

Pedestrian Road Safety Audit

Middlebrook Road

From Father Hurley Boulevard to Waring Station Road

December 2017

Prepared for



Montgomery County
Department of Transportation

Prepared by



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1. Introduction

1.1 Objective

The objective of this study was to complete a Pedestrian Road Safety Audit (PRSA) for Middlebrook Road between Father Hurley Boulevard and Waring Station Road in Germantown, Maryland. The study limits are shown in **Figure 1**. For the purpose of this report, Middlebrook Road is assumed to have an east-west orientation. The Corridor was selected for a PRSA based on its inclusion on the Montgomery County Department of Transportation's (MCDOT) list of High Incidence Areas (HIA). Montgomery County has recently adopted the international Vision Zero Initiative which strives to reduce the number of fatal and serious injury crashes to zero. A Two Year Action Plan has been finalized in November 2017 with input from the Pedestrian Bicycle and Traffic Safety Advisory Committee, community organizations, and the public. The audit was conducted to identify safety issues related to pedestrian and bicycle safety in the study area. As a result of the audit, the PRSA team has identified a variety of issues related to pedestrian and bicycle safety and developed a number of suggestions to improve overall safety in the audit area.

1.2 Background

The study area is an approximately 1.4 mile segment of Middlebrook Road located in Germantown, Maryland. The study area includes six signalized intersections at Father Hurley Boulevard, Century Boulevard, Germantown Road, Crystal Rock Drive, Great Seneca Highway, and Waring Station Road. There are three unsignalized intersections at Locbury Drive, Cross Ridge Drive, and Ridgecrest Drive as well as eight commercial driveways within the study area. Pedestrian activity throughout the study area is primarily generated by the adjacent shopping centers, residential land use, Seneca Valley High School at Crystal Rock Drive, and the public transit stops within the corridor.

The Middlebrook Road study area was identified as an HIA for pedestrian-related crashes, as part of the Montgomery County Executives' Pedestrian Safety Initiative. Based on crash data provided by MCDOT, 17 pedestrian crashes occurred during the study period from January 2011 through December 2015. The purpose of this PRSA is to identify safety issues that may be contributing to the reported pedestrian crashes in the study area.

The PRSA was performed on November 9 and November 10, 2016 during daytime and nighttime hours. The PRSA team consisted of nine members with expertise in pedestrian and bicycle safety and traffic engineering, representing:

- MCDOT,
- Montgomery County Division of Transit Services,
- City of Gaithersburg,
- Montgomery County Police Department,
- T3 Design, and
- STV Inc., the PRSA consultant.

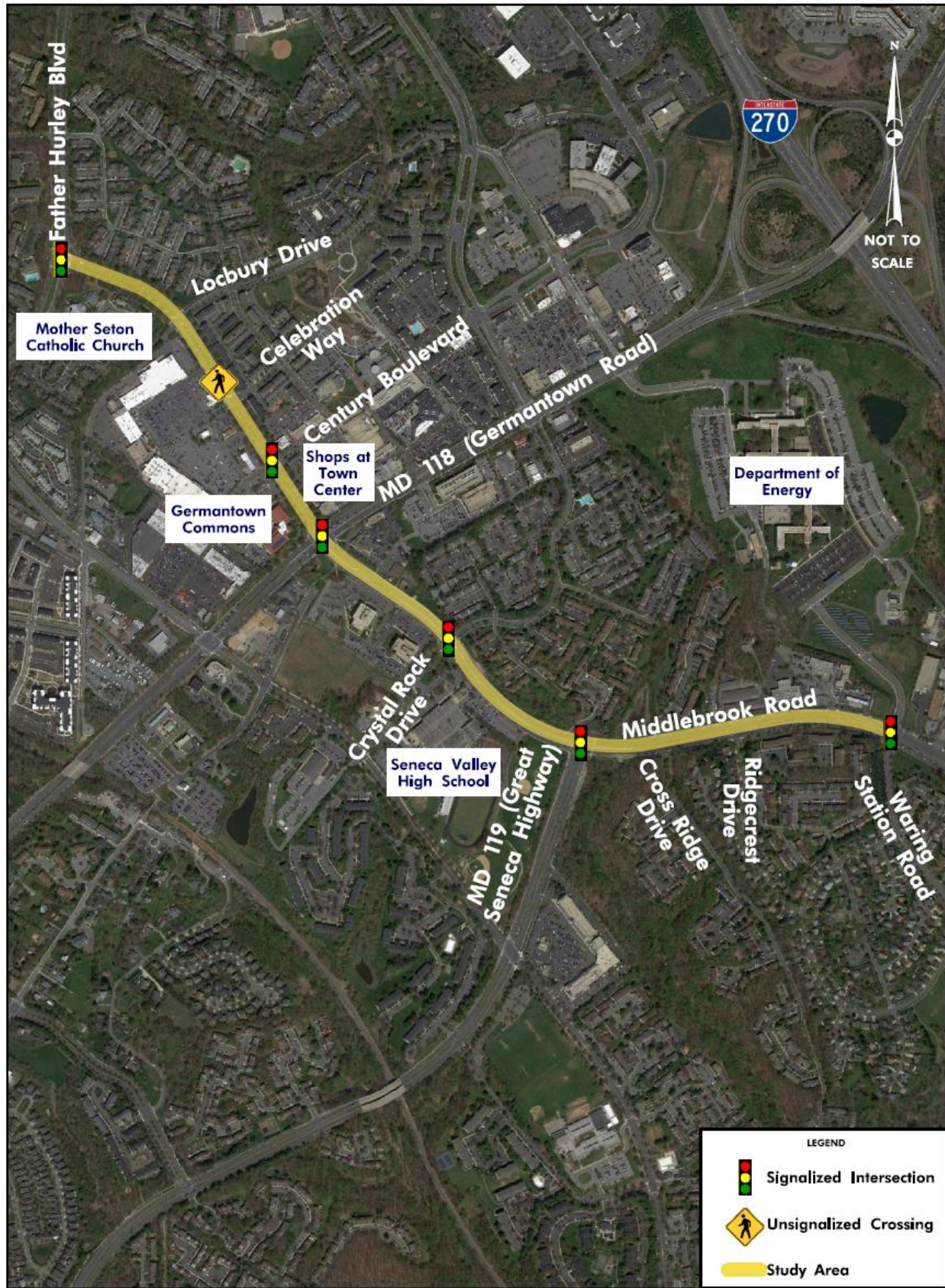


Figure 1: Middlebrook Road PRSA Study Area

1.3 Organization of the Report

This report first presents a description of the existing geometric, operational, and safety conditions for the study area based on field reviews and available data. Next, the report details the existing conditions and general issues throughout the corridor identified by the PRSA team. Finally, the report presents suggestions for pedestrian safety improvements based on the issues identified throughout the corridor.

This report has served as a resource to SHA and MCDOT, as well as other stakeholders for implementing pedestrian safety improvements within the audit area. There has been an ongoing vetting of the suggestions and recommendations in this report with collaboration among agencies and stakeholders to implement short- and intermediate-term recommendations and to assess the feasibility and constructability of long-term projects such as signal timing upgrades or a road diet. Ultimately, as a result of this process, a range of pedestrian safety recommendations will be implemented.

1.4 Existing Conditions

1.4.1 Site Characteristics

Within the study area, Middlebrook Road is classified as a divided business arterial roadway from Father Hurley Boulevard to Germantown Road, and a major highway from Germantown Road to Waring Station Road. The roadway varies from four through lanes west of Germantown Road to six through lanes east of Germantown Road and serves Germantown, Maryland. The posted speed limit on Middlebrook Road is 40 miles per hour throughout the study area. During school hours (6:45 AM – 3:00 PM) the speed limit is 30 miles per hour in the school zone between Germantown Road and Great Seneca Highway. The lane geometry throughout the corridor is shown in **Figure 2**. The study area includes six signalized intersections:

- Middlebrook Road at Father Hurley Boulevard
- Middlebrook Road at Century Boulevard
- Middlebrook Road at Germantown Road
- Middlebrook Road at Crystal Rock Drive
- Middlebrook Road at Great Seneca Highway
- Middlebrook Road at Waring Station Road

Within the study area, there is also one unsignalized intersection with a marked crosswalk on Middlebrook Road which provides access between residential land uses and shopping centers:

- Middlebrook Road at Celebration Way

The roadways intersecting Middlebrook Road are summarized below:

Father Hurley Boulevard

- Four-lane divided roadway that runs in the north-south direction.
- Consists of a dedicated left lane, a through lane, and a shared through/right-turn lane in the north- and southbound directions.
- Connects residential communities north and south of Middlebrook Road. Provides access to I-270 approximately one-mile north of Middlebrook Road

Celebration Way

- Two-lane roadway that runs in the north-south direction.
- Consists of a shared left/through/right-turn lane in the south- and northbound direction.
- Connects shopping centers to the south with the residential neighborhood to the north of Middlebrook Road.

Century Boulevard

- Two-lane roadway that runs in the north-south direction.
- Consists of a shared left/through/right-turn lane in the south- and northbound direction.
- Connects shopping centers north and south of Middlebrook Road.

Germantown Road

- Six-lane divided roadway that runs in the north-south direction.
- Consists of two dedicated left-turn lanes, two through lanes, and one through/right-turn lane in the southbound direction.
- Consists of two dedicated left-turn lanes, three through lanes, and one dedicated right-turn lane in the northbound direction.
- Connects residential communities and shopping centers north and south of Middlebrook Road. Provides access to I-270 approximately 0.5 miles north of Middlebrook Road.

Crystal Rock Drive

- Two-lane roadway that runs in the north-south direction.
- Consists of one left/through/right-turn lane in the south- and northbound directions.
- Connects residential communities north and south of Middlebrook Road. Provides access to Seneca Valley High School on the south side of Middlebrook Road.

Great Seneca Highway

- Four-lane divided roadway that runs in the north-south direction.
- Consists of two dedicated left-turn lanes and one dedicated right-turn lane in the northbound direction.
- Connects residential communities and shopping centers south of Middlebrook Road. Provides access to S. Christa McAuliffe Elementary School 0.4 miles south of Middlebrook Road.

Waring Station Road

- Roadway runs in the north-south direction.
- Three-lane roadway with a through lane in each direction and a Two -Way Left-Turn Lane south of Middlebrook Road.
- Consists of one dedicated left-turn lane and a shared through/right-turn lane in the southbound direction.
- Consists of a shared through/left-turn lane and a dedicated right-turn lane in the northbound direction.
- Connects to the US Department of Energy north of Middlebrook Road and residential communities south of Middlebrook Road.

Middlebrook Road Pedestrian Road Safety Audit

Middlebrook Road offers a number of pedestrian accommodations including concrete or asphalt sidewalk of varying width along both sides of Middlebrook Road throughout the entire length of the study area. Marked crosswalks and countdown pedestrian signals are provided at each of the signalized intersections. In addition, there is an unsignalized intersection crosswalk providing additional crossing opportunities at Celebration Way. There are bicycle accommodations to the east of Great Seneca Highway with a marked bike lane in both the east- and westbound directions.

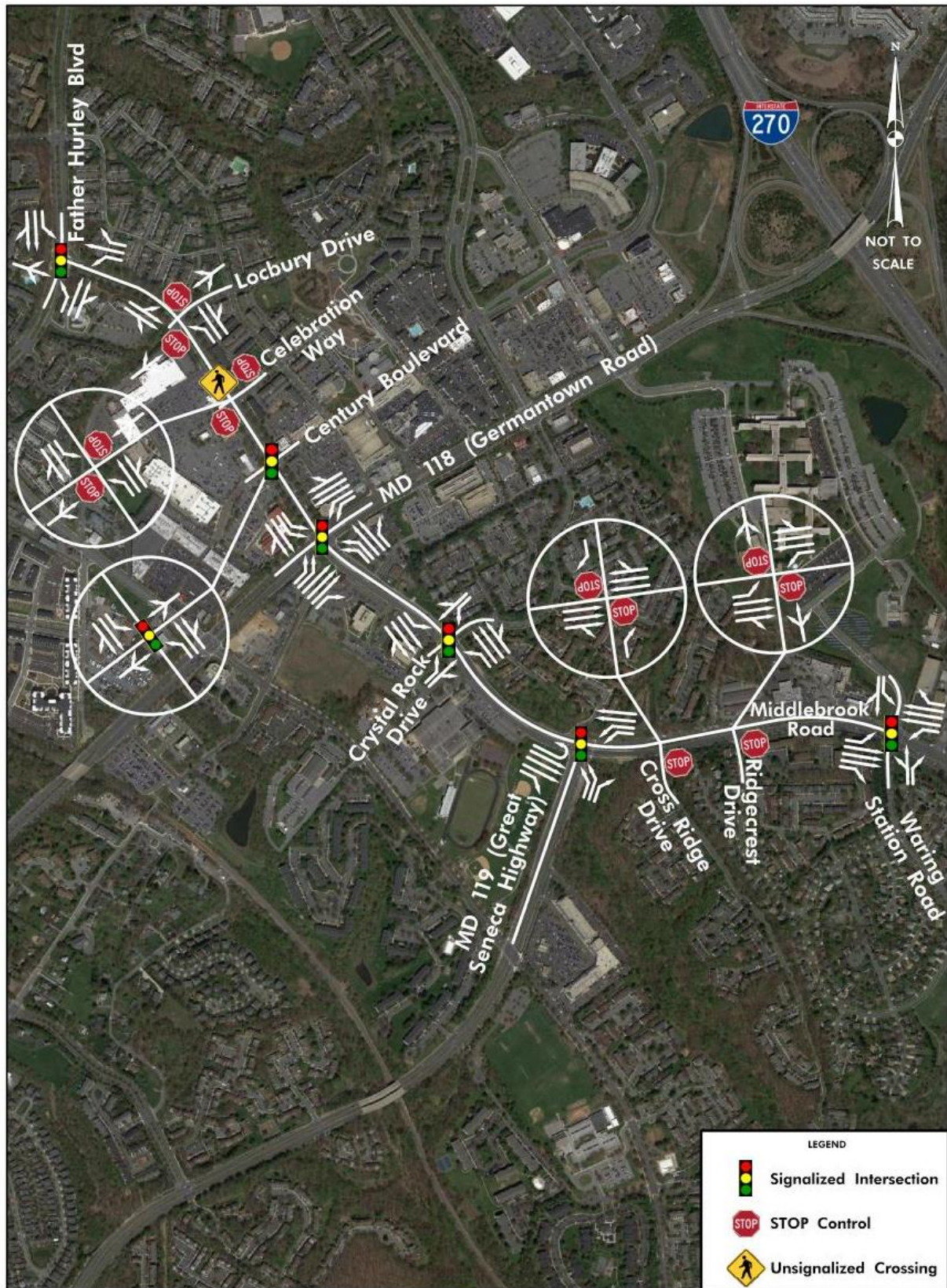


Figure 2: Study Area Lane Geometry

1.4.2 Traffic Data

Average annual daily traffic (AADT) volumes in vehicles per day for Middlebrook Road were obtained from a count conducted at Waring Station Road and is provided in **Table 1**.

Table 1: 2016 AADT

Road	Location	AADT
Middlebrook Road	Waring Station Road	33,670 vpd

Total peak hour vehicular volumes entering the intersections, provided in vehicles per hour (vph), from turning movement counts on Middlebrook Road are shown in **Table 2**.

Table 2: Traffic Count Data

Year	Location	AM Peak Hour	AM Peak Volume	PM Peak Hour	PM Peak Volume
2016	Middlebrook Rd at Father Hurley Blvd	7:15 – 8:15 AM	1,893 vph	5:00 – 6:00 PM	2,269 vph
2016	Middlebrook Rd at Century Blvd	7:30 – 8:30 AM	1,407 vph	6:00 – 7:00 PM	1,967 vph
2016	Middlebrook Rd at Germantown Rd	7:30 – 8:30 AM	3,303 vph	5:00 – 6:00 PM	4,315 vph
2016	Middlebrook Rd at Crystal Rock Dr	7:15 – 8:15 AM	2,137 vph	5:45 – 6:45 PM	2,621 vph
2016	Middlebrook Rd at Great Seneca Hwy	7:15 – 8:15 AM	3,342 vph	5:30 – 6:30 PM	3,741 vph
2016	Middlebrook Rd at Waring Station Rd	7:30 – 8:30 AM	3,463 vph	5:00 – 6:00 PM	3,886 vph

There are 16 bus stops within the study area, eight on the north side and eight on the south side of Middlebrook Road, that serve Montgomery County Ride On bus routes 97 and 74. Route 74 is only accessed by two stops on the corridor located between Crystal Rock Drive and Great Seneca Highway with headways of 27 to 45 minute headways during weekdays, while Route 97 services all 16 bus stops within the study area with headways of 15 to 30 minutes during weekdays. There are no bus stops located between Century Boulevard and Crystal Rock Drive, as buses use these roads to travel to the Germantown Transit Center.

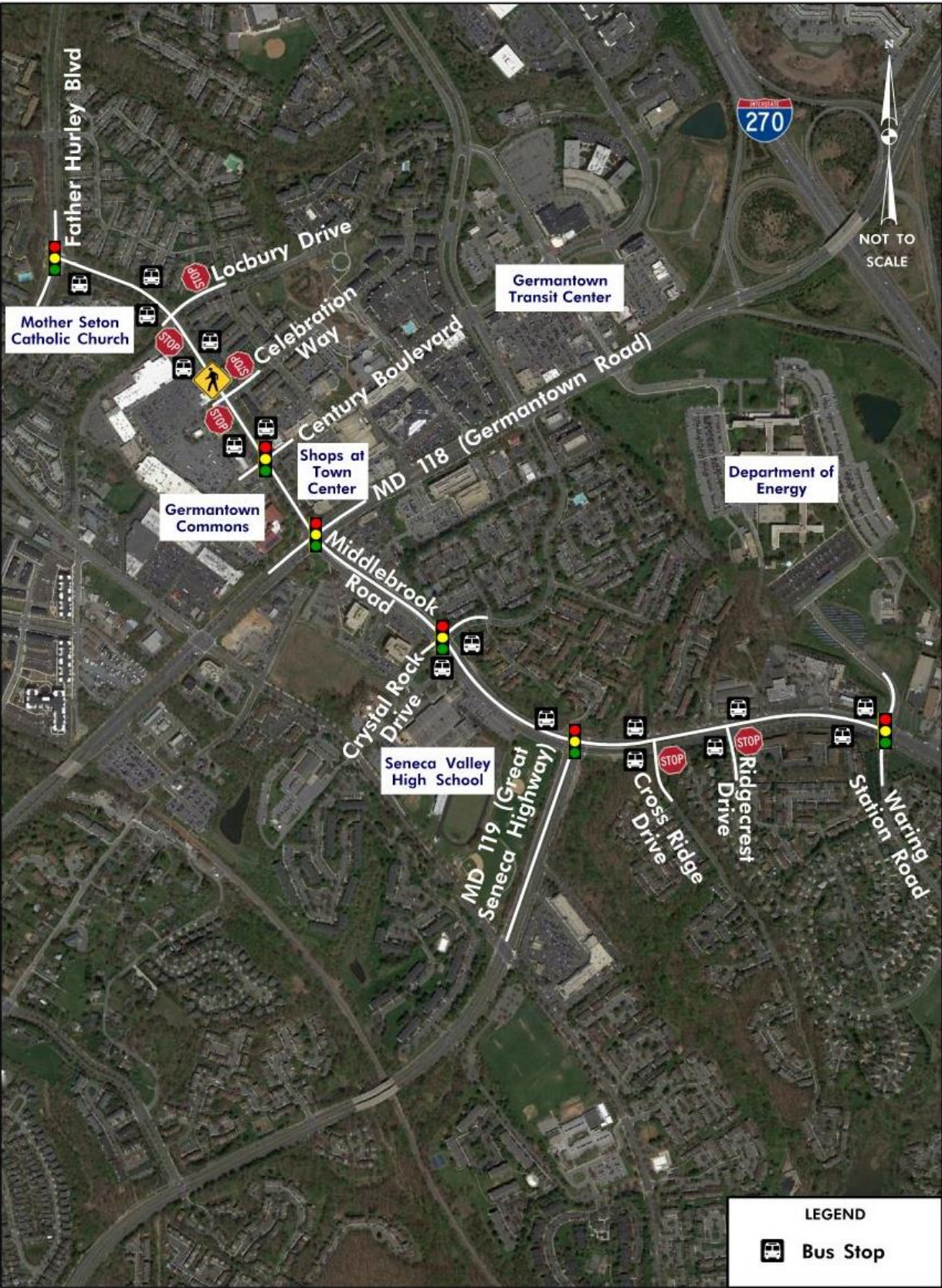


Figure 3: Study Area Bus Stops

1.4.3 Crash Data

The PRSA team reviewed all crash records collected by the Montgomery County Police Department in the study area during the study period from January 2011 through December 2015 to identify the location of all the reported pedestrian and bicycle crashes within the corridor. **Figure 4** summarizes the location, date, time, severity, type, and ambient conditions of each reported pedestrian and bicycle crash.

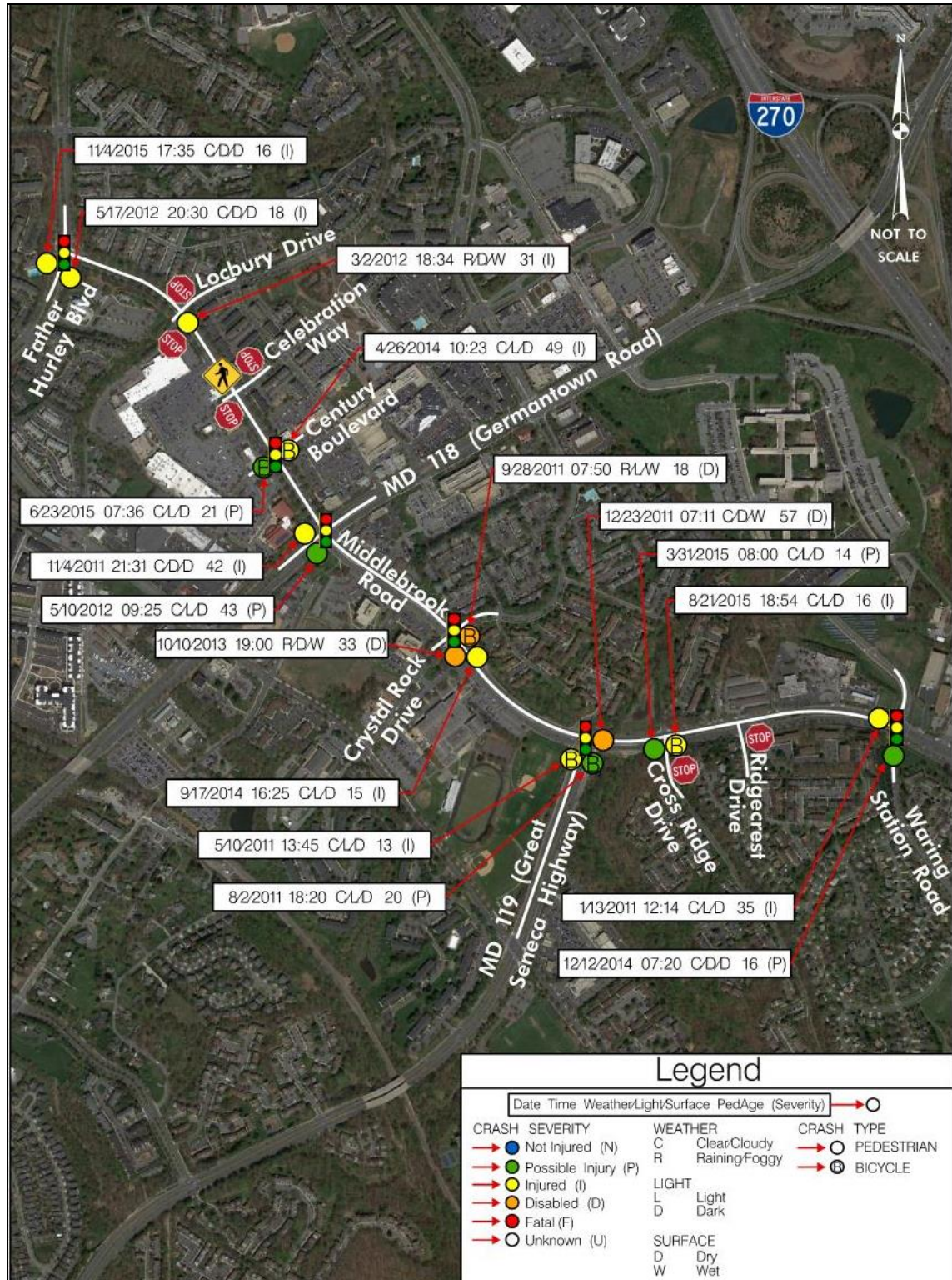


Figure 4: Pedestrian Crashes on Middlebrook Road 2011 – 2015

As shown in **Figure 5**, 17 pedestrian-related crashes occurred during the study period, 6 of which involved cyclists. The bicycle crashes occurred both within the area where bicycle lanes are provided east of Great Seneca Highway and the area where bicycle lanes are not provided west of Great Seneca Highway. There were 302 vehicle crashes within the study limits from 2011 through 2015, of which 53 crashes (18%) occurred at or near the Waring Station Road intersection, 50 crashes (17%) occurred at or near the Great Seneca Highway intersection, and 47 crashes (16%) occurred at or near the Germantown Road intersection. The number of vehicular crashes has varied over the years with no significant pattern over the 5 year study period. Although vehicular crashes are not the focus of this audit, additional future study of vehicular crash patterns at these intersections should be considered.

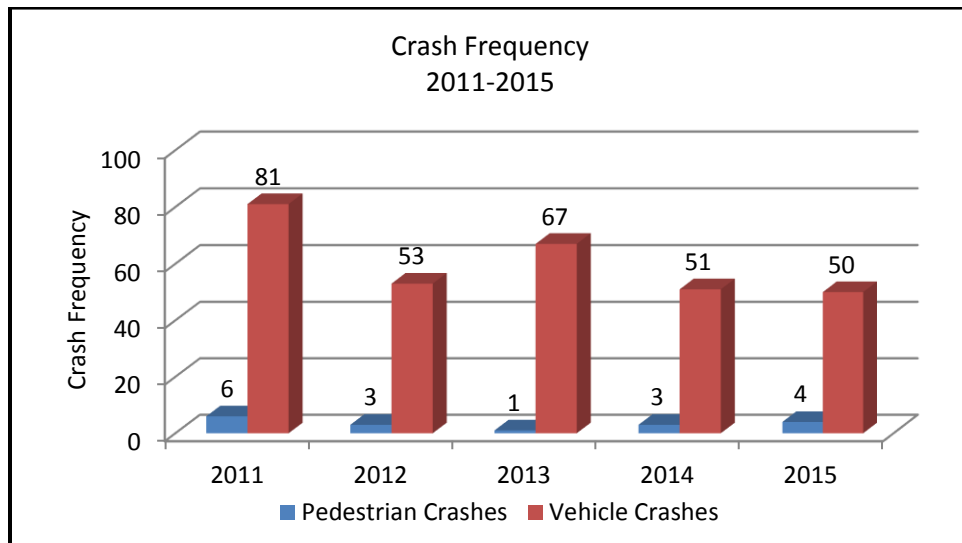


Figure 5: Study Area Crash Frequency

Figure 6 shows the pedestrian crash severity for the seventeen pedestrian crashes. Three of the crashes resulted in disablement of the pedestrian, and nine crashes resulted in injury. The other five pedestrian crashes resulted in possible injury. There were no crashes that resulted in fatalities during the study period.

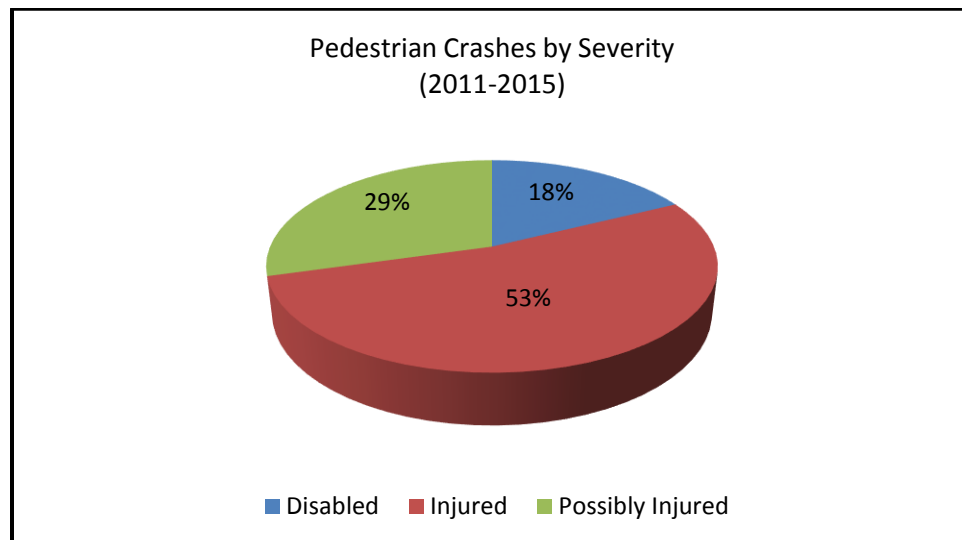


Figure 6: Pedestrian Crashes by Severity

Figure 7 shows the vehicle movements prior to the pedestrian crashes. As shown, 12 of the 17 pedestrians involved in crashes were struck by a vehicle making either a left or right turn. Based on field observations,

there are significant conflicts between turning vehicles and pedestrians in the crosswalk both during the Walk and Flashing Don't Walk phases of the pedestrian signal.

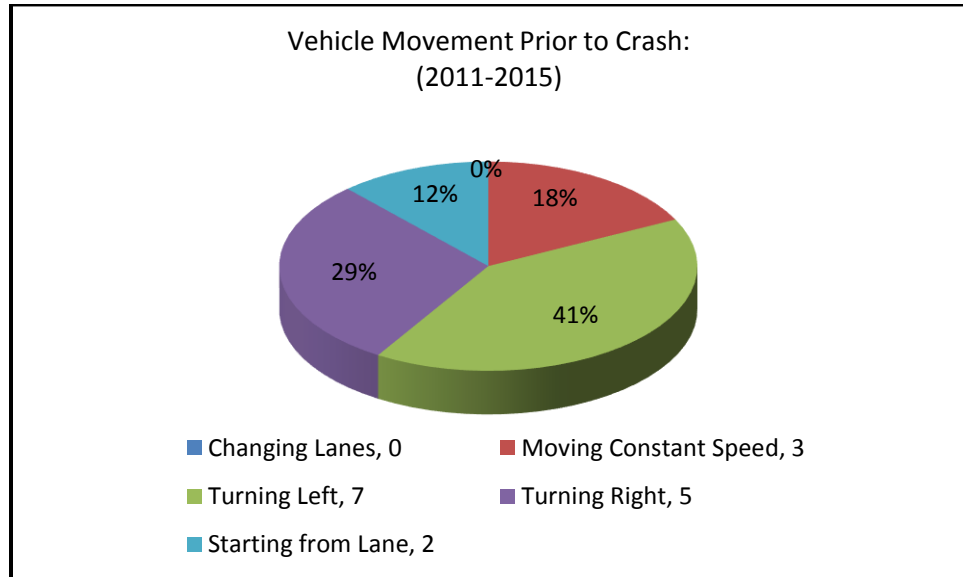


Figure 7: Vehicle Movement Prior to Pedestrian Crash

Figure 8 shows the distribution of pedestrian crashes compared to the distributed frequency of crashes by age group based on study area residential demographics. 2010 Census data (www.census.gov) for the study area zip code was obtained in order to distribute the total number of crashes (17) over the age demographics of the surrounding population. This was done in order to provide a comparison between the actual number of pedestrian crashes by age group (shown in red) and the distributed number of pedestrian crashes by age group based on the census data (shown in blue). Of the 17 pedestrians involved in crashes, eight (47%) were under the age of 20 (ages 13, 14, 15, 16, 16, 18, and 18). When compared to the study area demographics from the census data, the under 20 age group is over-represented in the 2011-2015 pedestrian crash data, while the over 50 age group is under represented. This trend is consistent with field observations and can be attributed to the high school in the study corridor.

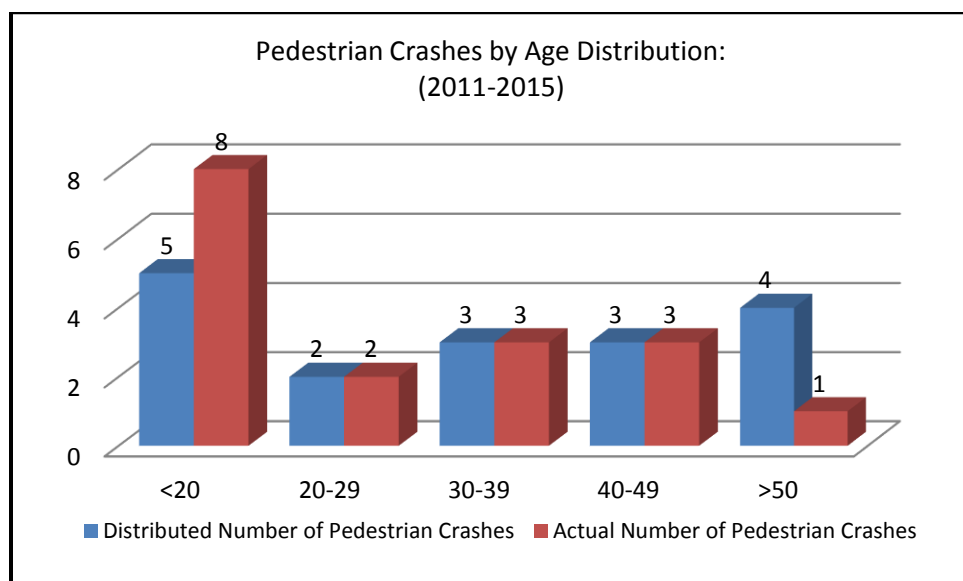


Figure 8: Pedestrian Crashes by Age

As shown in **Figure 9**, the majority of pedestrian crashes were uniformly distributed throughout the day from 6 AM to 12 AM, with no pedestrian crashes occurring during the pre-AM peak hours. Based on this information, time of day was not a significant factor in the pedestrian crashes. However, it should be noted that the high school arrival and dismissal times are currently 7:45 AM and 2:30 PM, respectively, which fall within the AM Peak and Midday categories, though these bell times were implemented in the 2015-2016 school year and were 20 minutes earlier during the earlier years that crash data was analyzed.

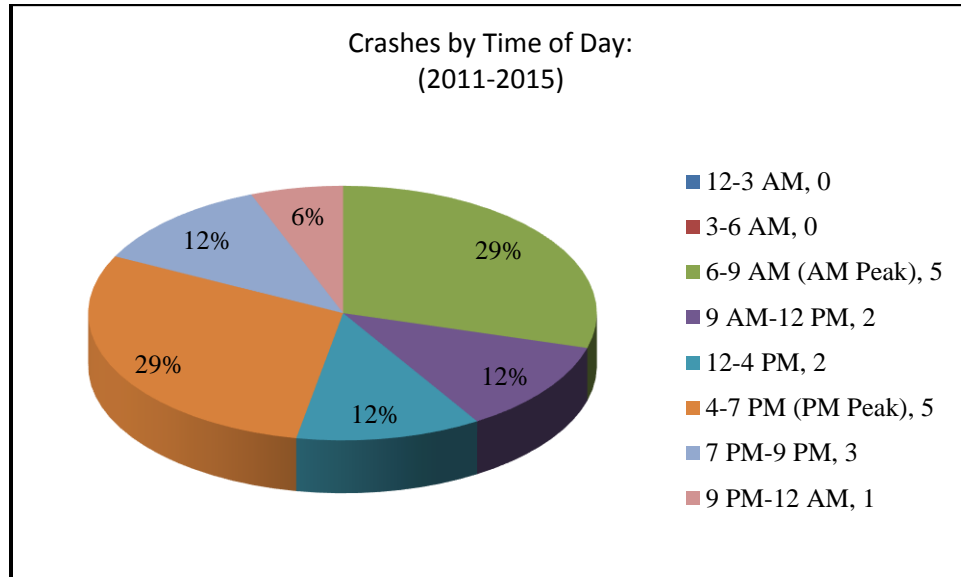


Figure 9: Pedestrian Crashes by Time of Day

Ten of the 17 pedestrian crashes occurred under daylight conditions. The other crashes occurred while dark when street lights were on. While the crash reports did not indicate that lighting was a contributing factor in any of the pedestrian crashes, it should be noted that several locations within the corridor appeared to not be adequately lit based on industry standards during the field audit.

Thirteen of the 17 pedestrian crashes occurred under dry pavement conditions. The crash reports did not indicate that weather was a contributing factor in any of the pedestrian crashes.

2. Road Safety Audit Findings

2.1 Safety Benefits of Existing Roadway Features

Notable existing roadway features that enhance pedestrian safety in the study area include, but are not limited to:

- Continuous Sidewalks:** A concrete or asphalt sidewalk of varying width is present along the north and south sides of Middlebrook Road. A concrete sidewalk is also provided along both sides of Father Hurley Boulevard, Locbury Lane, Celebration Way, Century Boulevard, Germantown Road, Crystal Rock Drive, Great Seneca Highway, Ridgecrest Drive, and the south side of Waring Station Road. Concrete sidewalk is provided along one side of White Saddle Drive and the north side of Waring Station Road. The majority of the sidewalks are five feet in width, but there are some places where they are three feet in width, which is less than the five feet required by Montgomery County's Context Sensitive Road Design Standards.

- **Pedestrian Signage:** Pedestrian crossing and advanced pedestrian signs are located along east- and westbound Middlebrook Road.
- **Countdown Pedestrian Signals (CPS):** Countdown pedestrian signals are provided at all six of the study's signalized intersections. Countdown pedestrian signal research has shown that pedestrians easily understand how the signal works, that more pedestrians start during the Walk phase, and that fewer people initiate walking late in the clearance phase. Studies have also shown that few pedestrians remain in crosswalks during the steady Don't Walk phase where countdown signals are used.
- **Accessible Pedestrian Signals (APS):** Accessible pedestrian signals are provided at the signalized intersections of Great Seneca Highway and at Germantown Road. Accessible pedestrian signals provide direction through audible and tactile signals which help pedestrians with hearing and visual impairments to cross the street safely.



Figure 10: Countdown Pedestrian Signal

2.2 Opportunities for Improvements

The Middlebrook Road PRSA team identified a number of pedestrian safety issues in the study area during the audit. These issues were discussed by the team and prioritized to identify the issues presenting the greatest impediments to pedestrian safety in the study area. This section describes the observed safety issues identified by the PRSA team and suggests improvements to address each issue.

Seneca Valley High School

Seneca Valley High School is located at the intersection of Middlebrook Road and Crystal Rock Drive, with two driveway access points east of Crystal Rock Drive along the south side of Middlebrook Road. The student drop off loop and additional parking is accessed from Crystal Rock Drive. Many school students were observed crossing Middlebrook Road at Crystal Rock Drive during school arrival and dismissal times (7:45 AM and 2:30 PM, respectively), and nearly half of the pedestrian crashes (8 of 17) involved high school-aged children. Students were also observed utilizing public transit to travel to and from school.

Seneca Valley High School is being rebuilt on the existing site and is slated to be completed by August 2019. As part of this redevelopment, the vehicular access point to the site are anticipated to change. Current plans show that the parking lot access and student drop off loop will remain on Crystal Rock Drive, while the additional parking areas are proposed to be access from Wisteria Drive, effectively closing the driveway access points on Middlebrook Road. While the reconfiguration of the school access points is expected to reroute pedestrians away from Middlebrook Road, the new school is expected to nearly double the capacity of the existing school (1,300 existing to 2,400 future students), potentially increasing the number of students crossing the street. The audit team recommends that at the completion of construction, the intersection of Middlebrook Road at Crystal Rock Drive be further reviewed to determine how the change in school access points has affected pedestrian travel patterns at this intersection.

Maryland-National Capital Park and Planning Commission (M-NCPPC) Road Diet Study

M-NCPPC, has conducted a road diet feasibility study in support of the MARC Germantown Rail Plan update. The study includes analysis of two proposed cross-sections on Middlebrook Road between Germantown Road and Great Seneca Highway that reduce vehicular travel lanes in order to install bicycle facilities, such

as buffered bike lanes or a protected bike path, which would tie into existing bike lanes provided on Middlebrook Road east of Great Seneca Highway.

Based on the field audit, there appears to be potential available capacity for vehicles on Middlebrook Road between Great Seneca Highway and Germantown Road. The intersection of Middlebrook Road at Crystal Rock Drive is a heavily crossed intersection due to its proximity to Seneca Valley High School, and the wide travel lanes and 6-lane section contribute to a vehicle centered design within this section. Removing travel lanes at this intersection and potentially reducing pedestrian crossing distances would reduce pedestrian exposure to vehicular conflicts and help calm vehicular traffic. Based on discussions with M-NCPPC, the audit team supports further consideration of the recommendation for the road diet which M-NCPPC is scheduled to present to the Planning Board in December 2017.

Pedestrian-Vehicle Conflicts

At multiple locations along the corridor, pedestrians were observed crossing outside of marked crossings or during the Don't Walk phase of the pedestrian signal. Additionally, conflicts between turning vehicles and pedestrians crossing during the Walk phase were observed. The audit team recommends coordination with the MCDOT Pedestrian Safety Coordinator and Seneca Valley High School to increase pedestrian education about where and when to cross and recommends that signal phasing changes, such as protected left-turn phases or Leading Pedestrian Intervals (LPIs), be evaluated where turn conflicts are present.



Left: Pedestrian crosses during Don't Walk phase. Right: Pedestrian crosses outside of marked crosswalk.

Figure 11: Examples of Pedestrian-Vehicle Conflicts

Pedestrian Facility Conditions

A number of issues related to pedestrian facilities were observed during the audit. Examples include lack of crosswalk markings across side-streets, faded crosswalks, and no Accessible Pedestrian Signals (APS) at some intersections.



Left: No marked crosswalks across side streets. Right: Crosswalk markings are faded.

Figure 12: Examples of Pedestrian Facility Issues

The audit team identified a number of suggestions to improve the condition of the existing pedestrian facilities including, but no limited to, the installation of crosswalks across all side-streets, restriping pavement markings for crosswalks and stop bars along Middlebrook Road, and installing APS where applicable.

Maintenance

A number of conditions were observed that may contribute to pedestrian safety issues that could be resolved through maintenance improvements. Such issues include signs that are damaged, sidewalk that is damaged or overgrown with vegetation.



Left: Damaged sidewalk on the south side of Middlebrook Road. Center: Sign is leaning east of Great Seneca Highway. Right: Overgrown vegetation greatly reduces sidewalk width.

Figure 13: Examples of Maintenance Issues

The audit team recommends that all damaged or missing signs be replaced and that all foliage along the sidewalk be trimmed to maintain the full available width of walkable space. The condition of the sidewalk should be assessed along Middlebrook Road and the feasibility of repairs should be evaluated.

Lighting Conditions

While the majority of crashes occurred during daylight, observations during dark conditions indicated that multiple light fixtures were non-functioning and have been reported for repair. Additionally, the unsignalized crossing at Celebration Way did not have dedicated lighting to improve pedestrian visibility at night.

Lighting throughout the study area can be improved by inspecting street lighting for repair. The audit team also recommends evaluating the feasibility of additional street lighting at the unsignalized crosswalk near Celebration Way.

2.3 Summary of Issues and Suggestions

The following section provides a summary of the issues identified during the PRSA process and the suggestions for improvements at each location discussed in this report. The anticipated timeframe for completion [Short Term (ST), Intermediate (I) and Long Term (LT)] is referenced after each suggestion.

Safety Issue	Suggestion(s)
Pedestrian Vehicle Conflicts	<ul style="list-style-type: none"> Consider installing lane arrow pavement markings along Middlebrook Road and lane usage or shoulder markings, particularly on side streets, where applicable. (ST) Restripe all faded stop bars along the corridor. (ST) Consider installing Turning Traffic Yield to Peds signs (R10-15L) at intersections with permissive left turns. (ST) Work with MCPD to ensure appropriate levels of enforcement of posted speed limits. (I) Consider coordination with the MCDOT Pedestrian Safety Coordinator to increase pedestrian education and enforcement along Middlebrook Road. (I) Determine the feasibility of installing a Leading Pedestrian Interval at signalized intersections with high left and right turn conflicts. (LT) Evaluate the feasibility of adding protected left turn phases for applicable approaches to reduce conflicts. (LT) Evaluate the traffic signal coordination along Middlebrook Road to help create gaps at unsignalized intersections. (LT) Consider installing speed limit sign (S5-1) with flashing lights during school hours to better notify vehicles of the speed reduction. (LT) Evaluate right turn radii, particularly at the Great Seneca Highway and Father Hurley Boulevard intersections, for opportunities to reduce turn radii to reduce crossing distances and vehicular speeds. (LT) Evaluate the feasibility of a road diet on Middlebrook Road between Crystal Rock Drive and Great Seneca Highway to assist with lowering speeds and reducing crossing distance as discussed in the M-NCPPC study. (LT)

Pedestrian Facility Issues	<ul style="list-style-type: none"> Consider installing pedestrian warning signs (W11-2) along the north and south sides of Middlebrook Road, where applicable. (ST) Consider installing Detectable Warning Surfaces (DWS), where necessary, to comply with ADA requirements. (ST) Consider restriping faded crosswalk markings and updating crosswalk markings to ladder markings where applicable. (ST) Consider installing crosswalks at unsignalized intersections, where applicable. (ST) Assess the condition of damaged sidewalk and asphalt path and determine the feasibility of repairs. (I) Consider relocating pedestrian push buttons to conform to ADA standards. (LT) Determine the feasibility of reconstructing sidewalk ramps to align with adjacent crosswalks where feasible. (LT) Consider installing or repairing the Accessible Pedestrian Signals (APS) where applicable. (LT) Evaluate the pedestrian crossing times at the signalized intersections to ensure that the Flashing Don't Walk interval meets standards. (LT) Consider the installation of green pavement for conflict areas within the marked bicycle lanes. (LT) Consider installing Rectangular Rapid Flashing Beacons (RRFB) on the pedestrian warning signs at the unsignalized crosswalk at Celebration Way. (LT)
Maintenance	<ul style="list-style-type: none"> Trim the foliage blocking signage along the corridor. (ST) Trim the foliage along and above the sidewalk. (ST) Replace all damaged or faded signage throughout the study area. Evaluate sign size to prevent vehicular damage to future signs. (ST) Consider adding route information to the bus stop signs throughout the corridor. (ST) Consider installing missing Keep Right (R4-7) signs in intersection medians where applicable. (ST) Consider reinstalling raised pavement markers to the correct height between Great Seneca Highway and Waring Station Road. (LT)
Lighting	<ul style="list-style-type: none"> Inspect street lighting throughout the corridor and repair or replace as necessary. (ST) Determine the feasibility of additional street lighting at unsignalized locations where pedestrians cross Middlebrook Road. (LT) Consider installing higher wattage lights between Germantown Road and Crystal Rock Drive. (LT)