicle-oriented trips and limited multimodal infrastructure
- Inconsistent and underutilized parking regulations
- Speeding along Mannakee Street
- Driver yielding compliance for pedestrians
- Pedestrian and bicyclist visibility challenges at crossings
- Competing interests for safety, multimodal improvements, and demand for on-street parking
- Limited curb to curb width to accommodate all modes
- Lack of parking compliance in No Parking zones

Additionally, the team identified the following opportunities:

- Montgomery College serves as a regional activity generator
- Regional connectivity with nearby Rockville Metro station
- Key activity sites include schools and Welsh Park
- Demand for multimodal travel
- Opportunities to expand and enhance existing traffic calming treatments
- Connections to future Martins Lane bicycle improvements
- Underutilized on-street parking
- Gateway treatments can indicate a slower, traffic calmed residential road
- Build on the corridor's assets of existing sidewalk network, tree-lined streets, crosswalks, speed hump, raised crosswalk, and Capital Bikeshare station
- Quick-build treatments offer near-term responses to community concerns

PUBLIC OUTREACH

The City hosted a virtual public meeting on April 9th, 2024, to present and discuss the purpose and present the alternatives for this Study. This section summarizes the public comments the team received and responses in **Table 11**.

Table 11 Summary of Public Comments

Questions/Comments from the Public and Responses	
I understand the process here but am a bit confused around the number of studies and public comments that need to be done/ made in order to mitigate a serious safety concern in an area full of children and to public parks and rec centers. It seems like the county is taking a wait and see approach. Cars still park illegally (as recent as last weekend) and both my husband and I almost got hit separately this week in the morning by cars flying down the road. The solution should be relatively simple- fix the speed bumps, fix the signs, adjust the speed limits.	
Response:	**The proposed project seeks to implement traffic calming measures, designed to slow vehicular speeds and enhance pedestrian/bicyclist safety along the corridor. While speed limits are not adjusted directly for the corridor, the proposed traffic calming measures will encourage vehicles to slow down through lane narrowing, added pedestrian refuge island, and raised crosswalk. Speed bumps and signage will be fixed.**
Thank you for increasing the visibility of this information, please see my comments related to the "Mannakee Street Complete Streets Feasibility". I would encourage the city to review Mannakee Street through an alternative perspective (this may require an additional forum and review – maybe through the City of Rockville Vision Zero Action Plan?). Many interested parties are more concerned with the safety of the street as it pertains to pedestrians. I understand that the "Mannakee Street Complete Streets Feasibility" "aims to improve multimodal safety and comfort for all users on Mannakee Street by exploring corridor redesign alternatives that better accommodate all modes and incorporate Complete Streets design" however, some basic safety principals seem to be overlooked (i.e., the crosswalk at the intersection of Smallwood and Mannakee). I understand there is an interest in the "Complete Streets Design", but I don't not think that should come at the price of overlooking basic safety measures that should be reviewed, updated and put in place. As far as Mannakee Street, I am not sure why the focus is on increasing "bicycle-ability". I understand there is a push for "Complete Streets Design" and the "Bikeway Master Plan" but in my observation, I rarely see Mannakee Street being used by bicyclists (other than small children who will be using the sidewalk). That in addition to an increase in the "work-from-home" population makes those efforts futile. Thus, I think the funds that would have been used for bicycle facilities should be diverted to focus on the safety of pedestrians (i.e., better crosswalks, more of an effort to control speeding between Rt. 28 to Montgomery County Community College (or 355). Additionally, I would suggest before allocating funds into bicycle facilities that there is actually a study focusing on how much those bike lanes would be used. If anything, I would argue that in recent years the amount of walking within the area (particularly with young children) has increased (walking to the schools, daycare facilities, the park, the swim center). I would also like to request that a survey be completed on the population of Mannakee Street and the neighboring streets to account for population structure. The number of young children within the area (next to a public park) makes it a prime target for a potentially dangerous situation without traffic controlling measures in place. Anecdotally, I have also noticed a shift in the population toward younger families (this should also be taken into account). I would request that the existing conditions of Mannakee Street be rereviewed. I see in the report that the team conducted their review between 10:00am-12:00pm on a Thursday. There are plenty of flaws within the timing of this review: this does not take into account the weekend traffic/park use, this does not take into account Spring/Summer/Fall use when the weather is nicer and more people are outside, and this does not take into account the morning or afternoon traffic from commuters using Mannakee Street as a cut-through to 355 or commuting to Montgomery Country Community College. I	

also disagree with the team's statements that the speed bump south of Welsh Park encourages traffic to slow, nor does the raised crosswalk near Welsh Park.

Within "Pedestrian Conditions" I disagree with the statement regarding "speed humps and a raised crosswalk that encourage traffic calming". I have seen and experienced many instances of speeding and lack of traffic slow/stop near the "speed humps and a raised crosswalk". As an adult I am able to be cautious but is a young child as aware? I am also unsure of where the information on "pedestrian crossing signage, and several opportunities for protected crossings"; signage that is available is either ignored or not visible due to parked cars and I am not sure where the protected crossings are located.

I am also concerned of increased congestion with the addition of bike lanes and a narrower street. For example, since it is mostly a residential street, I foresee issues regarding public services (i.e., trash collections, mail delivery). It does not seem like this has been considered. This can produce more dangerous situations and riskier traffic.

Overall, I feel that the recommendations missed the mark on what is really needed within Mannakee Street, particularly within the residential section. I would encourage the City of Rockville to rereview the population and activities to better focus funds that would protect and serve the community better this includes more of a focus on safer crosswalks and deliberate traffic control measures.

Response:	**Our team will be reviewing corridor and spot treatments that advance Complete Streets principles that seek to achieve reduced motor vehicle traffic speeds. We will be sure to review and propose recommendations for the intersection of Smallwood and Mannakee Street. We will also explore additional pedestrian safety improvements. Many recommendations that improve safety and comfort for people biking will also improve safety and comfort for people walking along Mannakee Street, as traffic calming and Complete Streets are intended to improve safety and comfort for all users. For instance, bicycle facilities, such as buffered bicycle lanes, narrow the curb-to-curb width of the roadway which leads to lower motor vehicle travel speeds. Our recommendations will focus on safer crosswalks and a mix of traffic calming treatments that will work in tandem with existing traffic control measures.**

I am a pedestrian who walks our dog around Welsh Park and uses the crosswalk to cross Mannakee Street at Smallwood Road. I have experienced two problems at the crosswalk: drivers speed both ways on Mannakee Street, and they park illegally on the Welsh Park side near the crosswalk, despite the no parking signage.

In response to speeding cars, I would like to see speed bumps on both sides of the raised crosswalk instead of the proposal for installing a speed bump on one side near the crosswalk. I propose that the crosswalk be painted brighter since the paint has faded. I also suggest installing a two-sided vertical stand up sign at the crosswalk to yield to pedestrians, which are posted at other crosswalks in Rockville.

Regarding the illegal parking at the crosswalk next to Welsh Park, I find it dangerous to cross with my dog from Welsh Park to Smallwood Road. It is difficult to see moving cars from the roadside when illegally parked cars block my view. When I walk on to the crosswalk to get a better look, I am too close to oncoming traffic. Cars especially park illegally in the no parking areas adjacent to the crosswalk on weekends during the spring, summer, and fall for soccer and softball games at Welsh Park, and for competitions at the nearby swim center. I have contacted Rockville's Department of Public Works and Parking Enforcement, and both have been responsive. While I appreciate their efforts toward reducing congestion at the crosswalk, we need more explicit and proactive measures to discourage cars from parking illegally in these no parking areas, such as larger no parking signs and diagonal yellow markings on the road to show where cars are prohibited from parking near the crosswalk.

Response:	**At the intersection of Mannakee Street/Smallwood Road, the project recommends painted curb extensions and daylighting with flex-posts. This will physically restrict users from parking in this area as well as increase visibility for pedestrians. Replacing the existing raised crosswalk is also proposed at the intersection. Altogether, the project team expects these changes to improve the speeding and parking issues encountered at this intersection.**

I was reviewing the presentation slides from the Mannakee Street Complete Streets Feasibility Study and I am really excited for this project and just wanted to reach out and share some of my opinions on it.

Since a complete streets study was done here, it would be incredibly valuable for some lane narrowing and bike lane improvements to be made. That's why option 3 is the best, option 2 second, and option 1 feels like no improvement at all. Painting a bike on a motor lane and calling it a sharrow does basically nothing to improve experience for anyone.

The shared use path from Welsh Park Drive to Martins Lane is especially exciting! As long as it will not require uprooting the trees that are along the sidewalk a shared use path would definitely make the west side of Welsh park a more pleasant walk and ride.

While I am indifferent to speed bumps, raised crosswalks are very much appreciated! They really help motorists be more aware and mindful of pedestrians than they otherwise would at a regular crossing.

I also would really like to see the bike lanes have something separating the motor lanes other than paint. The presentation shows flex posts being used which I think would be fine for a residential street, but a concrete or curb separator would be ideal. Without these, motorists tend not to respect the space and use the bike lanes for stopping/parking which only leads to bikers underutilizing the lanes.

TL;DR: Option 3 is the best, motor lane narrowing, raised crosswalks, separated bike lanes, and shared use paths are great!

Response:	**Thank you for your comment. We are considering flex-posts as a physical barrier between vehicles and the bicycle lane and will explore concrete curb separators in a later final design project phase.**

TOOLBOX OF STRATEGIES

The following strategies are organized into corridor strategies and intersection-related strategies. The strategies were identified after synthesizing the existing conditions, discussing goals and opportunities with the City, and reviewing local and state guidance and best practices. The City of Rockville and MCDOT have implemented several of these strategies at other locations throughout Rockville and Montgomery County.

Corridor Strategies

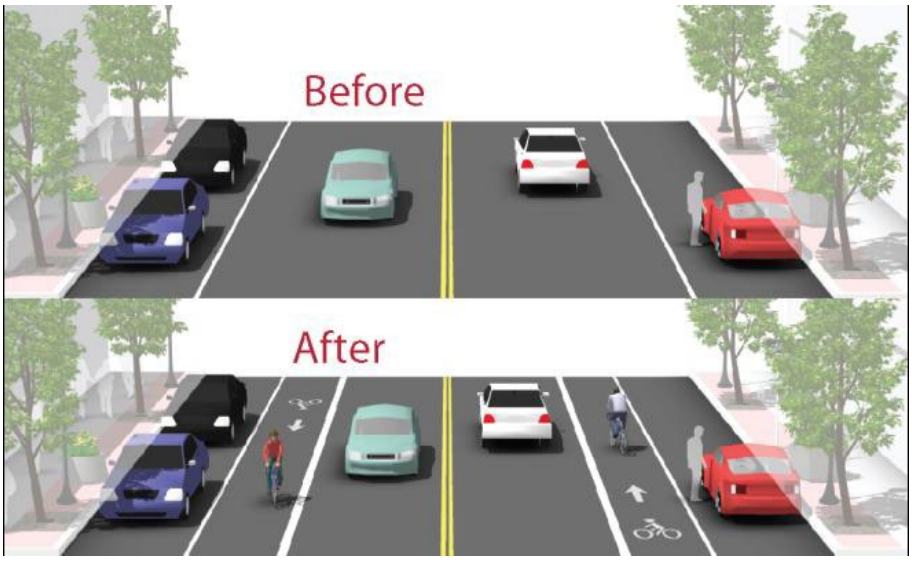
Corridor strategies focus on improving multimodal safety along Mannakee Street, between the study intersections and extending from MD 28 to MD 355. The following corridor strategies will be considered for Mannakee Street:

- Lane Narrowing
- Corridor-wide Traffic Calming
- Formalize On-Street Parking
- Buffered Bike Lanes
- Protected Bike Lanes
- Downhill Shared Lane Markings

LANE NARROWING

Lane narrowing refers to reducing the width of a travel lane, typically to make space for other uses including bike lanes, pedestrian refuge islands, and more. Narrow lanes help reduce vehicular speeds and minimize crashes on city streets by reducing the right-of-way and making drivers more aware of traffic and adjacent users.[1] With reduced speeds, pedestrians and bicyclists experience higher levels of comfort and safety. Lane widths of eleven feet are considered appropriate along Mannakee Street and can have a positive impact on safety without impacting traffic operations.[2] The alternatives for the project include a road diet and driving lanes of eleven feet. Lane narrowing involves near-term implementation, low costs, and minimal travel impacts (**Figure 27**).

Figure 27 Lane Narrowing



Source: Braintree, MA

[1] Global Designing Cities Initiative, *Traffic Calming Strategies.*
[2] NACTO, *Urban Street Design Guide: Lane Width*.

CORRIDOR-WIDE TRAFFIC CALMING

Traffic calming measures reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users.[3] Traffic calming may include vertical deflections (e.g., speed humps, raised intersections, flex-posts), horizontal shifts (e.g., chicanes, medians), and roadway narrowing to reduce speed and enhance the streetscape for non-motorists. **Figure 28** shows an example of neighborhood speed humps used to help slow vehicular travel.

Figure 28 Neighborhood Speed Hump

Source: City of Boston

FORMALIZE ON-STREET PARKING

The Mannakee Street corridor experiences a variety of parking-related issues, including visibility issues due to parked vehicles, inconsistent parking regulations throughout the corridor, and lack of parking compliance in specified "No Parking" zones. Formalizing on-street parking can be a strategic way to maximize the parking spots along a street, reduce safety issues caused by people parking and blocking pedestrian crossings, and clarify neighborhood parking rules for all users. **Figure 29** shows an example of striped on-street parking. Formalizing on-street parking can be installed in the near term for a low cost, with minimal impact on vehicle operations.

Figure 29 On-Street Parking Markings

Source: City of Jacksonville

[3] *US Department of Transportation, Traffic Calming to Slow Vehicle Speeds.*

BICYCLE FACILITY IMPROVEMENTS

This Study reviewed appropriate bicycle facility improvements along the corridor. There are several types of bicycle facilities that are appropriate, based on the characteristics along Mannakee Street, including vehicle volumes, posted speed limits, and existing curb to curb width. The Montgomery County Planning Department developed the Bicycle Facility Design Toolkit in July 2017 to outline best practices for bicycle facility design and application. **Figure 30** depicts bicycle facility types and indicates their level of separation from traffic.

Figure 30 Bicycle Facility Classification

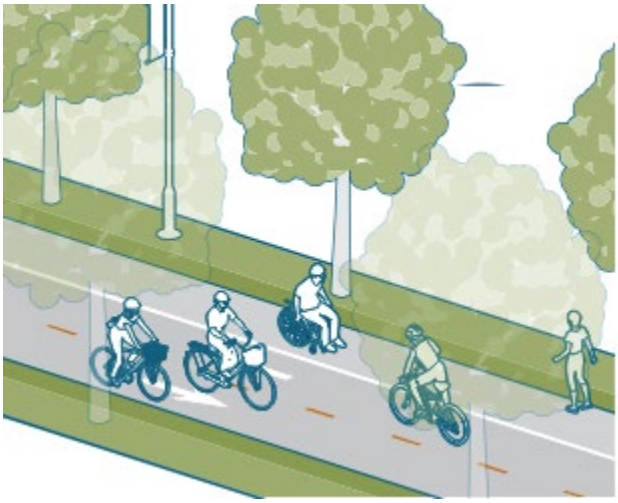
Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

Shared Use Path

Shared use paths are located parallel to and within the road right-of-way, and provide travel for walking, bicycling, jogging, and skating. An example of a shared use path is shown in **Figure 31**. Shared use paths are typically considered on any road with one or more of the following characteristics: three or more travel lanes; 30 mph and over posted speed limit; 6,000 daily vehicles or greater; frequent parking turnover; frequent bike lane obstruction; and designation as a truck or bus route.[4] Shared use paths may be preferable to separated bike lanes in cases where there is pedestrian activity, in order to minimize right-of-way impacts.

Shared use paths should be constructed with high-quality construction and maintenance that avoids pavement cracking and buckling, with asphalt as the preferred surface material. Concrete is also acceptable, with longer sections and small joints for a smoother riding experience.

Figure 31 Shared Use Path



Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

Separated Bike Lanes

Separated bike lanes are exclusive bikeways that are physically separated from motor vehicle traffic and distinct from the sidewalk, as shown in **Figure 32**. These facilities are typically considered on any road with one or more of the following characteristics: three or more travel lanes; 30 mph and over posted speed limit; 6,000 daily vehicles or greater ; frequent parking turnover; frequent bike lane obstruction; and designation as a truck or bus route.[5] Separated bike lanes are preferred in high density areas, adjacent to commercial and mixed-use development, and near major transit stations or locations where observed or anticipated pedestrian volumes will be higher. Separated bike lanes may be single or bi-directional.

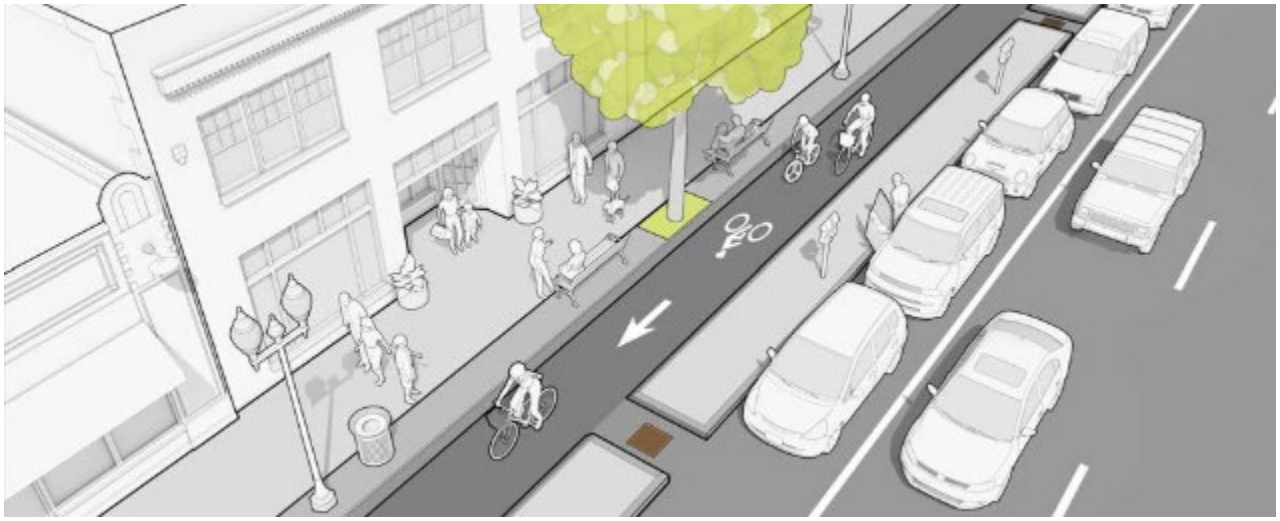
Separated bike lanes are more attractive to a wider range of bicyclists than striped bikeways on higher volume and faster speed roads due to the separation. The separation also prevents motor vehicles from driving, stopping, or waiting in in the bikeway.

The implementation timeline and costs associated with installing separated bike lanes vary depending on the type of separation. Separated bike lanes that require paint and flex posts may be implemented in the near term. Separated bike lanes that incorporate more robust separation, such as permanent curbs, planters, etc. may require additional time, funding, and coordination.

[4] Montgomery County Planning Department, *Bicycle Facility Design Toolkit*.

[5] Montgomery County Planning Department, *Bicycle Facility Design Toolkit*.

Figure 32 Separated Bike Lane



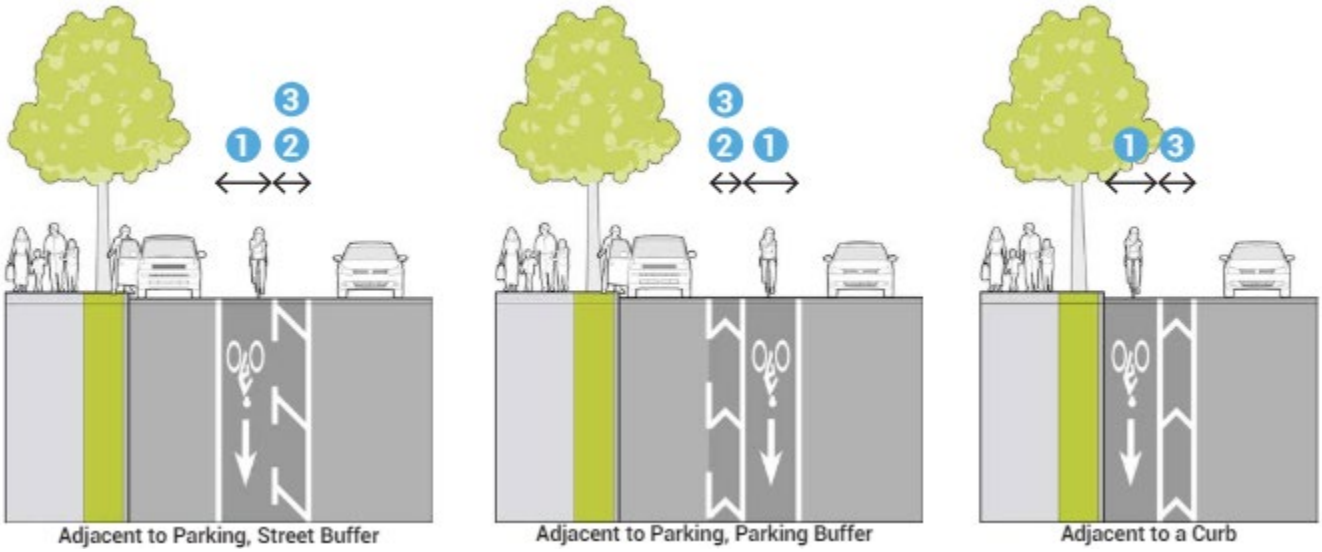
Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

Buffered Bike Lanes

Buffered bike lanes are conventional bike lanes paired with a designated buffer space separating the bike lane from the adjacent motor vehicle travel lane and/or parking lane to increase the comfort of bicyclists, as shown in **Figure 33** . These facilities are typically considered on any road with one or more of the following characteristics: three or more travel lanes; 30 mph and over posted speed limit; 9,000 daily vehicles or greater; infrequent parking turnover; infrequent bike lane obstruction; and where a separated bike lane or shared use path is infeasible or undesirable.[6] Buffered bike lanes can be used on one-way or two-way streets. Where there is high turnover parking, a buffer should be placed next to the parking lane.

Research has found that buffered bike lanes increase safety and the perception of safety. Buffered bike lanes are recommended over conventional bike lanes where there is at least seven feet of available roadway width.

Figure 33 Buffered Bike Lanes



Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

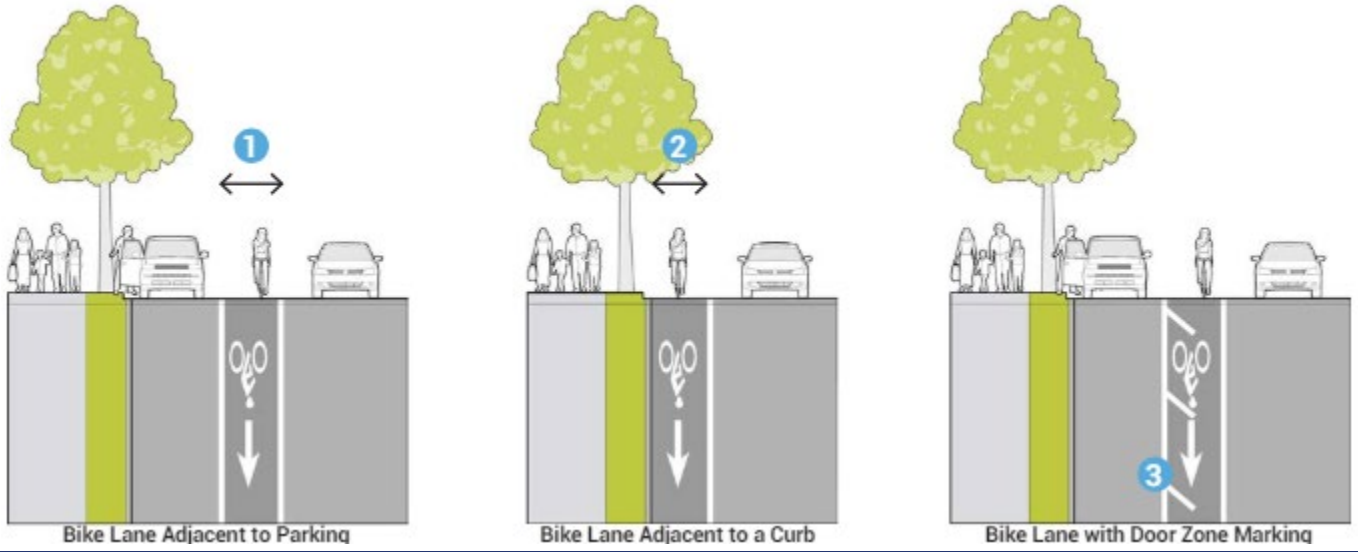
[6] Montgomery County Planning Department, *Bicycle Facility Design Toolkit*.

Conventional Bike Lanes

Conventional or standard bike lanes designate space for people biking adjacent to a travel lane. Conventional bike lanes use striping, signing, and pavement markings, as shown in **Figure 34**. These facilities are typically considered on any road with one or more of the following characteristics: three or more travel lanes; 30 mph and over posted speed limit; 9,000 daily vehicles or greater; infrequent parking turnover; infrequent bike lane obstruction; and where a separated bike lane or shared use path is infeasible or undesirable.[7]

The minimum width of a bike lane adjacent to parking is 5 feet, with a desirable width of 6 feet. The minimum width of a bike lane adjacent to a curb is 5 feet exclusive of a gutter, with a desirable width of 6 feet. Formalizing parking with hatch marks can highlight the vehicle door zone on constrained corridors with high parking turnover, and guide bicyclists away from doors, as shown in **Figure 34.**

Figure 34 Conventional Bike Lanes



Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

Shared Lane Markings

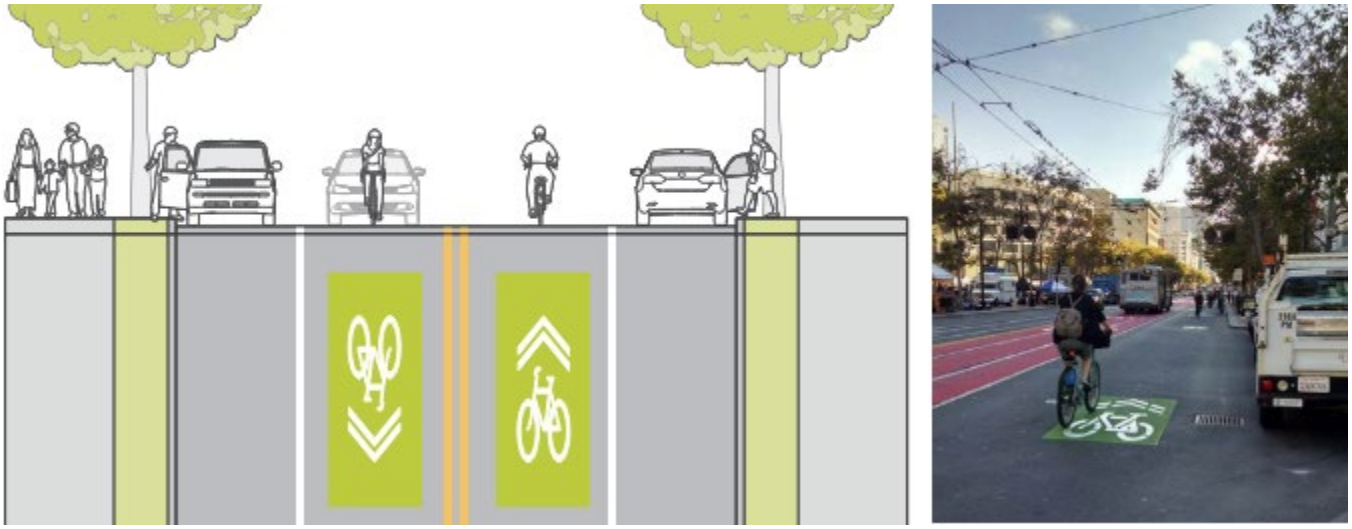
Priority shared lane markings communicate bicyclist priority within a shared lane and guide bicyclists to ride outside of the door zone. Colored backing and more frequent spacing make priority shared lane markings more conspicuous than standard shared lane markings (also known as sharrows), as shown in **Figure 35**.

Shared lane markings are typically applied on roadways where it is infeasible to install bike lanes, separated bike lanes or shared use paths, but it is desirable to communicate bicycle priority. Common applications of this treatment include streets with high on-street parking turnover, typically those with ground-floor retail and dining, or on low-speed, low-volume frontage roads. They may also be used in separated bike lane mixing zones where a protected intersection is not provided.[8]

Markings include white symbols and may have a green background color. Markings should be placed on streets with posted speed limits of 25 mph or less with average daily traffic of less than 3,000 vehicles per day. While they may be installed on streets with higher volumes and/or speeds (up to 6,000 average daily traffic and 30 mph or 20,000 average daily traffic and 25 mph), shared lane markings will likely not increase comfort levels for the majority of people biking.

[7] Montgomery County Planning Department, *Bicycle Facility Design Toolkit*.
[8] Montgomery County Planning Department, *Bicycle Facility Design Toolkit*.

Figure 35 Shared Lane Markings



Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

Intersection Strategies

Intersection strategies focus on improving multimodal safety at intersecting streets. As identified in the existing conditions, intersections are subject to vehicular, pedestrian, and bicycle crashes. The following sections outline the following intersection redesign strategies and pedestrian crossing enhancements:

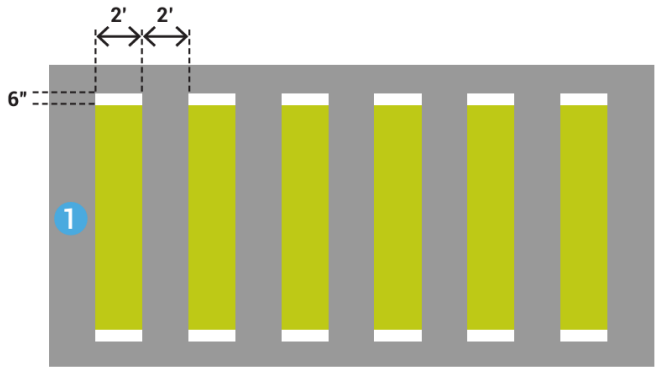
- Bike Crossings
- Daylighting
- Painted Curb Extensions
- No Right Turn on Red
- Gateway Treatments
- High Visibility Crosswalks
- Bike Box

Bike Crossings

A bicycle crossing includes a marked crossing across an intersection, driveway, or alley that delineates a preferred path for people bicycling through the intersection, as shown in **Figure 36**. Bike crossings are recommended to indicate a potential conflict points between people biking and driving and are recommended where separated bike lanes cross streets, alleys, and driveways that service at least ten vehicles per day.

Bicycle crossings may be supplemented with a green-colored surface to improve contrast with the surrounding roadway and adjacent pedestrian crossing, if present. Green surfacing may be desirable at crossings where concurrent vehicle turning movements are allowed. A minimum of 6.5 feet is recommended for a one-way separated bike lane, and 10 feet for a two-way separated bike lane with a recommended centerline.

Figure 36 Bike Crossings



Source: Montgomery County Planning Department Bicycle Facility Design Toolkit, 2017

Daylighting

Daylighting refers to removing parking within 20-30 feet of an intersection. This improves visibility for both drivers and pedestrians. Additionally, daylighting intersections can open space for pedestrian/bicyclist-oriented amenities, such as bicycle racks, or help to calm traffic through curb extensions. An example of a daylighting intersection is shown in **Figure 37**. Daylighting is designed to maintain existing on-street parking and to prevent non-compliant parking that is outlined by the City.

The City of Rockville has restrictions in place against stopping, standing, or parking in specified places.[9] No person shall stop, stand, or park a vehicle in situations that include (but is not limited to) the following:

- On a sidewalk;
- Within five feet of a driveway;
- In front of a driveway;
- Within an intersection;
- On a crosswalk, or within twenty feet of a crosswalk at an intersection;
- Within thirty feet of any beacon, stop sign, or traffic control signal located at the side of a roadway; and
- Upon a portion of the street of which there are painted lines on the surface of the street to indicate a designated bikeway.

Daylighting can be implemented in the near-term with minimal construction costs and impact on traffic operations.

Figure 37 Painted Daylighting

Source: Streetsblog SF

Painted Curb Extensions

Curb extensions narrow the roadway visually and physically, creating shorter crossings for pedestrians while increasing space for pedestrian amenities, such as lighting, trees, and benches, as shown in **Figure 38**. Painted curb extensions can be used to implement low-cost, quick-build solutions.

The FHWA notes curb extensions in their Unsignalized Intersection Safety Strategies brochure and recommends reducing or extending curb radii at unsignalized intersections at locations with high pedestrian activity. Curb extensions improve pedestrian visibility and mitigate left turning crashes between vehicles and people walking or biking.[10] Fully constructed curb extensions can be implemented in the mid-term. Construction costs are moderate and depend on stormwater and drainage requirements. Curb extensions have little to no impact on traffic operations.

Figure 38 Curb Extension

Source: NACTO

[9] Rockville City Code, Chapter 23, Article II, Section 23-26, https://www.rockvillemd.gov/DocumentCenter/View/44145/12-21-ORD-To-Levy-Assessments---Drivewaydocx

[10] US Department of Transportation, *Traffic Calming: Curb Extensions.*

No Right Turn on Red

Adding signage to signalized intersections that restrict vehicles from turning right on red reduces conflicts between right-turning vehicles and pedestrians and bicyclists traveling through the intersection. No right turn on red restrictions may improve safety and comfort for people biking and walking. This is a low-cost solution that can be implemented in the near-term. **Figure 39** depicts no right turn on red signage.

Figure 39 No Right Turn on Red

Source: DCist

Gateway Treatments

A gateway treatment can serve to mark the transition from a higher speed street to a slower speed, local, neighborhood street. Gateway treatments can serve as a pinch point for vehicles and create a narrow point that can effectively calm traffic. Gateway treatments may also feature pedestrian refuge areas where crosswalks are present, as shown in **Figure 40**. Pedestrian refuge islands have been shown to reduce pedestrian crashes by 56%.[11] Refuge islands should be at least six feet wide to ensure ADA compliance, with a preferred width of 8-10 feet. Medians at the intersection should have a "nose," or an extension past the crosswalk, which serves to protect people waiting and slow turning drivers. It is also recommended for pedestrian refuge islands to include curbs, bollards, or other safety features. Pedestrian refuge islands can be constructed in the near-term with moderate costs. Refuge islands have little to no impact on vehicle operations.

Figure 40 Pedestrian Refuge Gateway Treatment on Monument Street at Great Falls Road

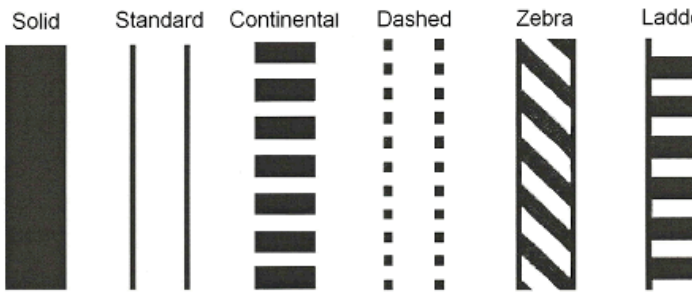
Source: Google Streetview

[11] US Department of Transportation, *Medians and Pedestrian Refuge Islands in Urban and Suburban Areas.*

High Visibility Crosswalks

There are several types of crosswalk striping, as shown in **Figure 41**. The City of Rockville Pedestrian Master Plan notes that zebra or ladder type crossings are more visible to motorists than standard crosswalks and can improve pedestrian safety. High-visibility crosswalks can be installed in the near term for a low cost. These types of crosswalks have minimal impact on vehicle operations. Existing crosswalk types along Mannakee Street vary from standard to ladder style. Additionally, pedestrian crossing signage improves pedestrian safety and visibility, as shown in **Figure 42**.

Figure 41 Types of Crosswalk Striping



Source: BikeWalkKC

Figure 42 Pedestrian Crossing Signage

© Texas A&M Transportation Institute.

Source: Federal Highway Administration

Bike Box

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase, as shown in **Figure 43**. Bike boxes increase the visibility of bicyclists and groups bicyclists together to clear the intersection quickly, which allow bicyclists to feel safer and more comfortable. Bike boxes can be installed where bicyclists and right-turning motorists conflict, and where a bicycle lane does not continue across an intersection.

Bike boxes are primarily installed at signalized intersections, with a minimum of 10 feet depth from the stop bar. Bike boxes are not intended to facilitate bicycle left turns (a two-stage turn queue box is the preferred method of accommodating left turns). There should be a minimum of 50 feet of bicycle lane prior to the bicycle box, so that bicyclists do not have to weave between queueing motor vehicles to access it.

Bike boxes can be installed in the near term for a low cost. Bike boxes have minimal impact on vehicle operations.

Figure 43 Bike Box

Source: Montgomery County, MDOT

ALTERNATIVES

This section outlines three preliminary design alternatives that focus on advancing complete street design principles along Mannakee Street, as well as intersection recommendations for the two signalized intersections along Mannakee Street. This section discusses corridor-wide treatments and spot treatments that were outlined and discussed in previous sections. Additionally, this section discusses opportunities for quick build implementation and includes an alternatives evaluation that summarizes the anticipated traffic impacts, costs, and implementation timeline for each design alternative. **Table 12** summarizes the three corridor alternatives by segment along Mannakee Street. While the three options differ mostly in regards to the proposed bicycle facility, all three options include traffic calming measures throughout Mannakee Street.

Table 12 Corridor Recommendations for Mannakee Street

Segment	Option 1: Traffic Calming	Option 2: Bicycle Corridor Improvements	Option 3: Multimodal Redesign
Segment 1 **MD 28 to Anderson Avenue**	Travel lanes with shared lane markings	Northbound: 5' bike lane Southbound: Shared lane marking	5.5' bike lanes
Segment 2 **Anderson Avenue to Henderson Circle**			Northbound: 5' bike lane Southbound: Shared lane marking
Segment 3 **Henderson Circle**		5' bike lanes with 3' buffers	5' bike lanes with 3' buffers
Segment 4 **Henderson Circle to Bradford Drive**		Northbound: 5' bike lane with 2' buffer Southbound: Shared lane marking	
Henderson Circle to Welsh Park Drive			5' bike lanes with 2' buffers
Welsh Park Drive to Martins Lane			Northbound: 12' shared use path Southbound: 5' bike lane and 2' buffer
Martins Lane to Bradford Drive			5' bike lanes with 2' buffers
Segment 5 **Bradford Drive to Montgomery College Parking Lot**		5' bike lanes with 2' buffers	5' bike lanes with 2' buffers

Option 1: Traffic Calming

Option 1 focuses on corridor-wide traffic calming to create a less stressful environment for people biking to share the road with people driving. This alternative can be implemented within the existing right of way and requires minimal construction. Option 1 maintains existing lane striping/configuration along the corridor and has minimal parking impacts. **Figure 44** depicts the corridor alternative and highlights additional intersection treatments that advance traffic calming, including:

- Painted curb extension at the northeast corner of Mannakee Street and MD 28
- High visibility crosswalks throughout the corridor
- Gateway treatment with pedestrian refuge island on the north leg of Mannakee Street and Henderson Circle
- Raised crosswalk on the south leg of Carr Avenue
- Painted curb extensions and daylighting at Lynch Street
- Painted curb extensions and daylighting at Wilson Avenue
- Painted curb extensions and daylighting at Smallwood Avenue

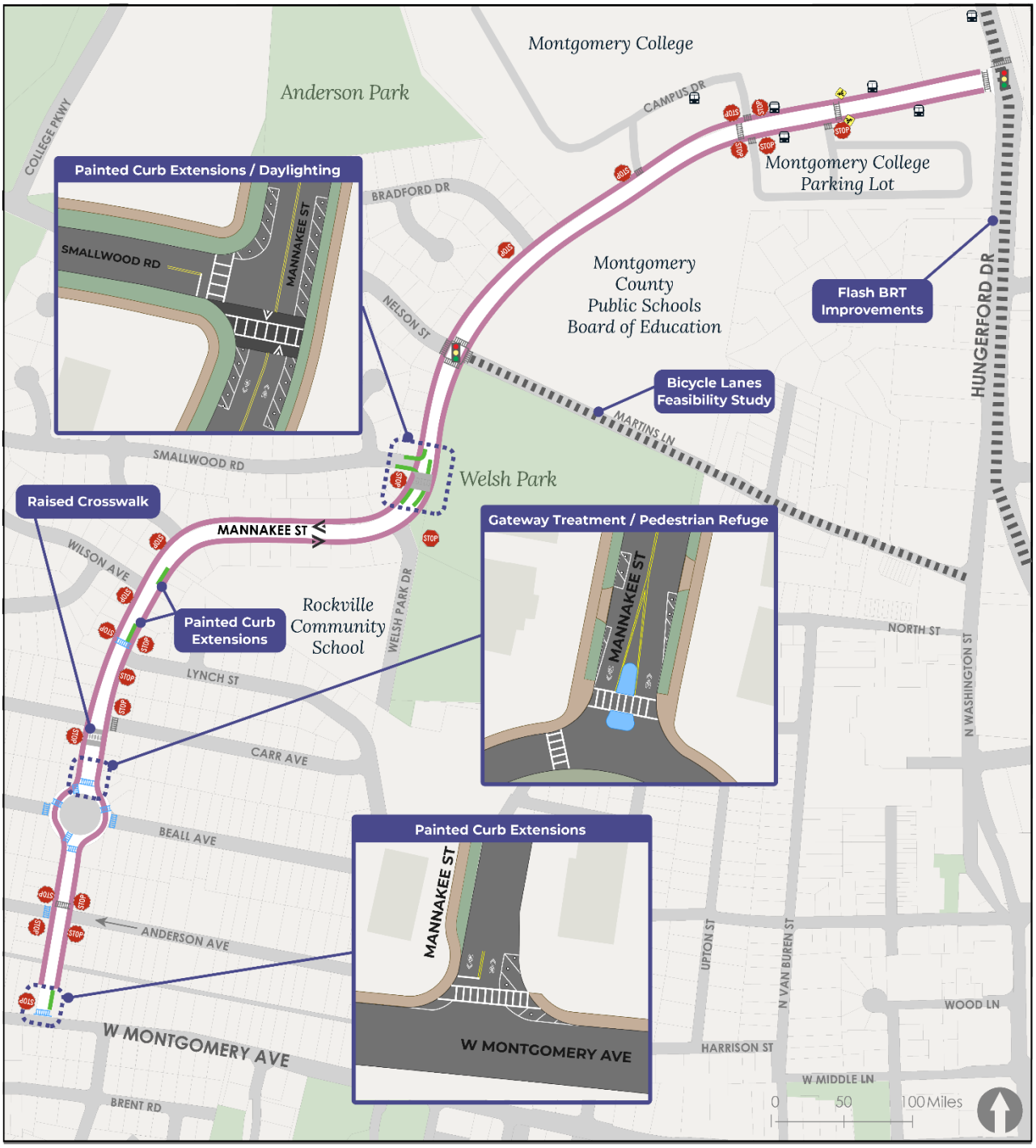
There are existing "No Parking" signs posted at the intersection of Mannakee Street and Smallwood Avenue. However, during peak activity at nearby Welsh Park, drivers fail to comply with parking regulations and block the existing crosswalk, limiting pedestrian visibility. **Figure 45** shows the proposed daylighting treatment at Smallwood Road that will help to enforce existing parking restrictions.

Additionally, **Figure 46** shows the proposed gateway treatment on the north leg of Mannakee Street and Henderson Circle. The treatment proposes adding a gateway with a pedestrian refuge island as a traffic calming treatment. This gateway treatment will also serve to prevent vehicles from parking near the intersection and will improve pedestrian visibility. The gateway treatment would have minor impacts on parking, with a loss of four existing parking spaces.

Figure 47 shows the proposed intersection design at Mannakee Street and MD 28, including a painted curb extension on the northeast leg of the intersection. This painted curb extension will improve pedestrian crossing visibility and help to slow vehicles as they turn on to Mannakee Street from MD 28. This treatment will have no impact on existing parking.

Figure 48 through **Figure 52** illustrate the typical cross sections for this alternative.

Figure 44 Option 1 Traffic Calming Treatments



Option 1: Traffic Calming Treatments
Mannakee Street
Complete Streets Feasibility Study

KITTELSON & ASSOCIATES

Figure 45 Daylighting and Painted Curb Extensions at Smallwood Road

Figure 46 Gateway Treatment at Henderson Circle

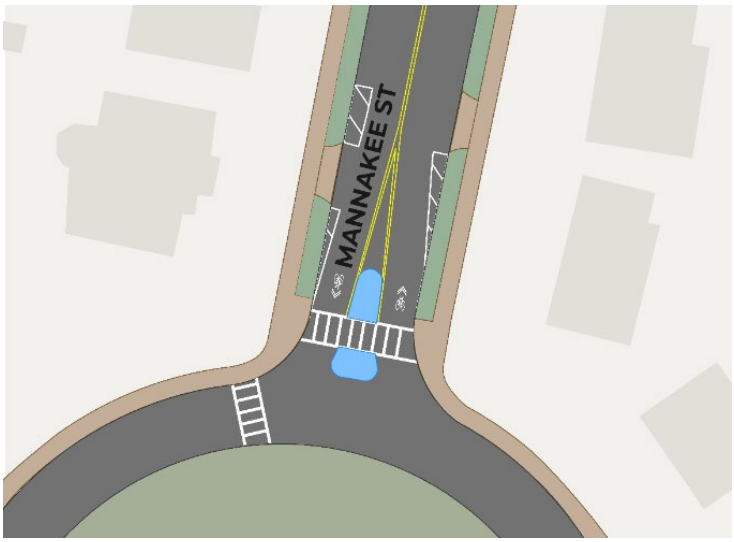
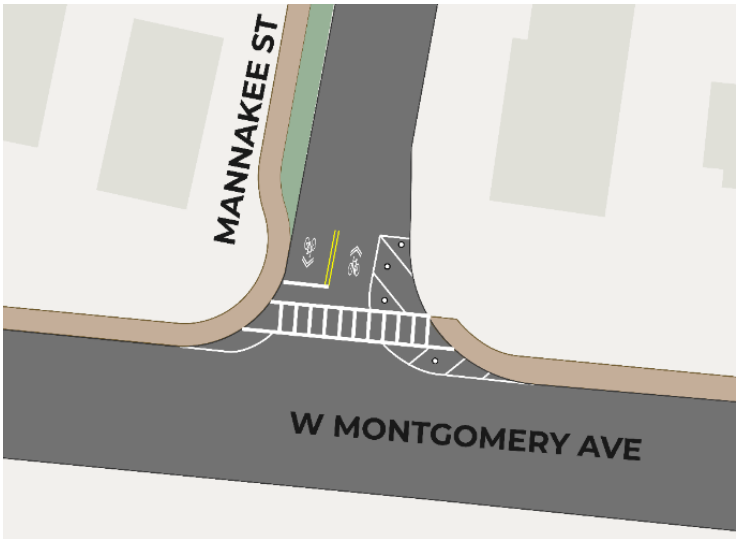


Figure 47 Painted Curb Extension at W Montgomery Avenue



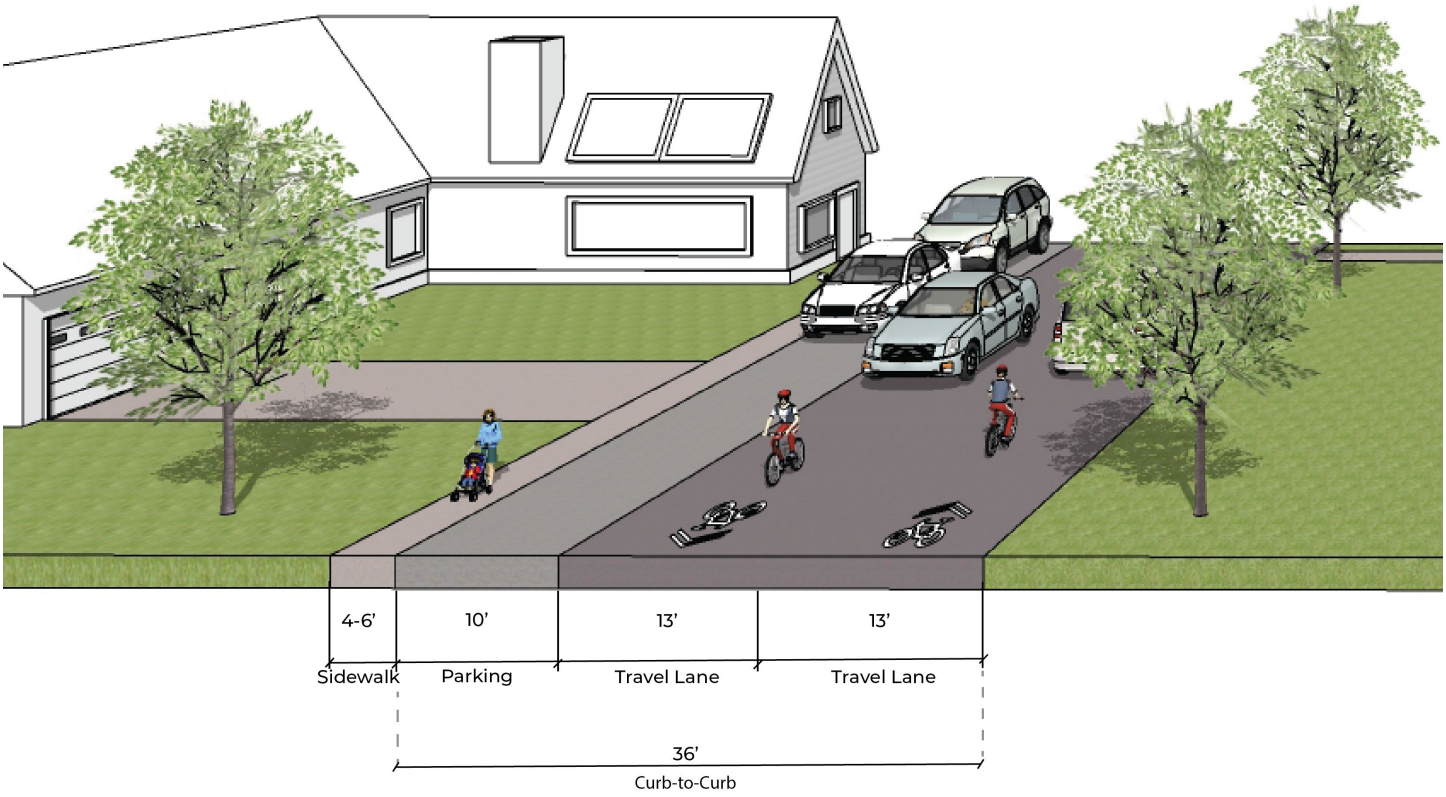


Figure 48. Option 1 | Segment 1: MD 28 to Anderson Avenue (facing north)

Kittelson and Associates, Inc.

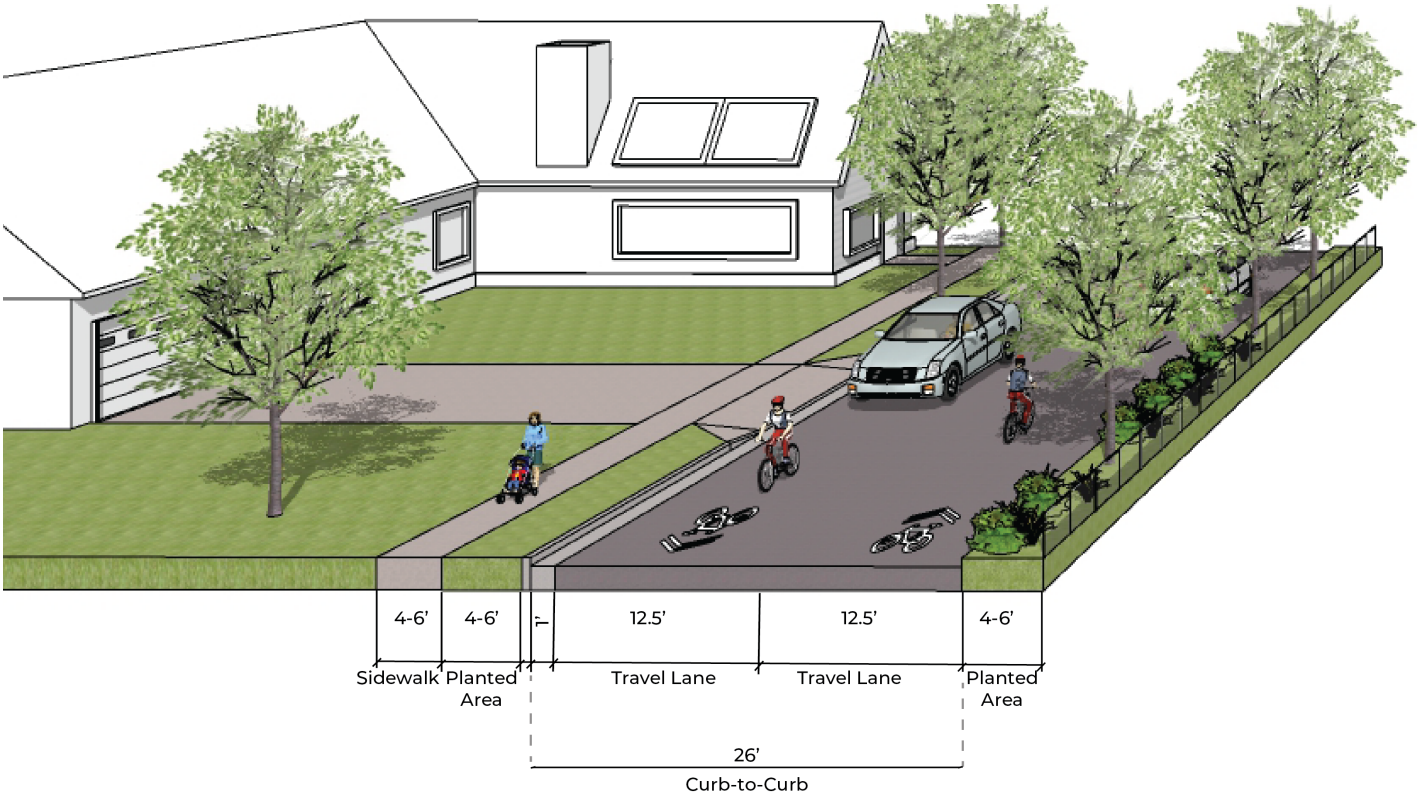


Figure 49. Option 1 | Segment 2: Anderson Avenue to Henderson Circle (facing north)

Kittelson and Associates, Inc.

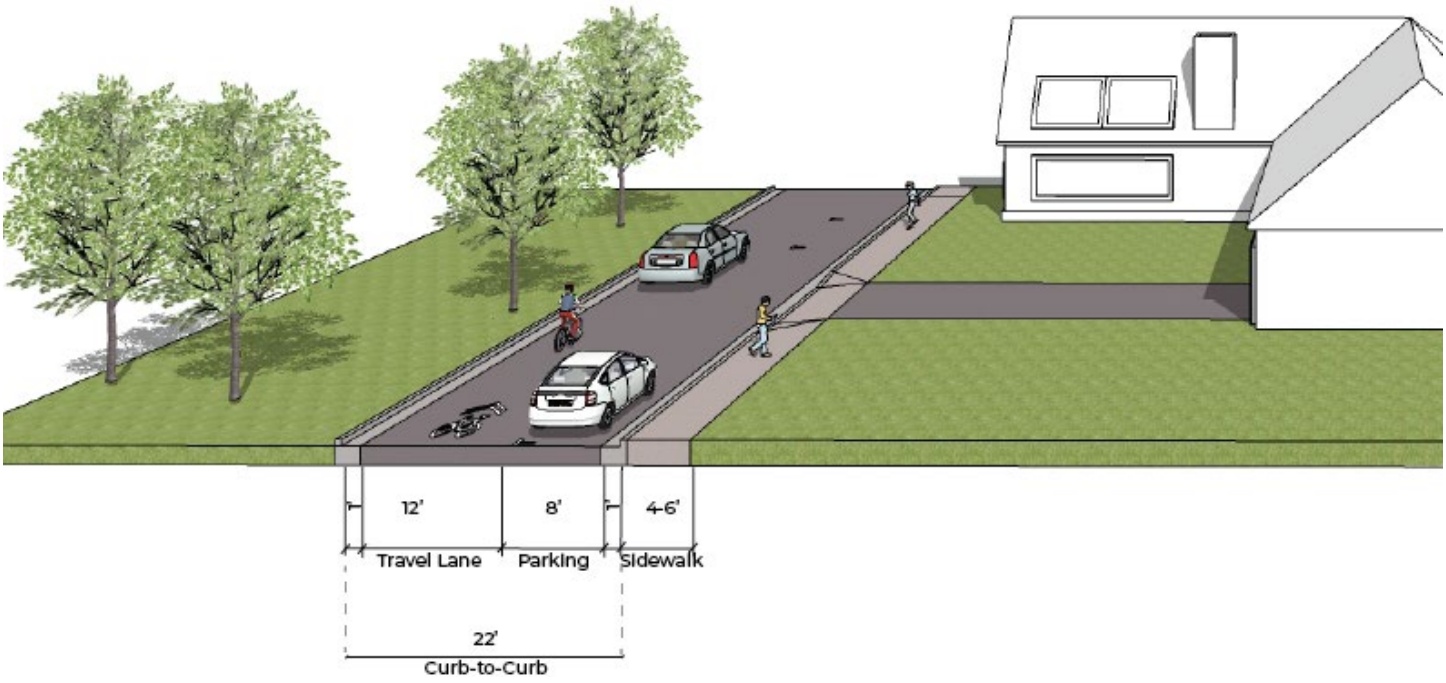


Figure 50. Option 1 | Segment 3: Henderson Circle

Kittelson and Associates, Inc.

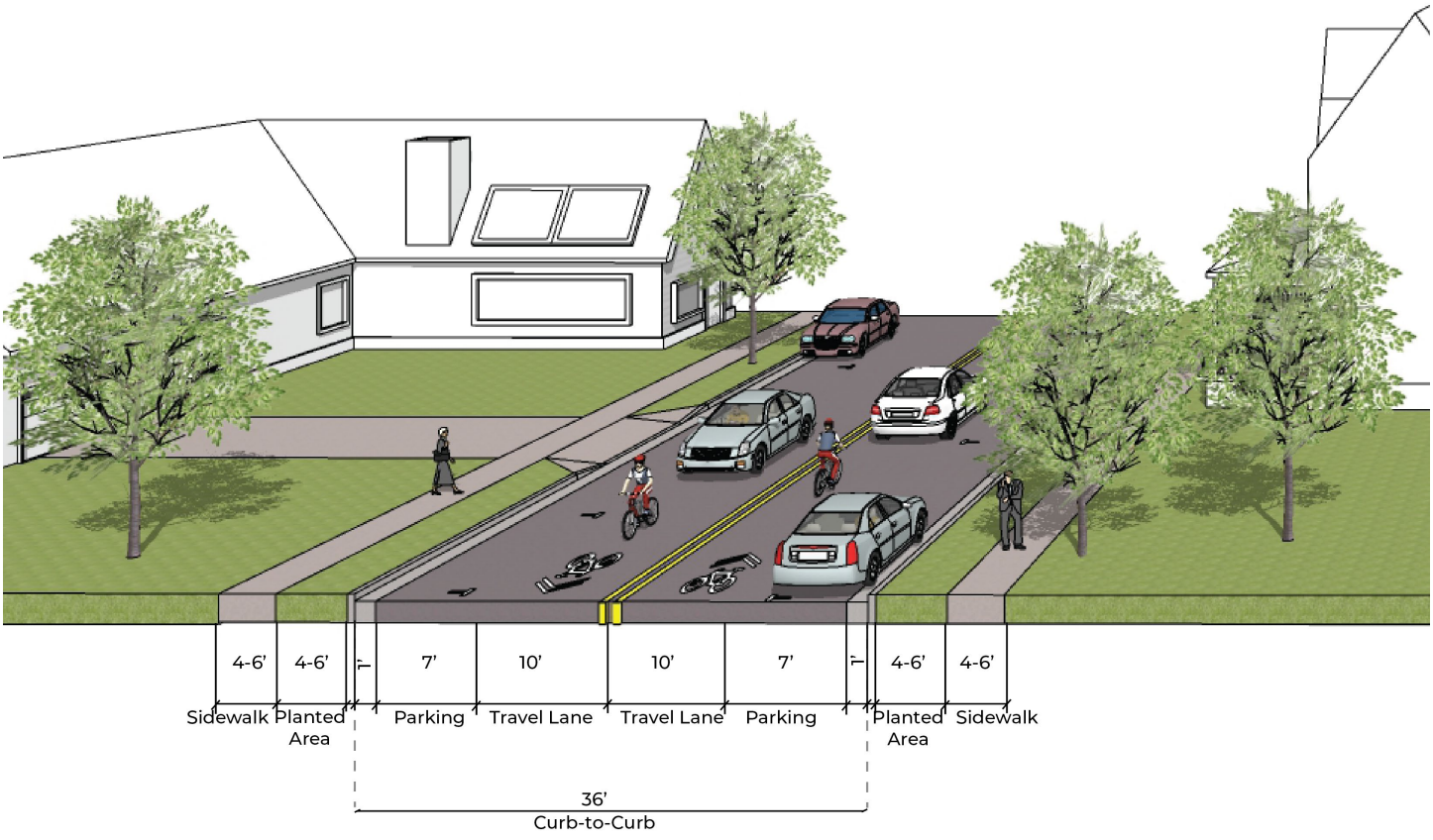


Figure 51. Option 1 | Segment 4: Henderson Circle to Bradford Drive (facing north)

Kittelson and Associates, Inc.

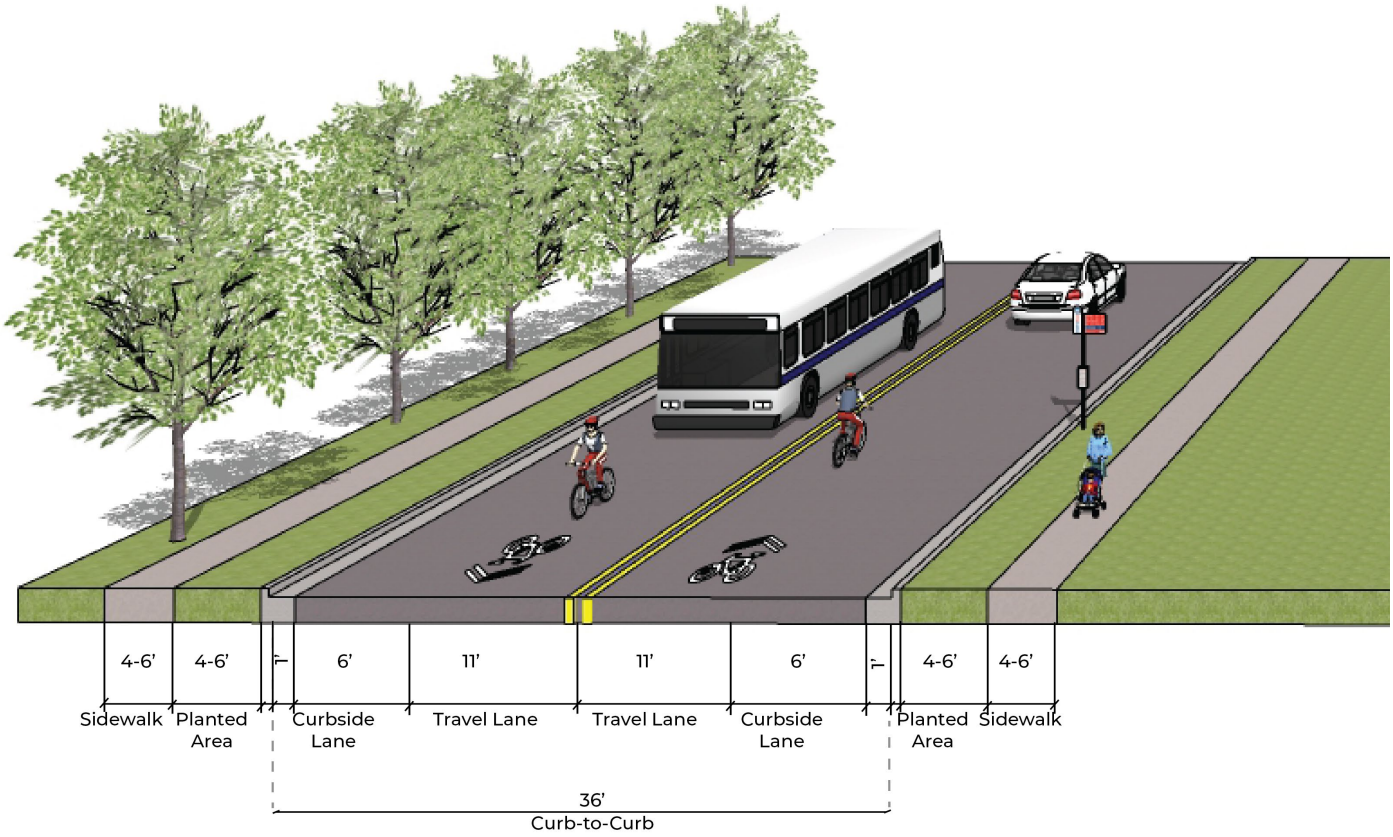


Figure 52. Option 1 | Segment 5: Bradford Drive to Montgomery College Parking Lot (facing north)

Kittelson and Associates, Inc.

Option 2: Bicycle Corridor Improvements

Option 2 focuses on improving bicycle facilities along the corridor while minimizing parking impacts. Traffic calming measures from Option 1 may be added to this alternative for additional benefits. Option 2 proposes a mix of bicycle facility treatments, including protected bike lanes, buffered bike lanes, standard bike lanes, and shared lanes. The type of bicycle facility proposed depends on the available right of way and the presence of on-street parking.

Table 13 summarizes the multimodal improvements and parking impacts for Option 2 and **Figure 53** depicts the alternative. In addition to the bicycle corridor improvements, this alternative proposes intersection treatments at Martins Lane/Nelson Street to improve bicycle safety and visibility and connect with plans for bicycle facilities on Martins Lane. Additionally, this alternative proposes a painted curb extension on the southeast corner of Mannakee Street and Martins Lane to prevent vehicles from parking too closely to the intersection and improving visibility for people walking and biking.

Figure 54 through **Figure 58** illustrate the typical cross sections for this alternative.

Table 13 Option 2: Bicycle Corridor Improvements Summary

Segment	Multimodal Improvements	Parking Impacts
MD 28 to Anderson Avenue	Northbound: 5' bike lane Southbound: Shared lane marking	No parking changes
Anderson Avenue to Henderson Circle	Northbound: 5' bike lane Southbound: Shared lane marking	
Henderson Circle	5' bike lanes with 3' buffers	Remove on-street parking
Henderson Circle to Bradford Drive	Northbound: 5' bike lane with 2' buffer Southbound: Shared lane marking	East side: Maintain parking West side: Remove parking
Bradford Drive to Montgomery College Parking Lot	5' bike lanes to 2' buffers	Remove parking

Figure 53 Option 2 Bicycle Corridor Improvements

Option 2: Bicycle Corridor Improvements
Mannakee Street
Complete Streets Feasibility Study

KITTELSON & ASSOCIATES

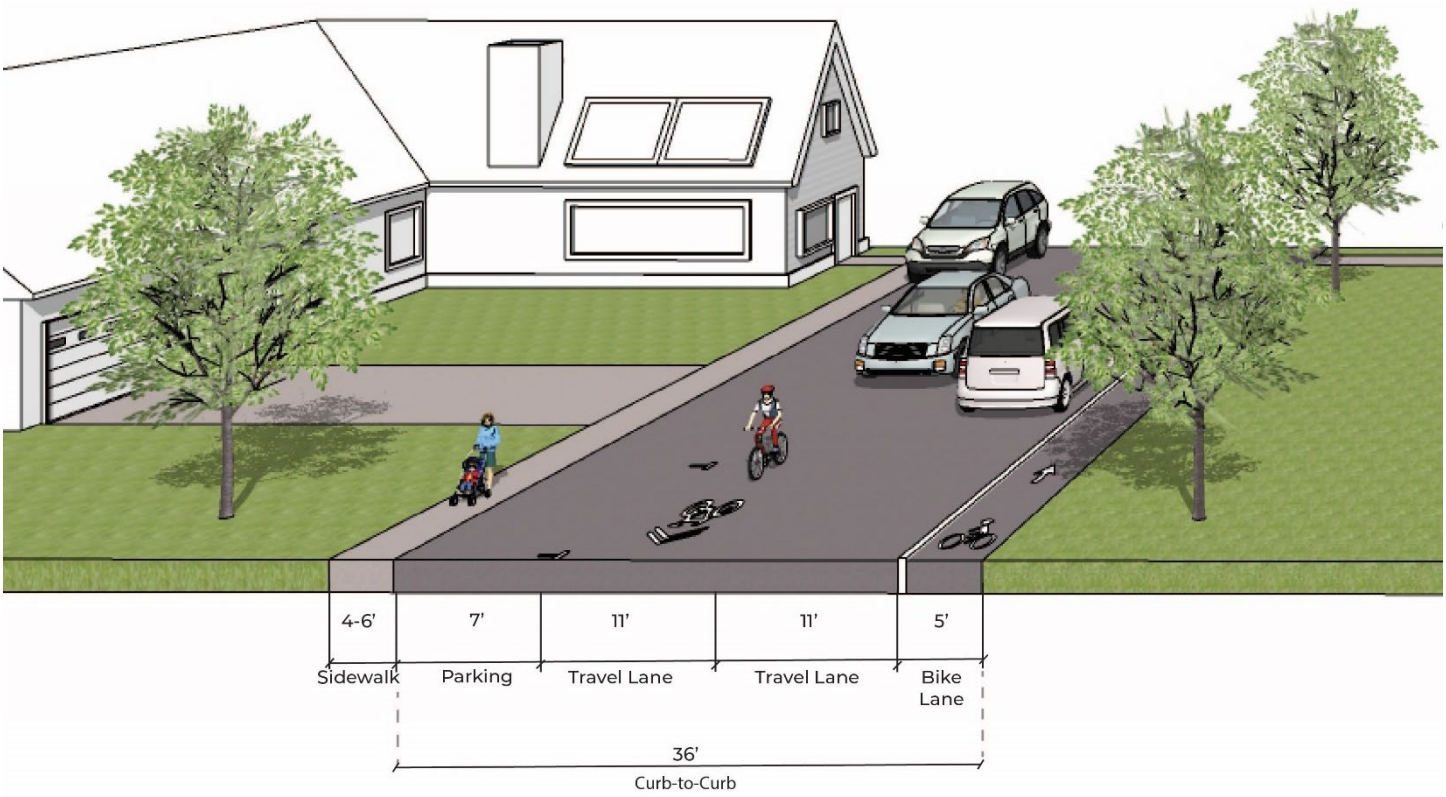


Figure 54. Option 2 | Segment 1: MD 28 to Anderson Avenue (facing north)

Kittelson and Associates, Inc.

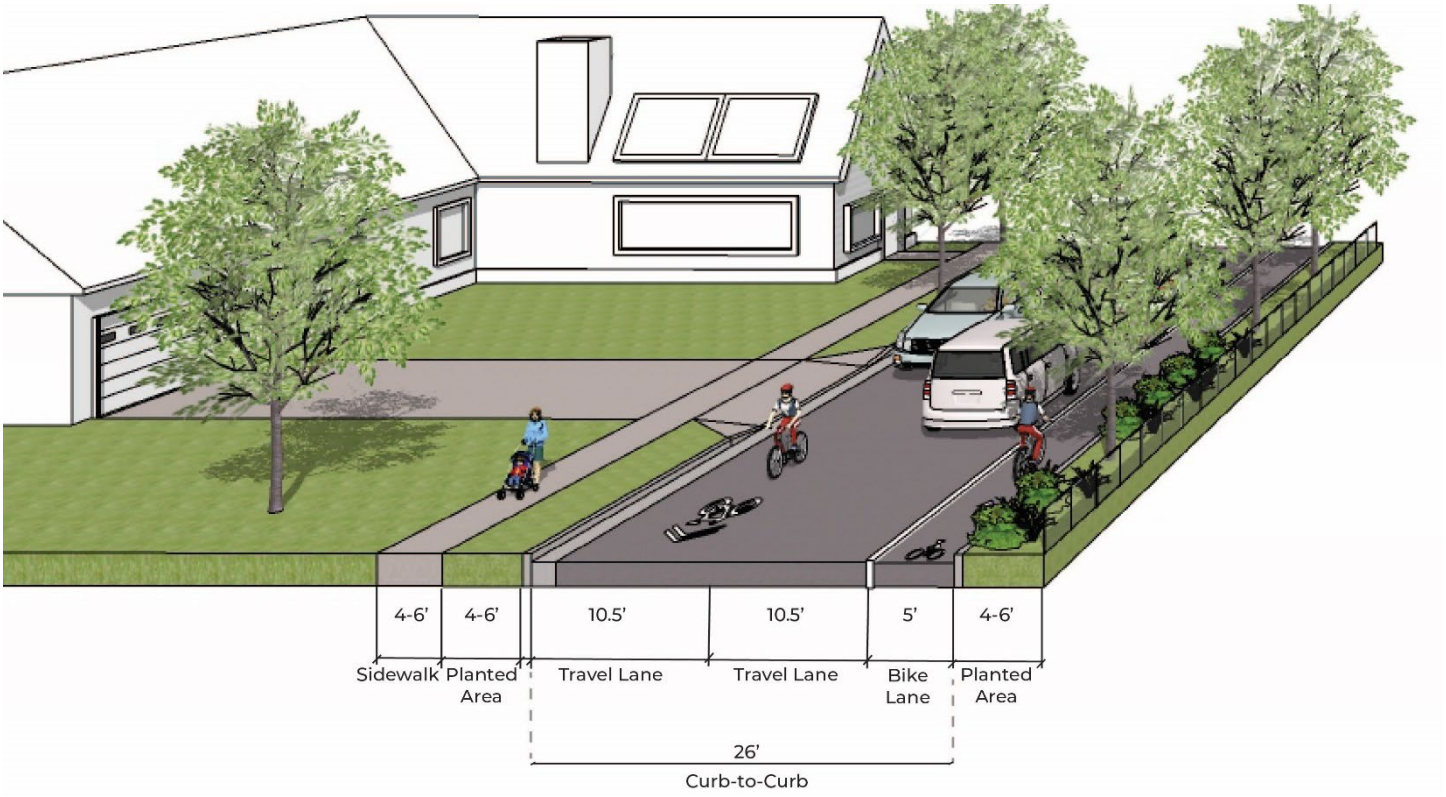


Figure 55. Option 2 | Segment 2: Anderson Avenue to Henderson Circle (facing north)

Kittelson and Associates, Inc.

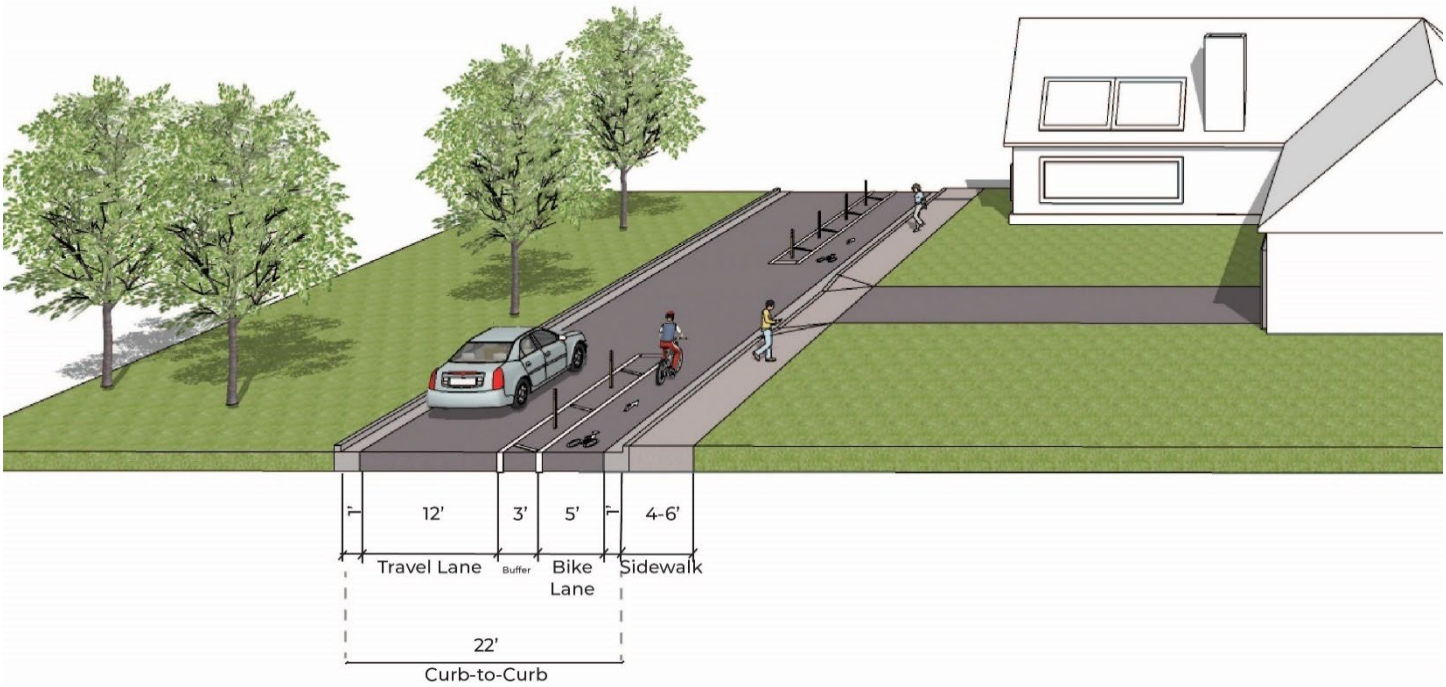


Figure 56. Option 2 | Segment 3: Henderson Circle

Kittelson and Associates, Inc.

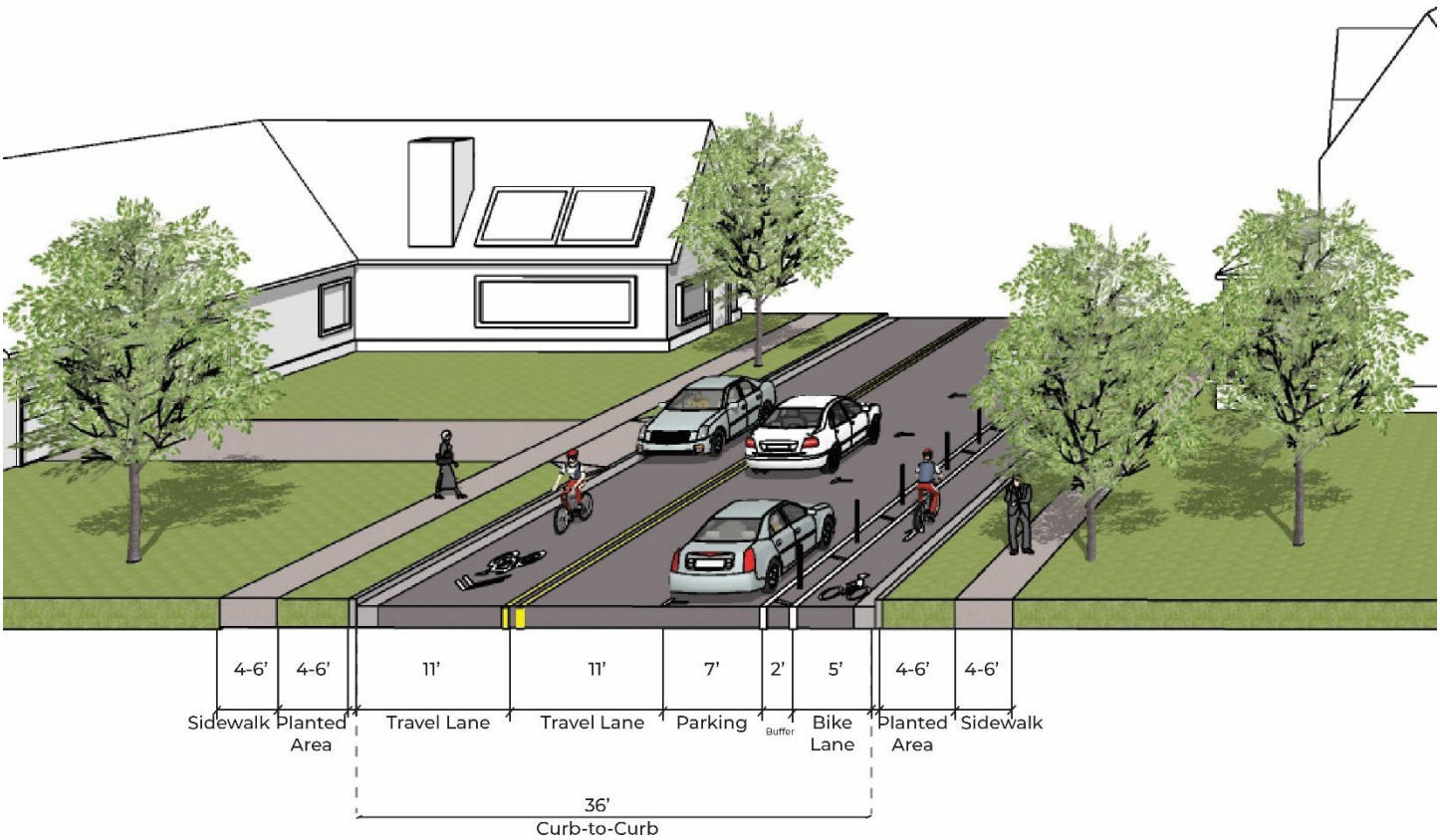


Figure 57. Option 2 | Segment 4: Henderson Circle to Bradford Drive (facing north)

Kittelson and Associates, Inc.

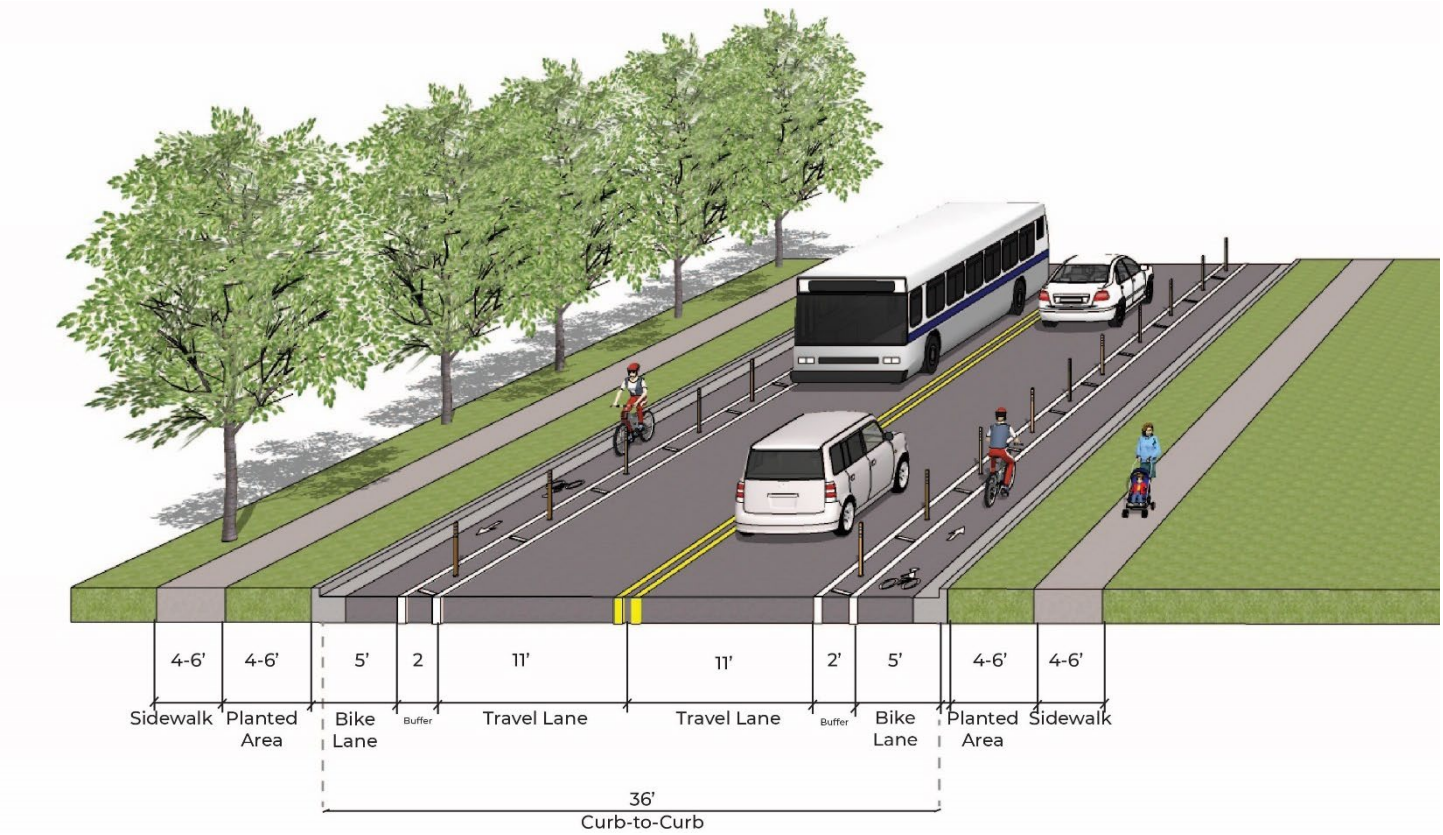


Figure 58. Option 2 | Segment 5: Bradford Drive to Montgomery College Parking Lot (facing north)

Kittelson and Associates, Inc.

Option 3: Multimodal Redesign

Option 3 proposes a multimodal redesign of Mannakee Street, including bicycle facilities along the corridor and a shared use path along segments of the corridor. This alternative has moderate parking impacts. Option 3 proposes a mix of bicycle facility treatments, including protected bike lanes, buffered bike lanes, standard bike lanes, and shared lanes. The type of bicycle facility proposed depends on the available right of way and the presence of on-street parking. Additionally, Option 3 proposes adding a missing sidewalk connection on the east side of Mannakee Street from W Montgomery Avenue to Henderson Circle. Traffic calming improvements from Option 1 may also be implemented with Option 3.

Table 14 summarizes the multimodal improvements and parking impacts for Option 3 and **Figure 59** depicts the alternative. In addition to the bicycle corridor improvements, this alternative proposes intersection treatments at Martins Lane/Nelson Street to improve bicycle safety and visibility and connect with plans for bicycle facilities on Martins Lane. Additionally, this alternative proposes a painted curb extension on the southeast corner of Mannakee Street and Martins Lane to prevent vehicles from parking too close to the intersection and improving visibility for people walking and biking.

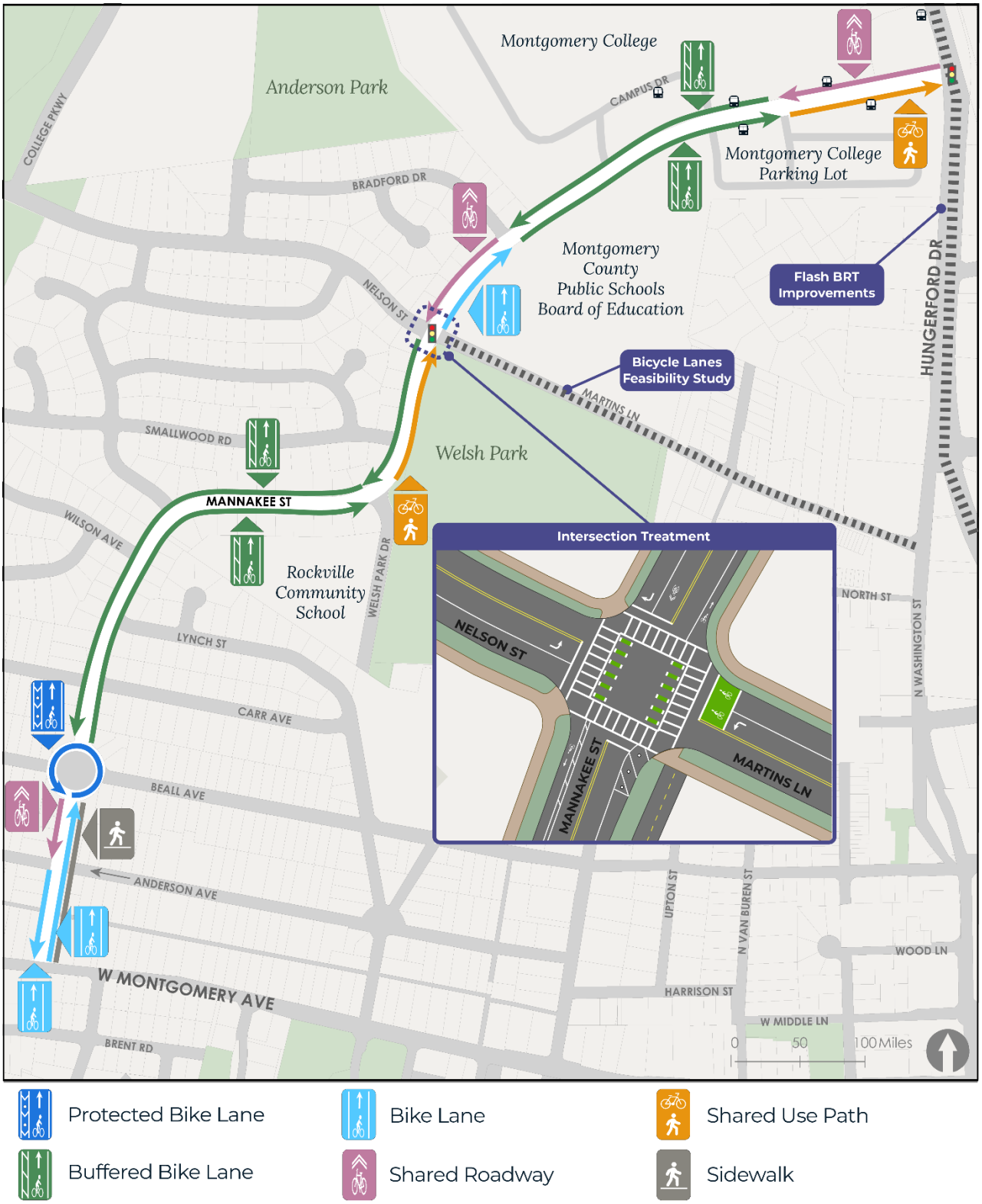
This alternative proposes a shared use path along Mannakee Street from Welsh Park Drive to Martins Lane and from the Montgomery College Parking lot to Hungerford Drive.

Figure 60 through **Figure 66** illustrate the typical cross sections for this alternative.

Table 14 Option 3: Multimodal Redesign Summary

Segment	Multimodal Improvements	Parking Impacts
MD 28 to Anderson Avenue	5.5' bike lanes	Remove parking
Anderson Avenue to Henderson Circle	Northbound: 5' bike lane Southbound: Shared lane	No parking changes
Henderson Circle	5' bike lanes with 3' buffers	Remove on-street parking
Henderson Circle to Bradford Drive		
Henderson Circle to Welsh Park Drive	5' bike lanes with 2' buffers	Remove parking
Welsh Park Drive to Martins Lane	Northbound: 12' shared use path Southbound: 5' bike lane and 2' buffer	East side: Maintain parking West side: Remove parking
Martins Lane to Bradford Drive	5' bike lanes with 2' buffers	Remove parking
Bradford Drive to Montgomery College Parking Lot	5' bike lanes with 2' buffers	Remove parking

Figure 59 Option 3 Multimodal Redesign



KITTELSON & ASSOCIATES

Option 3: Multimodal Redesign
Mannakee Street
Complete Streets Feasibility Study

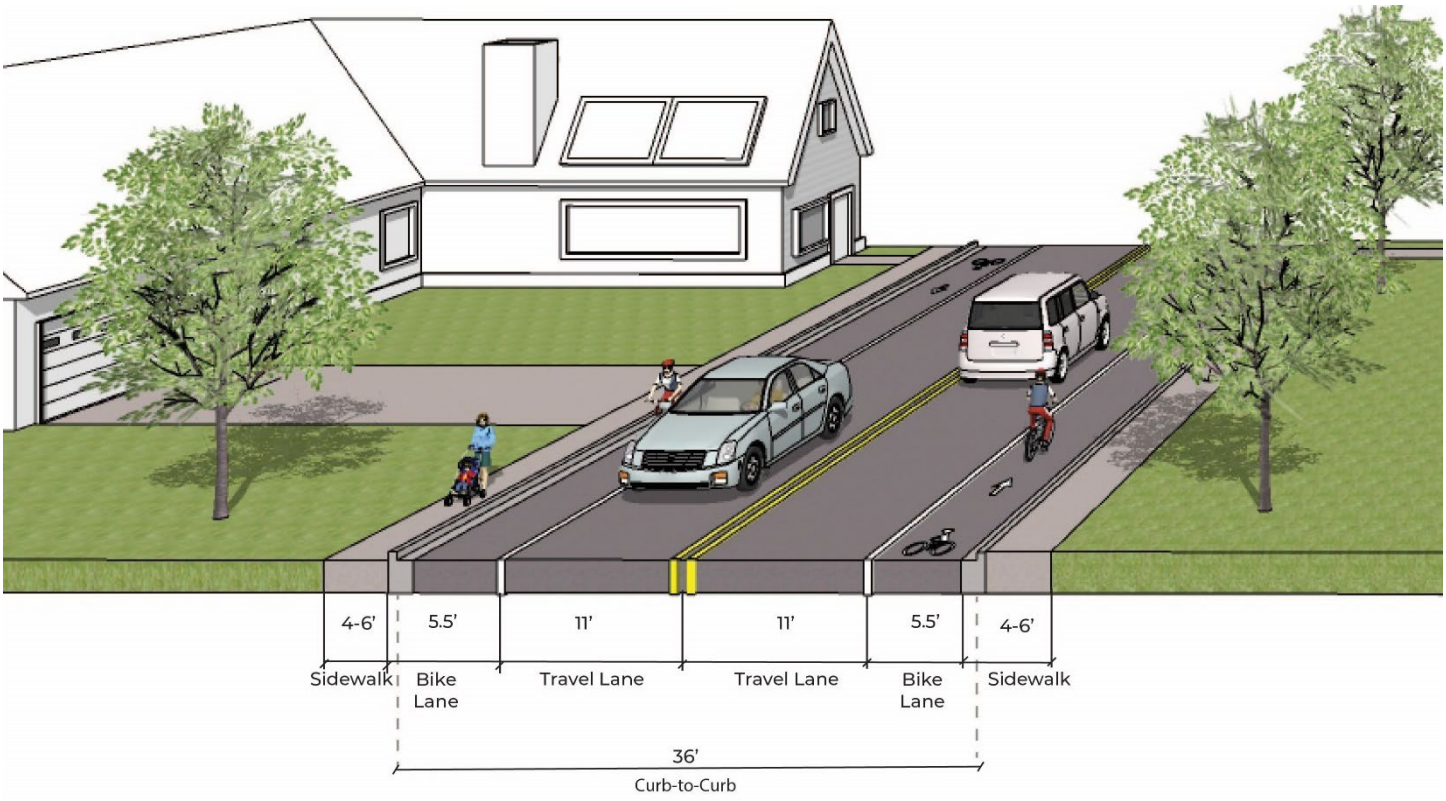


Figure 60. Option 3 | Segment 1: MD 28 to Anderson Avenue (facing north)

Kittelson and Associates, Inc.

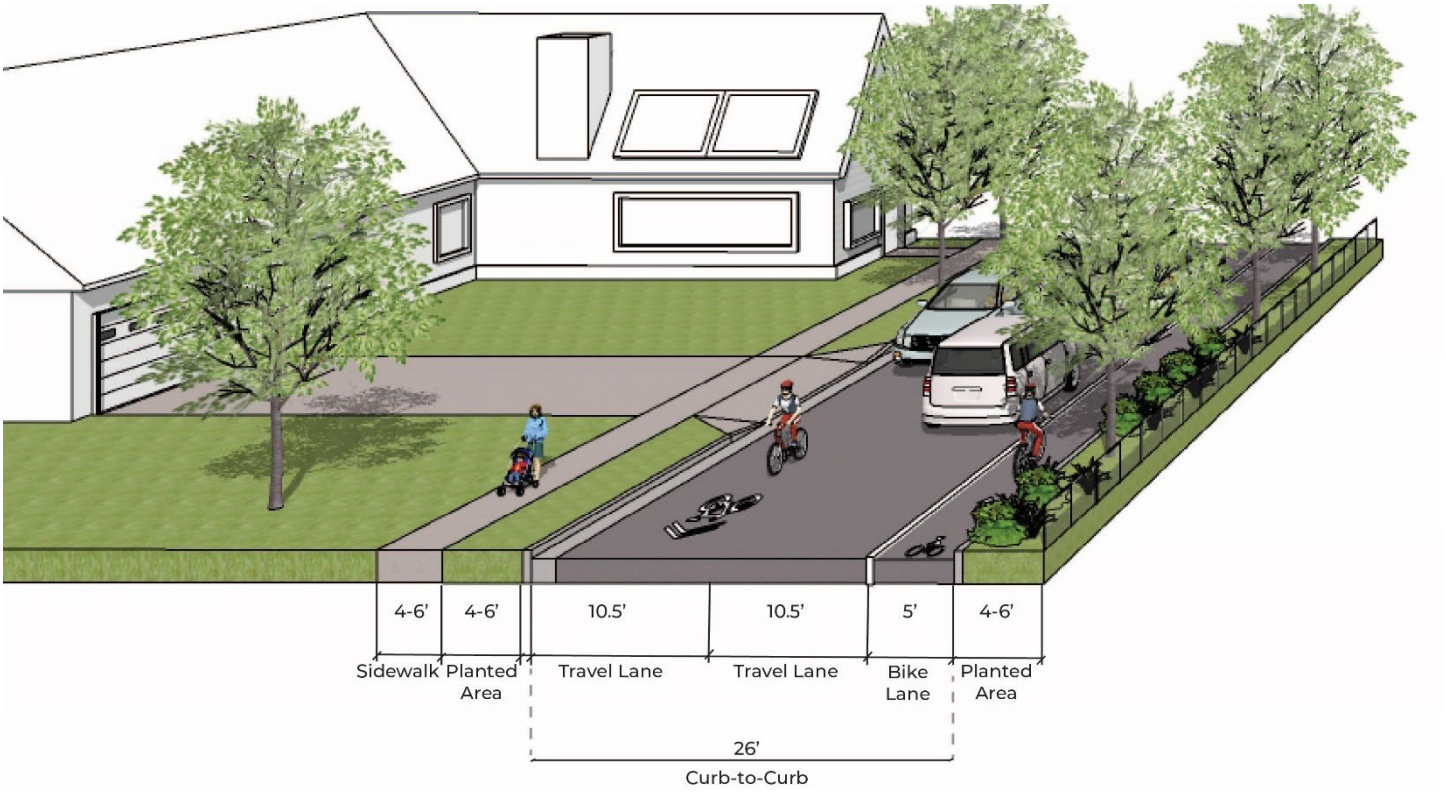


Figure 61. Option 3 | Segment 2: Anderson Avenue to Henderson Circle (facing north)

Kittelson and Associates, Inc.

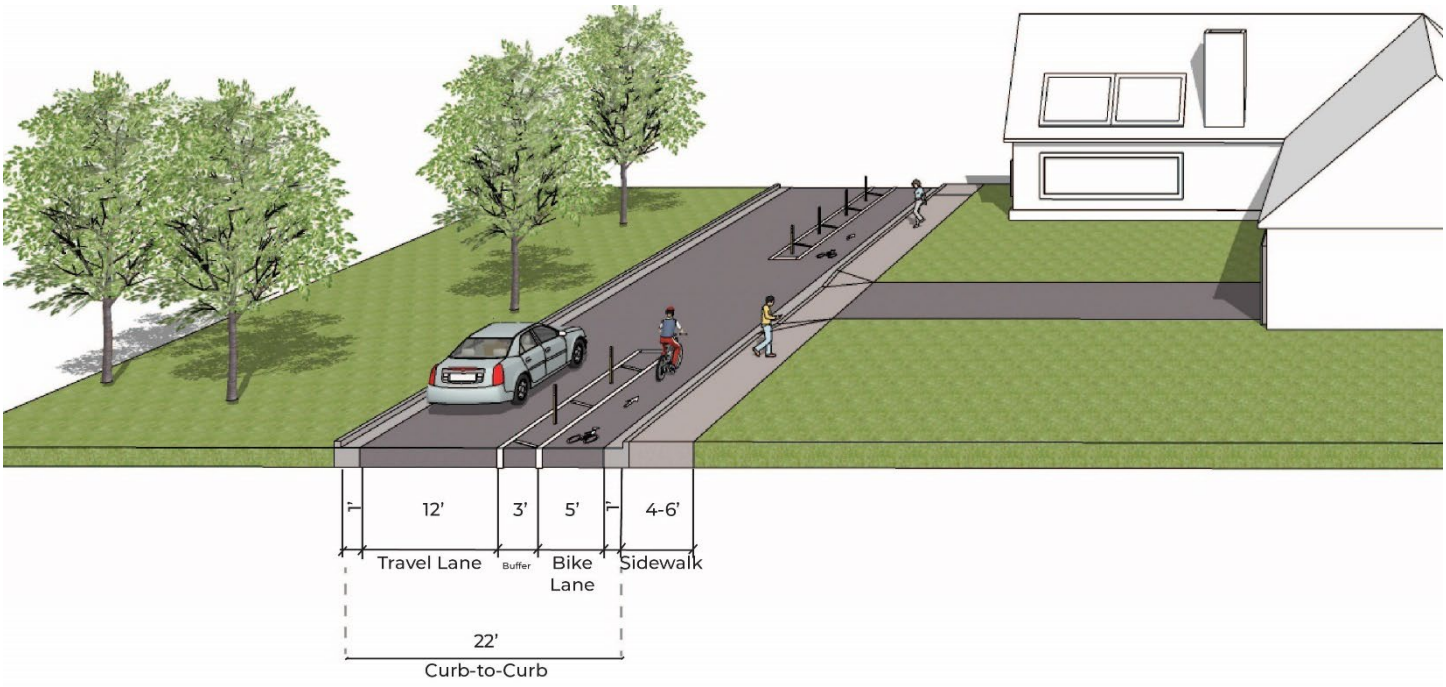


Figure 62. Option 3 | Segment 3: Henderson Circle

Kittelson and Associates, Inc.

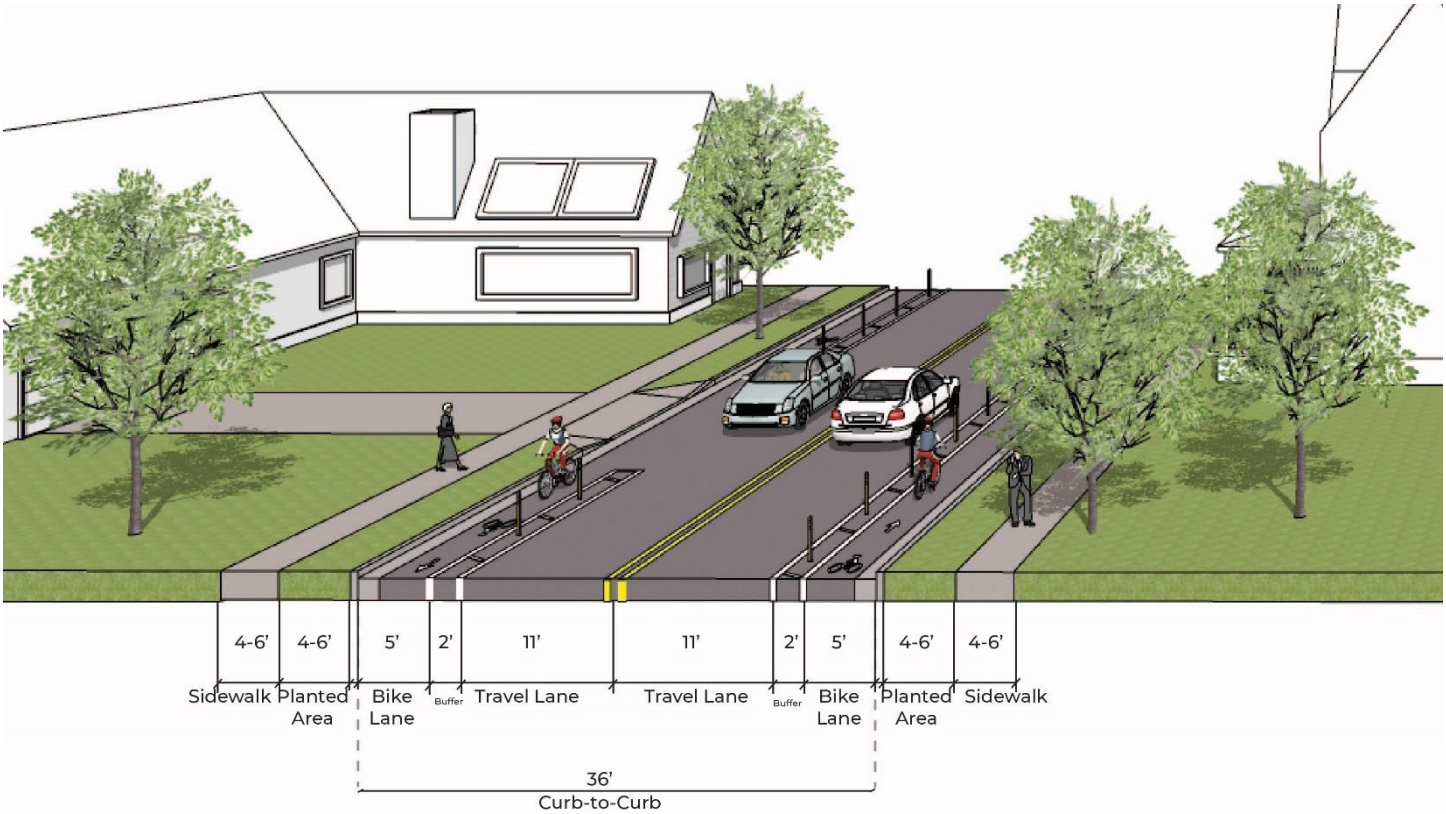


Figure 63. Option 3 | Segment 4: Henderson Circle to Welsh Park Drive (facing north)

Kittelson and Associates, Inc.

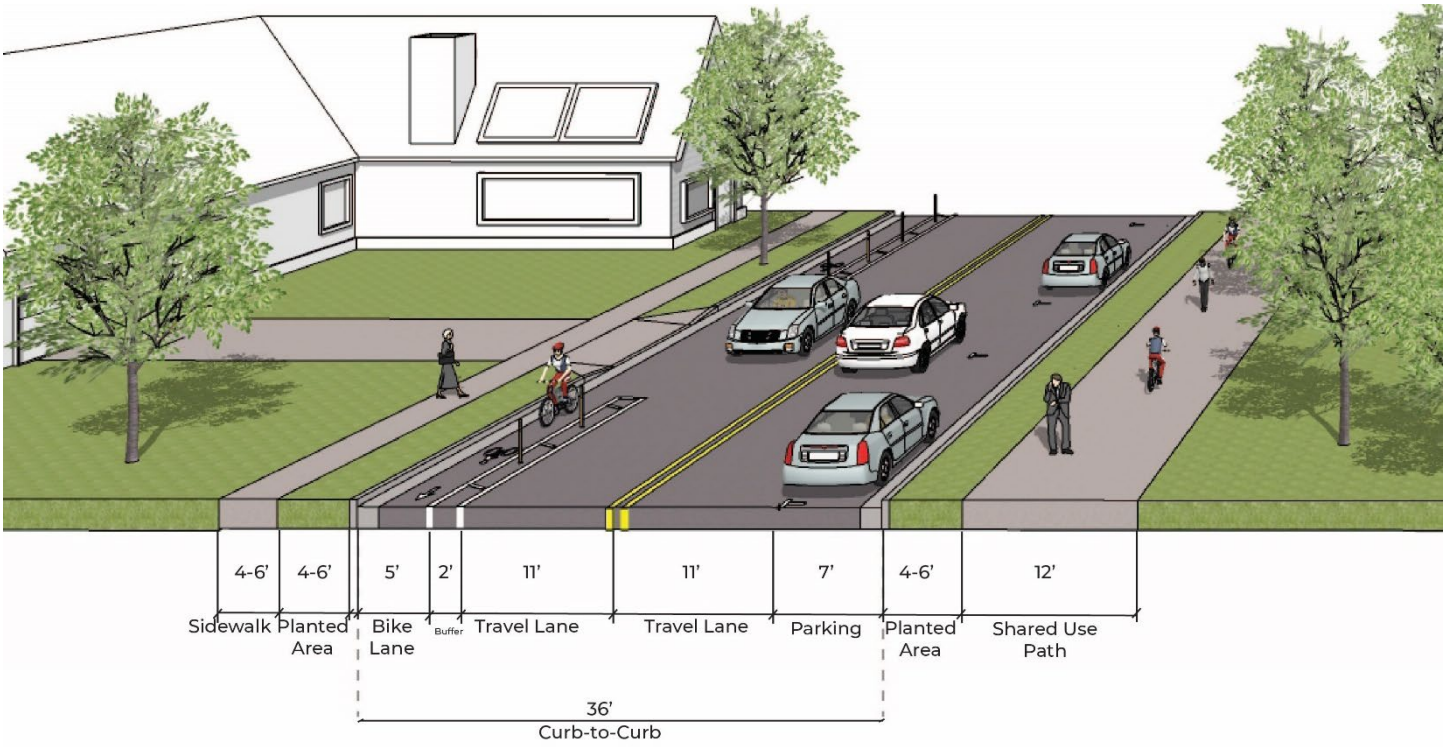


Figure 64. Option 3 | Segment 4: Welsh Park Drive to Martins Lane (facing north)

Kittelson and Associates, Inc.

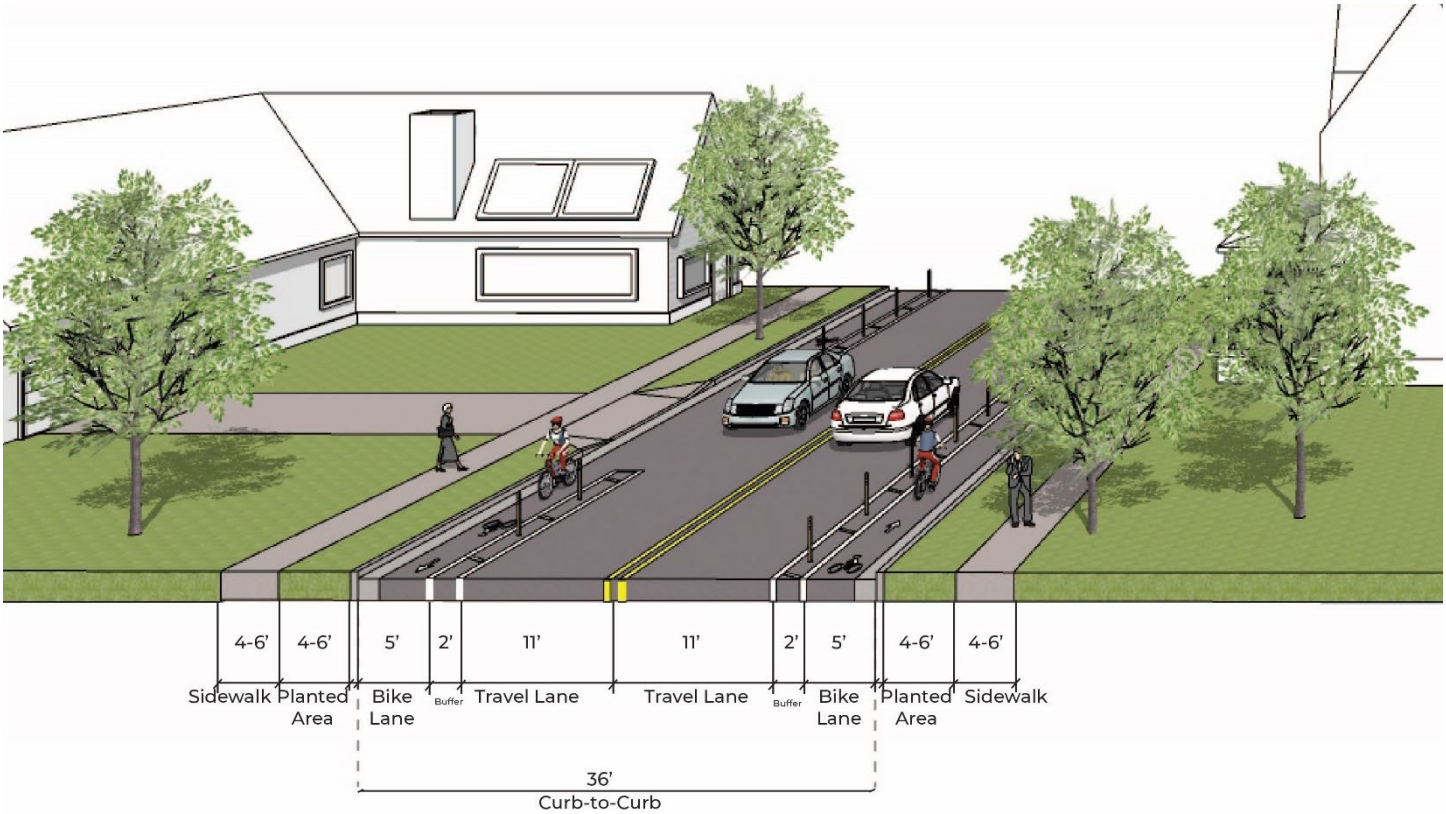


Figure 65. Option 3 | Segment 4: Martins Lane to Bradford Drive (facing north)

Kittelson and Associates, Inc.

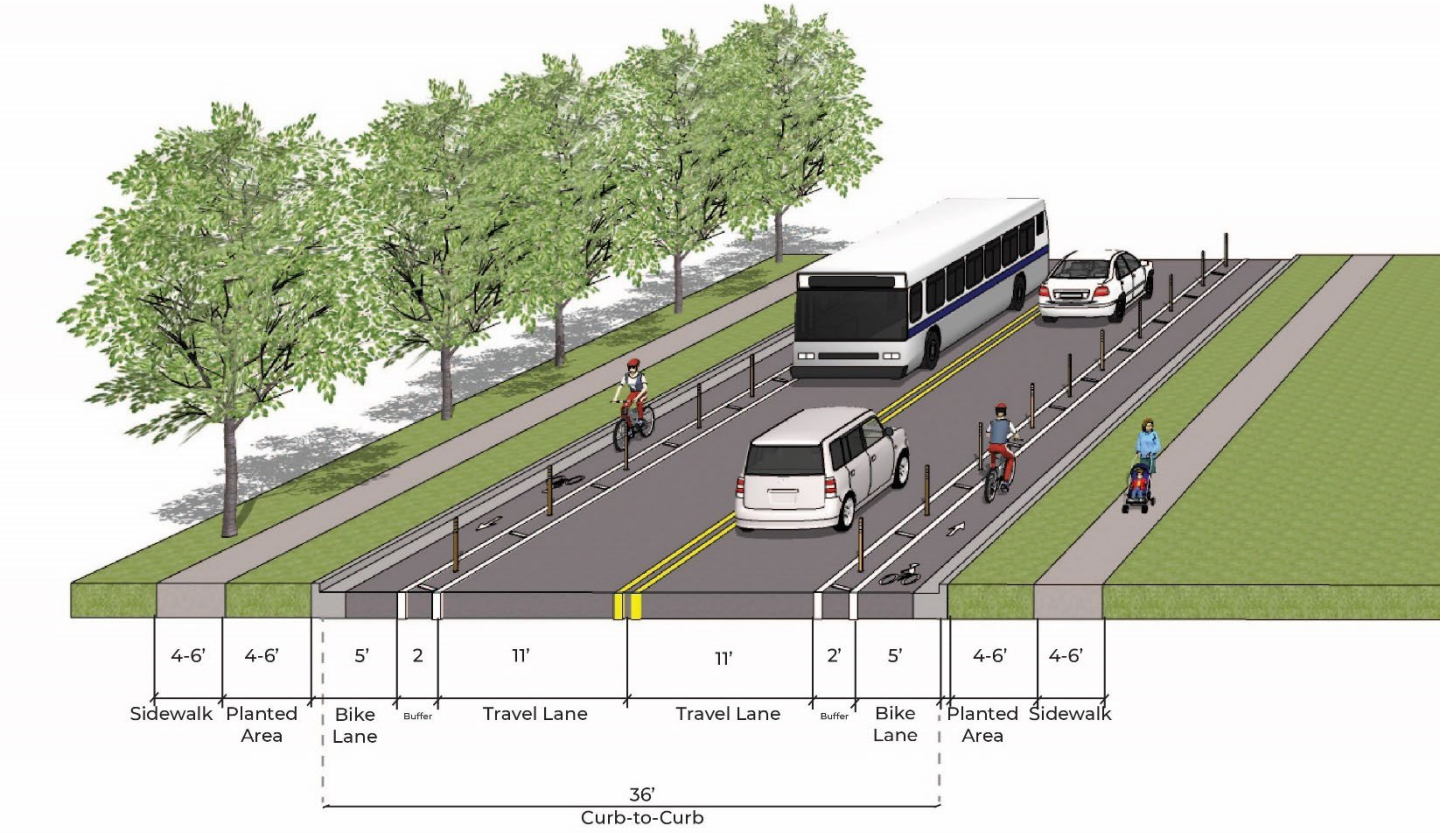


Figure 66. Option 3 | Segment 5: Bradford Drive to Montgomery College Parking Lot (facing north)

Kittelson and Associates, Inc.

Intersection Recommendations

Mannakee Street has two signalized intersections, including Hungerford Drive on the north end of the corridor and Martins Lane/Nelson Street located midway along the corridor. This section outlines the recommendations for each signalized intersection, based on a review of existing conditions, crash history, intersection geometry, and coordination with ongoing plans. Additionally, the team reviewed Mannakee Street and Carr Avenue to identify safety recommendations and improvement opportunities.

MANNAKEE STREET/HUNGERFORD DRIVE (MD 355)

The following section outlines improvements for the signalized intersection at Hungerford Drive (MD 355) and Mannakee Street. This intersection is owned by MDOT and maintained by MCDOT. Recommendations from this report will be shared with MDOT SHA for review. The following recommendations build on MCDOT's MD 355 Flash Bus Rapid Transit (BRT) plans:

- Implement Leading Pedestrian Interval (LPI).
- Optimize signal timing.
- Implement No Right-turn on Red at the eastbound right turn of Mannakee Street and the southbound right turn of MD 355.

In addition to improving traffic operations, these countermeasures are anticipated to enhance multimodal intersection safety as summarized below:

/ Signal timing optimization & Leading Pedestrian Intervals can:

- Help reduce the likelihood of intersection crashes by improving the coordination of traffic movements and reducing conflicts between vehicles and pedestrians.

- Improve pedestrian and cyclist accommodations: Signal optimization, which includes features such as leading pedestrian intervals, improves safety and convenience for non-motorized road users.
- Increased compliance with traffic signals: LPIs encourages greater adherence to traffic signals by providing pedestrians with a clear indication of when it is safe to cross, reducing the likelihood of jaywalking or risky pedestrian behavior.

/ Prohibit right-turn on red can:

- Enhance pedestrian safety by reducing conflicts between pedestrians and turning vehicles.
- Decrease the likelihood of collisions, particularly those involving pedestrians and cyclists.
- Enhance driver and pedestrian awareness and compliance with traffic signals.
- Create a safer environment for vulnerable road users, such as children, elderly individuals, and individuals with disabilities.

MANNAKEE STREET/NELSON ST/MARTINS LANE

The proposed improvements for the signalized intersection at Mannakee Street and Nelson Street/Martins Lane include the following:

/ Implement No right-turn on red restrictions at the northbound right-turn lane of Mannakee Street to accommodate a bike box.
/ Signal timing optimization and Leading Pedestrian Intervals.

Similar to MD 355 at Mannakee Street intersection, the safety benefits associated with these improvements are anticipated to create a safer environment for all roadway users, improve pedestrian and cyclists' accommodation, reduce conflicts between pedestrians and vehicles and reduce crash severity.

MANNAKEE STREET/CARR AVENUE

In order to improve the safety performance of the two-way stop controlled (TWSC) Mannakee Street and Carr Avenue, an evaluation was conducted to determine if the intersection qualifies for conversion to an All-Way Stop Controlled (AWSC) intersection. AWSC intersections can increase safety and comfort for all roadway users, reduce crash severity, and improve mutual visibility among pedestrians, bicyclists, and drivers as it regulates traffic flow and clarifies right of way. Stop signs should only be used to control and regulate traffic movement at an intersection; stop signs should not be used for traffic calming.

The team assessed the AWSC warrant analysis based on guidelines outlined by the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Control Devices (MUTCD). These guidelines dictate that warrant analyses must consider vehicle hourly volumes, crash history, pedestrian and bicycle volumes, and vehicular speeds.

The AWSC warrant analysis for the intersection of Mannakee Street and Carr Avenue did **not meet** the necessary criteria. Below is a detailed discussion of the specific warrant analysis conducted:

Warrant Analysis Criteria:

For an AWSC to be justified, the following four criteria should be met.

1/ Where traffic control signals are justified, the AWSC is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.
   a. **Criterion 1 is not met.** Since Mannakee Street and Carr Avenue intersection has low traffic volume, traffic signal will not be warranted.
2/ Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.
   a. **Criterion 2 is not met.** No crashes were reported for the five-year study period (2018 – 2023).
3/ (A). The vehicular volume entering the intersection from the major street approach averages at least 300 vehicles per hour for any 8 hours of an average day.
   a. **Condition A is met**. As per **Table 15**, the vehicular volume entering the intersection from Mannakee Street (both approaches) is greater than 300 vehicles per hour for 9 hours of the day, which is sufficient to meet this condition.

4/ (B). The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour.
   a. **Condition B is not met.** As per **Table 15**, the vehicular, pedestrian and bicycle volumes entering the intersection from the minor street Carr Avenue (both approaches) is not greater than 200 vehicles per hour for any hour of the day.

5/ Minimum volumes: **Table 15** presents the three peak periods hourly volumes combined for the major street (both approaches) and vehicular, pedestrian, and bicycle volume combined for minor street (both approaches).

Table 15: Major and Minor Street Volume – Multiway Stop-Control Evaluation

Intersection Name:	Mannakee Street and Carr Avenue		
	Mannakee Street (Major Street)	Carr Avenue (Minor Street)	**Warrant Satisfied?**
Required Volume Threshold	**300**	**200**	
7:00 - 8:00 AM	149	30	**No**
8:00 - 9:00 AM	327	47	**No**
9:00 - 10:00 AM	1114	82	**No**
10:00 - 11:00 AM	389	29	**No**
11:00 - 12:00 PM	164	12	**No**
12:00 - 1:00 PM	205	15	**No**
1:00 - 2:00 PM	351	26	**No**
2:00 - 3:00 PM	461	34	**No**
3:00 - 4:00 PM	453	33	**No**
4:00 - 5:00 PM	329	27	**No**
5:00 - 6:00 PM	349	32	**No**
6:00 – 7:00 PM	383	28	**No**

6/ (C). If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.
   a. **Condition 3C is not met.** The approach speed on the major street (Mannakee Street) is 25 mph. Since all Conditions A, B and C are required to be met, **Criterion 3 is not met**.

7/ Where no single criterion is satisfied, but where Criteria 2, 3.A, and 3.B are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition. For this condition to meet, the combined major street volume must be 240 vehicles or higher for any eight hours of the day and the combined minor street volume must be 160 vehicles for the same eight hours.
   a. **Criterion** 4 **is not met**, since the minor street volume does not meet the 80 percent threshold of 160 vehicles for any hour.

The all-way stop-controlled warrant evaluation indicates that **none of the four criteria was met** to install stop control on all approaches of Mannakee Street and Carr Avenue intersection.

ALTERNATIVES EVALUATION

This section compares and evaluates the three alternatives to quantify the impacts on multimodal safety, comfort for all transportation modes, and ability to create protected, comfortable, and low-stress multimodal facilities. The following section evaluates each alternative at a high level to determine:

- Pedestrian Safety and comfort
- Bicycle Safety and comfort
- Implementation timeline
- Travel impacts
- Cost

Safety

This section discusses the safety benefits associated with the proposed improvements along Mannakee Street. One safety measure considers Crash Modification Factors (CMFs). A CMF is used to compute the expected number of crashes after implementing a countermeasure on a road or intersection. The CMFs Clearinghouse is a FHWA-maintained website that provides a searchable database of CMFs, along with guidance and resources on using CMFs in road safety practice. The clearinghouse was used to identify any applicable CMFs for the different proposed options.

Table 16 presents the crash modification factors associated with the different improvements proposed along Mannakee Street. As shown, installing a dedicated bike lane is expected to reduce crashes by 49 percent. Additionally, installing a high visibility crosswalk would reduce crashes by 40 percent and the installation of raised pedestrian crosswalk would reduce crashes by 36 percent.

Table 16 Proposed Crash Modification Factor

Proposed Improvement	CMF	Crash Type	Safety Benefits
Install a bike lane	0.51	All	It is expected to reduce crashes by 49%
Install high-visibility crosswalk	0.6	All	It is expected to reduce crashes by 40%
Install raised pedestrian crosswalk	0.64	All	It is expected to reduce crashes by 36%

PEDESTRIAN SAFETY

Pedestrian safety refers primarily to reduced crash risk for pedestrians. Every traveler is a pedestrian at some point in their journey, whether walking to or from a parking lot or to or from a bus stop. Pedestrians are vulnerable roadway users that should be accommodated safely. Each of the recommended strategies outlined in the following sections are evaluated based on how well they improve pedestrian safety. Each strategy is ranked based on the following pedestrian safety levels:

- **High:** Strategy is anticipated to result in **high** pedestrian safety, including reduced crash risk and safer conditions for people walking.
- **Medium:** Strategy is anticipated to result in **medium** pedestrian safety, including moderately reduced crash risk and moderately safer conditions for people walking.
- **Low:** Strategy is anticipated to result in **low** pedestrian safety, including limited to no reduction in crash risk and little to no improved conditions for people walking.

PEDESTRIAN COMFORT

Pedestrian comfort measures the comfort and stress that pedestrians experience, based on several factors, including average daily traffic, sidewalk conditions, pedestrian-oriented amenities (i.e., shade, benches, etc.), and degree of separation between sidewalks and the road. Improving pedestrian facilities will ensure pedestrians can travel comfortably throughout the study intersections and surrounding area, further encouraging users to walk throughout the area. Each of the recommended strategies outlined in the following sections are evaluated based on how well they improve pedestrian comfort. Each strategy is ranked based on the following pedestrian comfort levels:

- **High:** Strategy is anticipated to result in **high** pedestrian comfort, including improved conditions for people walking.
- **Medium:** Strategy is anticipated to result in **medium** pedestrian comfort, including moderately improved conditions for people walking.
- **Low:** Strategy is anticipated to result in **low** pedestrian comfort, including limited to no improvement in conditions for people walking.

BICYCLE SAFETY

Bicycle safety refers primarily to reduced crash risk for bicyclists. Bicyclists are vulnerable roadway users that should be accommodated safely. Each of the recommended strategies outlined in the following sections are evaluated based on how well they improve bicycle safety. Each strategy is ranked based on the following bicycle safety levels:

- **High:** Strategy is anticipated to result in **high** bicyclist safety, including reduced crash risk and safer conditions for people biking.
- **Medium:** Strategy is anticipated to result in **medium** bicyclist safety, including moderately reduced crash risk and moderately safer conditions for people biking.
- **Low:** Strategy is anticipated to result in **low** bicyclist safety, including limited to no reduction in crash risk and little to no improved conditions for people biking.

BICYCLE COMFORT

Bicycle comfort measures the comfort and stress experienced by bicyclists, based on several factors, including average daily traffic, type of bicycle facilities, vehicle speeds, bicyclist-oriented amenities (bike racks, bike lanes, bike boxes, crossing treatments), and degree of separation from vehicles. Improving bicyclist facilities will ensure bicyclists can travel comfortably throughout the study intersections and surrounding area. Each of the recommended strategies outlined in the following sections is evaluated based on how well they improve bicycle comfort. Each strategy is ranked based on the following bicycle comfort levels:

- **High:** Strategy is anticipated to result in **high** bicyclist comfort, including improved conditions for people biking.
- **Medium:** Strategy is anticipated to result in **medium** bicyclist comfort, including moderately improved conditions for people biking.
- **Low:** Strategy is anticipated to result in **low** bicyclist comfort, including limited to no improvement in conditions for

Implementation Timeline

Implementation timeline measures the estimated time required to construct, implement, and/or advance each strategy. The implementation timeline for each strategy is ranked based on the following implementation timelines:

- **Long-Term (3-5 years):** Alternative is anticipated to take considerable amount of time to receive approvals and construct, resulting in a **longer-term** implementation timeline.
- **Mid-Term (1-3 years):** Alternative is anticipated to take a moderate amount of time to receive approvals and construct, resulting in a **mid-term** implementation timeline.
- **Near-Term (less than 1 year):** Alternative is anticipated to take little to no amount of time to receive approvals and construct, resulting in a **near-term** implementation timeline.

Travel Impacts

Travel impacts measure the estimated vehicular impact that results from each alternative. Travel impacts include queueing and travel time delays. The travel impacts for each strategy are ranked based on the following vehicle travel impacts:

- **High:** Alternative is anticipated to result in considerable travel impacts to drivers, resulting in a **high** travel impact.
- **Medium:** Alternative is anticipated to result in moderate travel impacts to drivers, resulting in a **medium** travel impact.
- **Low:** Alternative is anticipated to result in minimal travel impacts to drivers, resulting in a **low** travel impact.

Cost

The final evaluation measure for each strategy is cost. Cost provides a high-level estimate of the required fees associated with implementing or constructing each of the strategies. Each strategy is ranked based on the following costs:

- **High ($$$):** Alternative is anticipated to require more than $1,000,000 to construct, implement, and/or advance.
- **Medium ($$):** Alternative is anticipated to require $500,000 to $1,000,000 to construct, implement, and/or advance.
- **Low ($):** Alternative is anticipated to require less than $500,000 to construct, implement, and/or advance.

Summary of Alternatives Evaluation

Table 17 summarizes the high-level expected impacts for each of the three alternatives. Detailed cost, implementation, and travel impacts will be determined in subsequent project phases.

Table 17 Summary of Alternatives Evaluation

Strategy	Pedestrian Safety	Bicycle Safety	Pedestrian Comfort	Bicycle Comfort	Implementation	Travel Impact	Cost
Option 1: Traffic Calming	Low	Low	Low	Low	Near-term	Low	$
Option 2: Bicycle Corridor Improvements	Medium	Medium	Medium	Medium	Mid-term	Low	$$
Option 3: Multimodal Redesign	High	High	High	High	Long-term	Low	$$$

NEXT STEPS

Based on the existing conditions analysis, alternatives evaluation, and public feedback, the project team recommends a multi-phased approach to advancing Complete Streets designs to Mannakee Street to improve safety and comfort for all users. In the near-term, the project team recommends implementing quickbuild solutions that can be installed in the near-term, including:

/ Reconstructing the existing raised crosswalk at Smallwood Road and adding painted curb extensions and daylighting to improve visibility of pedestrians and bicyclists and prevent vehicles from parking too closely to the intersection;
/ Adding painted curb extensions and flexposts at Mannakee Street and W. Montgomery Avenue to create traffic calming for vehicles turning on to Mannakee Street from W. Montgomery Avenue; and
/ Restriping existing crosswalks to high visibility crosswalks.

As a next step, the team recommends advancing additional traffic calming measures that require construction, including:

/ Adding a gateway treatment on the north leg of Mannakee Street at Henderson Circle and
/ Adding a raised crosswalk at Carr Avenue.

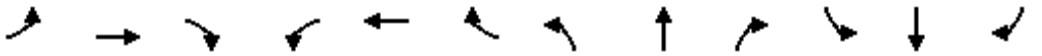
While these improvements can be implemented in the near-term, the City should continue to meet with the community to identify longer term solutions for improving multimodal infrastructure, including bike lanes, shared-use paths, and missing sidewalk connections.

This Study serves as the first step in identifying alternatives for Mannakee Street that advance Complete Street principles and improve multimodal safety, comfort, and connectivity for all users. Following this Study, the City will continue to refine the alternatives and will work with the community to advance a preferred alternative to final design and implementation. The next steps in this Study are summarized below:

- Continue public and stakeholder engagement
- Coordinate with ongoing and adjacent efforts, including:
  - Flash BRT
  - Martins Lane Bicycle Lanes Feasibility Study
- Develop detailed cost estimates
- Secure funding for design and construction

Each of these next steps will advance the findings and recommendations presented in this Study.

APPENDIX A SYNCHRO OUTPUT REPORTS



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	108	31	11	32	12	23	36	10	22	72	2
Future Volume (vph)	2	108	31	11	32	12	23	36	10	22	72	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5	4.5	4.5	4.5			4.5	4.5
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00			1.00	1.00
Frt		0.97			1.00	0.85	1.00	0.97			1.00	0.85
Flt Protected		1.00			0.99	1.00	0.95	1.00			0.99	1.00
Satd. Flow (prot)		1806			1839	1583	1770	1803			1841	1583
Flt Permitted		1.00			0.86	1.00	0.69	1.00			0.95	1.00
Satd. Flow (perm)		1801			1595	1583	1281	1803			1769	1583
Peak-hour factor, PHF	0.66	0.66	0.66	0.72	0.72	0.72	0.69	0.69	0.69	0.88	0.88	0.88
Adj. Flow (vph)	3	164	47	15	44	17	33	52	14	25	82	2
RTOR Reduction (vph)	0	16	0	0	0	14	0	5	0	0	0	1
Lane Group Flow (vph)	0	198	0	0	59	3	33	61	0	0	107	1
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		Prot	NA	Perm
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2					6
Actuated Green, G (s)		11.7			11.7	12.7	45.5	45.5			51.0	51.0
Effective Green, g (s)		11.7			11.7	12.7	45.5	45.5			51.0	51.0
Actuated g/C Ratio		0.16			0.16	0.18	0.63	0.63			0.71	0.71
Clearance Time (s)		4.5			4.5	4.5	4.5	4.5			4.5	4.5
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	2.0
Lane Grp Cap (vph)		293			260	379	812	1144			1259	1125
v/s Ratio Prot						0.00		0.03			c0.00	
v/s Ratio Perm		c0.11			0.04	0.00	0.03				c0.06	0.00
v/c Ratio		0.68			0.23	0.01	0.04	0.05			0.08	0.00
Uniform Delay, d1		28.2			26.1	24.3	4.9	5.0			3.2	3.0
Progression Factor		1.00			1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2		4.8			0.2	0.0	0.1	0.1			0.0	0.0
Delay (s)		33.0			26.2	24.3	5.0	5.0			3.2	3.0
Level of Service		C			C	C	A	A			A	A
Approach Delay (s)		33.0			25.8			5.0			3.2	
Approach LOS		C			C			A			A	

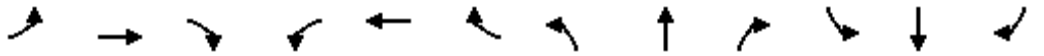
Intersection Summary			
HCM 2000 Control Delay	19.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	71.7	Sum of lost time (s)	13.5
Intersection Capacity Utilization	48.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	51	89	298	752	0	2407	303
Future Volume (vph)	51	89	298	752	0	2407	303
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.5	5.0		5.0	
Lane Util. Factor	1.00	1.00	1.00	0.91		0.91	
Frt	1.00	0.85	1.00	1.00		0.98	
Flt Protected	0.95	1.00	0.95	1.00		1.00	
Satd. Flow (prot)	1770	1583	1770	5085		5000	
Flt Permitted	0.95	1.00	0.05	1.00		1.00	
Satd. Flow (perm)	1770	1583	87	5085		5000	
Peak-hour factor, PHF	0.73	0.73	0.73	0.73	0.93	0.93	0.93
Adj. Flow (vph)	70	122	408	1030	0	2588	326
RTOR Reduction (vph)	0	113	0	0	0	11	0
Lane Group Flow (vph)	70	9	408	1030	0	2903	0
Turn Type	Prot	Perm	pm+pt	NA	Perm	NA	
Protected Phases	4		1	6		2	
Permitted Phases		4	6		2		
Actuated Green, G (s)	11.3	11.3	127.7	127.7		81.2	
Effective Green, g (s)	11.3	11.3	127.7	127.7		81.2	
Actuated g/C Ratio	0.08	0.08	0.85	0.85		0.54	
Clearance Time (s)	6.0	6.0	4.5	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	133	119	545	4329		2706	
v/s Ratio Prot	c0.04		c0.21	0.20		c0.58	
v/s Ratio Perm		0.01	0.43				
v/c Ratio	0.53	0.08	0.75	0.24		1.07	
Uniform Delay, d1	66.8	64.5	44.0	2.1		34.4	
Progression Factor	1.00	1.00	1.00	1.00		1.00	
Incremental Delay, d2	3.7	0.3	5.6	0.1		40.7	
Delay (s)	70.5	64.8	49.6	2.2		75.1	
Level of Service	E	E	D	A		E	
Approach Delay (s)	66.9			15.6		75.1	
Approach LOS	E			B		E	

Intersection Summary			
HCM 2000 Control Delay	55.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	111	118	23	126	76	107	120	28	28	103	13
Future Volume (vph)	8	111	118	23	126	76	107	120	28	28	103	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5			4.5	4.5	4.5	4.5			4.5	4.5
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00			1.00	1.00
Frt		0.93			1.00	0.85	1.00	0.97			1.00	0.85
Flt Protected		1.00			0.99	1.00	0.95	1.00			0.99	1.00
Satd. Flow (prot)		1735			1848	1583	1770	1810			1843	1583
Flt Permitted		0.99			0.82	1.00	0.66	1.00			0.93	1.00
Satd. Flow (perm)		1715			1534	1583	1223	1810			1733	1583
Peak-hour factor, PHF	0.88	0.88	0.88	0.85	0.85	0.85	0.78	0.78	0.78	0.83	0.83	0.83
Adj. Flow (vph)	9	126	134	27	148	89	137	154	36	34	124	16
RTOR Reduction (vph)	0	50	0	0	0	68	0	7	0	0	0	5
Lane Group Flow (vph)	0	219	0	0	175	21	137	183	0	0	158	11
Turn Type	Perm	NA		Perm	NA	pm+ov	Perm	NA		Prot	NA	Perm
Protected Phases		8			4	1		2		1	6	
Permitted Phases	8			4		4	2					6
Actuated Green, G (s)		13.2			13.2	17.1	42.2	42.2			50.6	50.6
Effective Green, g (s)		13.2			13.2	17.1	42.2	42.2			50.6	50.6
Actuated g/C Ratio		0.18			0.18	0.23	0.58	0.58			0.70	0.70
Clearance Time (s)		4.5			4.5	4.5	4.5	4.5			4.5	4.5
Vehicle Extension (s)		2.0			2.0	2.0	2.0	2.0			2.0	2.0
Lane Grp Cap (vph)		310			278	469	708	1049			1210	1100
v/s Ratio Prot						0.00		0.10			c0.01	
v/s Ratio Perm		c0.13			0.11	0.01	c0.11				0.08	0.01
v/c Ratio		0.71			0.63	0.04	0.19	0.17			0.13	0.01
Uniform Delay, d1		28.0			27.5	21.5	7.2	7.2			3.7	3.4
Progression Factor		1.00			1.00	1.00	1.00	1.00			1.00	1.00
Incremental Delay, d2		5.9			3.2	0.0	0.6	0.4			0.0	0.0
Delay (s)		33.9			30.7	21.5	7.9	7.5			3.7	3.4
Level of Service		C			C	C	A	A			A	A
Approach Delay (s)		33.9			27.6			7.7			3.7	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	72.8	Sum of lost time (s)	13.5
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	196	194	197	1847	0	1373	105
Future Volume (vph)	196	194	197	1847	0	1373	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.5	5.0		5.0	
Lane Util. Factor	1.00	1.00	1.00	0.91		0.91	
Frt	1.00	0.85	1.00	1.00		0.99	
Flt Protected	0.95	1.00	0.95	1.00		1.00	
Satd. Flow (prot)	1770	1583	1770	5085		5031	
Flt Permitted	0.95	1.00	0.10	1.00		1.00	
Satd. Flow (perm)	1770	1583	184	5085		5031	
Peak-hour factor, PHF	0.77	0.77	0.94	0.94	0.91	0.91	0.91
Adj. Flow (vph)	255	252	210	1965	0	1509	115
RTOR Reduction (vph)	0	207	0	0	0	4	0
Lane Group Flow (vph)	255	45	210	1965	0	1620	0
Turn Type	Prot	Perm	pm+pt	NA	Perm	NA	
Protected Phases	4		1	6		2	
Permitted Phases		4	6		2		
Actuated Green, G (s)	26.8	26.8	112.2	112.2		90.6	
Effective Green, g (s)	26.8	26.8	112.2	112.2		90.6	
Actuated g/C Ratio	0.18	0.18	0.75	0.75		0.60	
Clearance Time (s)	6.0	6.0	4.5	5.0		5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	316	282	318	3803		3038	
v/s Ratio Prot	c0.14		c0.08	0.39		0.32	
v/s Ratio Perm		0.03	c0.42				
v/c Ratio	0.81	0.16	0.66	0.52		0.53	
Uniform Delay, d1	59.1	52.1	20.5	7.8		17.3	
Progression Factor	1.00	1.00	1.00	1.00		1.00	
Incremental Delay, d2	14.0	0.3	5.1	0.5		0.7	
Delay (s)	73.1	52.3	25.5	8.3		18.0	
Level of Service	E	D	C	A		B	
Approach Delay (s)	62.8			9.9		18.0	
Approach LOS	E			A		B	

Intersection Summary			
HCM 2000 Control Delay	19.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group