Pedestrian Crosswalk Study

Hay Road (SR 642) and Stone Bridge High School Entrance

VDOT – EN14-053-109, PE101
UPC 106062
(Safe Routes to School – LCPS)
Loudoun County, Virginia

June 15, 2015

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INTRODUCTION

The following report presents the findings of a pedestrian crosswalk analysis to determine if an at-grade crosswalk can be established on the east side of the unsignalized intersection of Hay Road and the Stone Bridge High School entrance, and to evaluate whether there is a need for additional special devices at this location. The Hay Road and Stone Bridge High School entrance intersection is stop controlled at the minor street with four-lanes on Hay Road and two-lanes on the minor approach. Hay Road is currently a four lane undivided east-west roadway consistent with the Countywide Transportation Plan. Based on feedback received from VDOT, Hay Road is anticipated to be a candidate for the implementation of a ‘Road Diet’. An evaluation which considers a Road Diet for Hay Road is presented in this study. In addition, existing and future traffic conditions and physical characteristics of this location were evaluated to determine if the proposed pedestrian crosswalk is justified. A vicinity map showing the site location is included in Figure 1.

Figure 1: Location Map
HAY ROAD AND STONE BRIDGE HIGH SCHOOL ENTRANCE

Existing Conditions (2015)

Existing Roadway Network
A description of the existing roads at the study intersection is presented below. The existing lane configuration and traffic control for the study intersection are shown in Figure 2.

- Hay Road (SR 642) is a four lane undivided minor collector between Belmont Ridge Road (SR 659) and Claiborne Parkway (SR 901). The study section provides local access and is an undivided four-lane roadway with a posted speed limit of 35 mph. There are advance School warning signs (25 mph), with flashing beacons that are posted approximately 375’ west of the Stone Ridge High School entrance and approximately 625’ east of the High School entrance.

![Figure 2: Existing Lane Use](image)

Existing Traffic Data
In order to determine existing traffic conditions, 24-hour traffic data was collected on Tuesday, June 2, 2015 using Automated Traffic Recorders (ATRs). Traffic volumes were collected approximately 1000’ west of Claiborne Parkway and indicated that the daily traffic on Hay Road is approximately 8,050 vehicles. The ATR data is included in Appendix A.

Potential Road Diet (Hay Road)
Based on feedback received from VDOT, Hay Road is anticipated to be an ideal candidate for the implementation of a ‘Road Diet’. An evaluation which considers a Road Diet for Hay Road is presented in this study. Road diets often involve converting four-lane undivided roadways into three lanes (two through lanes and a center turn lane). An example showing a road diet configuration is shown in Figure 3.
Road Diets can often be beneficial to both vehicles and pedestrians, creating space for pedestrian refuge islands or added bike lanes, reducing pedestrian crossing distance and improving speed limit compliance. Per the FHWA Safety Program Road Diet Informational Guide, dated November 2014, Road Diets should be considered for one of the following reasons:

- To improve safety,
- To reduce speeds,
- To mitigate queues associated with left-turning traffic,
- To improve pedestrian environment,
- To improve bicyclist accessibility, or
- To enhance transit stops

A preliminary assessment of the existing roadway characteristics of Hay Road and criteria that help determine if a Road Diet should be considered are summarized in Table 1.

**Table 1: Road Diet Implementation Considerations**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Guidelines</th>
<th>Hay Road</th>
<th>Meets Criteria</th>
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<tbody>
<tr>
<td>Crash Problem</td>
<td>Higher than average?</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Existing Lane Width</td>
<td>Ideal - 4 - 12' Lanes</td>
<td>4 - 12' lanes</td>
<td>Yes</td>
</tr>
<tr>
<td>Speeds</td>
<td>Is traffic Calming needed?</td>
<td>Posted 35 mph</td>
<td>School Zone Area along Hay Road demands for lower speeds</td>
</tr>
<tr>
<td>ADT</td>
<td>&lt; 10,000 VDP (Yes)</td>
<td>8,050 VPD</td>
<td>Yes</td>
</tr>
<tr>
<td>10,000-20,000 VPD (Probable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Use (Beneficial for specific uses)</td>
<td>Block-style street grids</td>
<td>School Zone</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Shopping Areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>School Zones</td>
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</tr>
</tbody>
</table>
The above characteristics are preliminary considerations pertaining to a Road Diet. Accident data recorded in the past 3 years shows minimal incidents. The data presented in Table 1 concludes that Hay Road is an ideal candidate for a ‘Road Diet’ exercise and the following points support this conclusion:

- Hay Roads current 4-12’ lane geometry is ideal for a 3-lane Road Diet conversion, providing adequate right-of-way for two-though lanes, a center turn lane and bike lanes.
- The existing daily traffic on Hay Road is 8,050 VPD, indicating that traffic would not be rerouted and congestion would not increase with the implementation of a Road Diet.
- Hay Road provides access to Stone Bridge High School and several neighborhoods between Belmont Ridge Road and Claiborne Parkway. The school zone is a land use that supports a Road Diet.
- The closest offset intersections are approximately 315’ apart, therefore there should be minimal opposing traffic conflicts within the TWLTL (two-way left-turn lane).

Hay Road is anticipated to have three through lanes and a two-way-left-turn lane at the Stone Bridge High School entrance as illustrated in Figure 4.

**Figure 4: Anticipated Lane Configuration for Hay Road**
(Concept Plan Only- A separate signing striping plan will be submitted for this intersection at a later date.)
Stone Bridge High School Walk Zones

The Stone Bridge High School Walk Zone includes neighborhoods located to the south of Hay Road and west of Claiborne Parkway representing approximately 1/5th of the total walk zone as shown on Figure 5. Walkers from these neighborhoods are most likely to utilize the crosswalk at the proposed location on Hay Road.

Figure 5: Stone Bridge High School Walk Zone

PEDESTRIAN CROSSWALK ANALYSIS

The following section presents the detailed evaluation of the proposed pedestrian crosswalk location on Hay Road at the Stone Bridge High School entrance. The Virginia Department of Transportation’s (VDOT) Guidelines for the Installation of Marked Crosswalks were reviewed in this case. The guidelines provide recommendations for ‘Considering Marked Crosswalks and Other Needed Pedestrian Improvements at Uncontrolled Locations’. The basic justifications for determining whether a pedestrian crosswalk is necessary and what special devices are recommended are provided in the VDOT guidelines in the form of a flow chart. This flow chart is presented in Figure 6. The conditions that are met for this analysis are highlighted in red on the flowchart.
Figure 6: Flow Chart

1. Site visit to gather data
2. Location is near a pedestrian generator such as a school, park, hospital, library, senior center, shopping center, or employment center
3. Nearest marked crosswalk is at least 300 feet away
4. Pedestrians can be easily seen (from distance 10x speed limit)
5. Go to Table 1

- Insufficient need to justify a marked crosswalk
- 20 pedestrians per hour (15 elderly and/or children) or 60 in 4 hours cross at the location
- Direct pedestrian to the nearest marked crosswalk
- Unsafe location for a marked crosswalk Consider alternative location
The following steps, as labeled in Figure 3, were taken in accordance with the flow chart:

1) A site visit was made to the study location. The existing intersection at Hay Road and Stone Bridge High School is unsignalized. There are no significant obstructions barring drivers from viewing oncoming traffic and pedestrians. Figure 4 and Figure 5 show the current conditions on Hay Road approaching the vicinity of the intersection.

![Figure 7: Approximately 550’ from the proposed Crosswalk Location approaching from the West](image)

![Figure 8: Approximately 900’ from the Proposed Crosswalk Location approaching from the East](image)

2) The intersection is immediate to one (1) pedestrian generator: Stone Bridge High School. The High School is located immediately north of Hay Road and the crosswalk is proposed on the west side of the High School entrance on Hay Road. In addition to the school opening and closing time activity, some large volume spectator events are also held at the school attracting more pedestrian activity. In terms of walkability, sidewalks or trails are provided along the north and south sides of Hay Road between Belmont Ridge Road and up to Coppersmith Drive. All the surrounding residential neighborhoods have sidewalks encouraging pedestrian activity and the High Schools’ Walk zones include the neighborhoods located immediately to the south of Hay Road for approximately 2,500’. The
crosswalk location is proposed to provide a shorter and safer walking route for students located to the south of Hay Road but still within the High School Walk Zone.

Crosswalks on Hay Road currently exist at Claiborne Parkway and Belmont Ridge Road. Therefore, students living between Claiborne Parkway and Belmont Ridge Road on the south side of Hay Road, would typically have to walk pass the school entrance on Hay Road, utilize the crosswalk at Claiborne Parkway and either walk north on Claiborne Parkway to use the primary school entrance or head west on Hay Road to use the secondary entrance as shown in Figure 9.

![Figure 9: Additional Walking Distance for a Safe Route](https://www.google.com/maps)

Without the proposed crosswalk located near the school entrance on Hay Road, students located on the south side of Hay Road are required to walk over a ¼ mile to access a safe route to cross Hay Road.

3) The location of the intersection is more than 300 feet from another crossing location/controlled crossing location. The nearest crossing location is at the signalized intersection of Hay Road and Claiborne Parkway, which is approximately 640’ from the study intersection. Figure 10 shows the location of the nearest crosswalk.
4) Based upon a field visit to the site, the stopping sight distance at the study intersection is sufficient. Along Hay Road the intersection is visible from over 550’ from the west and over 775’ from the east. There are no obvious obstructions in the vicinity; i.e. hills, vegetation, trees, roadway curvature. The sight distance is greater than 350 feet (35 mph x 10), which is ten times the speed limit.

The final step on the flowchart is to evaluate the study intersection based on the VDOT guidelines table, which is shown in Figure 6.
Table 1. Recommendations for Considering Marked Crosswalks and Other Needed Pedestrian Improvements at Uncontrolled Locations

<table>
<thead>
<tr>
<th>ADT</th>
<th>2 lanes</th>
<th>3 lanes</th>
<th>+ 4 lanes, raised median</th>
<th>+ 4 lanes, no median</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 9,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;= 9,000 to &lt; 12,000</td>
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<tr>
<td>&gt; 12,000 to &lt; 16,000</td>
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<tr>
<td>&gt;= 16,000</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Candidate sites for marked crosswalks. Marked crosswalks must be installed carefully and selectively. First, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, but a more in-depth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, etc., may be needed at other sites. If the speed limit is less than or equal to 30 mph, use Level 1 or Level 2 devices. If the speed limit exceeds 30 mph, use Level 2 devices. Refer to Level 1 and Level 2 devices in the Special Treatments section.

Probable candidate sites for marked crosswalks. Pedestrian crash risk may increase if marked crosswalks are added without other pedestrian facility enhancements. Add Level 3 or Level 4 devices if feasible. Refer to Level 3 and Level 4 devices in the Special Treatments section.

Marked crosswalks alone are insufficient, since pedestrian crash risk may increase if only marked crosswalks are provided. Consider using Level 5 devices if feasible. If not feasible, use multiple treatments from Level 2, Level 3, or Level 4 devices. Refer to Level 5 devices in the Special Treatments section.

*These guidelines include intersection and mid-block locations with no traffic signal or stop sign on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median. Crosswalks should not be installed at locations that could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, substantial volumes of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make a crossing safer or necessarily result in more drivers stopping for pedestrians. Whenever marked crosswalks are installed, it is important to consider other pedestrian facility enhancements, as needed, to improve the safety of the crossing (for example, raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic calming measures, curb extensions). These are general recommendations; an engineering study should be performed to determine where to install marked crosswalks.

*Where the posted speed limit or 85th percentile speed exceeds 40 mph, marked crosswalks alone should not be used in uncontrolled intersections with an ADT greater than 15,000.

*The raised median or refuge island must be at least 4 feet (1.2 meters) wide and 6 feet (1.8 meters) long to adequately serve as a refuge area for pedestrians.


Hay Road: Speed Limit – 35 MPH; ADT – 8,050 vehicles; 3- Lane undivided Road (Assuming the Road Diet configuration)

Hay Road: Speed Limit – 35 MPH; ADT – 8,050 vehicles; 4- Lane undivided Road (Existing)

Figure 11: Recommendations Table – Hay Road
The guidelines table, as shown in Figure 6, is based on functional classification of the roadway, assuming a road diet is adopted for Hay Road, Average Daily Traffic (ADT) and the posted speed limit of the roadway. Using the input parameters outlined above, Hay Road with a 'Road Diet' falls under the category ‘Candidate sites for marked crosswalks’ in the guidelines table. It should be noted that Hay Road under existing conditions (4-lanes), falls under the category ‘Probable Candidate sites for marked crosswalks’.

Pedestrian Crosswalk Analysis Results

As shown in the previous table, Hay Road with a ‘Road Diet’ falls under the ‘Candidate sites for marked crosswalks’ category recommending a minimum Level 2 device since the speed limit is 35 mph. A Level 2 - High Visibility Crosswalk with advance warning signs would be a minimum recommendation for a crosswalk at this location. Hay Road under existing conditions recommends a minimum Level 3 or Level 4 device if feasible.

The following pedestrian enhancements included in VDOTs guidelines are outlined below and examples are shown in Appendix B:

- **Level 1 Devices**
  - Standard Crosswalks
  - Raised Crosswalks
  - Rumble Strips

- **Level 2 Devices**
  - High Visibility Crosswalks

- **Level 3 Devices**
  - Refuge Islands
  - Split Pedestrian Crossovers
  - Bulbouts

- **Level 4 Devices**
  - Overhead/Ground Mounted Signs and Flashing Beacons
  - In Roadway Warning Lights

- **Level 5 Devices**
  - Pedestrian-Actuated Signals
  - Grade-Separated Crossings

Table 1 below presents the possible enhancement devices (Level 1 through 5) and includes recommendations and whether the installation of the device is a feasible option at this intersection or not.
### Table 1: Device Implementation Recommendations

<table>
<thead>
<tr>
<th>Devices</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1 Devices</strong></td>
<td></td>
</tr>
<tr>
<td>Standard Crosswalks</td>
<td>Not Recommended; although feasible, Level 2 devices are recommended for roadway speeds greater than 30 mph.</td>
</tr>
<tr>
<td>Raised Crosswalks</td>
<td>Not Recommended; Although feasible, additional traffic calming that is typically achieved by raised crosswalks, has not been necessary at this location.</td>
</tr>
<tr>
<td>Rumble Strips</td>
<td>Not Recommended; Although feasible, rumble strips are typically only used under special circumstances to alert drivers of unusual traffic conditions that do not apply to this intersection.</td>
</tr>
<tr>
<td><strong>Level 2 Devices</strong></td>
<td></td>
</tr>
<tr>
<td>High Visibility Crosswalks</td>
<td>Yes; These types of crosswalks can increase driver awareness of pedestrian activity by improving visibility and creating a different audible tone.</td>
</tr>
<tr>
<td><strong>Level 3 Devices</strong></td>
<td></td>
</tr>
<tr>
<td>Refuge Islands</td>
<td>Not Recommended; Refuge islands would be feasible under the road diet scenario, however a raised median is not recommended at this location. As shown on Figure 11, under the road diet option, Level 3 devices are not needed.</td>
</tr>
<tr>
<td>Split Pedestrian Crossovers</td>
<td>Not Recommended; This special device is primarily used at mid-block locations and is not located near a transit connections.</td>
</tr>
<tr>
<td>Bulbouts</td>
<td>Not Recommended; Extending bulbouts is not recommended at a non-urban location.</td>
</tr>
<tr>
<td><strong>Level 4 Devices</strong></td>
<td></td>
</tr>
<tr>
<td>Overhead/Ground Mounted Signs and Flashing Beacons</td>
<td>Yes; These signs/beacons would alert drivers in advance of crossing pedestrians and have been found to increase driver yielding behavior at crosswalks as this location would be a primary crossing for students located on the south side of Hay Road.</td>
</tr>
<tr>
<td>In Roadway Warning Lights</td>
<td>Not Recommended; The pedestrians crossing this intersection will primarily do so during the day, rather than during the evening hours when the lights would be most visible.</td>
</tr>
<tr>
<td><strong>Level 5 Devices</strong></td>
<td></td>
</tr>
<tr>
<td>Pedestrian-Actuated Signals</td>
<td>No; Level 5 devices are not appropriate or cost effective for this roadway.</td>
</tr>
</tbody>
</table>

Based on the evaluation presented in the previous section, the following pedestrian enhancements are recommended at the intersection of Hay Road and Stone Bridge High School:

- Level 2 plus Level 4 Devices
  - High-Visibility Crosswalk + Ground Mounted Signs with Flashing Beacons

The recommended pedestrian enhancement option is a device which includes Level 2 and Level 4 devices. Level 4 devices are recommended since this location would be a primary crossing for students attending Stone Ridge High School. The Level 4 device would be pedestrian activated and this option would entail implementing ground mounted warning signs with flashing beacons. An example of a solar powered rectangular rapid-flashing beacon (RRFBB) is shown in Appendix C.
CONCLUSIONS

This report presents the findings of a safety study for the intersection of Hay Road and Stone Bridge High School entrance. The findings are summarized below:

- The existing intersection at Hay Road and Stone Bridge High School entrance is unsignalized. Based on feedback received from VDOT, Hay Road is anticipated to be a candidate for the implementation of a ‘Road Diet’. An evaluation which considers a road diet for Hay Road is presented in this study, which concludes that Hay Road is an ideal candidate for a ‘Road Diet’ exercise.

- Based on the functional roadway classification, Average Daily Traffic (ADT), and the posted speed limit along Hay Road, the study location is a candidate site for the addition of Level 2 devices.

- A significant area of the school walk zone is located on the south side of Hay Road and the proposed crosswalk location would be a primary crossing for students attending Stone Ridge High School. Hence it is recommended that a level 4 device be incorporated in addition to a Level 2 device.

- Level 2 and 4 devices outlined in the VDOT guidelines are listed below:
  - High Visibility Crosswalks (Level 2)
  - Overhead Signs and Flashing Beacons (Level 4)
  - In-Roadway Warning Lights (Level 4)

- The following pedestrian enhancement is recommended at the intersection of Hay Road and Stone Bridge High School under existing conditions (2015):
  - Level 2 plus Level 4 Devices
    - **High-Visibility Crosswalk + Ground Mounted Signs with Flashing Beacons**

This option entails both high visibility crosswalks and ground mounted warning signs with flashing beacons. It is recommended that roadside advance school crossing signs, pedestrian warning signs, and solar powered flashing beacons be installed along Hay Road. The pedestrian warning signs with flashing beacons should give adequate warning to drivers along Hay Road about possible pedestrians in the crosswalk. ADA ramps are not currently built at the proposed crosswalk locations; if the crosswalk studies are approved ADA ramps will be installed.
TECHNICAL APPENDIX

APPENDIX A
EXISING AVERAGE DAILY TRAFFIC VOLUMES

APPENDIX B
EXCERPTS FROM VDOT’S GUIDELINES FOR THE INSTALLATION OF MARKED CROSSWALKS

APPENDIX C
SOLAR POWERED RETANGULAR RAPID-FLASHING BEACON (RRFB)
APPENDIX A

EXISTING AVERAGE DAILY TRAFFIC VOLUMES
<table>
<thead>
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<th>Start Time</th>
<th>02-Jun-15 Westbound</th>
<th>Hour Totals</th>
<th>Eastbound</th>
<th>Hour Totals</th>
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Total 958 3163 1840 2092 2798 5255

Percent 23.2% 76.8% 46.8% 53.2% 34.7% 65.3%
APPENDIX B

EXcerpts from VDOT’s Guidelines for the Installation of Marked Crosswalks
Special Treatments

There are a number of innovative treatments for pedestrians at uncontrolled crossing locations. Level 1 devices are typically less costly to install and are found at locations with potentially lower levels of vehicle/pedestrian conflict. Level 2 through 5 devices can be more costly to install and are used at locations with an ascending order of potential vehicle/pedestrian conflicts.

Level 1 Devices

Standard Crosswalk

Standard crosswalks (Figure 4) consist of two parallel lines and can be used at uncontrolled intersections. They are not to be used at mid-block crossings. Refer to section 3B.17 of the MUTCD for further guidance on standard crosswalks.

![Figure 4. Standard Crosswalk](image)

Raised Mid-Block Crosswalk

Raised mid-block crossings (Figure 5) are sometimes constructed to provide a well-defined pedestrian crossing and to calm traffic. This type of crossing is suitable for only low-speed, low-volume local streets, since the raised crossing is essentially functioning as a speed table or hump.

Raised crossings enhance pedestrian safety by creating a vertical pavement undulation that forces motorists to slow down when approaching. They can function as an extension of the sidewalk and allow pedestrians to cross at a constant grade without the need for curb ramps or median cut-throughs. Raised crossings should have a 6-foot (1.8-meter) parabolic approach transition, raising the vehicle to 3 to 4 inches (7.6 to 10.2 centimeters) above the nominal pavement grade. The flat section of the crossing table should be 10 to 12 feet (3.0 to 3.7 meters) wide. Raised crossings need to be highly visible, either striped as a mid-block crossing or constructed of a contrasting pavement design. Raised crossings should be signed with advance warning signs and pedestrian crossing signs in the same manner as other mid-block crossings.
Rumble Strips

Rumble strips are series of intermittent, narrow, transverse areas of a rough-textured, slightly raised, or depressed road surface that are installed to alert road users to unusual traffic conditions.¹ They can be used as a temporary traffic control device in areas of temporary, unexpected crosswalks. Rumble strips should be placed in advance of a crosswalk. Because of maintenance issues, rumble strips should be used only in special circumstances.

Level 2 Devices⁶

High-Visibility Crosswalks

High-visibility crosswalks should be white and retroreflective (visible at night). They include the textured pavement crosswalks (Figure 6), “zebra” and “continental” crosswalks (Figure 7), and “triple-four” crosswalks (Figure 8). Textured pavement crosswalks are composed of stamped concrete or asphalt or brick pavers placed in a pattern and are outlined with white, retroreflective markings. These types of crosswalks can increase driver awareness of pedestrian activity by improving visibility and creating a different audible tone. The treatment can also improve the aesthetics of crosswalk installations. Disadvantages include higher construction and maintenance costs and the lack of smooth, accessible surfaces for pedestrians.¹³
Figure 6. Example of a Textured Pavement Crosswalk. From www.pedbikeimages.org / Dan Burden. Reprinted with permission.

Figure 7. “Zebra” Crosswalk (Left) and “Continental” Crosswalk (Right).
Level 3 Devices

Refuge Islands

Refuge islands (Figures 9 and 10) allow pedestrians to cross one segment of the street to a relatively safe location out of the travel lanes and then continue across the next segment in a separate gap. At unsignalized crosswalks on a two-way street, a median refuge island allows the crossing pedestrian to tackle each direction of traffic separately. This can significantly reduce the time a pedestrian must wait for an adequate gap in the traffic stream. A pedestrian pushbutton should be placed in the median of signalized mid-block crossings where the crossing distance exceeds 60 feet (18.2 meters). Curb ramps or cut-throughs should be provided for accessibility. Refer to VDOT’s Guidelines for the Placement of Curb Ramps for Accessible Routes and Continuous Passages on when and how to use curb ramps.
Split Pedestrian Crossover (SPXO)

The SPXO (Figure 11) is a pedestrian refuge that channels pedestrians to cross one half of the street; enter the island at one end; walk toward the flow of traffic; and exit at the other end to cross the second half of the street. This special treatment is primarily used at mid-block locations and is especially beneficial at or near transit connections.
Bulbouts

Intersections

At an intersection, each corner of the bulbout (Figure 12) is extended into the intersection by approximately 7 to 8 feet to shorten the crossing distance for pedestrians and raise their visibility to motorists.

Figure 12. Bulbouts at an Intersection.

Mid-Block Locations

At mid-block locations, bulbouts (Figure 13) are extended into the street by approximately 7 to 8 feet to shorten the crossing distance for pedestrians and raise their visibility to motorists.

Figure 13. Bulbouts at a Mid-Block Location.
Level 4 Devices

Overhead Signs and Flashing Beacons

Overhead signs can be various signs showing the universal pedestrian symbol, including standard yellow, fluorescent yellow, and LED displays that hang from a mast arm and extend over the street. Flashing beacons should accompany the overhead signs (Figure 14). A flashing beacon provides a relatively low-cost treatment for mid-block pedestrian crossings. The flashing light alerts drivers in advance of potential pedestrians without forcing them to stop unless there is actually a pedestrian in the crosswalk. This sort of device can be used on roadways with higher vehicular volumes without causing undue delay to drivers. Flashing beacons are most effective if they are operating only during times when there is a clear need to alert motorists, such as when pedestrians are actually present (rather than constantly flashing). This can be done by using pedestrian pushbuttons (Figure 15) or passive activation. Refer to Section 4K.03 in the MUTCD for further guidance on flashing beacons.1

Figure 14. Overhead Sign with Flashing Beacons. From www.pedbikeimages.org / ITE Pedestrian Bicycle Council. Reprinted with permission.

Figure 15. Pedestrian Pushbutton for Flashing Beacon Operation. From www.pedbikeimages.org / Dan Burden. Reprinted with permission.
In-Roadway Warning Lights (IRWLs)

IRWLs (Figure 16) should be installed with a flashing sign at the crosswalk and an advanced flashing sign ahead of the crosswalk. They should also be installed with advance audible warning devices for motorists, such as rumble strips. Refer to VDOT’s Guidelines for the Installation of In-Roadway Warning Lights for further guidance.16

Figure 16. In-Roadway Warning Lights at a Mid-block Crosswalk. From www.pedbikeimages.org / ITE Pedestrian Bicycle Council. Reprinted with permission.

Level 5 Devices6

Pedestrian-Actuated Signals

Pedestrian-actuated signals (Figure 17) should be placed at mid-block locations where vehicle and pedestrian volumes warrant a signal. Refer to Section 4C.05 Warrant 4, Pedestrian Volume of the MUTCD for further guidance on mid-block pedestrian-actuated signals.1

Figure 17. Pedestrian-Actuated Mid-block Signal. From www.pedbikeimages.org / ITE Pedestrian Bicycle Council. Reprinted with permission.
Grade-Separated Crossings

The purpose of grade-separated crossings is to separate pedestrian travel from vehicular travel completely. These crossing facilities should be used only where it is not possible to provide an at-grade facility. Examples are crossing a freeway or major highway (Figures 18 and 19), a rail yard, or a waterway. Grade-separated crossings should:

- be accessible.
- have minimal grade changes
- have a clear passage width of at least 3.7 meters (12 feet).11

Figure 18. Grade-Separated Crossing (Bridge) Over a Major Highway. From www.pedbikeimages.org / Dan Burden. Reprinted with permission.

Figure 19. Grade-Separated Crossing (Tunnel) Under a Roadway. From www.pedbikeimages.org / Dan Burden. Reprinted with permission.
APPENDIX C

SOLAR POWERED RETANGULAR RAPID-FLASHING BEACON (RRFB)
**Rectangular Rapid Flash Beacon (RRFB) LED Crosswalk Warning System**

RRFBs are user-actuated amber LEDs that supplement warning signs at intersections without signals or mid-block crosswalks. Two arrays of alternately flashing LEDs use an irregular flash pattern (similar to emergency flashers on police vehicles), commanding the attention of drivers day and night. The RRFB has been show to provide an 80% reduction to Yield-to-Pedestrian traffic, exceeding that of standard beacons. As a low cost alternative to traffic signals, it’s no wonder why RRFB systems are taking the country by storm! The RRFB units install easily onto new or existing signal poles, and TAPCO can provide completed system with poles and hardware. The FHWA requires that RRFB systems are solely for use in pedestrian or school crossings, and must be pedestrian activated (actively or passively).

- **TAPCO RRFB LEDs** are the brightest and most durable on the market
- **Wireless Synchronized Control**
- **Longest Range of Communication**
- **3-Year Warranty; Dedicated Support**
- **Lowest Power Consumption**
- **SAE Certified, Steerable LED Arrays**
- **Solar, 110VAC or 12VDC**
- **Two LED Array Sizes: RRFB, RRFB-XL**
- **Efficient Energy Management System**
- **Active or Passive Wireless Activation**
- **Pushbutton or Bollard or Infrared**
- **Individually Maintained Components**
- **Up to 30-day Autonomy**
- **ITS Compatible**
- **Signs & Anti-vandal Hardware**
- **RRFB LEDs** can flash on front and sides, alerting drivers and pedestrians simultaneously
- **Compatible with Intelligent Transportation Systems (ITS)**
- **MUTCD interim approval**

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**Solar powered. No AC required.**

1. **Pedestrian activates BlinkerBeam®** wirelessly activates the other RRFB unit

2. BlinkLink