Pedestrian Road Safety Audit
Rockville Pike (MD 355)

Hubbard Drive to Halpine Road - Rockville
Montgomery County, Maryland

Prepared For:
Department of Transportation
Montgomery County, Maryland

In partnership with the Maryland State Highway Administration

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Table of Contents

List of Figures

List of Tables

1. Introduction

1.1 Objective

The objective of this study was to complete a pedestrian and bicycle road safety audit (PRSA) for Rockville Pike (MD 355) between Hubbard Drive and Halpine Road in Rockville, Maryland (Figure 1). 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 segment of Rockville Pike under study is an approximately ½- mile long, six-lane arterial roadway traversing a medium density, mixed-use area in Rockville, Maryland. This road serves as a major commuter route between and within Montgomery County, Maryland and Washington, D.C. The area also experiences significant pedestrian and bicyclist activity, generated by the commercial and residential land uses as well as the nearby Twinbrook Metrorail station and area 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 (MDSHA), 22 pedestrian and bicyclist collisions occurred along the study corridor between January 1, 2003 and December 31, 2007. A high concentration of these crashes involved elderly pedestrians. The purpose of this PRSA was to identify safety issues that may be contributing to the observed pedestrian and bicyclist collisions in the study area.

The PRSA was performed on June 10, 2009 and June 11, 2009 during daytime and nighttime hours. The PRSA team consisted of ten members, representing:

- Montgomery County Department of Transportation (MCDOT)
- City of Rockville
- Local community members
- Maryland State Highway Administration (MDSHA)
- City of Laurel
- Vanasse Hangen Brustlin, Inc. (VHB), the PRSA consultant.

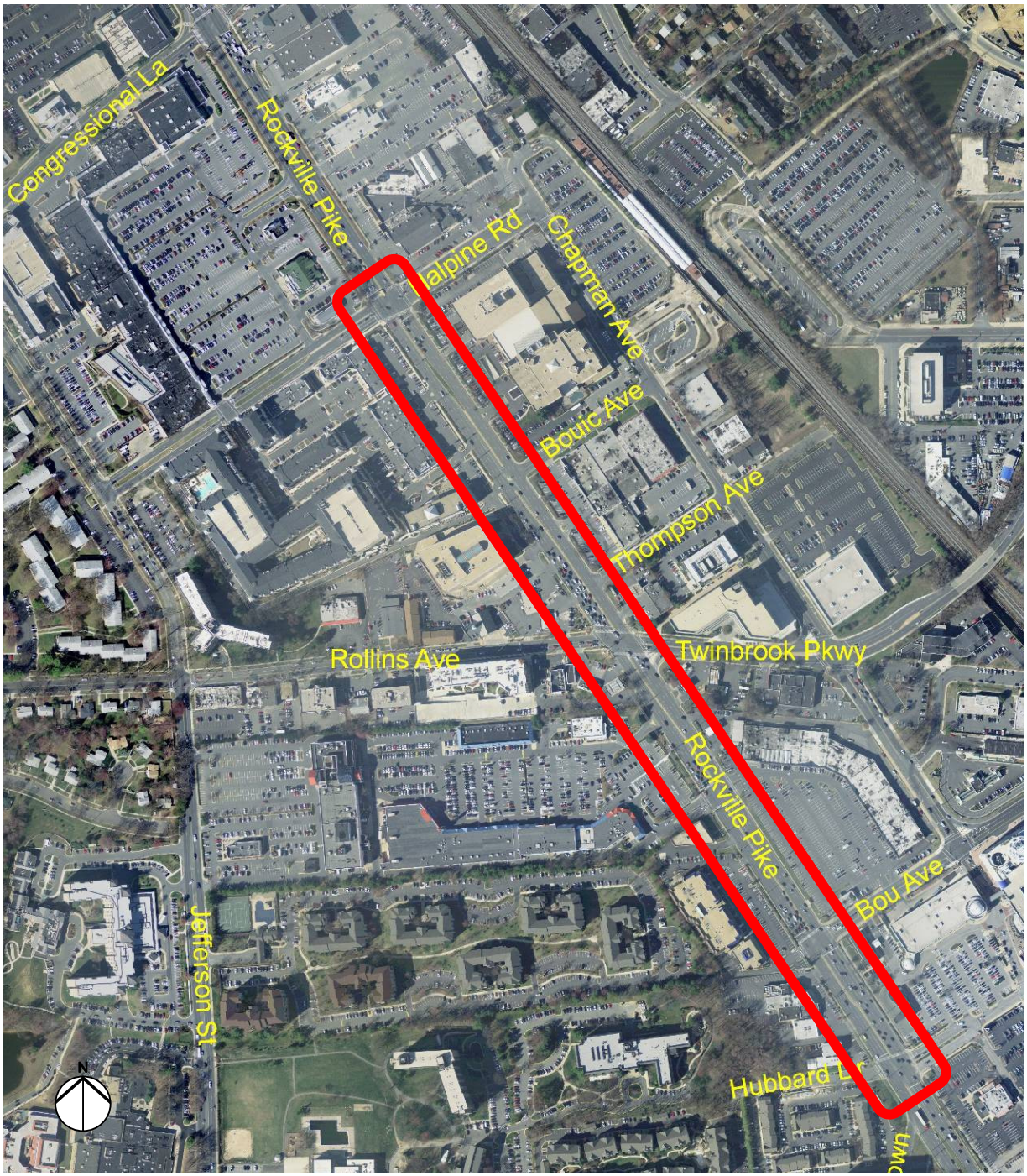

Figure 1: Study Area

1.3 Organization of the Report

This report first presents the existing conditions and general issues identified within the corridor. Next, the report identifies the existing conditions and general issues identified within the corridor by the PRSA team. Finally, this report presents general suggestions for pedestrian safety improvements throughout the study area. For each location, the assessment identifies issues, possible contributing factors, and suggestions for improvement. Additional feedback on the suggestions from stakeholder agencies (i.e. MDSHA) is included in the Appendix.

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 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 may be implemented.

1.4 Existing Conditions

1.4.1 Site Characteristics

Rockville Pike, between Halpine Road and Hubbard Drive, has six travel lanes with curb and gutter and sidewalk facilities on both sides of the road. Opposing traffic is separated by a raised median, and the posted speed along the corridor is 40 miles per hour.

The existing roadway offers several pedestrian and bicyclist accommodations:

- Countdown pedestrian signals,
- Right-Turn-on-Red (RTOR) restrictions,
- Raised medians which span some crosswalks for pedestrian shielding, and
- Sidewalks.

Traffic along Rockville Pike 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 Rockville Pike, expressed in vehicles per day (vpd) in Table 1.

Table 1: 2008 Rockville Pike AADT

Location	AADT
0.1 miles north of Montrose Road	51,982 vpd
0.5 miles south of Gude Drive	44,382 vpd

Public transportation is heavily utilized in the study area. The Twinbrook Metrorail station is located approximately 1/4-mile east of Rockville Pike (one block from the Rockville Pike/Halpine Road intersection). While only the Montgomery County Ride On bus route 46 operates on Rockville Pike in the study area, several other bus routes cross Rockville Pike or operate within a short

distance of the corridor. These bus routes include Ride On routes 5, 26, and 46, as well as WMATA routes C4 and J5.

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/bicyclist crashes within the corridor (Figure 2). Between 2003 and 2007, 139 vehicular crashes, 16 pedestrian crashes, and 6 bicyclist crashes were reported in the study area (Figure 3).

In terms of crash frequency, the greatest number of both vehicular and pedestrian/bicyclist crashes occurred in 2005. During that year, 39 vehicular crashes and 8 pedestrian/bicyclist crashes were reported.

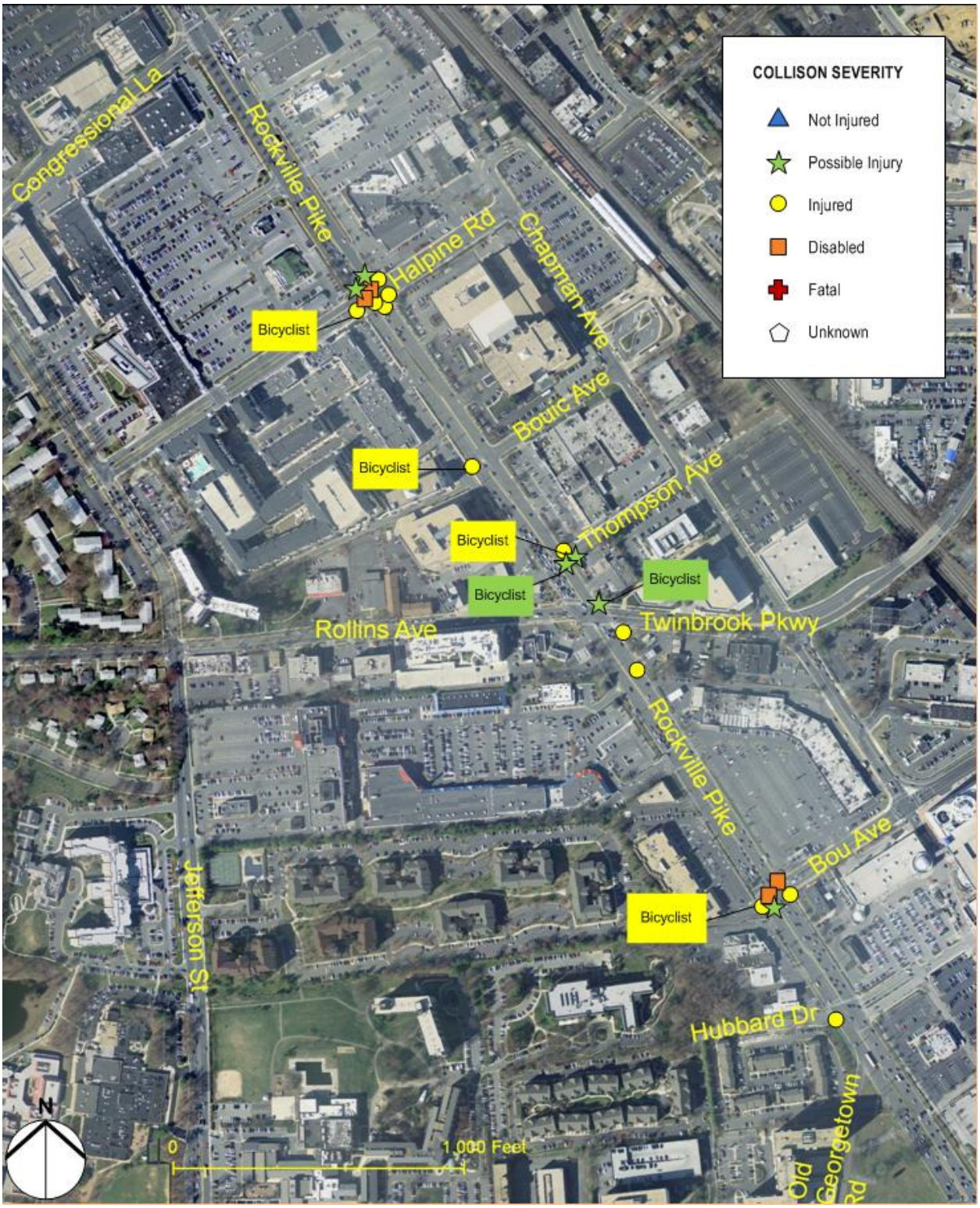

Figure 2: Rockville Pike Pedestrian and Bicycle Crashes (2003 – 2007)

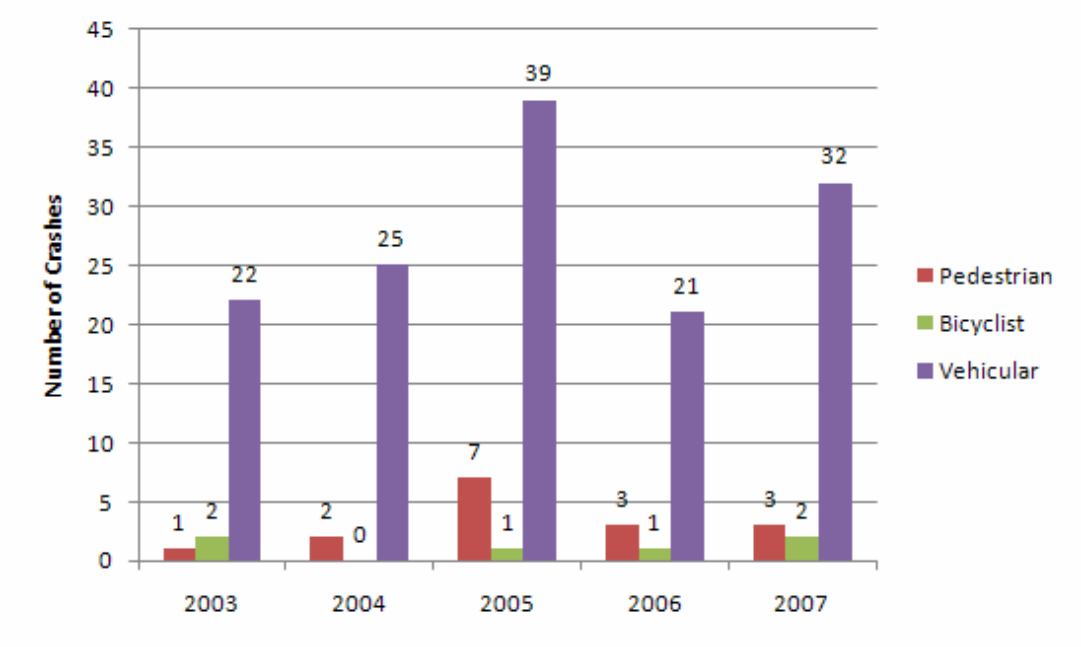

Figure 3: Study Area Crash Frequency (2003 – 2007)

The Rockville Pike/Halpine Road intersection experienced seven pedestrian/bicyclist crashes, which was the highest number among all intersections. The second highest collision frequency occurred at the Rockville Pike/Bou Avenue intersection, where five pedestrian/bicyclist crashes occurred (Figure 4).

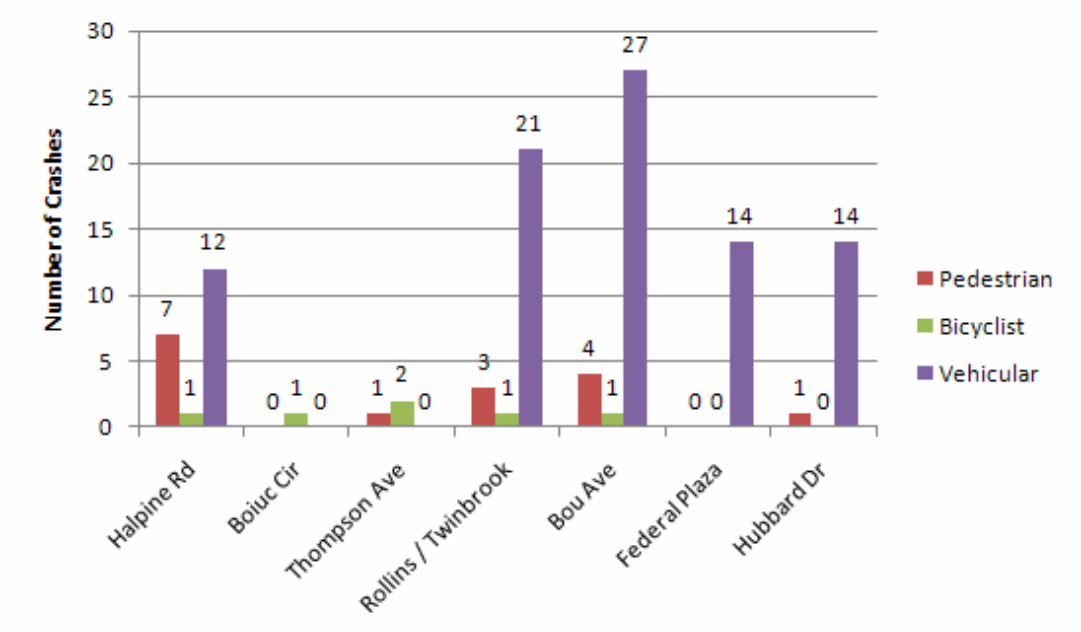

Figure 4: Intersection-Related Crash Frequency by Intersection (2003 – 2007)

Crash data indicate that all of the pedestrian/bicyclist crashes resulted in injuries (Figure 5). Over 50% of the crashes, 12 of 22, resulted in non-incapacitating injuries, and 4 of 22 resulted in serious, disabling injuries. Another five crashes resulted in possible injuries. This large proportion of moderate to severe injury crashes to non-injury crashes supports the need for pedestrian safety measures in the corridor.

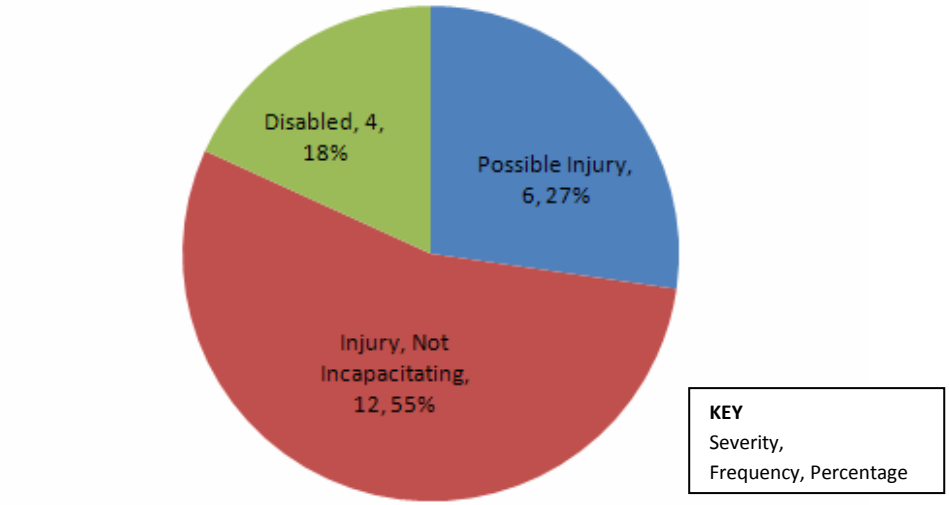

Figure 5: Pedestrian/Bicyclist Crashes by Crash Severity (2003 – 2007)

The age of those involved in the pedestrian/bicyclist crashes was identified as one of the primary motivations for conducting a pedestrian road safety audit on Rockville Pike. Figure 6 shows the age distribution of pedestrians and cyclists by age group. While all bicyclist crashes involved people under 40 years old, the greatest concentration of pedestrian crashes was experienced by the 65 years and older age group, followed by the 20 to 29 age group.

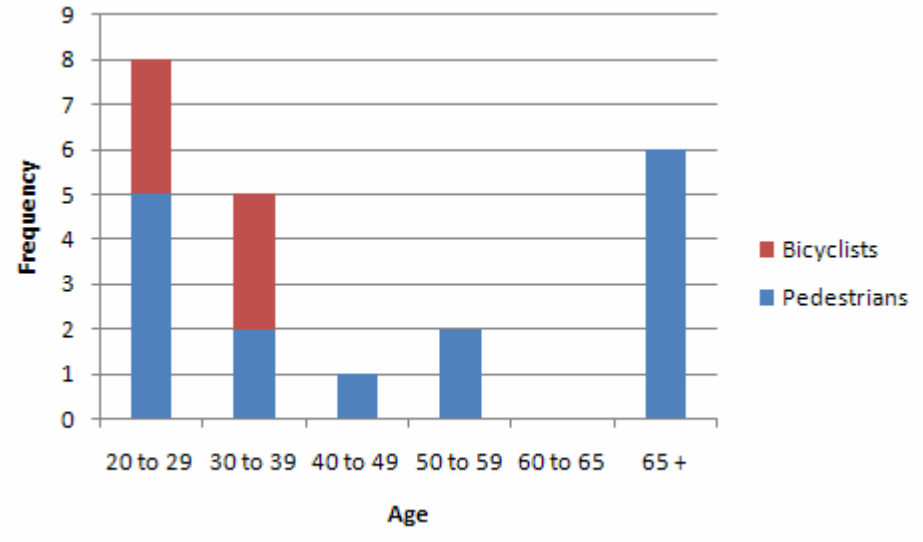

Figure 6: Pedestrian/Bicyclist Crashes by Age (2003 – 2007)

Overall, 38% of pedestrian-only crashes involved a person that was 65 years or older (Figure 7). This trend suggests that elderly pedestrians are at risk for invovlement in future collisions on this corridor.

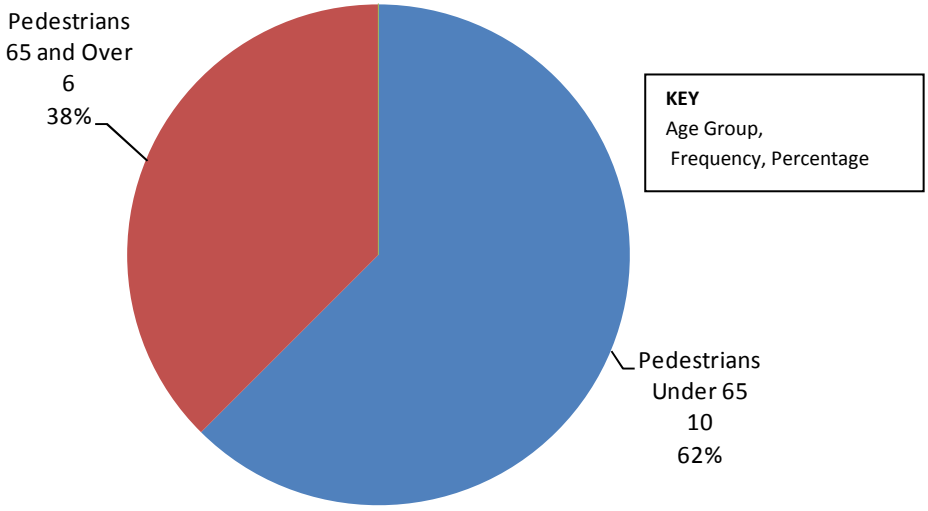

Figure 7: Crashes Involving Older Pedestrians (2003 – 2007)

A majority of the pedestrian/bicyclist crashes occurred during the day (Figure 8). Of the 22 crashes, 12 crashes occurred during the day, and 10 of 22 crashes occurred at night. A majority of the pedestrian/bicyclist crashes also occurred under dry road surface conditions (Figure 8). Eighteen of 22 crashes were reported under dry road surface conditions, while four of 22 crashes were reported under wet road surface conditions. Of the six bicyclist crashes, all occurred under clear and dry conditions, and five occurred during daylight hours. Five of the bicyclist crashes involved right-turning vehicles. All of the bicyclist crashes involved riders between the ages of 20 and 40.

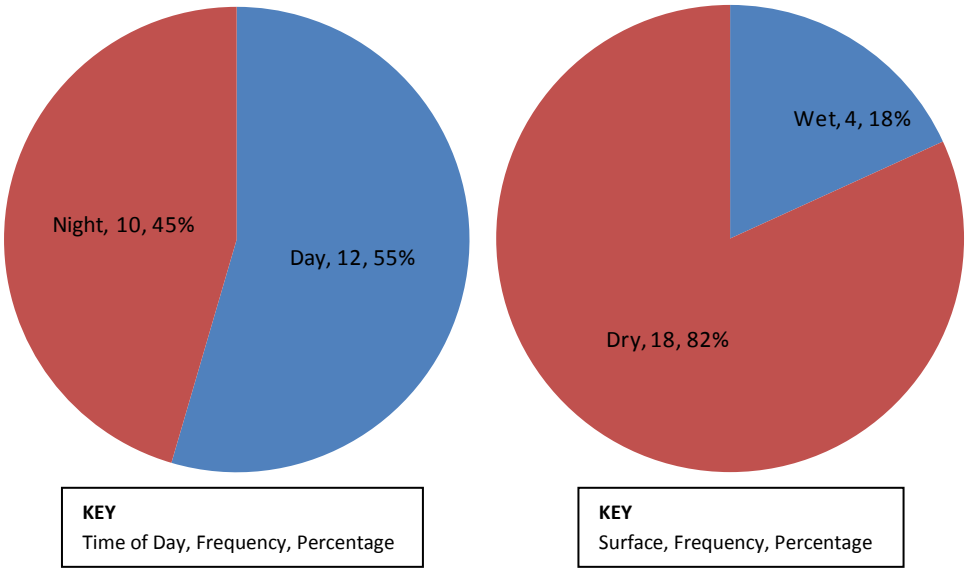

Figure 8: Pedestrian/Bicyclist Crashes by Time of Day and Road Surface Conditions (2003 – 2007)

2. Pedestrian 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 designated space for pedestrians in the corridor.
- *Countdown signals*: Pedestrian countdown signals are used throughout the area. Countdown pedestrian signal research has shown that pedestrians easily understand how the signal works, that more pedestrians start during the clearance phase, and that fewer people initiate walking late in clearance phase. Countdown pedestrian signals have been found to reduce pedestrian injury crashes and improve pedestrian compliance to traffic controls in several national studies. Pedestrian countdown signals were observed at each corner at the intersection of Rockville Pike and Twinbrook Parkway/Rollins Ave and have been recently installed at the Rockville Pike/Halpine Road intersection. Countdown signals should be considered at all intersections, especially where commercial foot traffic is prevalent.

Photo of a countdown signal

- *Right Turn on Red (RTOR) Restrictions*: Since many right-turning motorists do not come to a full stop and yield to pedestrians at red traffic signals (especially at intersections with wide turning radii), RTOR restrictions are used at several locations in the study area to eliminate this conflict with pedestrians. Research suggests allowance of RTOR movements at intersections increases the risk for pedestrian collisions by 43 to 108 percent, according to multiple studies cited in the Federal Highway Administration's "Desktop Reference for Crash Reduction Factors" (FHWA-SA-07-015). RTOR restrictions are present at the intersection of Rockville Pike and Twinbrook Parkway/Rollins Avenue in the eastbound and westbound directions.

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

2.2 Observed Issues, Contributing Factors, and Opportunities for Improvements

The Rockville Pike 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 – Conflicts are often an indicator of the likelihood of a pedestrian-vehicle crash. Most of the pedestrian conflicts in the study area occur at intersections and as pedestrians cross Rockville Pike. Contributing causes include the relatively high volume of traffic on Rockville Pike, the long crossing distances (higher exposure), and significant pedestrian activity in the study area. These conditions unavoidably create conflicts at intersections where pedestrians and motorists may be more inclined to focus on mobility than safety. Pedestrians in the study corridor are particularly susceptible to permissive left-turn and right-turn conflicts. Left-turn conflicts may be exacerbated by relatively long delays for left-turning vehicles and drivers turning through small gaps in oncoming traffic. Wide right-turn lanes may contribute to right-turn conflicts between pedestrians and vehicles at relatively high turning speeds.

Conflicts at Driveway Locations – Driveways providing access to private properties are present throughout the Rockville Pike corridor. Driveways can create conflicts between pedestrians and motorists, often as a result of drivers watching for other vehicles rather than pedestrians. Closely spaced driveways increase conflicts between pedestrians and vehicles and can deter pedestrians from walking on sidewalks. Additionally, wide driveways may increase the severity of a pedestrian-vehicle crash because the larger width may enable higher vehicle speeds.

Uncontrolled Midblock Crossings – Uncontrolled midblock crossings were observed at numerous locations along the corridor. The long distance between some intersections, long wait times at signalized intersections, and pedestrian non-compliance contribute to midblock crossing activity.

Limited Sight Lines – Vegetation encroaching on some sidewalks may contribute to difficulty for drivers to see pedestrians on the sidewalks or within crosswalks.

Accessibility for all Pedestrians – Sidewalk width and the location or lack of curb ramps may present obstacles for the mobility of pedestrians throughout the corridor. Furthermore, some older sidewalks or wheelchair ramps in the corridor may not comply with the current American Disabilities Act (ADA) requirements.

Narrow Sidewalks – Some of the sidewalks in the study area appeared too narrow to reasonably allow two pedestrians to walk past one another, or allow pedestrians to pass an individual waiting at a bus stop, without traveling in unpaved areas. In some cases, vegetation or landscaping on private property also encroaches on the sidewalks. To address this issue, the following actions may be considered:

- Clear areas where landscaping is encroaching on sidewalk space. Preferably, an offset of at least two feet between objects and the edge of the sidewalk should be provided, as objects on the edge of the sidewalk will reduce the effective width of the sidewalk (see Chapter 18 of the *Highway Capacity Manual*).
- Maintain planter strips. Plantings may also encroach on the sidewalk reducing the effective width.
- Provide separate landing areas at bus stops. Consider establishing a sidewalk zone system based on traffic speeds and volume detailing buffer widths, sidewalk clear zone widths, and frontage/maintenance zone widths. Depending upon the width of each of these zones, the bus stop waiting area may be placed in the buffer zone or on the opposite side of the sidewalk where the maintenance offset is typically located.
- Provide wider sidewalks and buffers based on the zone system established for the corridor. Figure 9 shows a typical roadway cross-section with various zones for different users and a buffer zone between the roadway and the sidewalk. Preferably, the buffer would be landscaped, providing a physical and visual separation between the sidewalk and the roadway.

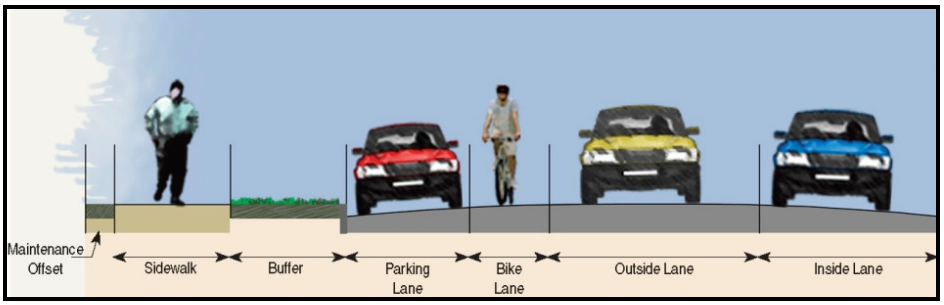

Figure 9: Roadway Cross-section with Buffer

Lighting Conditions – Certain areas along the corridor appear to be dimly lit or have low levels of lighting. Also minor gaps in lighting were identified, including side-street approaches. To address this issue, the following actions may be considered:

- Evaluate lighting along the corridor to ensure appropriate lighting levels and adherence to current lighting standards.
- Consider regular maintenance to replace expired streetlights.

Driver Compliance with Traffic Control Devices – In some locations, drivers ignored signal indications and illegally proceeded through red signal indications. Some vehicles performing U-turns appeared unaware of pedestrians crossing Rockville Pike during the WALK signal indication.

Bicyclists Riding on Sidewalks – Bicyclists were observed riding on the sidewalks, creating conflicts with pedestrians as well as vehicles turning to/from intersections and driveways. Bike activity on sidewalks may be related to traffic volume on Rockville Pike and the absence of a dedicated bicycle travel way along the corridor. While these issues are beyond the scope of this audit to address, the following actions should be considered:

- Provide wayfinding signing and public outreach at key destinations such as Metro stations to inform bicyclists of appropriate paths.
- Place bicycle route maps at Metro and other key destinations.

Compliance of Pedestrians to Signals – Pedestrians were observed violating pedestrian signals. Possible factors that influence a pedestrian's decision when to cross include pedestrian wait times at signals, a limited understanding of pedestrian signal indications, and typical non-compliance due to impatience. To address this issue, the following actions should be considered:

- Conduct an analysis of cycle length modifications to reduce pedestrian wait times for various time periods.
- Implement a pedestrian education program.

Obstructions on Sidewalks – A few obstructions on sidewalks or affixed to permanent objects within the sidewalks were observed during the audit. Obstructions on the sidewalk pose a safety concern to all pedestrians, but especially to pedestrians with vision impairments and should be removed whenever possible.

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 throughout the study corridor. 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	▪ Explore implementing lead pedestrian intervals (LPI) at some signals. (ST) ▪ Evaluate the potential capacity and pedestrian safety impacts of implementing protected left-turn phasing at some signals. (I) ▪ Consider installing signage to warn drivers of pedestrian activity. (ST) ▪ Evaluate the potential capacity and pedestrian safety impacts of installing signage to restrict Right Turn on Red movements. (I) ▪ Assess the need and feasibility of installing signage to discourage vehicles blocking intersections. (ST) ▪ Determine the feasibility and constructability of constructing curb extensions at some intersections. (I) ▪ Consider installing or upgrading crosswalks, compliant with MDSHA standards. (ST, I) ▪ Monitor pedestrian conditions at some locations after the MDSHA construction project at Montrose Road is complete. (ST)

Safety Issue	Suggestions
Pedestrians Crossing Rockville Pike	▪ Consider strategically placing pedestrian warning signs on Rockville Pike. (ST) ▪ Assess the need and feasibility of realigning skewed crosswalks to provide perpendicular crossings. (I)
Vehicles Making Improper Left-turns	▪ Ensure the appropriate levels of enforcement. (ST) ▪ Consider installing or upgrading crosswalks, compliant with MDSHA standards. (I) ▪ Reinforce left-turn restrictions by installing post-mounted delineators or modifying medians. (I, LT)
Conflicts at Driveways and Unsignalized Side Streets	▪ Consider installing or upgrading crosswalks, compliant with MDSHA standards. (ST) ▪ Determine the feasibility and constructability of curb extensions at some driveways or side streets. (I, LT) ▪ Consider installing skip marks to guide traffic at some signalized driveways. (ST) ▪ Consider installing enhanced lane markings on some side streets to better direct traffic. (I) ▪ Determine the feasibility and constructability of improving sidewalk connections at some driveways. (LT) ▪ Determine the feasibility and constructability of constructing medians or raised curb islands at some driveways to provide pedestrian refuges. (I, LT)
Obstructed Sight Distance	▪ Consider trimming and removing some shrubs at intersections or driveways. (ST)
Vehicle Compliance with Traffic Control Devices	▪ Evaluate the potential capacity and pedestrian safety impacts of restricting U-turn movements at some locations. (ST) ▪ Determine the feasibility and constructability of constructing median end caps to provide additional protection for pedestrians in crosswalks. (I)
Limited Street Lighting	▪ Evaluate lighting along the corridor to ensure appropriate lighting levels and adherence to current lighting standards. (I) ▪ Consider repairing any malfunctioning street lighting in appropriate locations. (ST)
Sidewalk and Wheelchair Ramp Conditions	▪ Assess the need and feasibility of repaving some asphalt sidewalks with concrete. (ST) ▪ Assess the need and feasibility of expanding pedestrian landing areas at some corners. (ST) ▪ Determine the feasibility and constructability of constructing curb extensions in some areas. (I) ▪ Assess the need and feasibility of relocating some existing push buttons for better accessibility. (I)

Safety Issue	Suggestions
Right-turning Vehicle Speed	▪ Consider installing crosswalks compliant with MDSHA standards, pedestrian signage, and pavement markings to indicate pedestrian activity. (ST) ▪ Determine the feasibility and constructability of constructing curb extensions, reconstructing corner turning radii for slower speeds, or constructing narrower lanes. (LT)
Bicycle activity on sidewalk	▪ Suggestions intended to address pedestrian-vehicle conflicts will also address bicycle conflict issues. ▪ Consider dedicated bicycle facilities and improved bicycle signage as part of future redevelopment reviews. (LT)
City of Rockville Pedestrian Safety Inventory Study	▪ Reconstruct the existing 4-foot sidewalk along parts of Rockville Pike with a 5-foot sidewalk. ▪ Relocate the pedestrian signals in some locations to maintain adequate distance from the roadway. ▪ Reconstruct some sidewalk ramps to improve landing areas. ▪ Increase flashing pedestrian signal timings at some signals.
Maintenance	▪ Consider replacing missing median/divider sign. (ST) ▪ Consider replacing aged and faded signage. (ST)

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