Pedestrian Road Safety Audit

University Boulevard (MD 193) and Colesville Road (US 29)

Montgomery County, Maryland

Prepared For:
Department of Transportation
Montgomery County, Maryland

In partnership with the Maryland State Highway Administration

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1. Introduction

1.1 Objective

The objective of this study was to complete a pedestrian road safety audit (PRSA) for the intersection of Colesville Road (US 29) and University Boulevard (MD 193) in Silver Spring, Maryland (Figure 1). This intersection and its environs are sometimes referred to as Four Corners. 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 pedestrian and bicycle safety in the study area.

1.2 Background

The study area is the Colesville Road and University Boulevard intersection, located approximately 0.3 miles from the Colesville Road and I-495 interchange. Colesville Road and University Boulevard are divided major highways traversing a densely populated, mixed land use area in Silver Spring, Maryland. The eastbound and westbound lanes of University Boulevard are separated by commercial and institutional land uses at the intersection, creating two signalized intersections on Colesville Road and two signalized U-turn crossovers to the east and west.

Colesville Road and University Boulevard serve as major commuter routes within Montgomery County, Maryland and between Maryland and Washington, D.C. The study area also experiences significant pedestrian activity, generated by the adjacent commercial and residential land use, Montgomery Blair High School, situated in the southeast quadrant of the intersection, and nearby transit bus stops.

The study area was identified as one of Montgomery County's High Incidence Areas for pedestrian-related collisions, as part of the Montgomery County Executives' pedestrian safety initiative. Based on collision data provided by Montgomery County and the Maryland State Highway Administration, 18 pedestrian collisions occurred in the study area between January 1, 2004 and December 31, 2008. The purpose of this PRSA was to identify safety issues that may be contributing to the observed pedestrian collisions in the study area.

The PRSA was performed on January 6 and January 7, 2010 during daytime and nighttime hours. The PRSA team consisted of nine members, representing:

- Montgomery County Department of Transportation (MCDOT)
- Local community members
- Maryland State Highway Administration (MDSHA)
- Federal Highway Administration (FHWA)
- American Association of State Highway Transportation Officials (AASHTO)
- Vanasse Hangen Brustlin, Inc. (VHB), the PRSA consultant.

Figure 1: 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 identifies the existing conditions and general issues identified within the corridor by the PRSA team. Finally, the report presents suggestions for pedestrian safety improvements in the study area. For each location, the assessment identifies issues, possible contributing factors, and suggestions for improvement.

This report will be a resource to MDSHA and MCDOT, as well as other stakeholders, for implementing pedestrian safety improvements within the audit area. There will be an ongoing vetting of the suggestions and recommendations in this report with collaboration among agencies and stakeholders to implement short and intermediate-term suggestions and assess the feasibility and constructability of long-term projects. Ultimately, this process will assess the merits of these suggestions and establish a process whereby a range of pedestrian safety improvements are implemented.

1.4 Existing Conditions

1.4.1 Site Characteristics

In the study area, Colesville Road is a divided, closed-section, eight-lane arterial roadway with turning bays. The posted speed limit on Colesville Road is 40 mph. Four through lanes and a right

turn bay are present on the northbound approach to the University Boulevard (EB) intersection. North of the intersection, the right lane becomes a right turn-only lane. Four through lanes are present on the southbound approach to the University Boulevard (WB) intersection; no turn bays are present. South of the intersection, the right lane also becomes a right turn-only lane. A raised median, with plantings interspersed, is provided continuously along Colesville Road through the study area.

University Boulevard is a divided, closed-section, six-lane arterial roadway with turning bays and median, U-turn crossovers. The posted speed limit on University Boulevard is 40 mph. Active commercial establishments separate the eastbound and westbound lanes. Three through lanes, a right turn lane, and a left turn bay are present on the eastbound approach to the intersection. East of the intersection, the right turn lane continues as a right-turn only lane into Montgomery Blair High School. A left turn bay also serves the median, U-turn crossover east of the intersection. Four through lanes, a right turn bay, and a left turn bay are present on the westbound approach to Colesville Road. West of the intersection, the left lane becomes a left turn-only lane for the median U-turn crossover.

Sidewalk facilities are present along both sides of Colesville Road and University Boulevard within the study area. High-visibility crosswalks are provided on all four legs of both signalized intersections. Crosswalks across Colesville Road also include median cut-throughs (i.e. median end caps), which guide turning vehicles into the travel lanes and help to buffer pedestrians from left turning vehicles. Crosswalks are also provided at both signalized U-turn crossovers on University Boulevard.

Traffic along Colesville Road is heavy, primarily because the road serves as a major commercial and commuter corridor between Montgomery County, Maryland and Washington, D.C. The heavy vehicular traffic in the area is reflected in the average annual daily traffic (AADT) along Colesville Road (Table 1). University Boulevard also serves as a major commercial and commuter corridor, although traffic volumes are less than those on Colesville Road.

Table 1: 2008 AADT

Road	Location	AADT
Colesville Road	0.1 miles north of University Boulevard	60,461 vpd
Colesville Road	0.2 miles south of University Boulevard	56,841 vpd
University Boulevard	0.2 miles west of I-495	36,671 vpd
University Boulevard	0.5 miles west of I-495	36,811 vpd

Public transportation is heavily utilized in the study area. WMATA bus routes Z2, Z6, Z8, Z9, Z11, Z13 and Z29 and Montgomery County Ride On routes 9, 19, 21, and 22 have stops at the study intersection.

Peak hour vehicular and pedestrian volumes from a 2006 MDSHA traffic count are shown in Table 2. Detailed traffic count reports are included in the Appendix.

Table 2: Traffic Count Data

Location	AM Peak Hour	AM Peak Volume	PM Peak Hour	PM Peak Volume	Daily Ped Volume
Colesville Rd & University Blvd (EB)	8 – 9 AM	6,544 vph	5 – 6 PM	6,979 vph	1,230 ppd
Colesville Rd & University Blvd (WB)	7 – 9 AM	6,339 vph	5 – 6 PM	6,753 vph	919 ppd

1.4.2 Crash Data

A review of all collision records collected by Montgomery County allowed the PRSA team to identify the location of all reported pedestrian crashes within the corridor (Figure 2). Between 2004 and 2008, a total of 216 vehicular crashes and 18 pedestrian crashes were reported in the study area (Figure 3).

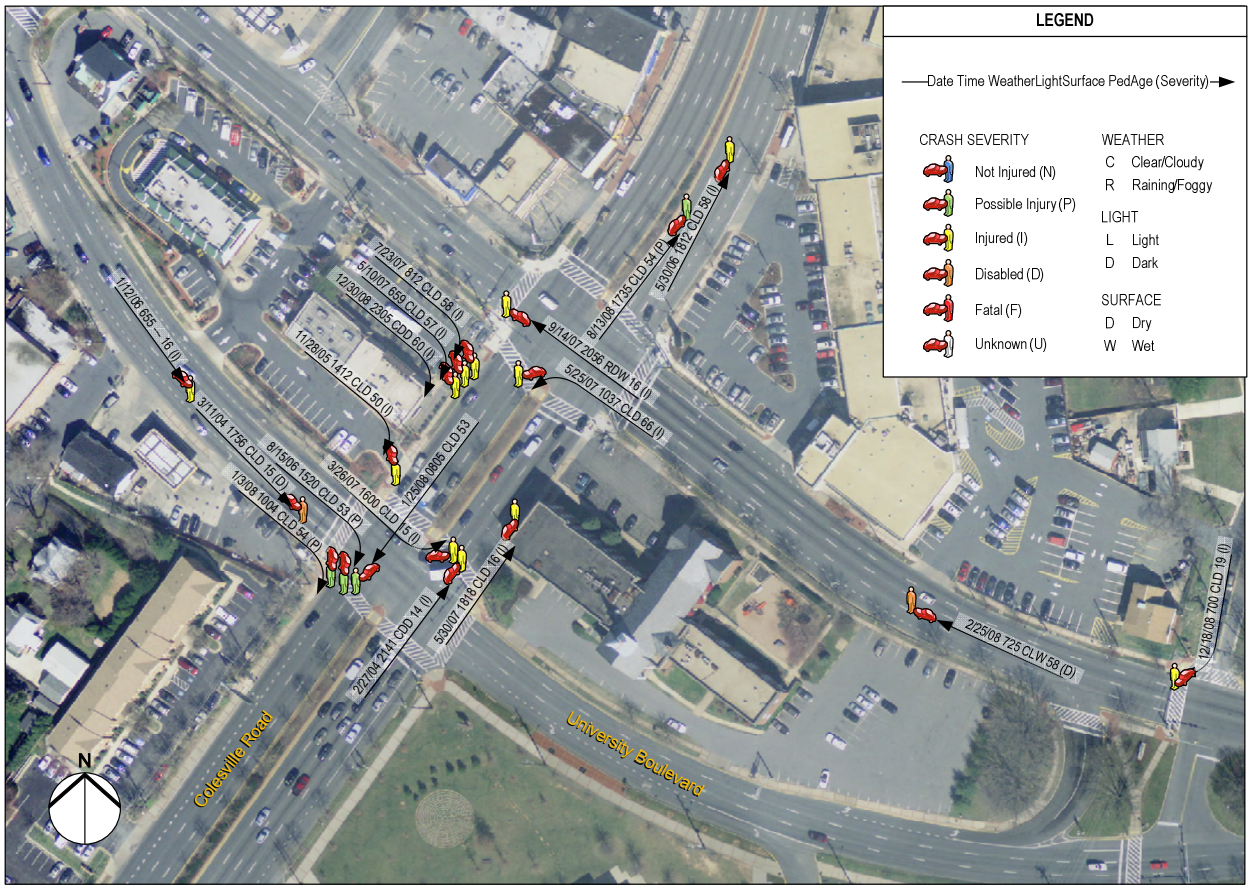

Figure 2: Colesville Road at University Boulevard Pedestrian Crashes 2004 – 2008

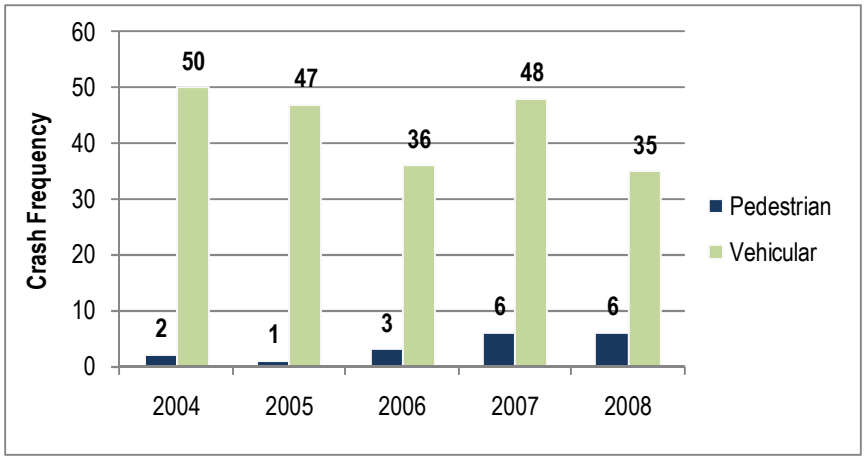

Figure 3: Study Area Crash Frequency 2004 - 2008

Crash data indicate that all of the pedestrian crashes resulted in injuries (Figure 4). Two-thirds of the crashes, 12 of 18, resulted in non-incapacitating injuries, and 2 of 18 resulted in serious, disabling injuries. Another four crashes resulted in possible injuries. In addition to the total number of pedestrian collisions, the large proportion of moderate to severe injury crashes supports the need for pedestrian safety measures in the corridor.

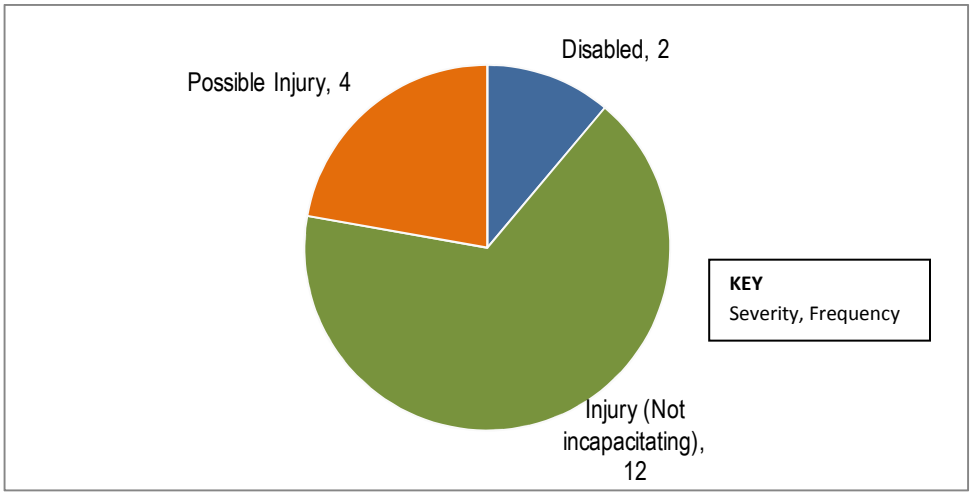

Figure 4: Pedestrian Crashes by Crash Severity 2004 - 2008

Figure 5 shows vehicle movements prior to the pedestrian crashes at the study location. Six of 18 crashes involved vehicles moving at constant speed, and an equal number involved vehicles turning right. Other vehicle movements prior to the crashes invovled making a left turn, starting from the lane, slowing or stopping, and accelerating.

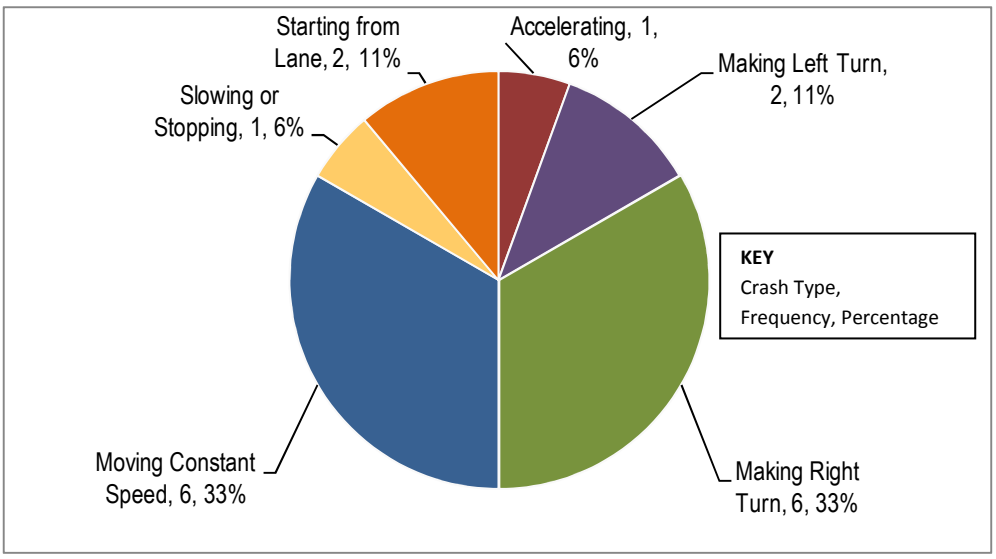

Figure 5: Vehicle Movement Prior to Pedestrian Crash 2004 - 2008

The age of those involved in the pedestrian crashes was identified as one of the primary motivations for conducting a pedestrian road safety audit at this location. Figure 6 shows the age distribution of pedestrians by age group. Pedestrians involved in crashes were either in the 50-59 and 60+ age groups or the youngest age group of 20 year olds and younger. The proximity of the intersection to Montgomery Blair High School likely contributes to crashes involving younger pedestrians.

A comparison of the age distribution of pedestrian crashes to county-wide data revealed that the proportion of crashes for the Four Corners area was significanly greater for these two age groups. Over the five-year period from 2004 through 2008, the percentage of pedestrians younger than 20 years involved in crashes averaged 26% per year, which is consistent with county demographic distibutions. As indicated in Figure 6, this age group amounted to seven pedestrians or 39% for the Four Corners audit area.

Additionally, the county-wide data for the "late middle age" (45 to 64 years) and "senior" (65 years and older) combined to be an average of 36% per year. A similar age group examined in the Four Corners audit (i.e. 50 years and older) amounted to 61% (i.e., 11 pedestrians) of the total number of pedestrians involved in crashes, despite consisting of a slightly smaller age range.

As noted above, the proportion of pedestrians younger than 20 years is likely attributable to the nearby high school, which supports daily school attendance, as well as after-school activities. The proportion of pedestrians older than 50 years may be attributable to several factors, including the surrounding well-established residential communities and the types of services provided in the area (i.e., banks, grocery stores, churches, dining). Also, the relative absence of major employers in the immediate area, such as those that are typically found in the county's central business districts, reduces the presence of significant proportions of the "early and late middle-age" population.

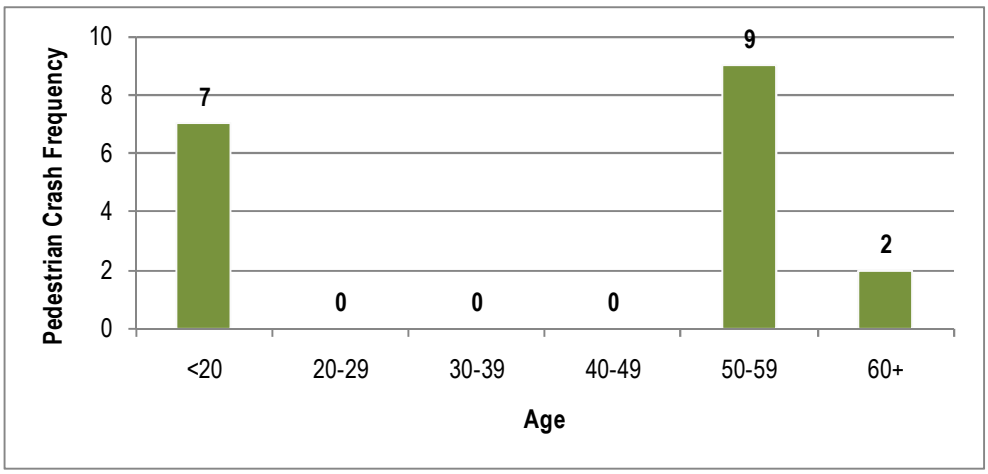

Figure 6: Pedestrian Crashes by Age 2004 - 2008

A majority of the pedestrian crashes occurred during the day and under adequate lighting conditions (Figure 7). Of the 18 crashes, 14 crashes occurred during the day, three of 18 crashes occurred at night, and the lighting conditions for one crash was unknown. A majority of the pedestrian crashes also occurred under dry road surface conditions (Figure 7). Fifteen of 18 crashes were under dry road surface conditions, while two of 18 crashes were under wet road surface conditions, and conditions were unknown for one crash.

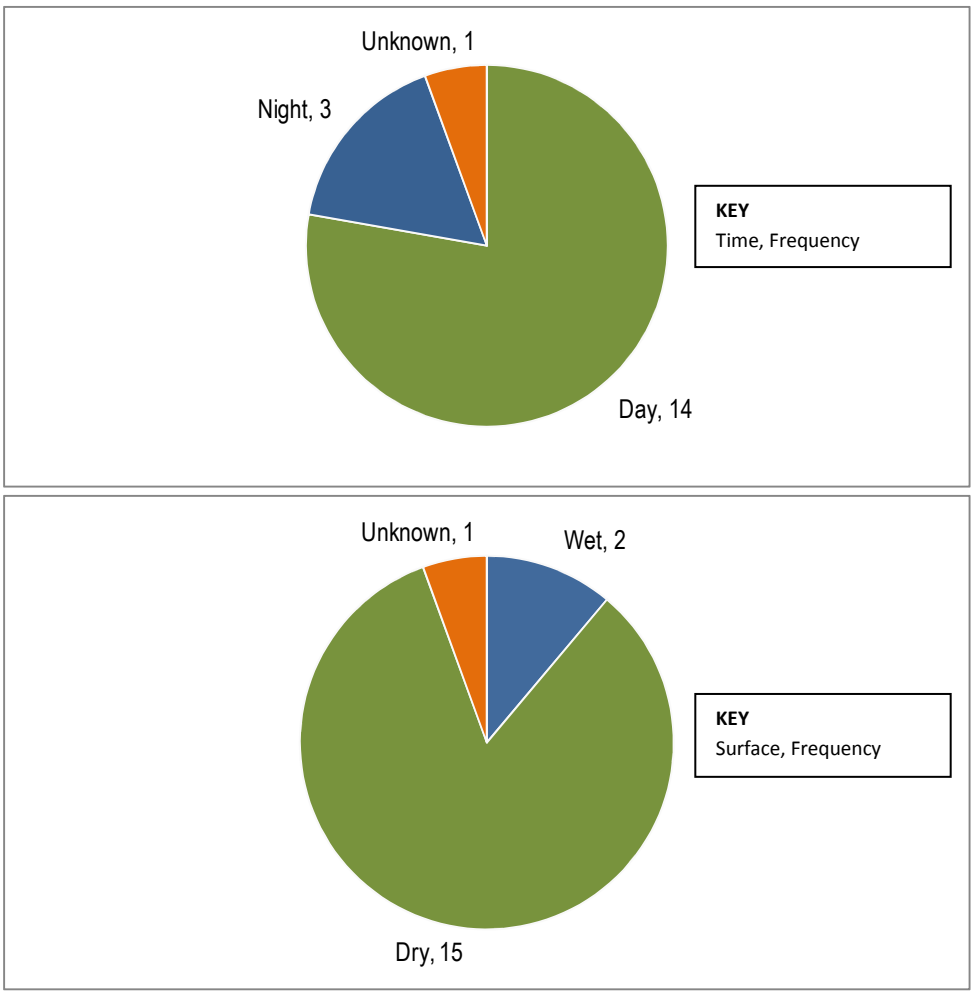

Figure 7: Pedestrian Crashes by Time of Day and Road Surface Conditions 2004 - 2008

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*: Sidewalks within the corridor are continuous and provide a clearly designated space for pedestrians along the corridor.
- *High-visibility crosswalks*: Crosswalks with transverse or diagonal striping patterns (which increase visibility) are provided on all legs of the Colesville Road/University Boulevard intersections and are accompanied by pedestrian signals at all locations. High-visibility crosswalks with pedestrian signals are also provided at the signalized east and west crossovers on University Boulevard.
- *Countdown pedestrian signals*: Pedestrian signals with countdown indicators are used at the intersections of Colesville Road at University Boulevard eastbound (EB) and westbound (WB). Countdown signals have also been installed at the University Boulevard crossover at Lexington Avenue (to the east of Colesville Road), but not at the University Boulevard crossover to the west of Colesville Road. Countdown pedestrian signals have been found to reduce pedestrian injury crashes and improve pedestrian compliance to traffic controls in several national studies.

Photo of a countdown signal

- *Audible pedestrian signals*: The intersection of Colesville Road at University Boulevard WB has recently been equipped with audible pedestrian signals (referred to in some states as Accessible Pedestrian Signals). These signals are activated when the pedestrian push button is depressed and deliver an audible message to pedestrians when it is proper to cross the street (i.e. "You may now cross Colesville Road."). This message is repeated during the full extent of the walk phase for each crosswalk.
- *Pedestrian Signage*: The study area contains a variety of pedestrian signage, including school crossing signs at all crosswalks, signs prohibiting uncontrolled mid-block pedestrian crossing activity on Colesville Road, and a "Yield to Peds" sign on northbound Colesville Road at University Boulevard EB.

Photo of "Yield to Peds" sign

- *Lane Configuration*: The separated east-west lane configuration of University Boulevard at Coleville Road reduces the number of turning movement conflicts between vehicles at these intersections. Additionally, left-turns from Colesville Road onto University Boulevard are prohibited, effectively eliminating all left-turn conflicts between vehicles on Colesville Road and University Boulevard. The lane configuration reduces the number of turning-movement conflict points between vehicles, pedestrians, and bicyclists at each intersection.

Left-turn restrictions at Colesville Road and University Boulevard WB

Figure 8: Left-turn Restrictions

- *Raised Median*: A raised median, approximately 8 feet wide, is provided along Colesville Road through the study area. Although the county's pedestrian signals are timed to allow pedestrians to cross the entire the width of the roadway, this median provides a refuge for pedestrians that may disregard the pedestrian signal and begin crossing at a time other than during the WALK phase of the pedestrian signal. At the Colesville Road intersections with both University Boulevard eastbound and westbound, the ends of the median are capped by diverter islands that provide a physical separation between vehicles in the intersections and pedestrians in the marked crosswalks.

Pedestrian in median refuge on Colesville Road

Figure 9: Colesville Road Median Refuge

These measures help improve driver awareness of pedestrians and compliance of traffic signals. In general, implementation of these features can reduce the potential for collisions.

2.2 Observed Issues, Contributing Factors, and Opportunities for Improvements

The 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 challenges to pedestrian safety in the study area. The following section describes the identified pedestrian safety issues, in order of importance to the audit team:

Pedestrian-Vehicle Conflicts – Most pedestrian conflicts in the study area occur as pedestrians cross Colesville Road or University Boulevard. The relatively high traffic volumes, the distance to cross four or more lanes, and significant pedestrian activity in the study area lead to relatively high exposure levels for pedestrians in the area. Pedestrians were also observed violating pedestrian signals routinely. Possible contributing factors include long pedestrian wait times and long signal timings.

Both right and left-turning traffic was observed to conflict with pedestrians at the Colesville Road/University Boulevard EB intersection. These conflicts may deter students from crossing at crosswalks.

Figure 10: Pedestrian Conflicts with Turning Vehicles

Uncontrolled Mid-block Crossings – Uncontrolled mid-block crossings refer to pedestrians crossing roadways at locations away from intersections and without a designated crossing treatment, such as a crosswalks or pedestrian signal. Uncontrolled mid-block crossings are prevalent throughout the corridor and were identified as one of the primary contributing factors to pedestrian collisions in the study area. Possible causes of uncontrolled mid-block crossings are the locations of various land uses, including the Blair High School and various commercial land uses, on all sides of the intersection and within the parcels between University Boulevard EB and WB. Additionally, the locations of bus stops may contribute to uncontrolled mid-block pedestrian crossing activity.

Multiple people cross University Boulevard WB between McDonald's and the bus stop near Sutherland Road (top). A pedestrian crosses the Colesville Road northbound lanes (north of University Boulevard WB) to the median after disembarking from a bus (lower left). High school students cross University Boulevard EB from the brick pavers in front of the high school (lower right).

Figure 11: Uncontrolled Mid-block Crossings

Unmarked Crossings – Some driveways or cross streets, which experience significant pedestrian activity during the morning and afternoon peak periods, are not provided with marked crosswalks.

Conflicts at Driveway Locations – Commercial land uses throughout the study area contribute to significant turning movements at driveways. Driveways can introduce conflicts between pedestrians and motorists, often as a result of drivers watching for other vehicles rather than pedestrians. Closely spaced driveways increase opportunities for conflict between pedestrians and vehicles and can deter pedestrians from walking on sidewalks, in order to avoid conflicts with vehicles.

No pedestrian warning or entry prohibition signage is provided at the commercial driveway (upper left). Curbing along the wheel chair ramps (right) and vegetation at the back of sidewalk (lower left) tend to encourage pedestrians to cross in front of waiting vehicles. The crash data for this location suggests drivers are more focused on gaps in traffic than pedestrians on the sidewalk.

Figure 12: Commercial Driveway on Colesville Road

Adverse Signage Placement or Condition – A number of traffic control and warning signs are posted in locations that obstruct vehicle sight lines or are blocked by vegetation. Additionally, some signs were observed to be missing, faded, or worn.

Photos from the Colesville Road at University Boulevard EB intersection (clockwise from upper left): Pedestrian warning signage at the SE corner is posted too low and close to roadway, potentially blocking driver sight lines of waiting pedestrians. Do Not Enter sign on west leg is blocked by a tree. Vegetation on the SW corner partially obstructs eastbound driver views of the overhead directional signage, even in winter.

Figure 13: Signage Obstructions

Limited Bus Stop Waiting Area – Significant crowding was observed at a number of bus stops in the study area during periods of peak activity. The crowding at these locations contributes to pedestrians standing very close to roadways and traffic traveling at relatively high speeds. Pedestrians were observed standing in unexpected places, having difficulty passing on the sidewalks (leading to unexpected pedestrian routes on the roadway or private property), and obstructing driver sight distance.

Large groups of pedestrians waiting for transit buses along Colesville Road and University Boulevard (left) leave little or no room for pedestrians to pass along the sidewalk and obstruct visibility of the south leg crosswalk for right-turning vehicles. Pedestrians occupy the entire sidewalk and stand close to traffic traveling in excess of 45 mph on southbound Colesville Road, south of University Boulevard EB (right).

Figure 14: Bus Stop Crowding and Sight Obstructions

Maintenance – The team observed a defective pedestrian signal, for which a work order was immediately issued to have the signal repaired. The study team identified a number of streetlights in the study area that were burned out or otherwise not functioning.

2.3 Summary of Issues and Suggestions

2.3.1 Study Area 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	Suggestions
Pedestrian - Vehicle Conflicts	▪ Consider signage to improve driver awareness of pedestrians and reduce turning movement conflicts at intersections. (ST) ▪ Evaluate pedestrian signal timing. (I) ▪ Determine the feasibility of geometric roadway improvements to reduce pedestrian crossing distances or improve pedestrian refuge spaces. (I) ▪ Remove or relocate obstructions in sidewalk. (ST) ▪ Ensure appropriate levels of enforcement. (LT)

Safety Issue	Suggestions
Mid-block Crossings	▪ Consider signage to improve driver awareness of pedestrians. (ST) ▪ Determine the feasibility and constructability of installing median or roadside barriers to deter mid-block crossings. (I) ▪ Consider streetscape features and improvements to impede pedestrians from crossing at mid-block locations. (I) ▪ Work with MDSHA to designate this area as a school zone and installing signage, flashing beacons, and pavement markings. ▪ Implement a pedestrian education program. (LT) ▪ Ensure appropriate levels of enforcement and perform targeted enforcement. (ST) ▪ Identify potential mid-block locations to conduct a pedestrian warrant study for a signalized or high-visibility pedestrian crossing. (I) ▪ Post additional speed limit signs where appropriate. (I)
Unmarked Crossing Locations	▪ Install high-visibility crosswalks at locations where markings should be provided or where existing crosswalks are faded. (ST)
Driveway Access Conflicts	▪ Consider pavement markings, such as stop bars, to discourage vehicle encroachment on pedestrian crossing paths. (ST) ▪ Consider signage to improve driver awareness of pedestrian activity and reduce conflicts at driveways. (ST) ▪ Work with the business community to pursue physical modifications to driveways and sidewalks to reduce conflicts at driveways. (LT) ▪ Explore the use of different paving materials on or along sidewalks at conflict areas to delineate pedestrian pathways. (I) ▪ Remove vegetation that limits pedestrian-vehicle visibility. (I)
Adverse Signage Placement or Condition	▪ Re-posting signage at standard heights and distances from the roadway. (ST) ▪ Replace missing signage. (ST) ▪ Relocate obstructed traffic control signage or remove obstructions. (ST) ▪ Re-orient pedestrian crossing signage to ensure visibility by pedestrians. (ST) ▪ Upgrade outdated signage. (ST) ▪ Assess potential sight line obstructions when vegetation is in full bloom. (I)
Limited Bus Stop Waiting Areas	▪ Coordinate with Transit Services to pursue expanding pedestrian landings and bus stop waiting areas; and installing additional bus shelters at locations with relatively high ridership. (LT)
Maintenance	▪ Repair defective pedestrian signals. (ST) ▪ Report non-functioning street lighting to PEPCO for repair. (ST)