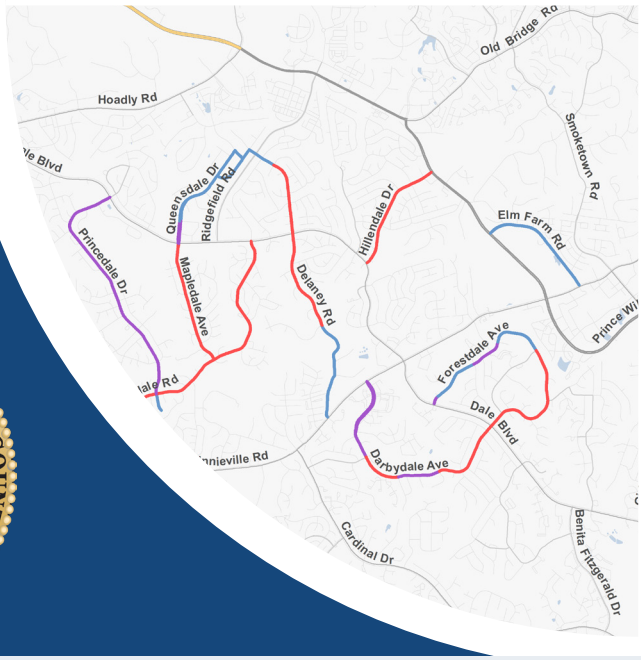
PRINCE WILLIAM COUNTY LEGACY ROADWAY PROGRAM



Prepared for Prince William County

MAY 2022

ACKNOWLEDGMENTS

Richard Weinmann, Prince William County
Salah Salem, Prince William County
Paolo Belita, Prince William County
Meagan Landis, Prince William County
Daniel Scolese, Michael Baker International
Jacob Thornton, Michael Baker International

About GAP-TA

Visit vtrans.org/about/GAP-TA for information about the Growth and Accessibility Planning Technical Assistance program.

Contact information

Richard Weinmann
703.792.8002
RWeinmann@PWCgov.org

Prince William County Government
Department of Transporation, Traffic and Safety Engineering Branch
5 County Complex Court
Prince William, VA 22192

The opinions and conclusions expressed or implied in this report are those of the authors and are not necessarily those of the Office of Intermodal Planning and Investment (OIPI).

OIPI does not endorse products or manufacturers. Any trade or manufacturers' names that appear herein are solely because they are considered essential to the object of the report.

CONTENTS

CONTENTS

FIGURES

TABLES

INTRODUCTION

Legacy roadways in PWC are roadways that were constructed prior to the year 1980 when design standards were different than the design standards of today. These roadways tend to have wide pavement sections, substandard pedestrian facilities, unwarranted traffic control measures, limited stormwater system capacity, and limited residential parking due to increasing car ownership. The purpose of this program is to address these deficiencies through modernization and retrofits. The program provides a guide to identify needs that fall short of modern design standards and comprehensive goals and a toolbox of solutions to address those needs.

All of the procedures within this manual are subject to change and do not replace the standards and practices set forth by VDOT and/or Prince William County to implement a final solution. Furthermore, the procedures, needs, and mitigation issues are specific to PWC and do not supersede statewide programs such as the Virginia's Transportation Plan (VTrans).

For questions on any of the enclosed policies please contact the Prince William County Department of Transportation at 703-792-6825.

Acronyms Listing

Average Annual Daily Traffic – AADT
Equivalent Property Damage Only – EPDO
Instructional & Informational Memorandum – IIM
Manual on Uniform Traffic Control Devices - MUTCD
Office of Intermodal Planning and Investment - OIPI
Origin – Destination - O-D
Pedestrian Action Plan - PSAP
Pedestrian Level of Traffic Stress – PLTS
Potential for Safety Improvement – PSI
Prince William County – PWC
Traffic Operations and Safety Analysis Manual – TOSAM
Virginia Department of Transportation – VDOT
Virginia Transportation Plan – VTrans

LEGACY ROADWAY ELIGIBILITY

Legacy Roadway Eligibility

Legacy roadways in Prince William County are identified as roadways that were constructed prior to 1980 and have characteristics similar but not limited to:

- Wide Pavement Cross-sections for two-lane roadways (Greater than 30 feet or 12 foot travel lanes)
- Substandard pedestrian facilities (sidewalks less than 5 feet) with minimal or no buffer strips between the roadway and sidewalk
- Unwarranted traffic control measures unchecked following contractor completion
- Stormwater system capacity limited or degrade by nearby development
- Limited residential parking due to increasing car ownership

Eligibility of a roadway for this program should be located near or within a Small Area Plan. Figure 1 shows the locations of Small Area Plans within the county.

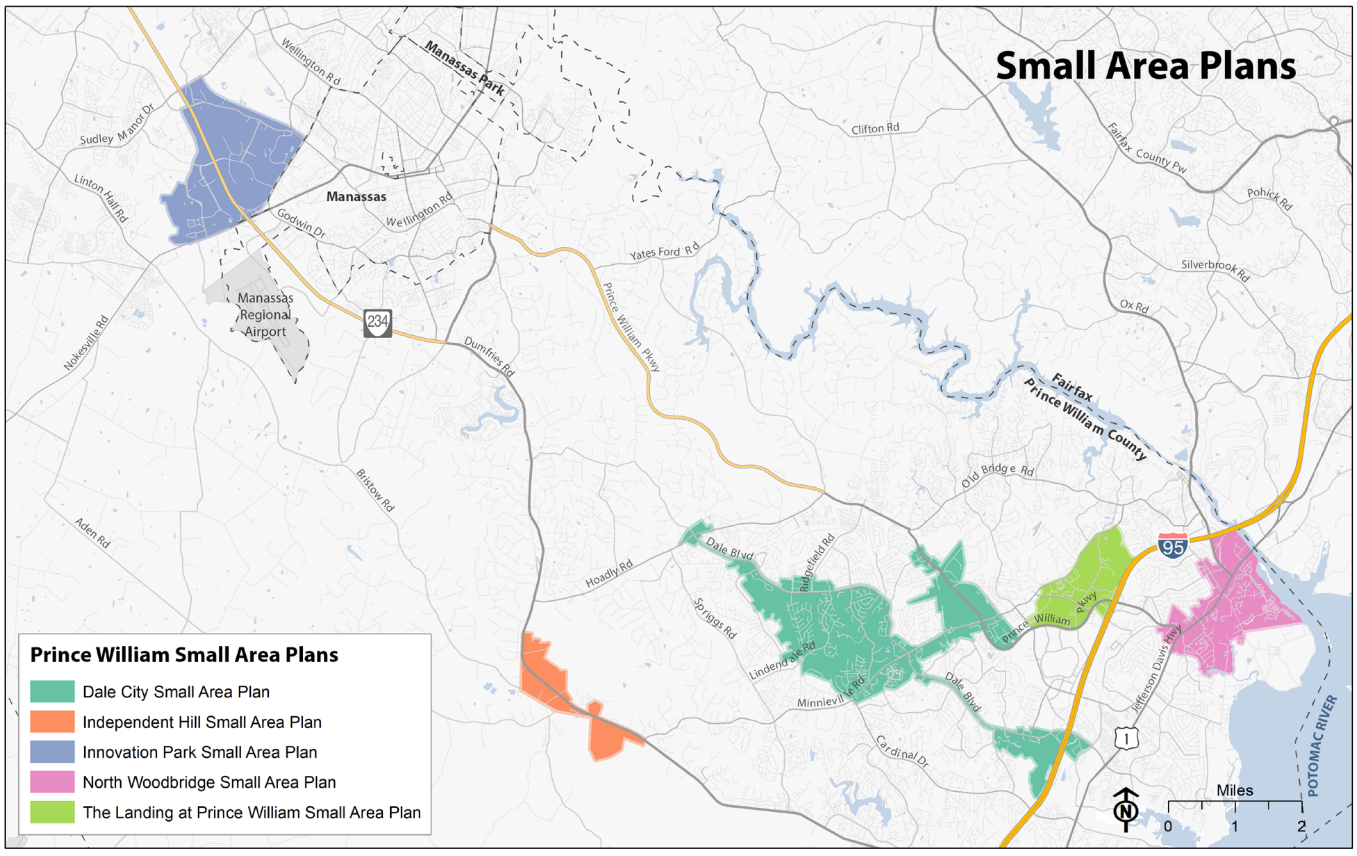
Legacy roadways in Prince William County are identified as roadways that were constructed prior to 1980 and have characteristics similar but not limited to:

- Wide Pavement Cross-sections for two-lane roadways (Greater than 30 feet or 12 foot travel lanes)
- Substandard pedestrian facilities (sidewalks less than 5 feet) with minimal or no buffer strips between the roadway and sidewalk
- Unwarranted traffic control measures unchecked following contractor completion
- Stormwater system capacity limited or degrade by nearby development
- Limited residential parking due to increasing car ownership

Eligibility of a roadway for this program should be located near or within a Small Area Plan. Figure 1 shows the locations of Small Area Plans within the county.

All legacy roadways entering the program must be approved by the XXXX. A current list of eligible legacy roadways can be found in Appendix A or on Prince William County GIS. This list will be updated periodically.

Figure 1: Location of Small Area Plans



NEED IDENTIFICATION

Need Categories

A summary of legacy roadway needs, and characteristics are necessary in order to evaluate the applicable measures to modernize legacy roadways. The need categories evaluated on legacy roadways are as follows:

- Bicycle Infrastructure
- Pedestrian Infrastructure
- Candidate locations for new crosswalks
- Candidate enhancements for existing crosswalks
- Curb Management
- Parking Needs
- Ramp Accessibility Condition
- Potential for cut-through traffic
- Potential for speeding
- Intersection safety
- Segment safety
- Intersection control candidates for review
- Potential for Flooding

It should be noted that the needs identified by this process are specific to PWC and do not supersede state or federal programs such as VTrans. However, if a state or federal identified needs exist on a legacy roadway, the information from this program may be used to supplement future studies. Furthermore, the needs identified from this program are not definitive but informative to determine next steps, support future studies, or influence funding programs.

Evaluation Frequency

Needs for legacy roadways shall be evaluated as soon as reasonably possible when the roadway enters the program. Existing needs should be re-evaluated periodically as described below. Since most legacy roadways have fully built-out land-uses and lower volumes, it is anticipated that existing needs will not change significantly over time. However, the following situations are reasons to re-evaluate needs:

- Implementation of countermeasures or mitigation strategies.
- Finalized engineering and planning studies performed on legacy roadway
- Three years following development abutting or within a reasonable distance of legacy roadway.
- Three years following construction of improvements on parallel and intersecting non-legacy roadway facilities.
- Updates from State and Federal plans such as the Virginia Transportation Plan or VDOT's Potential for Safety Improvement (PSI) locations.

The PWC program manager may choose to re-evaluate needs outside of the situations stated above.

Need Changes

Changes are expected to occur over the course of the Legacy Roadway Program. It is possible that need categories are no longer relevant, new need categories are needed, or processes need to be updated based on new information. Therefore, all proposed changes shall be submitted or initiated by the PWC program manager.

Existing Policy and Guidance

Existing state, federal, and local policies exist that outline mandated requirements to determine eligibility and scope. The policies tend to rely on specific data sources and engineering studies to identify the problem and determine a solution. These studies are typically confined to a small areas and are resource intensive. The Legacy Roadway Program scope is large in geographic area but resource friendly by using readily available data to determine needs. Process development is guided by using existing policy to increase validity. Therefore, when a policy was used to aid in need determination, a process will reference the policy guidance. If there is a policy shortfall to mitigate a need, the countermeasures section of the Legacy Roadway Program will identify the missing data. Below is a summary of the referenced policy and guidance measures used to help develop processes:

- Prince William County Residential Traffic Management Guide – 2020
- VDOT Traffic Calming Guide for Neighborhood Streets – September 23, 2018
- VDOT Policy and Procedures Control of Residential Cut-Through Traffic
- VDOT Instructional & Informational Memorandum (IIM) – TE-384.0: Pedestrian Crossing Accommodations at Unsignalized Locations
- 2009 Manual on Uniform Traffic Control Devices (MUTCD) (Revisions 1 and 2)
- 2011 Virginia Supplement to the Manual on Uniform Traffic Control Devices (MUTCD) (Revision 1)
- Traffic Operations and Safety Analysis Manual (TOSAM) – Version 2.0

NEED DETERMINATION PROCESS

The following sub-sections will outline the steps and data required to determine a particular need. The outcome of each process is to identify if a need exists and the location. Needs are classified under a segment and/or intersection location. Table 1 identifies need location classification. The segmentation process is performed by breaking up the legacy roadway by intersecting public roadways. It should be noted that some segments may be long, therefore some needs may be concentrated to a portion of the segment and should be analyzed in studies outside this program.

Supporting Data

Each need category has a process that requires evaluating data set(s) to determine if a need exists. Data includes items such as roadway characteristics or daily traffic volumes. Each category process will outline the required data set (s), however sources of data are important to help with need validity. The acceptable sources and its applicable data are summarized in Table 2.

Table 1: Location Classification

Location Type	Need Category
Segmentation	• Bicycle Infrastructure • Pedestrian Infrastructure • Candidate locations for new crosswalks • Candidate enhancements for existing crosswalks • Ramp Accessibility Condition • Potential for cut-through traffic • Potential for speeding • Segment safety • Potential for Flooding
Intersection	• Candidate locations for new crosswalks • Candidate enhancements for existing crosswalks • Curb Management • Intersection safety • Intersection control candidates for review

NEED DETERMINATION PROCESS

Table 2: Location Classification

Source	Data
VDOT	• Roadway characteristics • Average Annual Daily Traffic (AADT) • Crash history • Intersection characteristics • Bicycle Infrastructure • Pedestrian Infrastructure
OIPI	• Bicycle Infrastructure • Pedestrian Infrastructure • Intersection safety • Segment safety • Potential for Flooding
PWC GIS Databases	• Roadway characteristics • Bicycle Infrastructure • Pedestrian Infrastructure • Land Use/Zoning • Parking
Streetlight	• Origin - Destination (O-D)
Traffic data within last 2 years[1]	• Speed • Volumes • Vehicle classification • Origin - Destination (O-D)
Field Visits/Aerial Imagery[2]	• Roadway characteristics • Intersection characteristics • Bicycle Infrastructure • Pedestrian Infrastructure • Land Use • Parking

1 Traffic Operations and Safety Analysis Manual (TOSAM) – Version 2.0 Section 6.2.2 Traffic count data older than two years may be considered given that minimal change has occurred to the average daily traffic or traffic growth.

2 Aerial and Streetview imagery are acceptable if no significant geometric or land uses changes have occurred since time of review.

NEED DETERMINATION PROCESS

Any source outside from the ones listed in Table 1 should be verified and approved by the PWC project manager.

Processes do not supersede existing local, state, or federal policy. As well, in some instances, determination of a need alone does not necessitate that it exists. Therefore, all needs are informative to determine next steps, support future studies, or influence funding programs.

All legacy roadway needs are summarized in Appendix B and within a PWC geodatabase file, which may be given upon request to the PWC Legacy Roadway program manager.

Bicycle Infrastructure

The purpose of this process is meant to identify bicycle infrastructure needs for a segment. Existing planning studies (listed below) have already been performed by PWC and the state. Therefore, the required sources for need determination are:

- VTrans
- Prince William Comprehensive Plan
- Prince William Mobility Plans
- Prince William Small Area Plans

Process

A segment has a bicycle infrastructure need if any source identifies a planned route along a legacy roadway. As well, if a planned bicycle infrastructure route intersects a legacy roadway segment, that segment shall meet a bicycle infrastructure need.

Pedestrian Infrastructure

The purpose of this process is meant to identify pedestrian infrastructure needs for a segment. This process does not identify accessibility requirements, which is identified in the Ramp Accessibility Condition section. The required data for need determination are:

- Speed Limit
- Sidewalk location
- Sidewalk width
- Buffer type
- Buffer width
- Street lighting presence
- Land Use

Process

A pedestrian infrastructure need exists on a segment if the Pedestrian Level of Traffic Stress (PLTS) is 3 or more. The PLTS is determined by the highest PLTS score for a category. The PLTS calculation for each category is as follows:

1. Determine the PLTS for Land Use

a. Identify the abutting land use on a segment and assign a PLTS score based on Table 3.

Table 3: Land Use PLTS Scores

Source	Description	PLTS Score
LANDFILL	Landfill	4
PP	Power Plant	4
QUARRY	Quarry	4
RAIL	Railroad	4
UT	UTILITY	4
IND	Industrial	4
CB	Commercial - Big Box	3
C	Commercial	2
AGR	Agricultural	2
RL	Residential Low Density	2
RX	Residential Very Low Density	2
GOLF	Golf Course	1
GOLF-P	Golf Course - Private	1
INST	Institutional	1
MANASSAS	Park	1
MANASSAS PARK	Park	1
OS	Open Space	1
REC	Recreational PWC Land	1
RH	Residential High Density	1
RM	Residential Medium Density	1
SCH	School	1
SCH-P	School - Private	1
US-NON-REC	Non-Recreational Federal Lands	1
US-REC	Recreational Federal Lands	1
VA-NON-REC	Non-Recreational State Lands	1
VA-REC	Recreational State Lands	1
WATER	Open Water	1

2. Determine the Lighting plus Sidewalk Width PLTS Score

a. Identify if lighting exists on the majority of the sidewalk segment

i. Assign a "0" if lighting exists on segment

ii. Assign a "1" if lighting does not exist on segment

b. Assign a Sidewalk Width PLTS Score using Table 4.

Table 4: Sidewalk Width PLTS Score

Actual Sidewalk Width (ft)[1]	PLTS Score
None Exists	4
<4	3
≥4 to <5	2
≥5	1

1 Can include other facilities such as walkways, trails, and shared-use paths.

c. Calculate the Lighting plus Sidewalk Width PLTS Score for the segment.

3. Determine the buffer width PLTS Score using Table 5.

a. The buffer width should include any distance from the edge of travel to edge of sidewalk

i. I.e. Parking plus buffer strip = total buffer width

Table 5: Buffer Width PLTS Score

Total Number of Travel Lanes in Both Directions	<5 Ft	≥5 ft to <10 ft	≥10 ft
2	2	2	1
3	3	2	1
4-5	4	3	1
6	4	4	2

4. Determine the buffer type PLTS Score using Table 6.

Table 6: Buffer Type PLTS Score

Buffer Type	≤30 MPH	≥35 MPH
No Buffer	3	4
Solid Surface	2	2
Landscaped	2	2
Landscaped with Trees	1	2

5. A need exists if any of the PLTS scores exceed 3. The segment shall be coded by the PLTS scores that exceed 3. Otherwise, no need exists.

a. SWL = Sidewalk width + lighting

b. SW = Sidewalk width

c. BW = Buffer Width

d. BT = Buffer Type

Multiple codes may be provided for a segment. If no need exists, code as "No." or if no sidewalk exists, code as "No Sidewalk."

Candidate Locations for New Crosswalks

The purpose of this process is meant to identify candidate locations for new crosswalks on a roadway segment or at an intersection. This process is only meant to identify new candidate locations, not to improve existing crosswalks (See "Candidate for Existing Crosswalk Enhancements"). The following data will be required:

- AADT
- School Locations
- Land Use
- Crash History – Pedestrian Crashes
- VDOT Pedestrian Action Plan (PSAP)
- Existing Crosswalk Locations

This process relies on existing guidance from the VDOT IIM – TE-384.0: Pedestrian Crossing Accommodations at Unsignalized Locations and the 2009 MUTCD. Both of these policies outline strict guidance for the implementation and must be consulted prior to implementation. The countermeasures section will outline additional data that will help satisfy these policies.

Location Identification
A candidate location may exist on a segment as a mid-block location (typically uncontrolled) or at an intersection.

If a candidate location is found to be on a segment, the need shall be coded with a "M." Whereas a candidate location at an intersection shall be coded with a "I." If no need exists, a "No" shall be placed for that segment.

Process
A candidate location for a new crosswalk if the following process is met:

1. The volume across the approach is above 1,500 vehicles per day[1]
   a. YES – Proceed to Step 3
   b. NO – Proceed to Step 2

2. Does the possible location meet one of the following criteria.
   a. Criteria A: The candidate location is on a quarter mile route that does not require a mid-block crossing to access a school entrance.[2]
   b. Criteria B: The candidate location is on a quarter mile route to a ped-oriented land use (Future or existing) 5
      i. Residential on both sides does not satisfy this criteria requirement.
   c. If neither criteria is met Proceed to Step 3

3. Is there a documented pedestrian crash history on the segment or within 250' of an intersection? Or is the segment on the VDOT PSAP?
   a. YES – Proceed to STEP 4
   b. NO – STOP – No need exists

4. Does a parallel crosswalk exist within 300 feet of a candidate location?[3]
   a. YES – STOP – No need exists
   b. NO – STOP – Identify the candidate crosswalk location as "I" or "M"

Candidate Enhancements for Existing Crosswalks

The purpose of this process is to identify potential pedestrian crossing enhancements needs for existing crosswalk locations. Pedestrian crossing enhancements may include signage, high-visibility crosswalks, or other measures. The following data will be required:

- AADT
- School Locations
- Existing Crosswalk Locations
- Crosswalk length
- Crash History – Pedestrian Crashes
- VDOT Pedestrian Action Plan (PSAP)

This process relies on existing guidance from the VDOT IIM – TE-384.0: Pedestrian Crossing Accommodations at Unsignalized Locations and the 2009 MUTCD. Both of these policies outline strict guidance for the implementation of crosswalk enhancements and must be consulted prior to implementation. The countermeasures section will outline additional data that will help satisfy these policies.

Process
A candidate location for a new crosswalk if the following process is met:

1. Is the volume across the approach is above 1,500 vehicles per day?[4]
   a. YES – Proceed to Step 2
   b. NO – Proceed to Step 3

2. Is the candidate location on a quarter mile route that access a school entrance?[5][6]
   a. YES – STOP – Crosswalk is a candidate for crosswalk enhancements
   b. NO – Proceed to Step 3

3. Is the crossing width > 36 feet and on an uncontrolled approach?[7]
   a. YES – STOP – Crosswalk is a candidate for crosswalk enhancements
   b. NO – Proceed to Step 4

1 VDOT IIM-TE-384.0 – The typical minimum volume for marked crosswalks and other needed pedestrian improvements across uncontrolled approaches.
2 VDOT IIM-TE-384.0 & MUTCD – Crosswalk markings may be considered along school routes and ped-oriented land uses.
3 VDOT IIM-TE-384.0 – Section 5.3: The location is 300 feet or more from another marked crosswalk across the same road, or engineering judgment determines that sufficient demand and pedestrian desire lines exist to justify both crosswalks.
4 VDOT IIM-TE-384.0 – The typical minimum volume for marked crosswalks and other needed pedestrian improvements across uncontrolled approaches.
5 VDOT IIM-TE-384.0 & MUTCD – Crosswalk enhancements may be considered along school routes and ped-oriented land uses.
6 Virginia Safe Routes to School As written in SAFETEA-LU, the purpose of the SRTS program is to enable and encourage children to walk and bike to school by making facilities safer and more appealing.
7 VDOT IIM-TE-384.0 – Table 2 of the IIM outlines conditions where additional enhancements may be considered based on speed, volume, and number of travel lanes. Typically, on low-speed low-volume roadways, if the number of lanes a pedestrian must cross is three or more (which is typically 36'), a crosswalk enhancement may be considered.

4. Is there a documented pedestrian crash history on the segment or within 250' of an intersection? Or is the segment on the VDOT PSAP?
   a. YES – STOP – Crosswalk is a candidate for crosswalk enhancements
   b. NO – STOP – No need exists

Curb Management

The purpose of this process is to identify potential opportunities for curb management. The curb management practice will improve safety for both vehicles and pedestrians at intersections by reducing obstructions within a roadway users' sight-distance. This process is specific to intersections and existing crosswalks at uncontrolled intersection approaches. The following data will be required:

- Intersection Location
- AADT
- Street parking

Process:
A curb management need exists based on the following process.

1. Does on-street parking exists along the roadway?
   a. YES - Continue to Step 2
   b. NO - STOP – No need exists

2. The AADT intersecting street is 1,500 vehicles per day or more?
   a. YES - Continue to Step 3
   b. NO - STOP – No need exists

3. Does parking exist within 100' of an intersection or crosswalk?
   a. YES – STOP – A need exists
   b. NO - STOP – No need exists

Parking Needs

The purpose of this process is meant to identify if a segment has a preservation or mitigation need for parking.

- Census Tract Data
  - Vehicles per household

Process:
A preservation need exists if the average vehicle per household is 2.2 vehicles/household. (2±10%)

A mitigation need exists if the average vehicle per household is more than 2.2 vehicles/household. (2±10%)

The average vehicle per household is determine by which census tract overlays on top of the segment. If two or more boundaries meet, average the intersecting average per household values.

Curb Ramp Accessibility Condition

The purpose of this process is to identify if a curb ramp meets existing ADA, VDOT, and PWC design standards.

- Curb ramp information

Process:
If an existing curb ramp does not meet ADA, VDOT, and PWC design standards, or a curb ramp does not exist at the location of an existing crosswalk, then a need exists.

Potential for Cut-through Traffic

The purpose of this process is meant to identify the potential for a cut-through on a roadway. The following data will be needed:

- Speed limits
- AADT
- Streetlight Origin-Destination (O-D) data

This process relies on existing guidance from the PWC Residential Traffic Management Guide and the VDOT Policy and Procedures Control of Residential Cut-Through Traffic. Both policies outline strict eligibility guidance, values, and metrics for determining if a cut-through problem exists, and therefore must be used for final determination. This process only evaluates the risk of a cut-through traffic occurring on a legacy roadway.

Process:
The potential for cut-through is be determined by Origin-Destination Data using Streetlight. Streetlight uses location-based services from mobile devices and GPS-navigation data from personal vehicles and commercial trucks to assess the mobility of a network.

1. Determine the daily volume of the legacy roadway and K Factor of the legacy roadway

2. Calculate the peak hour volume for one direction
   - Calculation: AADT x K Factor x 60% directional split = Peak Hour Volume for One Direction
3. Obtain Origin-Destination data from Streetlight

4. Identify the highest percentage of cut-through traffic from the origin-destination data between 7am and 7pm.

5. Determine the product of the percentage from Streetlight and the Peak Hour Volume for one direction
   - Calculation: Peak Hour Volume for One Direction x

Streetlight Percentage = Estimate Cut-through traffic

6. Does the calculated cut-through traffic exceed 150 vehicles?[8]
   a. YES - STOP - A high probability that consistent cut-through traffic is occurring - HIGH
   b. NO - Continue to Step 7

7. Is the Streetlight percentage between 20% and 40%?[9]
   a. YES - STOP – There is a probability that cut-through traffic may occur. Cut-through traffic may occur or be more prevalent during certain seasons, schoolyear, and/or specific days of the week – MODERATE
   b. NO - STOP – There is a low probability that cut-through traffic is occurring consistently. If cut-through traffic does occur it may be because of infrequent single events such as weather, work zones, accidents, and/or events - LOW

Potential for Speeding

The purpose of this process is meant to identify the potential for a speeding on a legacy roadway. Although speeding may occur by individuals, speeding concerns as defined by VDOT and PWC policy is determined based on the average or 85th percentile of all traffic.[10] Therefore, a potential for speeding need is evaluating the risk probability that the entirety of traffic may exceed posted speed limits. This process does not estimate, calculate, or determine the average or 85th percentile speeds of traffic. The following data will be required:

- Travel lane Width
- Shoulder Type
- Potential for cut-through data
- Existing traffic calming measures

This process relies on existing guidance from the PWC Residential Traffic Management Guide and the VDOT Traffic Calming Guide for Neighborhood Streets. Both policies outline strict eligibility guidance, values and metrics for measuring if a speeding problem exists, and therefore must be used for final determination. This process only evaluates the risk of a speeding on a legacy roadway.

Potential for Speeding Need Process

The potential for speeding can be measured by multiple roadway attributes. A segment speeding potential need is determined by the average score of the following criteria:

1. Reduce lane width by 1 foot for segments with unmarked parking.[11]
2. Assign a score for each roadway attribute using Table 7.
3. Average the three roadway attributes score
   - Calculation: (Travel Lane Width Score + Shoulder Type Score + Potential for Cut-through score) / 3
4. Reduce the calculated average for a segment by 0.5 points if a traffic calming device exists within 500 feet or on the segment.[12]
5. Increase the calculated average for a segment by 0.5 points if the road has more than two-lanes.
6. Using the calculated average, determine the speeding potential using table 8.

8 VDOT Policy and Procedures Control of Residential Cut-Through Traffic: For at least one hour of the day on a typical travel day of concern (typically a weekday, excluding holidays but may be other days/times of day) in a single travel direction, the street must have a minimum "residential cut-through traffic" volume of 150 vehicles or more that comprises 40% or more of the total vehicular traffic in the same hour and travel direction (e.g. on a street for a particular travel day where there is a total hourly traffic volume of 1,375 vehicles in a single travel direction, 550 or more vehicles within the same hour and travel direction must be cut-through traffic). An engineering study is required to assess any cut-through concerns.

9 The Streetlight process outlined in Appendix X is based on the yearly average of all Tuesday through Thursdays. Therefore, it is possible that other seasons or days may reduce the calculated cut-through percentage.

10 PWC Residential Traffic Management Guide & VDOT Traffic Calming Guide for Neighborhood Streets: Policies outline that the average or 85th percentile are required to determine speeding concerns.

11 Unmarked parking tends to be on roadways with a pavement width less than 36 feet. Although during most of the day when most vehicles are on a roadway, the parking along a roadway is sparse but can affect travel lane width and driver behavior when navigating around a parked car. Therefore, this should be viewed as a shoulder with less than 6 feet and reduce the lane width by 1 foot.

12 VDOT Traffic Calming Guide for Neighborhood Streets: Traffic calming measures are outlined in this guide but may include chockers, speed tables, and chicanes. Stop-signs are not traffic calming devices. Physical traffic calming measures require a minimum spacing of 500 feet or greater between devices.

Table 7: Points by Roadway Attribute

Score	Tavel Lane Width (ft)[1]	Shoulder Type	Potential for Cut-through[2]
1	≤10	No Shoulder/Curb and Gutter with no parking	LOW / NONE
2	>10 to ≤11	Shoulder width <6 or unmarked parking	MODERATE
3	≥12	Shoulder width ≥6 or marked parking	HIGH

1 FHWA Highway Capacity Manual: Lane widths are a function of capacity and speed. Lane width less than 12 feet have a speed reduction factor on the Base Free Flow Speed. VDOT Traffic Calming Guide for Neighborhood Streets: Lane width reduction is a traffic calming tool to mitigate speeding.

2 Cut-through traffic is typically a result of vehicles attempting to save time by using an alternative path not intended to carry the cut-through traffic. Therefore, more cut-through traffic has the potential to increase the base (average) speed where as a low potential for cut-through traffic does not.

Table 8: Speeding Potential Score

Speeding Potential	Calculated Average
High - There is a high-risk speeding could occur on a roadway	≥2.5
Moderate - There is a possibility speeding could occur on a roadway	≥2 to ≤2.5
Low - There is a low or no probability speeding could occur on a roadway	<2

1 Can include other facilities such as walkways, trails, and shared-use paths.

Intersection Safety

The purpose of this process is meant to identify the safety needs related to vehicular travel at an intersection relative to the crash history. This process does not focus on speeding, cut-through, or pedestrian/bicycle safety issues. Those needs are handled under different sections. The following data is required:

- VDOT Crash Data (5-Years)[13]
- VDOT District Potential for Safety Improvement (PSI) (Most recent data)
- VTrans Mid-Term Needs (Intersection) (Most recent data)

There are two safety needs for vehicles which are summarized below:

- Intersection Safety: Crashes that occur within the vicinity of an intersection (non-residential or commercial driveway).
- Segment Safety: Crashes that occur along a segment not related to an intersection (includes non-residential and commercial driveways). This section can be found under "Vehicular Segment Safety Needs"

Separation is key as solutions for intersections and segments can be vastly different. However, either intersection or segment improvements can extend benefits (i.e. roundabouts slowing drivers or bump-outs reducing intersection approach speeds).

Intersection Safety Need:
A safety need exists for an intersection if the total Equivalent Property Damage Only (EPDO) score is greater than or equal to 20 or the total number of crashes at an intersection was five (5) or more.[14]

The following outlines the intersection safety need process:

1. Download crash history within the last five-years from VDOT by using the following parameters:

- Find the location of the intersection by setting:
  - VDOT District: Northern Virginia
  - Physical Jurisdiction: Prince William
  - Route Name: USER DEFINED
  - Intersection Node Info: USER DEFINED
    - May be pulled from GIS or Virginia Roads

13 VDOT Crash Analysis Tool

14 The metrics were determined by the top 25% locations within Prince William County.

- Intersection (Select ft radius on Node Offset): Intersection
- Crash Severity: All
- Select no for the following parameters: Work Zone, Bicycle, Pedestrian, Alcohol Impaired, Animal Related.

- Alternatively, data can be downloaded via the Virginia Roads GIS layers and manipulated in ArcMap.

2. Calculate the EPDO by applying a KABCO rating to each crash using the following weights[15]
   - K – Fatality – 85
   - A – Serious Injury – 85
   - B – Minor Injury – 10
   - C - Possible Injury – 5
   - Property Damage Only – 1

3. Do 5 or more crashes exist or is the EPDO equal to or greater than 20?
   - YES – Continue to Step 3
   - NO – STOP – No need exists

4. A code is assigned to each intersection based on the predominant crash type or the crash type with the largest percentage:
   - R – Rear End Crashes
   - A – Angle Crashes
   - L – Lane Departure Crashes
     - Fixed Object Off-road
     - Head-On
     - Sideswipes

   - A "V" code is assigned to each intersection if a VDOT PSI District need exists or a VTrans safety need exists.[16]

Segment Safety

The purpose of this process is meant to identify the safety needs for vehicular travel on a segment relative to the crash history. This process does not focus on speeding, cut-through, or pedestrian/bicycle safety issues. The following data is required:

- VDOT Crash Data (5-Years)
  - County Crash Data
- VDOT District Potential for Safety Improvement (PSI) (Most recent data)
- VTrans Mid-Term Needs (Segments)

There are two safety needs for vehicular travel which are summarized below:

- Intersection Safety: Crashes that occur within the vicinity of an intersection (non-residential or commercial driveway).
- Segment Safety: Crashes that occur along a segment not related to an intersection (includes non-residential and commercial driveways). This section can be found under "Vehicular Segment Safety Needs"

Separation is key as solutions for intersections and segments can be vastly different. However, either intersection or segment improvements can extend benefits (i.e. roundabouts slowing drivers or bump-outs reducing intersection approach speeds).

Segment Safety Need:
A safety need exists for a segment if the total Equivalent Property Damage Only (EPDO) score is greater than or equal to 20 or the total number of crashes on a segment was five (5) or more.[17]

The following outlines the intersection safety need process:

1. Download crash history within the last five-years from VDOT by using the following parameters:
   - Find the location of the intersection by setting:
     - VDOT District: Northern Virginia
     - Physical Jurisdiction: Prince William
     - Route Name: USER DEFINED
       - Ensure both directions are selected.
     - Intersection: Not Intersection
     - Crash Severity: All
     - Select no for the following parameters: Work Zone, Bicycle, Pedestrian, Alcohol Impaired, Animal Related.
   - Alternatively, data can be downloaded via the Virginia Roads GIS layers and manipulated in ArcMap.

2. Calculate the EPDO by applying a KABCO rating to each crash using the following weights[18]
   - K – Fatality – 85
   - A – Serious Injury – 85
   - B – Minor Injury – 10
   - C – Possible Injury – 5
   - O – Property Damage Only – 1

3. Do 5 or more crashes exist or is the EPDO equal to or greater than 20?
   a. YES – Continue to Step 3
   b. NO – STOP – No need exists

4. A code is assigned to each intersection based on the predominant crash type or the crash type with the largest

15 The EPDO weights are based similarly on the VDOT SMART SCALE process.
16 VDOT PSI most recent data can be found at Virginia Roads. VTrans Mid-term needs can be found at VTrans.org
17 The metrics were determined by the top 25% locations within Prince William County.
18 The EPDO weights are based similarly on the VDOT SMART SCALE process.

percentage:

- R – Rear End Crashes
- A – Angle Crashes
- L – Lane Departure Crashes
  - Fixed Object Off-road
  - Head-On
  - Sideswipes
- A "V" code is assigned to each segment if a VDOT PSI District need exists or a VTrans safety need exists.

Intersection Control Candidate Review

This process is meant to identify if an intersection's traffic control should be reviewed further, primarily for all-way or multi-way stop control intersections. The process does not replace a required engineering study. The following data is required:

- AADT
- Intersection Safety Needs
- Intersection Control

This process relies on existing guidance from the Prince William Residential Traffic Management Guide Multi-Way Stop Program, 2009 MUTCD and the VDOT MUTCD Supplement. Both policies outline strict guidance for all intersection control measures. This process only determines if the intersection control should be reviewed further for compliance. An engineering study is required for modifying intersection traffic control.

Process:

An intersection is a candidate for intersection control review if the following criteria are met:

- The intersection may meet volume warrants and safety concerns or;
- The intersection's existing control may not meet volume warrants or safety concerns (Multi- or All-way stops only).

The intersection may meet volume warrants and safety concerns if the following are met:[19]

1. A safety need has been identified by the "Intersection Safety Needs" within this program and;
2. The roadway daily volume exceeds or meet the VDOT 2013 MUTCD Supplement Table 4C-V1 Warrant Using Average Daily Traffic Estimate Condition A at 100%

19 2009 MUTCD Section 2B.07 Multi-Way Stop Applications: Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal; Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.

The intersection's existing traffic control may not meet volume warrants or safety concerns (Multi- or All-way stops only) if the following criteria are met:

1. A safety need has been identified by the "Intersection Safety Needs" within this program or;
2. The intersection daily volume is greater than 600 vehicles per day as defined by the Prince William Residential Traffic Management Guide Multi-Way Stop Program

Potential for Flooding

The purpose of this process is meant to identify if the potential for flooding on a legacy roadway. The following data is required:

- Wetland Data
- Flood Hazard Areas
- VTrans Flooding Risk Assessment

This process is intended to support other needs and inform the recommendation process. As well, flowing data may be supplemented by crowd-source call center information to the County and/or VDOT.

Process:

A flooding risk exists on a segment if one of the following criteria is met:

- A wetland intersects the roadway
- A flood hazard intersects or covers the roadway
- A VTrans Flooding Risk Assessment is identified[20]

20 VTrans Mid-term needs can be found at VTrans.org

COUNTERMEASURES AND MITIGATION STRATEGIES

Countermeasures

This section of the Legacy Roadway Program is focused on countermeasures that will improve safety and promote access for bicycles and pedestrians. As well, the countermeasures can be utilized to enhance communities by providing opportunities such as gateways and greenspaces.

The toolbox of countermeasures within this guide are not meant to be comprehensive. As such other solutions may be appropriate and shouold be evaluated. Furthermore, countermeasures in this toolbox may over time have unintended effects and should be evaluated periodically for removal from the program. Below is a list of countermeasures within this guide:

- High-visibility Crosswalks
- Rectangular Rapid Flashing Beacon (RRFB)
- Pedestrian Hybrid Beacon (PHB)
- Pedestrian Median Refuge
- Raised Median Island
- Raised Crosswalks
- Raised Offset Crosswalks
- Raised Intersection
- Curb Extensions
- Smart Lighting
- Mini-roundabouts
- Diverters
- Road Diet
- Supplemental Beacons for Traffic Signage
- Sidewalk
- Shared Use Path
- Bike lanes

Toolbox Purpose

The purpose of the toolbox is to provide purpose, application, cost, and design considerations. All countermeasures will require a justified need and a study prior to implementation. As well, countermeasures shall follow the appropriate design requirements from Prince William County, VDOT, and other standards. The toolbox will identify some of the standards and design manuals that are typically required to be referenced for implementation.

Costs

All costs provided in the toolbox are based on 2022 dollars. The provided costs are intended for planning and alternative analyses purposes. Constructions costs were developed from the following resources:

- VDOT Transportation and Planning Division Bike and Ped Treatments
- VDOT Design Manuals
- Statewide Planning Cost Estimate tool (SPLCE)
- VDOT District and Statewide unit average

Costs do not include right-of-way, utility relocation, or preliminary engineering fees. It is possible however that some of these improvements may not require any of these additional fees. Any final cost should be a detailed cost estimate developed in accordance with the guidelines of the approving authority (i.e., SMART SCALE, TAP, RAISE, etc.).

Temporary Materials

Temporary materials are traffic devices that are not considered permanent or final physical improvements. These materials include flexposts, temporary striping, variable message signs, or temporary signage. Certain countermeasures may be implemented using temporary materials for the purposes of community testing, quick implementation with the intention to make permanent later, or site-specific reasons. Although temporary materials are cheaper, they tend to require higher maintenance. Its use should be selective and approved by the locality responsible for maintenance.

Table 9: Referenced Guidance

Name
VDOT Road Design Manual (RDM)
VDOT Road and Bridge Standards
VDOT Instructional and Informational Memoranda (IIM)
VDOT Traffic Operations and Safety Analysis Manual (TOSAM)
VDOT Residential Traffic Guide
Prince William County Residential Guide to Traffic Calming
Prince William Design and Construction Standards (DCSM)
National Cooperative Highway Research Program (NCHRP) Publications

High Visibility Crosswalks

Description

Hi-Vis Crosswalks feature wide longitudinal lines or a bar-pair pattern, to guide pedestrians across the street and alert motorists.

Needs Addressed

New crosswalks and enhancing existing: High-visibility crosswalks enhance the safety of a pedestrian crosswalk by making crossings more visible to road users. Crashes can be reduced up to 30% when High-visibilty crosswalks are installed.[1]

Application

Any installation of a high-visibility crosswalk shall be in accordance with VDOT IIM TE-384.0 "Pedestrian Crossing Accommodations at Unsignalized Locations" and the VDOT Road and Bridge Standards. Below are typical locations of a high-visibility crosswalk.

- Uncontrolled roadway approaches above 35 MPH.
- Roundabouts.
- A shared usepath crossing an uncontrolled approach above 25 MPH.
- Warranted Pedestrian Hybrid Beacons.
- School routes or other locations with high-pedestrian activity.

Cost to Implement: $1,500 to $2,000 per crossing (~30 feet)

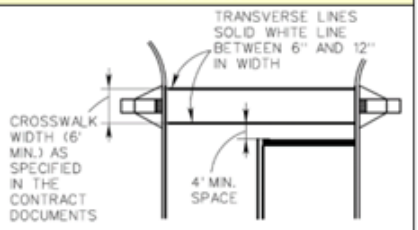
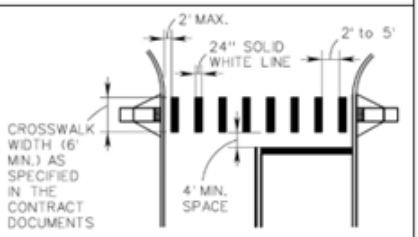
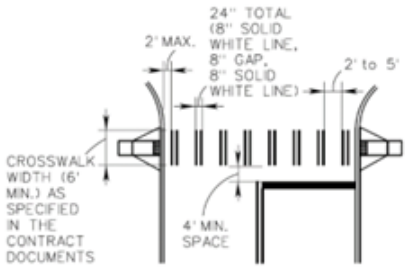
- This cost represents the implementation of one crosswalk with no other countermeasure.

Design

Additional information can be found in VDOT IIM TE 384.0 and VDOT Road and Bridge standards. Below are typical design considerations. The following figure are typical permissible crosswalk types.

1 "SMART SCALE Planning Level CMFS", Virginia Department of Transportation, 2020

Figure 2: Crosswalk Design

Type	Class	Design details	Sketch
Transverse Lines (two parallel lines)	Standard	• The transverse lines shall be between 6" and 12" in width. • Typically, VDOT uses 6" width, however 8", 10", or 12" widths can be used to increase the visibility of the lines as they become worn over time.	
Longitudinal Lines ("continental")	High-Visibility	• Refer to PM-3 standards for details of longitudinal line widths and placement. • Longitudinal lines should be spaced to avoid the wheel paths of through vehicles.	
Bar Pairs	High-Visibility	• Identical to Longitudinal Lines crosswalk, but uses pairs of 8" lines with 8" gap (8/8/8 pattern) in lieu of a 24" longitudinal line. • Spacing between the 8/8/8 bar pairs shall be the same as the requirements of PM-3 for spacing between Longitudinal Lines. • The bar pairs should be spaced to avoid the wheel paths of through vehicles.	

Rectangular Rapid Flashing Beacon (RRFB)

Description

Rectangular Rapid Flashing Beacon (RRFB) are pedestrian-actuated conspicuity enhancements that notify drivers at uncontrolled crosswalk locations when a pedestrian is entering the roadway. The devices are typically mounted with pedestrian crossing signage and have rectangular-shaped yellow indications that flash with high frequency when activated.

Needs Addressed

New crosswalks and enhancing existing crosswalks: RRFBs enhance the safety of a crosswalk by notifying drivers of pedestrian crossings when the device is activated. Pedestrian crashes can be reduced up to 50% and a reduction in vehicular rear-end crashes can also be expected when an RRFB is installed.[2]

Application

Any installation of a RRFB shall be in accordance with Figure 1 or Figure 3 on page A16 of the VDOT IIM TE-384.0 Pedestrian Crossing Accommodations at Unsignalized Locations and the VDOT Road Design Manual Appendix F. Below are typical locations where an RRFB may be appropriate:

- Uncontrolled mid-block roadway approaches with high pedestrian volumes, typically above 20 pedestrians an hour for any one hour.
- Middle or elementary school routes where 10 pedestrians per hour are expected.

Cost to Implement: $5,000 to $60,000 per RRFB

- Electrical source locations must be considered prior to installation.
- Solar powered devices do exist but maintaining authority will need to make final determination.
- Right-of-way may be required based on electrical source.
- Utilities should be evaluated to ensure any conduits do not conflict.

Design

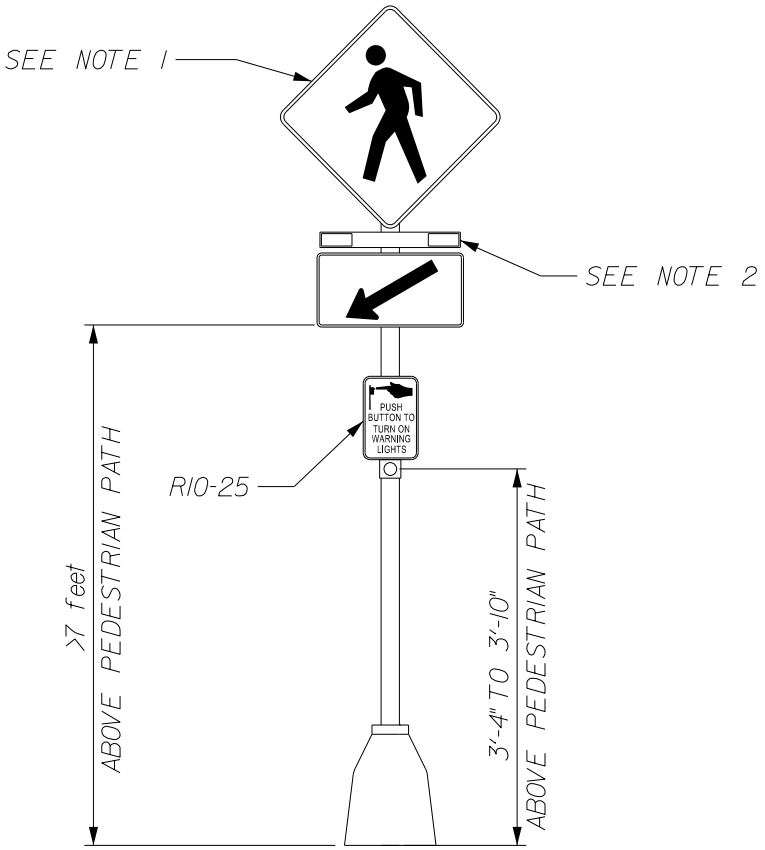
FHWA Interim Approval 21- Rectangular Repair-Flashing Beacons at Crosswalks shall be used when installing a beacon.

- Beacon flashing requirements must meet FHWA Interim Approval 21 and VDOT standards.

- RRFB are always installed with pedestrian warning signage.
- Activation of a RRFB shall be a push-button with accessible features, such as locator tone and/or audible messaging.
- Presence detection should be considered on a case-by-case basis and discussed with the maintaining authority.

1 "SMART SCALE Planning Level CMFS", Virginia Department of Transportation, 2020

Figure 3: RRFB Design



RAPID FLASHING BEACON (RRFB)

1. SIGN MAY BE W11-1 (BICYCLE), W11-2 (PEDESTRIAN), W11-15 (BICYCLE / PEDESTRIAN) OR W11-15A (TRAIL CROSSING). SIGN MUST BE DOUBLE-SIDED WHEN LOCATED BETWEEN EACH TRAVEL WAY DIRECTION.

2. BEACON SIZE AND FLASHING REQUIREMENTS TO MEET MINIMUM FHWA INTERIM APPROVAL 21 - RECTANGULAR RAPID-FLASHING BEACONS AT CROSSWALKS

3. DURATION OF OPERATION SHOULD BE BASED ON PROCEDURES PROVIDED IN SECTION 4E.06 OF THE MUTCD FOR THE TIMING OF PEDESTRIAN CLEARANCE TIMES FOR PEDESTRIAN SIGNALS

4. POWER SOURCES MAY BE HARD OR SOLAR. SOLAR PANELS TO BE MOUNTED ABOVE BEACON ASSEMBLY.

ALL RRFB INTALLATIONS SHALL BE IN ACCORDANCE WITH LOCAL, STATE, AND FEDERAL STANDARDS

Pedestrian hybrid beacon (PHB)

Description

A pedestrian hybrid beacon (PHB) is a traffic control device similar to a traffic control signal that when activated requires vehicles to stop for pedestrians. This device is considered a controlled crossing if warranted.

Needs Addressed

New crosswalks and enhancing existing: PHB's enhance the safety of a pedestrian crosswalk by requiring drivers to stop prior to a crosswalk when activated by pedestrians. Pedestrian crashes can be reduced up to 55% and vehicle rear-end crash risk can be reduced when installed.[3]

Application

Any installation of a PHB shall be in accordance with Chapter 4F of the MUTCD and criteria established in IIM-TE-384. Below are typical locations where a PHB may be warranted:

- Uncontrolled mid-block multi-lane roadway approaches with high pedestrian volumes, typically above 20 pedestrians an hour
- Roadways with more than 9,000 vehicles per day
- Roadways with speeds equal or greater than 40 miles per hour.

Cost to Implement: $230,000 to $300,000 per signal

- A hard electrical source location must be considered prior to installation.
- Right-of-way may be required based on electrical source and pole locations
- Utilities should be evaluated to ensure any conduits or mast arms do not conflict.

Design

All PHBs shall be installed in accordance with the Chapter 4F MUTCD and the VDOT MUTCD supplement.

- Activation should be a push-button with accessible features, such as locator tone and/or audible messaging.
- Other pedestrian enhancements, such as curb extensions or median refuges, should be evaluated to reduce crossing distance and projected vehicle delays.

Design of a PHB is similar to that of a standard traffic signal. The VDOT Traffic Engineering Design Manual shall be consulted during the design and PHBs should be acceptable into VDOT signal system operations. As well, the VDOT Road and Bridge Standards Section 1300: Traffic Control Devices section will outline typicals and standards for:

- Mast arm and poles
- Signal heads
- Push buttons
- Controllers and cabinets
- Signage and markings

3 "SMART SCALE Planning Level CMFS", Virginia Department of Transportation, 2020

Pedestrian Median Refuge

Description

A raised median with a cut to provide a refuge for pedestrians crossing a street to minimize crossing distances.

Needs Addressed

New crosswalks and enhancing existing crosswalks:
A pedestrian median refuge can reduce crossing distances on a roadway and divide a long crossing into two stages.

- Uncontrolled locations: Pedestrians need to only look one way as they cross-each direction (Instead of both ways at once). This improves user understanding and pedestrian safety.
- Controlled locations: Dividing up crossing distance into two separate crossings reduces vehicle delays and the time a pedestrian is crossing travel lanes.

Traffic Calming - Speeding and Safety:
If median refuges are installed with a new median, the treatment can give the appearance of narrowing vehicle travel lanes and reduce driver speeds.[4]

Application

Median refuges are typically installed at the following areas:

- Uncontrolled mid-block crosswalks with multi-lane roadway approaches.
- Where the pavement width from edge-of-travelway to edge-of-travelway exceeds 36 feet.

Median refuges can also be applicable at locations where road diets are being considered because pavement areas are being re-utilized.

Cost to Implement: $10,000 to $20,000 per crossing.

- See Raised Median Island countermeasure for more involved crossings.
- All work should occur within the roadway and therefore no right-of-way should be required.
- Utilities should be evaluated to ensure pavement cuts do not conflict.

Design

All medians shall be in accordance with the VDOT Road and Bridge Standards Section 200 and the Prince William County Design and Construction Standards Manual.

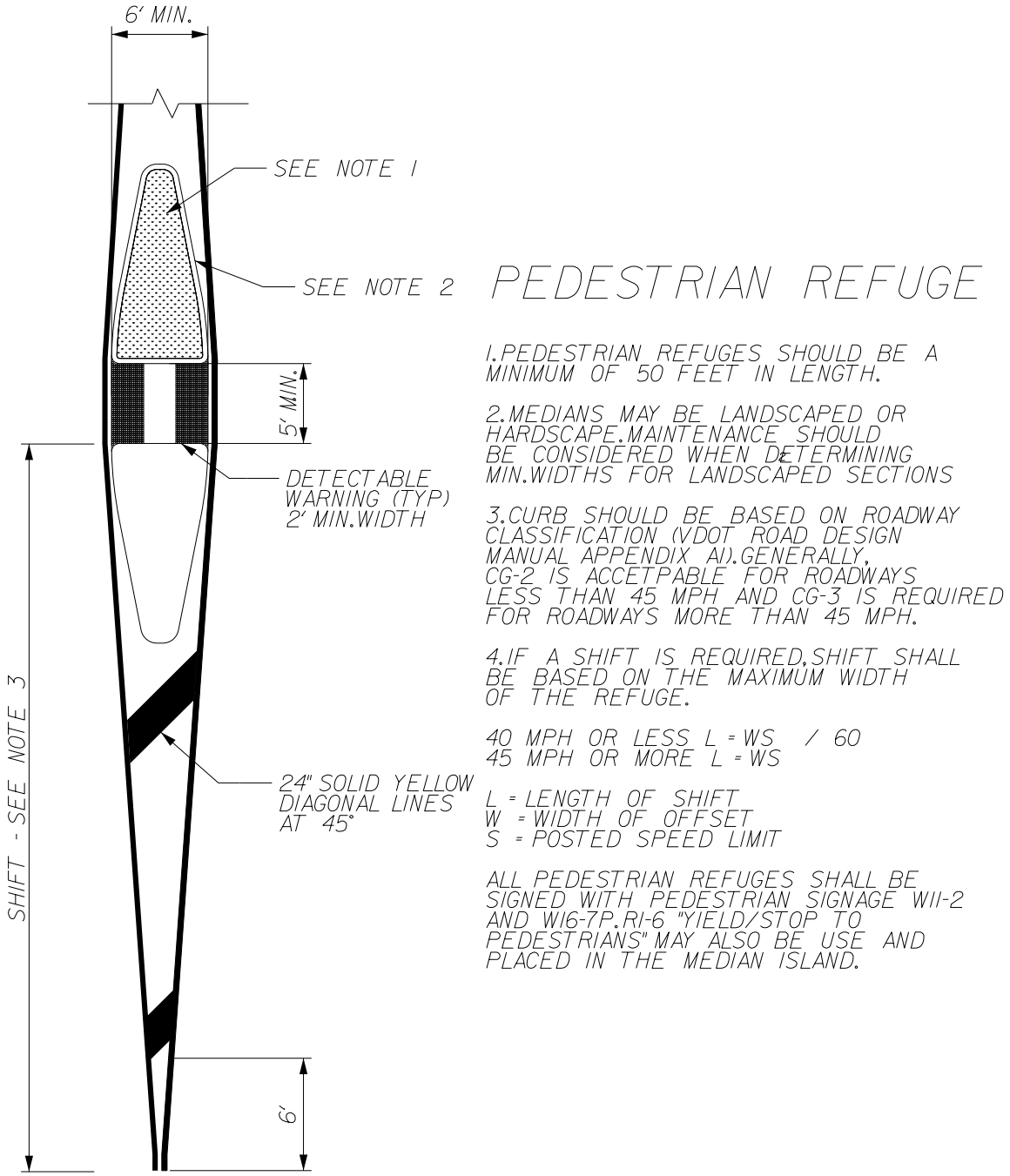
- Median refuge widths shall be no less than 6ft.
- The median width cut-through shall be no less than 5 ft.
  - The existing width of the receiving ADA handicap ramp and walkway facility shall match.

Temporary Materials

- A median can be implemented with flexposts or modular curb and pavement markings. Signage and pavement marking's location is important to for drivers to differentiate travel lanes and correct direction of travel.
- R1-6 "Stop for Pedestrians" should be incorporated as well.
- Pedestrian crossing signage and detectable surfaces are still required.

4 "Traffic Calming Guide for Neighborhood Streets", VDOT, 2018.

Figure 4: Pedestrian Median Refuge Design



Raised Median Island

Description

Raised concrete or landscaped island constructed in the middle of a roadway to narrow or give the appearance of narrowing vehicle travel lanes and thus reduces driving speeds.

Needs Addressed

Traffic Calming – Speeding and Safety: Raised medians can give the appearance of narrowing vehicle travel lanes and can reduce driver speeds by up to 4 MPH.[5]

Raised medians can also support a pedestrian median refuge or area plan landscaping goals by providing "green space."

Application

Raised medians can be installed on most roadways where pavement width exists to accommodate the existing number of travel lanes and parking.

- Any lane reduction or parking removal should be evaluated by an traffic engineering study in accordance with the VDOT TOSAM.
- Medians are usually considered on roadways with speeds equal or greater than 45 MPH and volumes over 7,000 vehicles per day.[6] Engineering judgement should dictate if a median enhances safety or streetscape.

Cost to Implement: $1.5M to $2.0M per mile (at 4′ width)

Depending on the roadway facility, maintenance of traffic should be considered when installing.

- All work should occur within the roadway and therefore no right-of-way should be required.
- Utilities should be evaluated to ensure pavement cuts do not conflict.
- Median construction often requires pavement reconstruction especially if landscaping is considered.
- Underdrains or drainage layers are typically required with landscaping.

Design

All medians shall be in accordance with the VDOT Road and Bridge Standards Section 200 and the Prince William County Design and Construction Standards Manual.

- Median widths shall be no less than 4ft unless a pedestrian refuge is being provided.
- Standard Curb (CG-2/3) is typically used for median construction.

Temporary Materials

A median can be implemented with flexposts or modular curb and pavement markings. Signage and pavement marking's location is important to for drivers to differentiate travel lanes and correct direction of travel.

5 "Traffic Calming Guide for Neighborhood Streets", VDOT, 2018.
6 "Design and Construction Standards Manual: Section 600." Prince William County, 2018.

Raised Crosswalks

Description

Similar to a speed table, a raised crosswalk is a speed table with pavement markings for pedestrian crossings.

Needs Addressed:

New crosswalks and enhancing existing
Raised crosswalks enhance pedestrian safety by requiring approach vehicles to slow down further in advance. Pedestrian crashes can be reduced by up to 45%.[7]

Traffic Calming – Speeding and safety
Raised crosswalks, similar to speed tables, can reduce driver speeds by up to 9 MPH.[8]

Application

Any installation of a new crosswalk shall be in accordance with VDOT IIM TE-384.0 Pedestrian Crossing Accommodations at Unsignalized Locations and the VDOT Road Design Manual. Raised crosswalks shall also follow VDOT's and Prince William County's Residential Guide to Traffic Calming. Other considerations are:

- Only install a mid-block location, not at an intersection
- Avoid areas with high density of driveways or drainage structures
- Typically, only installed on roadways with speed less than 30 MPH and volumes less than 9,000 vehicles per day.

Cost to Implement: $5,000 to $8,000 per crosswalk

*Excludes ancillary facilities and curb ramps

High risk cost factors are:

- Utilities manhole and drain inlet relocation.
- Roadway width.
- Any drainage upgrades in areas with flooding concerns.

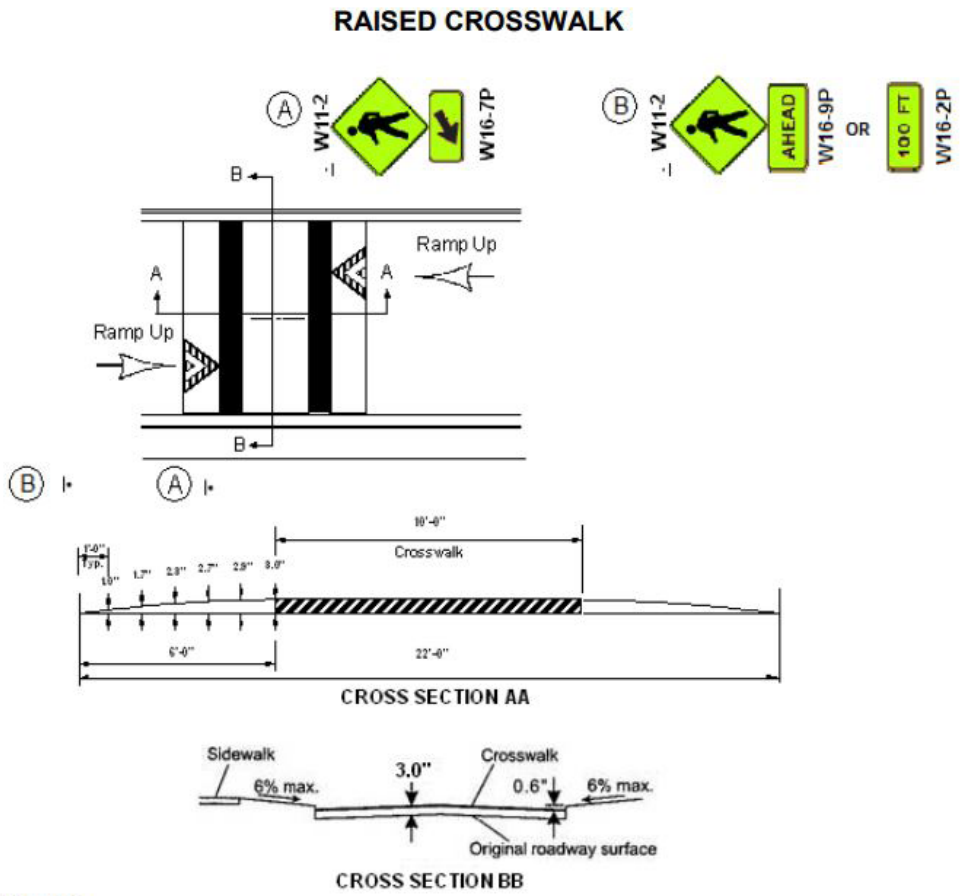
Design

All raised crosswalks shall be in accordance with the VDOT's and Prince William County's Residential Guide to Traffic Calming. General design specifications are:

- Advance signage for both the location of speed table and crosswalk are required.
- Speed tables are 3 inches tall and at least 22 feet long which includes a 10-foot-wide section for the crosswalk.
- Crosswalks shall conform to VDOT IIM-TE-384.0.

7 "Safer Transportation for Every Pedestrian: Raised Crosswalk." FHWA, 2018.
8 "Traffic Calming Guide for Neighborhood Streets", VDOT, 2018.

Figure 5: Raised Crosswalk Design



NOTES:

1. For appropriate application, see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.
2. VDOT's Traffic Engineering Instructional & Informational Memorandum IIM-TE-384.0 titled "Pedestrian Crossing Accommodations at Unsignalized Locations" governs new crosswalks or modifications to an existing crosswalk or other pedestrian-related accommodations.
3. Per the 2009 MUTCD and the VaSupMUTCD:
   i. Section 3B.25 –speed hump (table) markings are not required but if used they must comply with options per Section 3B.25.
   ii. Section 2C.50 -the W11-2 may be used in advance of a crosswalk and if used; shall include supplementary plaque W16-9p or W16-2P. If used at the location of a crossing point, the W11-2 should include the supplemental W16-7P plaque.
   iii. Section 2C.50 -The W11-2 sign must be fluorescent yellow-green with black legend and border.
4. A 12" wide, 1" depth grind around the perimeter of the device is recommended in order to allow the surface course to be keyed into the pavement for a more durable application, particularly for snow plowing.
5. Leave gutter pan open to facilitate drainage.

Raised Offset Crosswalks

Description

Similar to a speed table, a raised crosswalk is a speed table with traffic markings for pedestrian crossings.

A raised offset crosswalk is a speed table with pavement markings for pedestrian crossings that are placed in advance of an intersection approach.

Needs Addressed

New crosswalks and enhancing existing
Raised crosswalks enhance pedestrian safety by requiring approach vehicles to slow down further in advance. Pedestrian crashes can be reduced by up to 45%.[9]

Traffic Calming – Speeding and Cut-through traffic
Raised crosswalks, similar to speed tables, can reduce driver speeds by up to 6-9 MPH.[10] As well, volumes can be reduced by up to 20%.[11]

Raised offset crosswalks can also improve enforceability at warranted stop-control approaches by requiring vehicles to slow in advance of stop-signs.

Application

Raised offset crosswalks are a relatively newer device that its context and function to a stop-controlled approaches must be evaluated with VDOT Traffic Engineering prior to advancing as an alternative.

Any installation of a new crosswalk shall be in accordance with VDOT IIM TE-384.0 Pedestrian Crossing Accommodations at Unsignalized Locations and the VDOT Road Design Manual. As well, raised crosswalks still must follow VDOT's and Prince William County's Residential Guide to Traffic Calming. Other considerations are:

- Typically installed 10 feet in advance of a stop-controlled intersection approach (not a traffic signal or roundabout).
- Typically installed on two or three-lane roadways less 25 MPH and daily traffic less than 4,000 vehicles per day.
- Avoid areas with high density of driveways or drainage structures

Cost to Implement: $5,000 to $8,000 per crosswalk

*Excludes ancillary facilities and curb ramps

High risk cost factors are:

- Utilities manhole and drain inlet relocation.
- Roadway width.
- Any drainage upgrades in areas with flooding concerns.

Design

All raised crosswalks shall be in accordance with the VDOT's and Prince William County's Residential Guide to Traffic Calming. General design specifications are:

- Advance signage for both the location of speed table and crosswalk are required.
- Speed tables are 3 inches tall and at least 22 feet long which includes a 10-foot-wide section for the crosswalk.
- Grades and other roadway geometric factors will need to be evaluated.
- Crosswalks shall still conform to VDOT IIM-TE-384.0.
- If paired with a refuge, lane widths and drainage shall be evaluated prior to installation.

9 "Safer Transportation for Every Pedestrian: Raised Crosswalk." FHWA, 2018.
10 "Traffic Calming Guide for Neighborhood Streets", VDOT, 2018.
11 "Biking and Pedestrian Treatments." VDOT TMPD, 2021.

Raised Intersection

Description

Incorporate a speed table concept by encompassing the entire area of the intersection and thus provide traffic calming on all connecting streets.

Needs Addressed

New crosswalks and enhancing existing

Raised intersections enhance pedestrian safety by requiring approach vehicles to slow down further in advance of an intersection crosswalk crossing.

Traffic Calming – Speeding and safety

Speeds be reduced driver speeds by up to 0.3-1 MPH.[12]

Raised intersections can be incorporated as part of landscaping goals from area plans by using different pavement materials such as brick.

Application

A raised intersection must follow VDOT's and Prince William County's Residential Guide to Traffic Calming. Other considerations are:

- Only install raised intersections at non signalized intersections.
- Avoid areas with high density of driveways or drainage structures.
- Typically, only installed on roadways with speeds less than 25MPH and volumes less than 4,000 vehicles per day.

Cost to Implement

High risk cost factors are:

- Utilities manhole and drain inlet relocation.
- Intersection area size.
- Any drainage upgrades in areas with flooding concerns.

Design

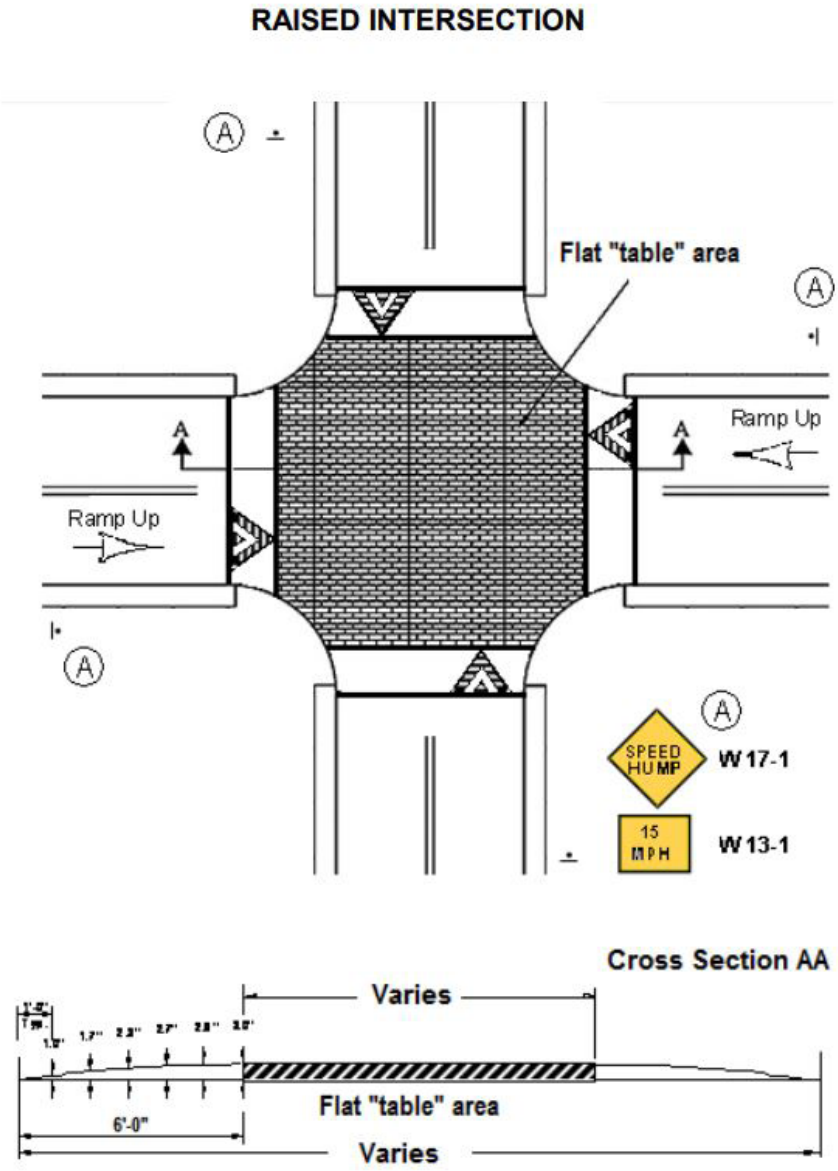
All raised intersection shall be in accordance with the VDOT's and Prince William County's Residential Guide to Traffic Calming. General design specifications are:

- Advance signage for location of raised intersection is required.

- Raised intersection are 3 inches tall and "Ramp-up" following the stop bar location.
- Any landscaped pavement material shall conform to VDOT and Prince William County design standards.

12 "Traffic Calming Guide for Neighborhood Streets", VDOT, 2018.

Figure 6: Raised Intersection Design



NOTES:

1. For appropriate application, see FIGURE A – Subdivision street characteristics pertaining to the selection of traffic calming devices in this document.
2. The flat "table" area length varies based on width of intersection.
3. Per the 2009 MUTCD:
   i. Section 3B.25 –speed hump (table) markings are not required but if used they must comply with options per Section 3B.25.
   ii. Section 2C.29 - warning sign W17-1 is optional but if used, should include the advisory speed plaque (W13-1) and; the sign may use "Speed Bump" instead of "Speed Hump."

Curb Extensions

Description

A curb extension, otherwise known as a bulb-out or neckdown, extends the sidewalk or curb line into an adjacent parking lane, thus reducing the roadway width for vehicles as well as the crossing distance necessary for pedestrians.

Needs Addressed

New crosswalks and enhancing existing: Curb extensions reduce the effective crossing distance for pedestrians across the roadway. They also improve visibility for drivers and pedestrians because the extensions tend to create a physical barrier to prevent vehicles from parking within the intersection influence area. Finally, the curb extensions encourage pedestrians to cross at designated locations, thus reinforcing a new or existing crosswalk.

Curb management

Curb extensions at intersections can be used to manage parking within an intersection influence area to enhance safety. They also can be used to provide more visible bus stops.

Intersection safety and traffic calming: In addition to pedestrian improvements, drivers have better unobstructed sight-distance because of the parking restrictions. As well, curb extensions control a vehicles speed when turning because of the reduced radius compared to conventional curbs.

Application

- Curb extensions can be installed on most roadways and intersection where on street parking exists or planned.
- Curb extensions are typically implemented with a pedestrian crossing, however, can be considered in applications such as curb management, transit stops, and traffic calming.
- Curb extensions should be avoided at intersections with high heavy vehicle percentages or right-turn volumes.
  - Exception would be if intent is to discourage cut-through traffic.

Cost to Implement: $2,000 to $20,00 per corner

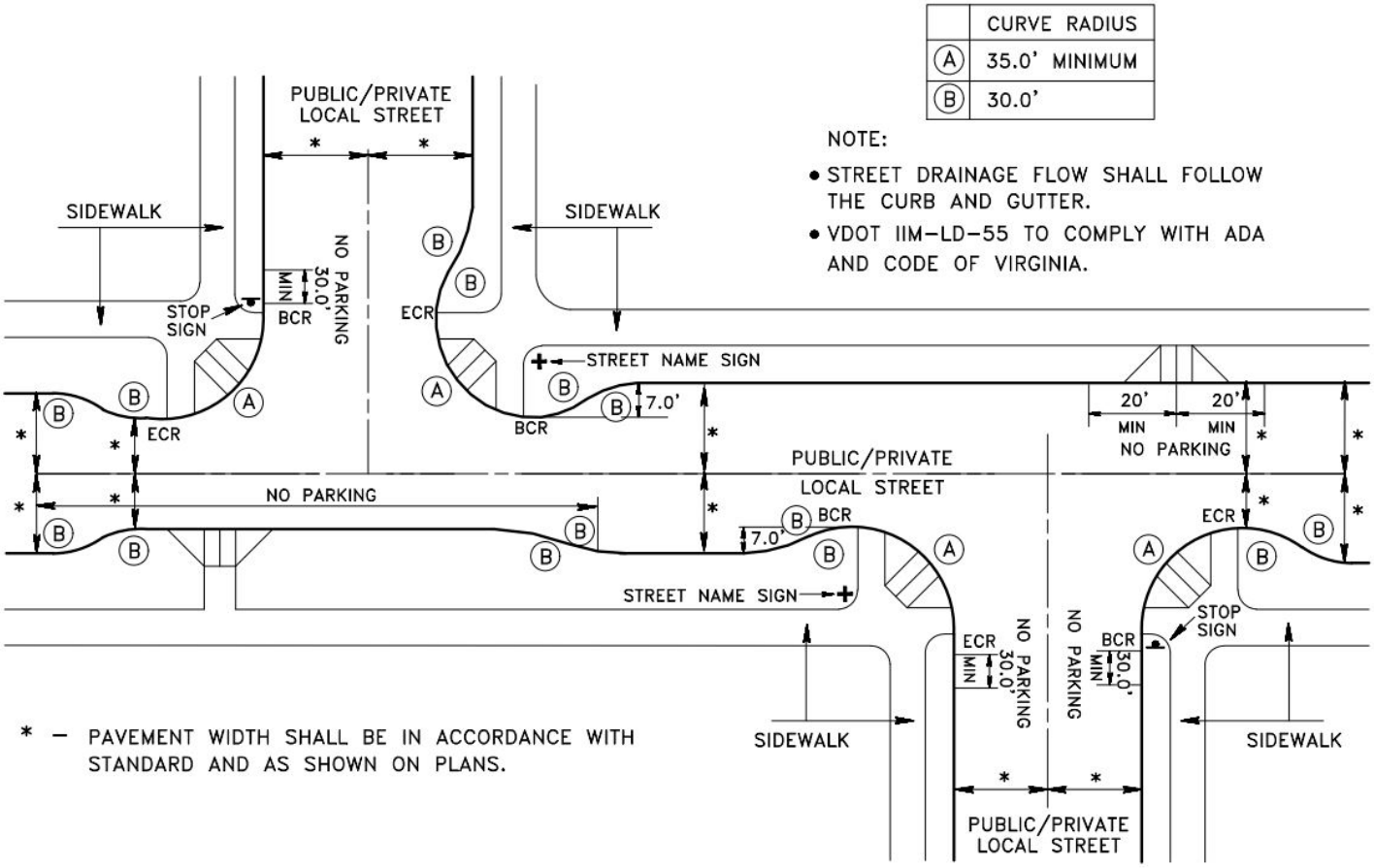
- Drainage site conditions may significantly increase cost
- Existing pavement conditions within influence area may increase cost
- Utilities such as manhole covers, valve, hydrants, and utility poles may increase the cost.

Design

All curb extensions shall be in accordance with the Prince William County's Design and Construction Standards Manual Section 600. General design specifications are:

- Curb extensions should be between 6 feet and 8 feet
  - Consideration should be given to exceed these values when the width of the space between the edge of travel way and edge of curb exceeds 8 feet
- Feasibility of curb extensions should be evaluated further if the volume of right-turning vehicles exceeds 5 %
  - Turn movement counts with classification may indicate which corners to avoid curb extensions.
  - Textured concrete or mountable curbs may be an additional consideration to accomodate these locations
  - See "radii reduction" which is an alternative method with similar benefits to a curb extension
- If the curb extension is being built with a pedestrian crossing location, the curb ramp shall be perpendicular to the intersecting roadway.
  - New crosswalks shall conform to IIM-TE-384.0 Pedestrian Crossing
  - Accommodations at Unsignalized Locations and the Manual of Uniform Traffic Control Devices
- If a curb extension is being considered where an exclusive right-turn lane exists, a curb extension shall not encroach into turn lane or;
  - If an exclusive right-turn lane is being removed, a traffic analysis should determine if a right-turn lane is warranted based on VDOT Road Desig Manual Appendix F and the removal of a right-turn lane will not cause operational and safety concerns.

Figure 7: Curb Extension Design



Smart Lighting

Description

Smart lighting, or adaptive lighting, is a type of pedestrian device that once activated, increases a pedestrian's or bicyclist's visibility to drivers through illumination. Smart lighting provides an alternative to static lighting in locations with light pollution concerns, especially in urban residential environments, by limiting illumination only to occasions when pedestrians are present.

Needs Addressed

New crosswalks and enhancing existing: Lighting increases visibility of a crosswalk but can also increase driver yielding when lighting is activated by a pedestrian.

Adaptive lighting can be beneficial in areas where complaints about light pollution need to mitigate.

Application

Adaptative lighting shall meet requirements under VDOT TE-390 LED Lighting and Prince William County Design and Construction Standards Manual. Typically, these measures are implemented at:

- Crossing locations with frequent crashes that occur during hours of darkness.
- School crossings
- Locations with high pedestrian activity during hours of darkness.

Cost to Implement

- May be cheaper in locations with existing lighting
- In locations with no existing lighting, electrical sources will need to be identified.

Design

Adaptative lighting shall meet requirements under VDOT TE-390 LED Lighting and Prince William County Design and Construction Standards Manual. Typical requirements are:

- All lights shall be LED.
- Lighting analyses may be required in locations with medians, landscaping, or wide roadway widths to ensure proper coverage.
- If adaptive lighting is activated by a user, it is recommended to be a push-button with accessible features, however presence detection should be considered on a case-by-case basis and discussed with the maintaining authority.

  - Light "on" timing should be based on pedestrian clearance intervals that are determined using the MUTCD.
- Adaptative lighting may also be set to pre-determined times when crosswalks are most utilized.

Mini-Roundabouts

Description

A circular, unsignalized intersection where all traffic moves in a counterclockwise direction around a center island. Traffic entering the mini roundabout slows down and yields to traffic already inside

Needs Addressed

Intersection safety

Mini roundabouts can improve operations of an intersection but can also reduce crashes by up to 60%.[13]

Bike and Pedestrian Safety

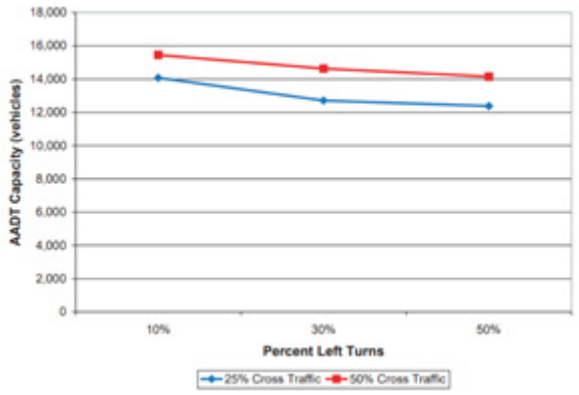
A roundabouts geometry tends to promote slower speeds and conflict points, thus reducing collision risk with cyclists and pedestrians.

Application

Roundabout implementations require a traffic study in accordance with the VDOT TOSAM. Studies should outline existing operational and safety issues and the proposed benefits. Typical applications include:

- Volumes less than 15,000 vehicles per day.[14]
- Two-lane roadways or where road diets are being considered.[15]

Figure 8: Road Volumes and Left Turns



- Speeds less than 30 MPH.[16]

13 "SMART SCALE Planning Level CMFS", Virginia Department of Transportation, 2020

14 "NCHRP Report 672 Roundabouts: An Informational Guide." Transportation Research Board. 2020

15 "Road Design Manual: Appendix A3." VDOT. 2019.

16 "NCHRP Report 672 Roundabouts: An Informational Guide." Transportation Research Board. 2020

- Heavy vehicles make up less than 5% of total volume.[17]

Cost to Implement

- Right-of-way and utility impacts should be considered especially if additional pavement area is required.
- Pedestrian and bike amenities, such as refuges and bike lanes, may increase size of mini roundabout.

Design

All mini roundabouts shall conform to NCHRP Report 672 Roundabouts: An Informational Guide and the VDOT Road Design Manual. Design considerations are:

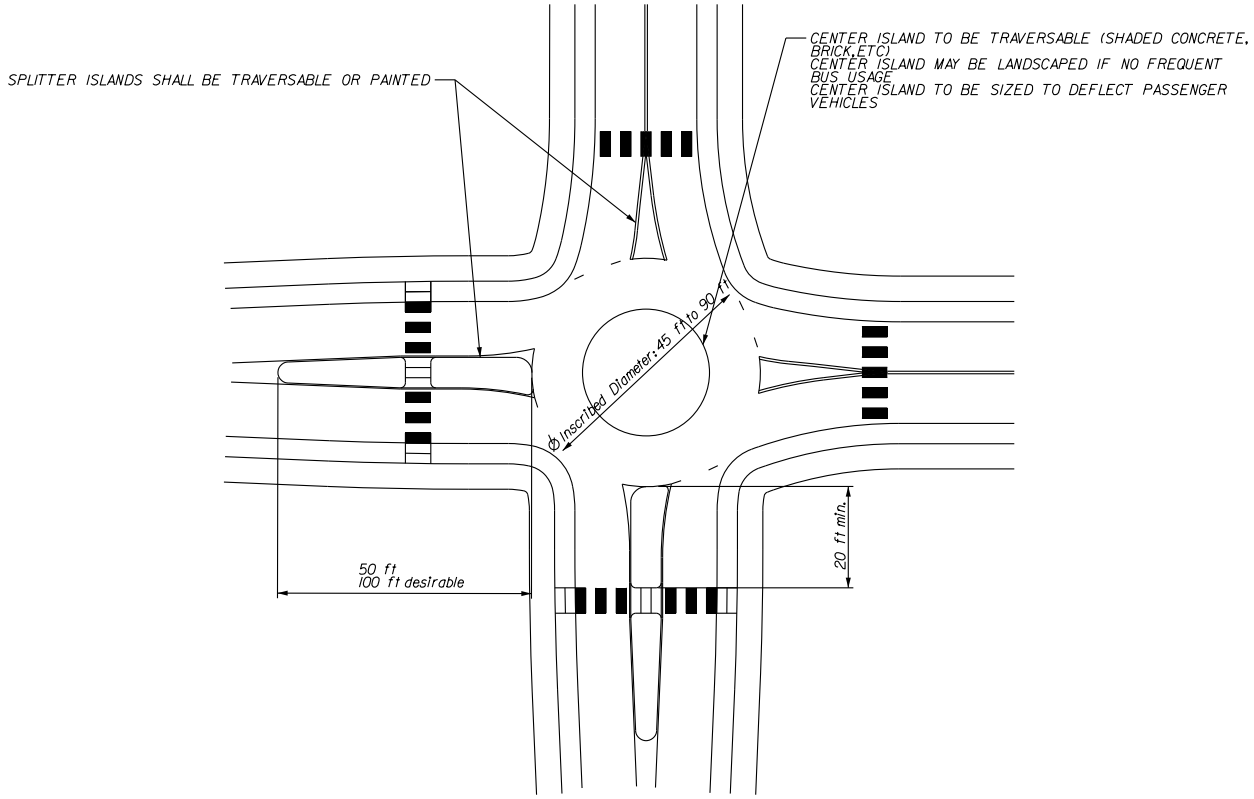
- Central island diameter of 20 feet to 50 feet which is fully mountable.
- Splitter islands may be physical or painted.
- The Circular width should be at least 12 feet. Design vehicles and intersection angle may increase width.
- Approach lanes should be between 10 and 11 feet to reduce speeds.

Temporary Materials

- Modular roundabouts are prefabricated materials that make for quick and easy installation. Any modular roundabout installation should involve the VDOT Innovative Intersections Committee and VDOT District engineers
- Certain intersections with very low heavy vehicle volumes can use flexposts as the center island.

17 "Road Design Manual: Appendix A3." VDOT. 2019.

Figure 9: Mini-Roundabout Design



Diverters

Description

A diverter is an island built diagonally across a street intersection which prevents certain through and/or turning movements.

Needs Addressed

Intersection safety

Diverters in some instances can be used to implement access management measures and reduce the number of conflict points at an intersection to enhance safety.

New crosswalks and enhancing existing

Diverter islands can be constructed in a fashion to accommodate median refuges and reduce crossing distances for pedestrians.

Cut-through traffic

By restricting certain movements, diverters will discourage cut-through traffic by decreasing travel-time savings or preventing a movement.

Application

The purpose of the diverter should be identified following a traffic study that evaluates safety, volumes, and traffic patterns. Below are the following considerations based on purpose:

Access Management

A traffic study in accordance with VDOT TOSAM confirming that restricting movements would reduce related crashes. Applications usually apply to minor approaches only and include reconfigurations such as:

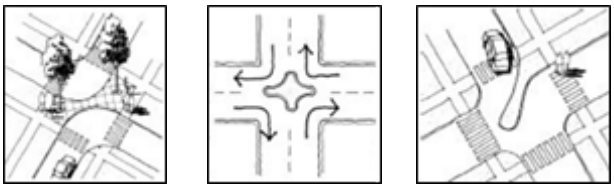
- Right-in/right-outs (forced turn islands)
- Closing a minor approach (cul-de-sac)
- Lefts-in including right-in/rights (directional medians)

Cut-through Mitigation

In addition to a traffic study, the application must meet VDOT's Cut Thru Policy. Applications are only permitted on local residential streets with speeds less than 25 miles per hour. As well, cut-through eligibility must have identified a minimum "residential cut-through traffic" volume of at least 150 vehicles or more that comprises of 40% or more of the total vehicular traffic in one travel direction.

Typical reconfigurations include:

- Right-in/right-outs (forced turn islands)
- Closing a minor approach (cul-de-sac)
- Lefts-in including right-in/rights (directional medians)
- Restrict through movements on all approaches (diagonal diverters)
- Rights only (star diverters)
- Partial restriction of through movements (truncated diverter)



Diagonal | Star Diverter Types | Truncated

Cost to Implement: $15,000 to $45,000 each

- Most work should be within the existing pavement are
- Utilities may need to be relocated
- Drainage should be evaluated.

Design

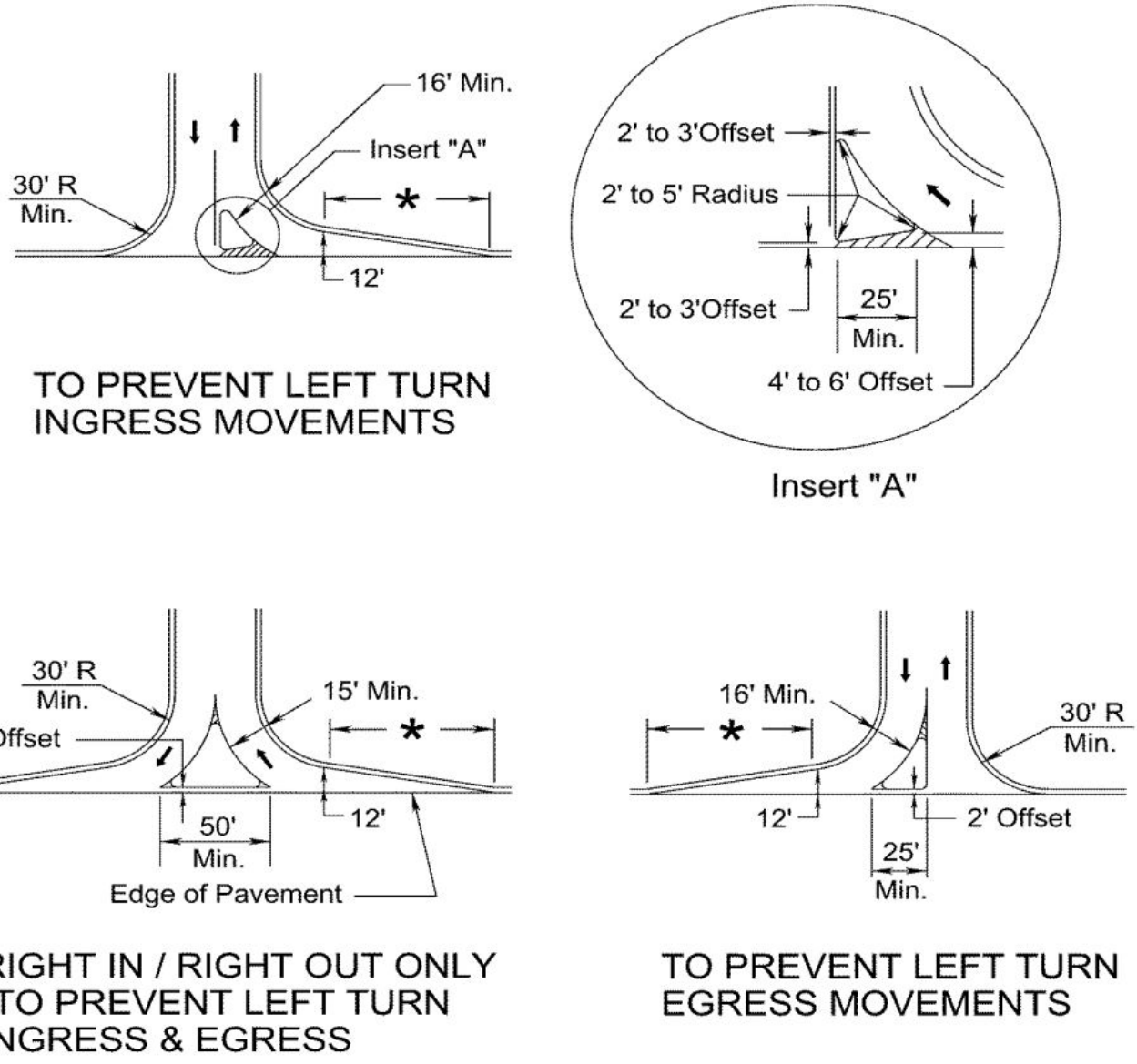
Any diverter shall conform to VDOT Road Design Manual, VDOT Road and Bridge Standards and Prince William County Design and Construction Standards Manual. Design considerations are:

- Median widths should be no less than 4 feet unless a median refuge is being providing and therefore must be no less than 6 feet.
- Standard curbing should be used unless bicycle facilities are provided through a diverter.
- Signage notifying roadway users of permitted movements is required. Advance signage should be considered to help drivers navigate the roadway network.
- Lane widths must still meet the minimums for its classification.
- Drainage such as underdrain or structures should be considered if relocating existing or the diverter lies within an area with documented flooding.

Temporary Materials

- A diverter can be implemented with flexposts or modular curb and pavement markings. Signage and pavement marking's location is important to for drivers to differentiate travel lanes and correct direction of travel.

Figure 10: Diverter Types



Road Diet

Description

A road diet typically involves reducing the number of lanes of a multi-lane facility (often undivided) with the purpose of re-utilizing the pavement for bike lanes, turn-lanes, or other facilities.

Needs Addressed

Intersection and segment safety

By incorporating contextually appropriate cross-sections, road characteristics meet driver expectations which improve safety and speed. Road diets can also introduce warrant turn lanes and shorter intersection crossing distances. Road diets have been shown to reduce crashes up to 45%.[18]

Bike and pedestrian infrastructure

Road diets can also be used to reconfigure existing through lanes into bike lanes or relocate the curb line to install wider paths and sidewalks.

Traffic calming

Road diets have been shown to reduce speeds by up to 5 miles per hour.[19]

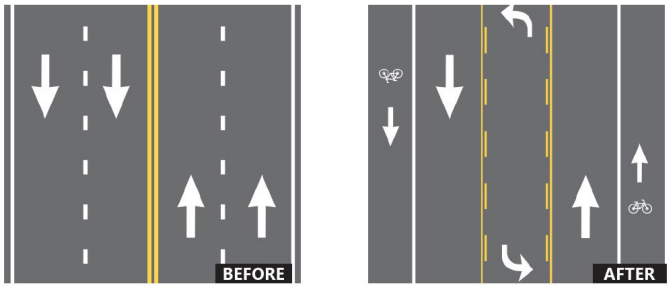
Application

According to VDOT TMPD guidance, road diets may be considered on four-lane roadways with less than 20,000 vehicles per day. A traffic study is required to verify operational and safety impacts. Road diet configurations may consist of:

- Providing a two-way left-turn lane
- Installing bike lanes
- Relocating the curb line to install paths
- Widening the shoulder
- Providing off-set or regular turn lanes

Cost to Implement: Varies

- 4" pavement markings range between $1.00 and $7.00 per linear foot
- Overlays with milling can be between $25 to $50 Square Yard
- Right-of-way and utility impacts are typically not an issue with road diets.



Design

All road diets should be design to the appropriate roadway classifications found in VDOT's Road Design Manual and Prince William County's Design and Construction Standards Manual. Typical design considerations are:

- Obscuring old markings is required. Often, an overlay with or without planning should always be considered so that old markings do not confuse drivers.
- Signage should be replaced and updated to reflect new cross-section
- Bike lanes must conform to VDOT Complete Streets: Bicycle and Pedestrian Facility Guidelines.
- Curb line relocation will require drainage system evaluation. However, since pavement is being re-utilized, treatment and quantity costs may be minimized or avoided.

18 "SMART SCALE Planning Level CMFS", Virginia Department of Transportation, 2020

19 "Road Diet Information Guide." FHWA. 2014

Supplemental Beacons for Traffic Signage

Description

A stand-alone circular flashing beacon or L.E.D.'s that are arranged around a sign that flashes constantly or when activated to improve driver notification and responses.

Needs Addressed

Intersection and segment safety: Supplemental flashing beacons or L.E.D.'s enhance the visibility of the sign which improves driver response and reduces the risk of intersection or segment related crashes.

New and existing crosswalks: The supplemental lights will also enhance visibility of pedestrian signage and crosswalks especially for locations that may otherwise be difficult to see.

Application

Flashing beacons and border L.E.D.'s are permitted on regulatory and warning signs that meet the guidelines in the MUTCD Chapter 4L and VDOT IIM-TE-394: Flashing Beacons.

This countermeasure should only be used at locations justified by a traffic study where documented issues related to drivers' failure to stop/yield or low visibility of existing signage and roadway features.

The countermeasure should not be used if visibility can be improved by removing the obstacle (vegetation, structures, etc.) or the underlying issue is drivers failing to judge gaps or other sight distance issues.

Cost to Implement: Varies

- Flashing beacons: $15,000 to $50,000 for two signs (i.e., one approach)
- Enhanced Signage (L.E.D.'s): $3,000 to $40,000 for two signs (i.e., one approach)

Design

All flashing beacons and border L.E.D.'s are permitted on regulatory and warning signs and must conform to the MUTCD, VDOT MUTCD Supplement, and VDOT Road and Bridge Standards. Common design considerations are:

- Electrical sources should be physical connections or solar powered.
- All posts must be breakaway.
- Flashing frequency should be between 50 and 60 times per minute.

- If activated by a pre-emption device (loop or video), the detection zone should be placed in advance of sign based on driver perception-reaction times.
  - Pedestrian pre-emption devices are considered Rapid Flashing Beacons or Pedestrian Hybrid Beacons and must follow those guidelines.
- Placement of any illuminated device should consider nearby residences. If device is static and always on consider time-of-day restrictions. Otherwise, a pre-emption device may reduce the amount of time the device is on.

Flashing Beacons

- Signage must be replaced with the appropriate regulatory or warning sign.
- Installation of shall conform to FB-2 VDOT Road and Bridge Standard.

Walkways, Bikeways, and Shared Use Paths

Description

A stand alone off-road facility that serves both pedestrians and/or cyclists.

Needs Addressed

Pedestrian Infrastructure: Dedicated pedestrian facilities increase mobility, reduce vehicle trips, and provide a safe location for pedestrians to walk.

Bicycle Infrastructure: Dedicated facility that serves both cyclist and pedestrians. Normally, users can comfortably travel in both directions.

Application

Sidewalks can be installed along most roadway alignments where there are favorable grades, where right-of-way is wide, or limited utilities.

Shared use-paths can also be installed along most roadways with similar constraints. On roadways with vehicles more than 6,000 vehicles per day and above 40 MPH[20] they should strongly be considered when demand exists.

Cost to Implement: Varies

- Sidewalk: $1.4M to $2.0M per mile for one side.
- Shared Use Path: $1.5M to $1.8M per mile for one side.
- Stormwater facilities will increase cost.
- Right-of-way and utilities will increase costs if sufficient space is not available.

Design

All walkways shall conform to VDOT Road Design Manual, VDOT Road and Bridge Standards, and the Prince William County Design and Construction Standard Manuals. Common design requirements are:

Sidewalks

- A minimum 4-foot buffer strip is required, unless used for landscaping which requires a 6-foot buffer strip.
- Sidewalks should be 5 feet wide and include a 5 foot by 5-foot pedestrian passing area every 200 feet.
- Multidirectional sidewalks should be 8 feet wide and do not require passing areas.
- 1 foot right-of-way is required beyond the outside edge of a sidewalk.

Shared Use Paths

- Shared use paths are typically 10 feet wide, although a minimum 8 feet width can be provided if right-of-way is prohibitive.
- An 8-foot buffer is required between the edge of roadway and shared use path.
- Typically, between 4 and 7 feet of right-of-way is required beyond the outside edge of the path.
- A design speed of 18 miles per hour should be used when evaluating horizontal curves for cyclists.

20 "Road Design Manual Complete Streets: Bicycle and Pedestrian Facility Guidelines." VDOT. 2020.

Bike Lanes

Description

Dedicated bicyclist facility on a roadway that delineates roads space.

Needs Addressed

Bicycle Infrastructure: Bike lanes allow safer and more comfortable travel for cyclists by identifying separate lanes for vehicles and cyclists. Where cyclist and vehicle crashes exist, crashes can be reduced by up to 58%.

Application

Bike lanes can be installed on most roadways and its design should be based on VDOT's Complete Street: Bicycle and Pedestrian Guidelines. The type of bike lane treatment varies based on speed, volumes, and parking conditions. Typical bike lane applications may include:

- Signed shared roadway
- Traditional bike lanes
- Buffered bike lanes
- Separated bike lane - Dedicated on-road space for two-way cycling travel. A physical median could be provided between road and bike lane

Cost to Implement (2022 dollars): Depends on implementation

Bike lanes may be implemented as part of a road diet, pavement re-utilization, or new pavement areas. Typical pavement marking costs are:

- 4" pavement markings range between $1.00 and $7.00 per linear foot
- 6" pavement markings range between $1.00 and $9.00 per linear foot
- Pavement marking icons and messages range between $100 to $400 each.

Areas where new pavement is required for a standard 5' bike lane typically range between $1.0M to $1.5M per mile for one side of 5-foot pavement.

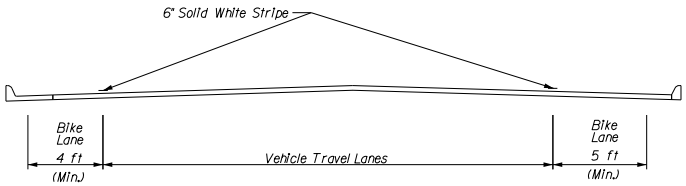
- Stormwater facilities will increase cost
- Right-of-way and utilities will increase costs if sufficient space is not available.

Design

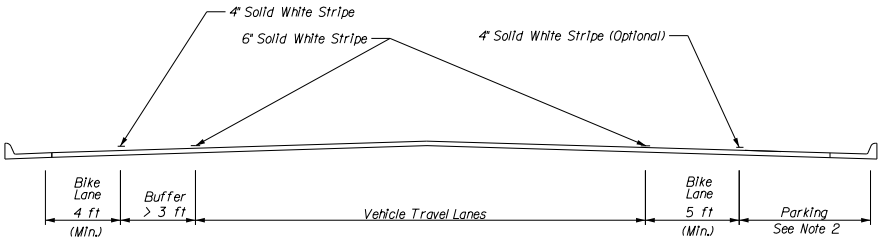
All bike lanes shall conform to VDOT Road Design Manual, VDOT Road and Bridge Standards, and the Prince William County Design and Construction Standard Manuals. Common design requirements are:

- Bike lanes are typically 4 feet wide but must be 5 feet wide where parking is present.
- A 6" white line shall be placed between the bike lane and travel lanes.
- Parking does not have to be marked but is strongly encouraged to reduce encroachment.
- Drainage inlets and utility covers should be avoided or reconfigured to avoid cyclist conflicts.
- Separated bike lanes should be a minimum of 8 foot wide and may either be separated by pavement markings or a physical 4 foot wide median.
- Bike lane treatment should follow VDOT's Complete Street: Bicycle and Pedestrian Guidelines Table A(1)-1-1 or Table A(1)-1-2.

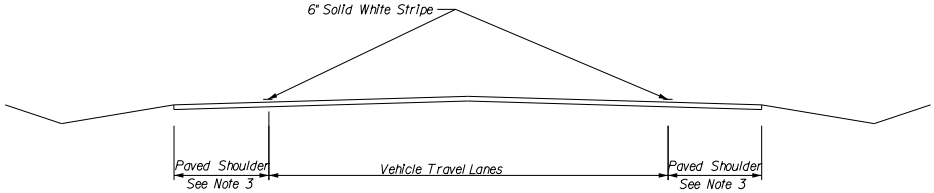
Figure 11: Bike Lane Design



BIKE LANES WITH NO PARKING - CURB AND/OR GUTTER



BUFFERED BIKE LANES AND BIKE LANES WITH PARKING



BIKE LANES WITH SHOULDER / DITCH

DESIGN/ POSTED SPEED	AVERAGE DAILY TRAFFIC VOLUME (ADT)								
	W/O PARKING (CURB / GUTTER)			W/ PARKING (CURB / GUTTER)			SHOULDER DITCH		
	< 3,000	3,000 TO 6,000	>6,000	< 3,000	3,000 TO 6,000	>6,000	< 3,000	3,000 TO 6,000	>6,000
25 MPH	WC 14	WC 15 OR BL 4	BL 5	WC 14	BBL OR BL 5	SUP OR SBL	SH 4	SH 4	SH 5
30-35 MPH	BL 4	BL 5	BBL OR BL 6	BL 5	BBL OR BL 6	SUP OR SBL	SH 4	SH 5	SH 6
40-45 MPH	SUP OR SBL	SUP OR SBL	SUP OR SBL	—	—	—	SH 6	SUP OR SH 6	SUP OR SH 6
>45 MPH	SUP	SUP	SUP	—	—	—	SUP OR SH 6	SUP OR SH 6	SUP OR SH 6

WC - WIDE CURB / BL - BIKE LANE / BBL / BUFFERED BIKE LANE / SH - SHOULDER / SBL - SEPERATED BIKE LANE / SUP - SHARED USE PATH
NUMBERS REPRESENT MIN.WIDTHS

1. ALL BIKE LANES SHALL BE INSTALLED IN ACCORDANCE WITH THE MUTCD,VDOT ROAD DESIGN MANUAL APPENDIX A1,FHWA SEPERATED BIKE LANE PLANNING AND DESIGN GUIDE,AND NACTO URBAN BIKEWAY DESIGN GUIDE.
2. FOR CURB AND GUTTER TYPICAL SECTIONS WITH PARKING - 7' FT PARKING STALL WIDTH ON RESIDENTIAL STREET,8' FT ON ALL OTHERS.
3. FOR SHOULDER AND DITCH TYPICAL SECTIONS - ALL BIKE LANE WIDTHS ARE IN ADDITION TO THE REQUIRED SHOULDER WIDTH.
4. SHARED LANE MARKINGS (SHARROWS) SHALL NOT BE USED ON SHOULDERS
5. MARKED SHARED ROADWAYS ARE DESIGNATED BY SHARED LANE MARKINGS "SHARROWS" AND ARE TO BE ONLY USED WHEN THE ROADWAY POSTED SPEED LIMIT IS 35 MPH OR LESS.
6. SEPERATED BIKE LANES SHALL HAVE A PHYSICAL MEDIAN SEPERATING VEHICALS AND PEDESTRIANS. SEPERATION SHALL BE 7 FT OR GREATER.
7. SHARED USE PATHS SHALL FOLLOW VDOT ROAD DESIGN MANUAL APPENDIX A1 GUIDANCE.

APPENDIX A: LIST OF ELIGIBLE LEGACY ROADWAYS

Dale City SAP

- Darbydale Avenue – Minnieville Road to Dale Blvd
- Delaney Road - Minnieville Road to Quade Lane
  - Quade Lane – Delaney Road to Queensdale Drive
- Elm Farm Road – Prince William Pkwy to Minnieville Road
- Forestdale Avenue – Dale Blvd/Darbydale Avenue to Dale Blvd
- Hillendale Drive – Prince William Pkwy to Dale Blvd
- Lindendale Road – Spriggs Road to Dale Blvd
- Mapledale Avenue – Dale Blvd to Lindendale Rd
- Princedale Drive – Dale Blvd to Lindendale Road
- Queensdale Drive – Qualls Lane to Dale Blvd
- Ridgefield Road

North Woodbridge SAP

- Bayside Avenue – Mt Pleasant Drive To Longview Drive
- Colchester Road – Featherstone Road to Hope Street
- Dawson Beach Road – Route 1 to Highams Court
- Horner Road – Occoquan Road to End
- Hylton Avenue – Occoquan Road to End
- Longview Drive – Route 1 to Melbourne Avenue
- Longview Drive – Prince William Pkwy to Montgomery Avenue
- Mt Pleasant Drive/Fisher Ave/Harrison Street – Longview Drive to Route 1
- Occoquan Road – Old Bridge Road to Horner Road

List to be continually updated by the Legacy Roadway Program Manager.

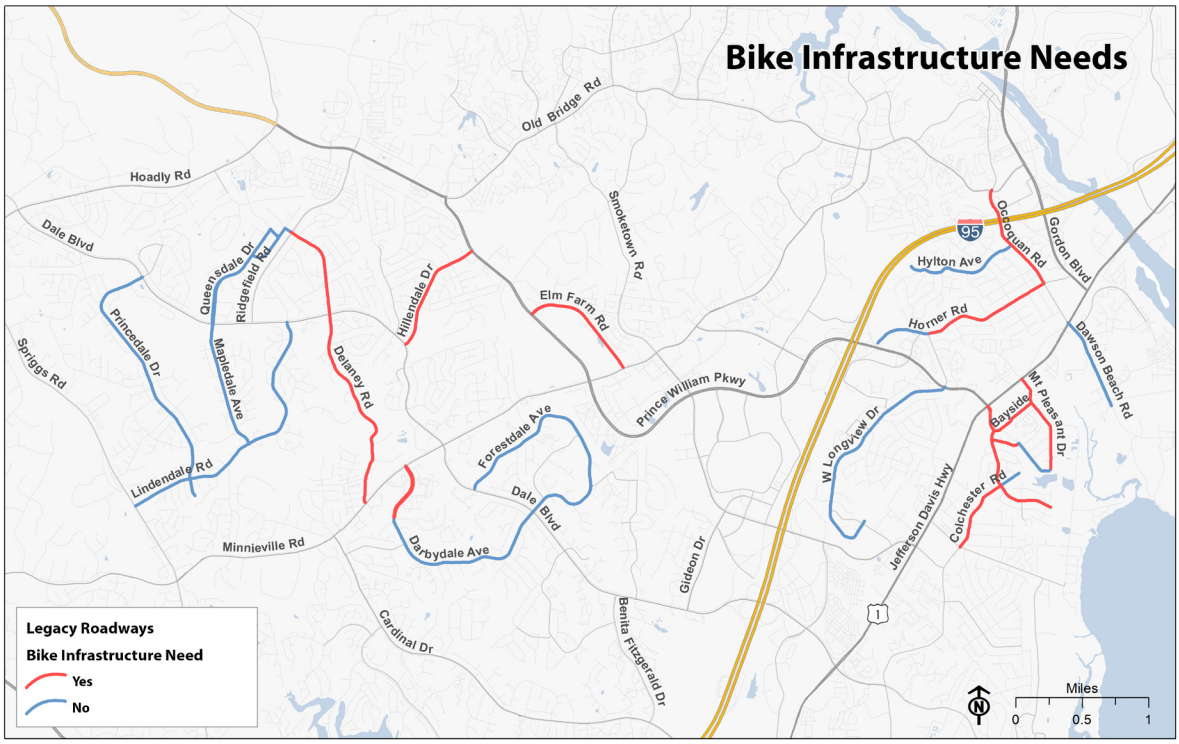
APPENDIX B: SUMMARY OF LEGACY ROADWAY NEEDS

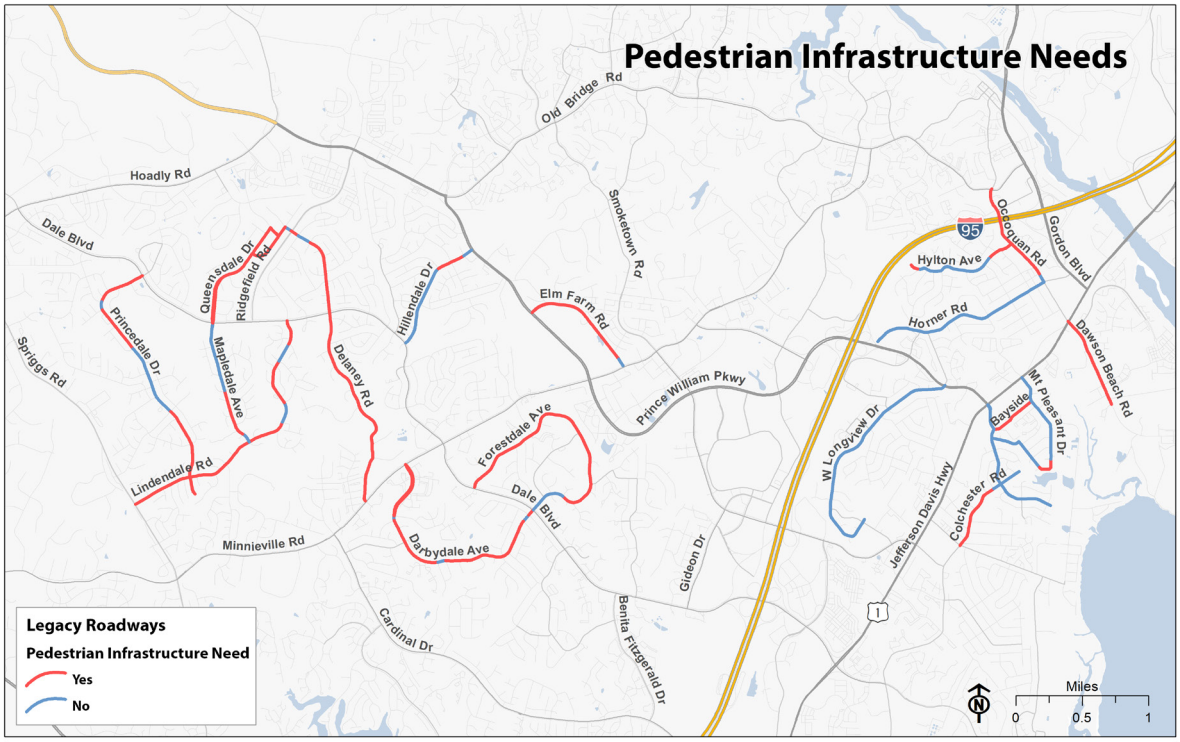
Introduction:

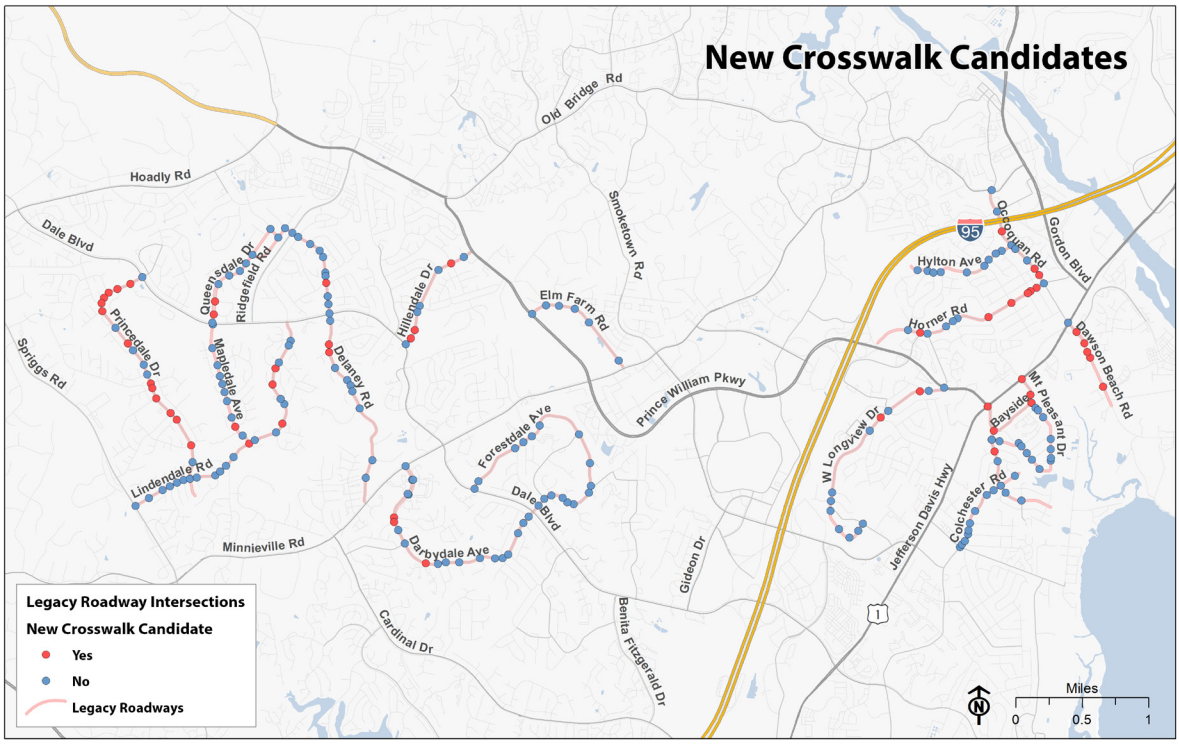
All legacy roadway needs are determined using the processes and data as specified by the Legacy Roadway Program. All needs can be found within this Appendix or on the Prince William County Geodatabase upon request. Calculations for each process can also be requested.

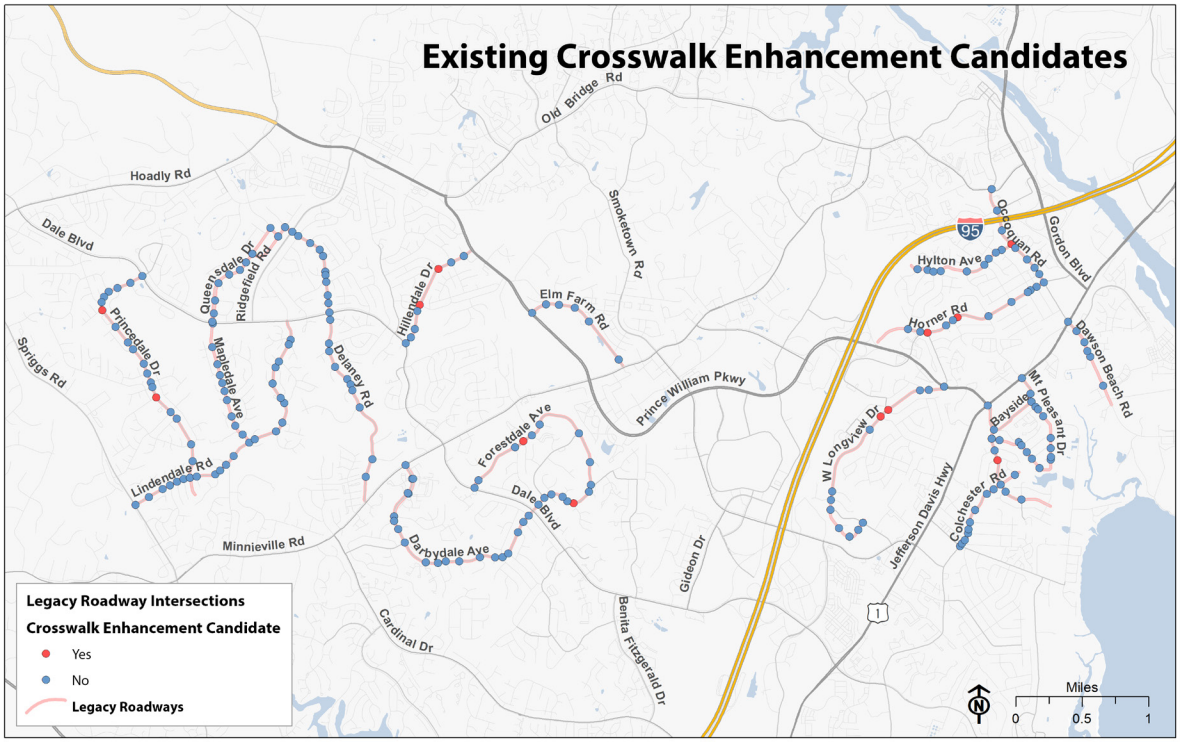
All needs are summarized in following table by segment. An intersection need can be found by matching a "road name" with the "from column."

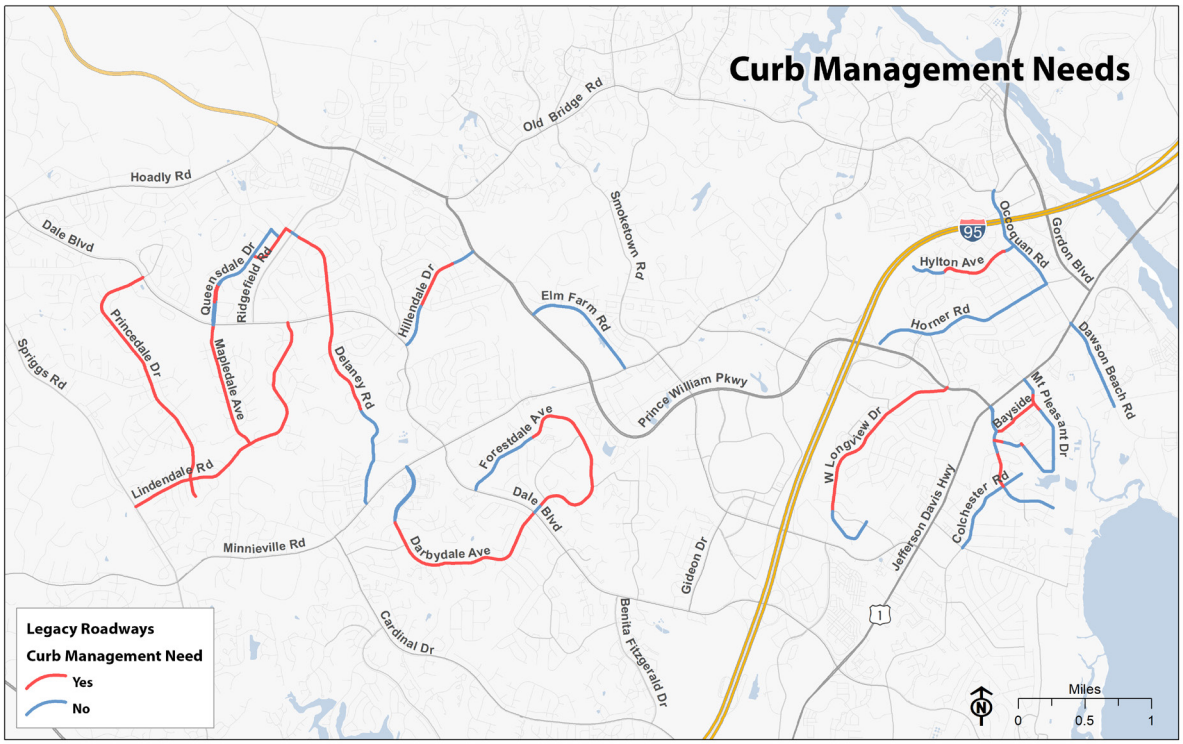
The needs assessment shall be continually updated by the Legacy Roadway Program Manager

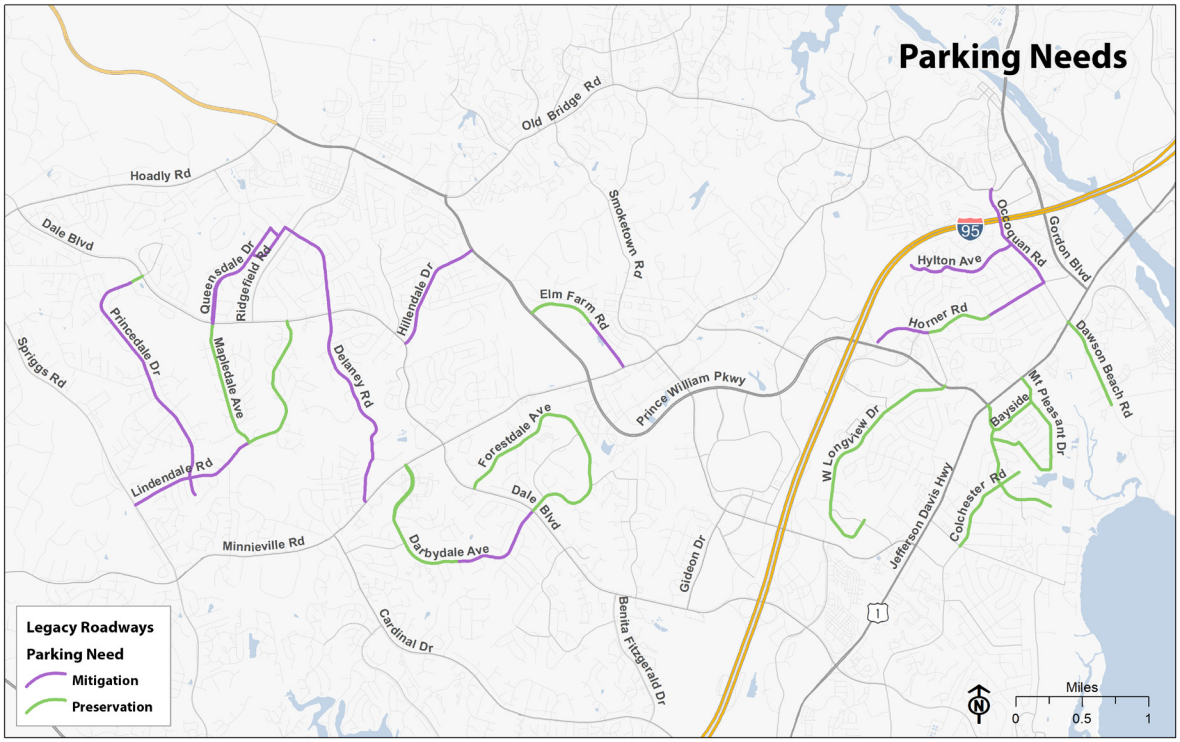

Bike Infrastructure Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Mapledale Ave
Springs Rd
Lindendale Rd
Minnieville Rd
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Prince William Pkwy
Forestdale Ave
Dale Blvd
Darbydale Ave
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
Bayside
Mt Pleasant Dr
Colchester Rd
Jefferson Davis Hwy
W Longview Dr
95
1
Legacy Roadways
Bike Infrastructure Need
Yes
No
Miles
0
0.5
1

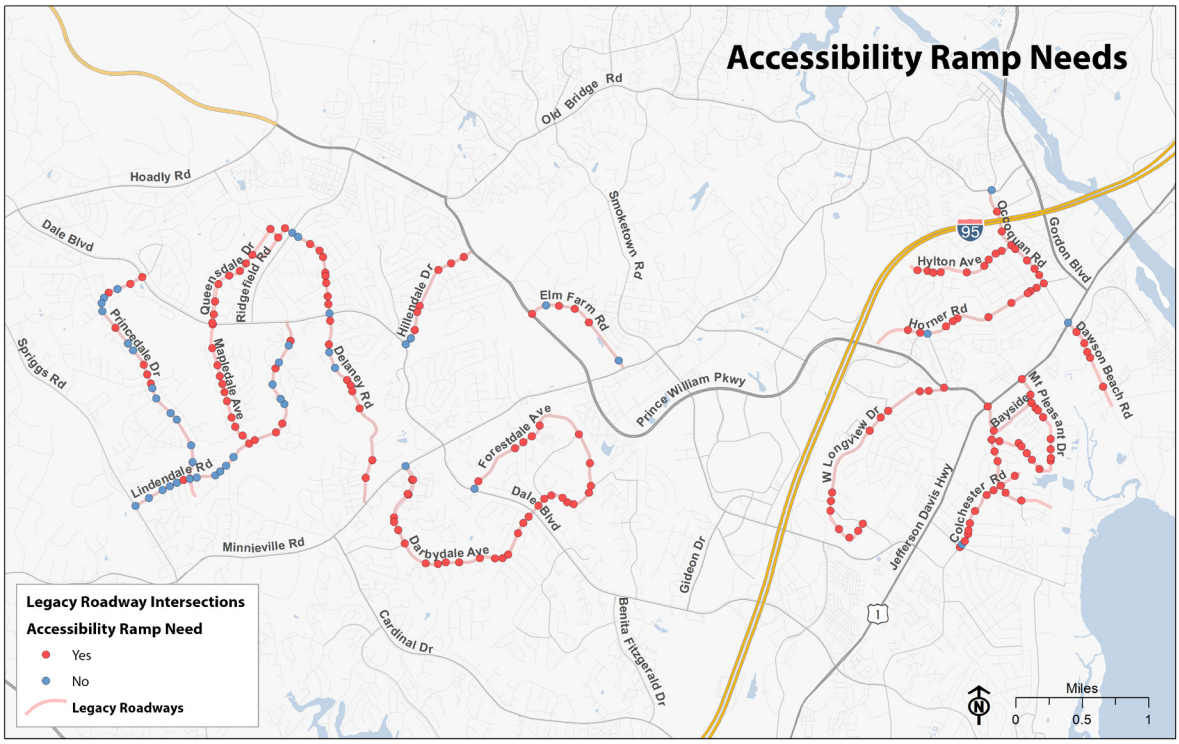

Pedestrian Infrastructure Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Mapledale Ave
Springs Rd
Lindendale Rd
Minnieville Rd
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Prince William Pkwy
Forestdale Ave
Dale Blvd
Darbydale Ave
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
Bayside
Mt Pleasant Dr
Colchester Rd
Jefferson Davis Hwy
W Longview Dr
95
1
Legacy Roadways
Pedestrian Infrastructure Need
Yes
No
Miles
0
0.5
1

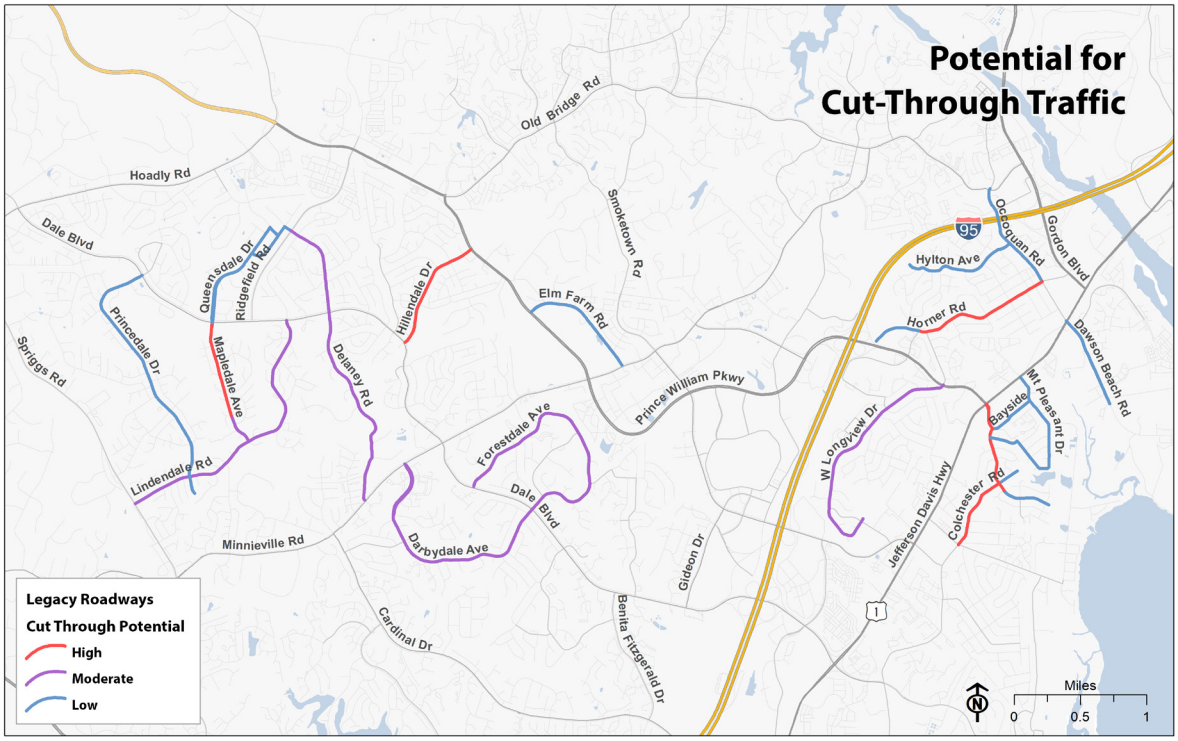

New Crosswalk Candidates
Old Bridge Rd
Hoadly Rd
Dale Blvd
Springs Rd
Princedale Dr
Queensdale Dr
Ridgefield Rd
Maplesdale Ave
Lindendale Rd
Delaney Rd
Hillendale Dr
Elm Farm Rd
Smoketown Rd
Prince William Pkwy
Forestdale Ave
Dale Blvd
Darbydale Ave
Minnieville Rd
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
Bayside
Mt Pleasant Dr
W Longview Dr
Jefferson Davis Hwy
Colchester Rd
95
1
Legacy Roadway Intersections
New Crosswalk Candidate
Yes
No
Legacy Roadways
N
Miles
0
0.5
1

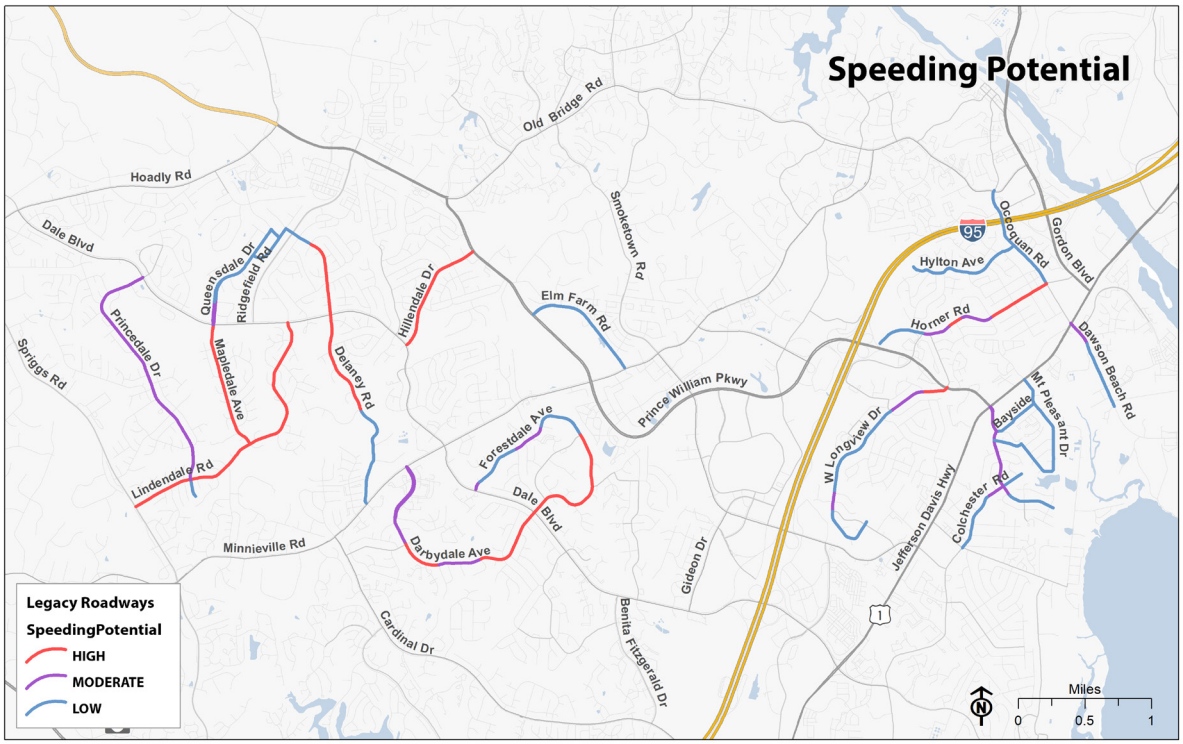

Existing Crosswalk Enhancement Candidates
Old Bridge Rd
Hoadly Rd
Dale Blvd
Springs Rd
Princedale Dr
Queensdale Dr
Ridgefield Rd
Maplesdale Ave
Lindendale Rd
Delaney Rd
Hillendale Dr
Elm Farm Rd
Smoketown Rd
Prince William Pkwy
Forestdale Ave
Dale Blvd
Darbydale Ave
Minnieville Rd
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
Bayside
Mt Pleasant Dr
W Longview Dr
Jefferson Davis Hwy
Colchester Rd
95
1
Legacy Roadway Intersections
Crosswalk Enhancement Candidate
Yes
No
Legacy Roadways
N
Miles
0
0.5
1

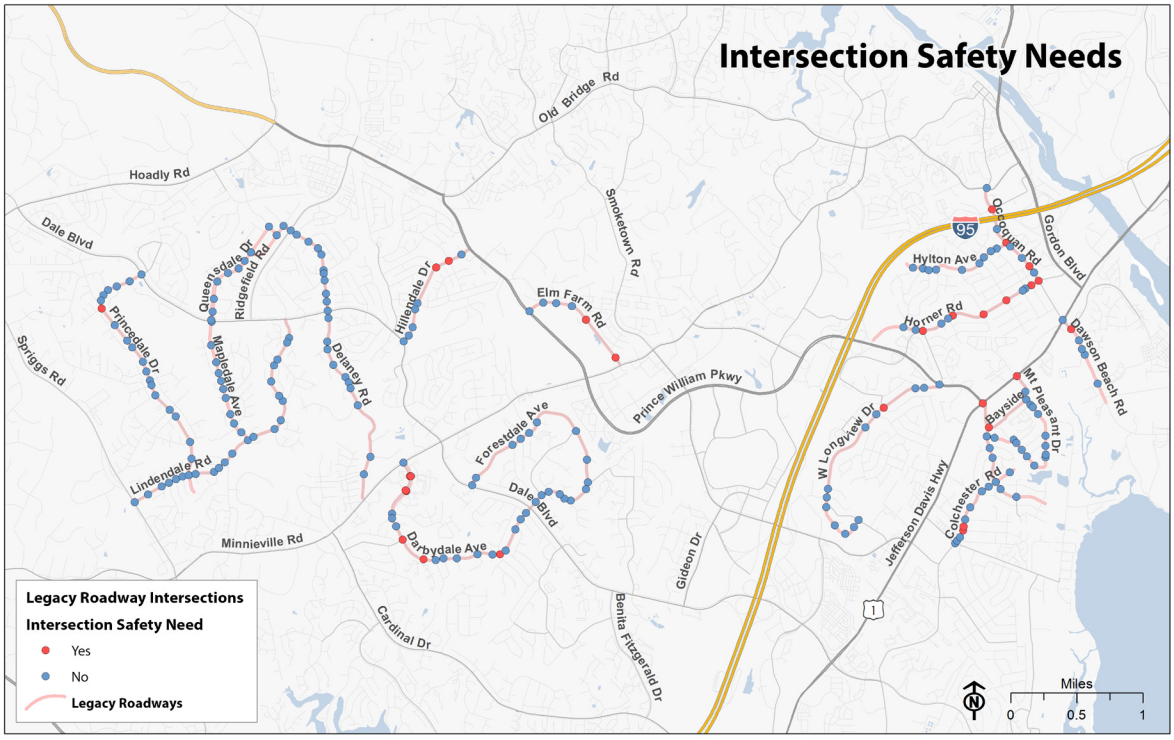

Curb Management Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Springs Rd
Mapledale Ave
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Prince William Pkwy
Lindendale Rd
Minnieville Rd
Forestdale Ave
Dale Blvd
Darbydale Ave
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
W Longview Dr
Bayside
Mt Pleasant Dr
Jefferson Davis Hwy
Colchester Rd
95
1
Legacy Roadways
Curb Management Need
Yes
No
Miles
0
0.5
1

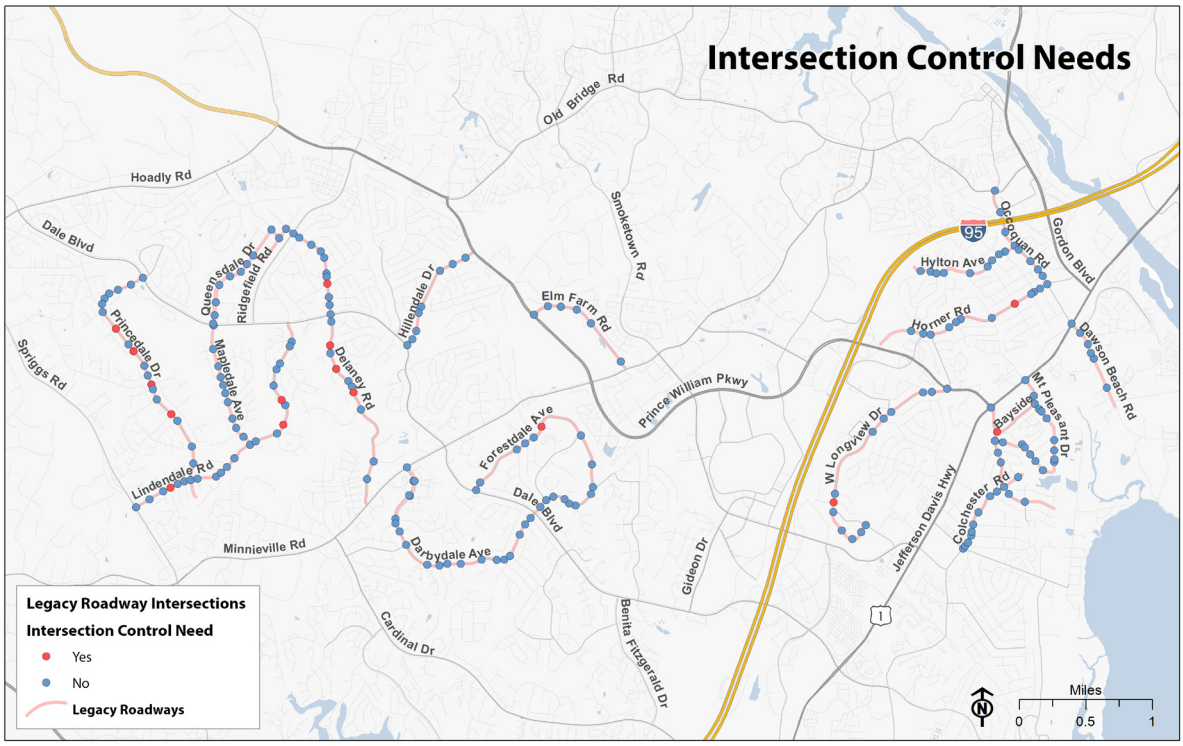

Parking Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Springs Rd
Mapledale Ave
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Prince William Pkwy
Lindendale Rd
Minnieville Rd
Forestdale Ave
Dale Blvd
Darbydale Ave
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
W Longview Dr
Bayside
Mt Pleasant Dr
Jefferson Davis Hwy
Colchester Rd
95
1
Legacy Roadways
Parking Need
Mitigation
Preservation
Miles
0
0.5
1

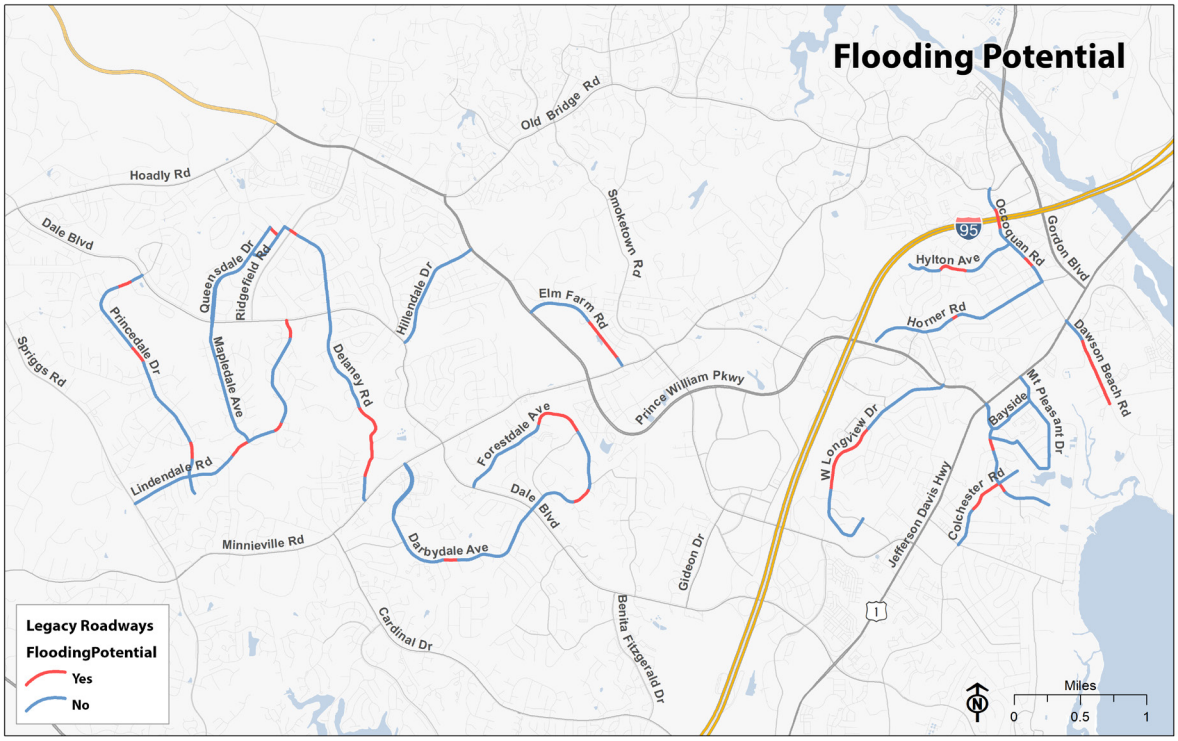

Accessibility Ramp Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Maplesdale Ave
Springs Rd
Lindendale Rd
Delaney Rd
Hillendale Dr
Elm Farm Rd
Smoketown Rd
Prince William Pkwy
Forestdale Ave
Dale Blvd
Darbydale Ave
Minnieville Rd
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
W Longview Dr
Jefferson Davis Hwy
Bayside
Mt Pleasant Dr
Colchester Rd
95
1
Legacy Roadway Intersections
Accessibility Ramp Need
Yes
No
Legacy Roadways
N
Miles
0
0.5
1


Potential for
Cut-Through Traffic
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Maplesdale Ave
Springs Rd
Lindendale Rd
Delaney Rd
Hillendale Dr
Elm Farm Rd
Smoketown Rd
Prince William Pkwy
Forestdale Ave
Dale Blvd
Darbydale Ave
Minnieville Rd
Cardinal Dr
Benita Fitzgerald Dr
Gideon Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
W Longview Dr
Jefferson Davis Hwy
Bayside
Mt Pleasant Dr
Colchester Rd
95
1
Legacy Roadways
Cut Through Potential
High
Moderate
Low
N
Miles
0
0.5
1


Speeding Potential
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Mapledale Ave
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Springs Rd
Lindendale Rd
Minnieville Rd
Forestdale Ave
Dale Blvd
Darbydale Ave
Prince William Pkwy
Gideon Dr
Cardinal Dr
Benita Fitzgerald Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
Mt Pleasant Dr
Bayside
W Longview Dr
Jefferson Davis Hwy
Colchester Rd
95
1
Legacy Roadways
SpeedingPotential
HIGH
MODERATE
LOW
Miles
0
0.5
1


Intersection Safety Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Mapledale Ave
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Springs Rd
Lindendale Rd
Minnieville Rd
Forestdale Ave
Dale Blvd
Darbydale Ave
Prince William Pkwy
Gideon Dr
Cardinal Dr
Benita Fitzgerald Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
Mt Pleasant Dr
Bayside
W Longview Dr
Jefferson Davis Hwy
Colchester Rd
95
1
Legacy Roadway Intersections
Intersection Safety Need
Yes
No
Legacy Roadways
Miles
0
0.5
1


Intersection Control Needs
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Springs Rd
Maplesdale Ave
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Prince William Pkwy
Lindendale Rd
Minnieville Rd
Forestdale Ave
Dale Blvd
Darbydale Ave
Gideon Dr
Benita Fitzgerald Dr
Cardinal Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
W Longview Dr
Jefferson Davis Hwy
Bayside
Mt Pleasant Dr
Colchester Rd
95
1
Legacy Roadway Intersections
Intersection Control Need
Yes
No
Legacy Roadways
N
Miles
0
0.5
1


Flooding Potential
Old Bridge Rd
Hoadly Rd
Dale Blvd
Queensdale Dr
Ridgefield Rd
Princedale Dr
Springs Rd
Maplesdale Ave
Delaney Rd
Hillendale Dr
Smoketown Rd
Elm Farm Rd
Prince William Pkwy
Lindendale Rd
Minnieville Rd
Forestdale Ave
Dale Blvd
Darbydale Ave
Gideon Dr
Benita Fitzgerald Dr
Cardinal Dr
Occoquan Rd
Gordon Blvd
Hylton Ave
Horner Rd
Dawson Beach Rd
W Longview Dr
Jefferson Davis Hwy
Bayside
Mt Pleasant Dr
Colchester Rd
95
1
Legacy Roadways
FloodingPotential
Yes
No
N
Miles
0
0.5
1


THE SEAL OF PRINCE WILLIAM COUNTY VA