COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION

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Commissioner

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December 10, 2021

The Honorable Ralph Northam
Members of the General Assembly
Members of the Commonwealth Transportation Board

Dear Governor Northam, Members of the General Assembly and Members of the Commonwealth Transportation Board:

Chapter 130 of the Virginia Acts of Assembly, 2021 Special Session 1 directs the Commissioner to convene a working group with relevant stakeholders, including the Virginia Association of Counties and the Virginia Municipal League to perform the following tasks:

- Determine whether there should be model policies for crosswalk design and installation in the Commonwealth.
- If the working group determines that there should be model policies, it is directed to establish recommendations for such model policies. Such model policies shall promote statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility.
- The working group is furthermore directed to monitor and provide input to the U.S. Department of Transportation and the Federal Highway Administration as updates to crosswalk designs are considered in the *Manual on Uniform Traffic Control Devices for Streets and Highways*.

The attached report details the working group's recommendations and findings for the tasks noted above and represents the report produced in response to the legislation. Please contact Vanloan Nguyen at (804) 786-2918 if you have any questions.

The working group would like to thank and acknowledge Delegate Keam and Girl Scout Troop 1673 for bringing this important topic of crosswalk design to the forefront for further discussion and review.

Sincerely,

Stephen C. Brich, P.E.
Commissioner of Highways

PREFACE

HB 1841, introduced by Delegate Mark Keam, was enacted into law pursuant to the 2021 Special Session of the Virginia General Assembly (see Chapter 130 of the Acts of Assembly, 2021 Special Session 1). The legislation directs the Commissioner of Highways or his designee to convene a Working Group (WG) comprised of relevant stakeholders to determine if there should be model policies for the design and installation of crosswalks in Virginia and if so, to identify recommendations for such model policies. The list of sitting members in the HB 1841 WG, in no particular order, is as follows:

- Delegate Keam and Staff
- Girl Scout Troop 1673 (both Troop leaders and the individual Girl Scouts)
- Virginia Association of Counties (VACo)
- Virginia Municipal League (VML)
- American Federation for the Blind, Virginia Chapter
- National Federation of the Blind, Virginia Chapter
- American Council of the Blind of Virginia (ACB-VA)
- American Planning Association, Virginia Chapter
- Virginia Department for the Blind and Vision Impaired (DBVI)
- Virginia Department of Aging and Rehabilitative Services (VDARS) (invited)
- City of Richmond
- City of Falls Church
- City of Alexandria
- Virginia Transportation Research Council (VTRC)
- Virginia Department of Transportation (VDOT)

The WG members represent a broad spectrum of advocacy, transportation, and other government agencies, and the WG was intended to bring various stakeholders with diverse perspectives together to collaboratively respond to the topics within HB 1841.

TABLE OF CONTENTS

PREFACE i
TABLE OF CONTENTS ii
EXECUTIVE SUMMARY vi
Introduction to HB 1841 vi
Commonwealth Transportation System vii
Literature Review on Crosswalks and Pedestrians with No/Low Vision vii
Current Governing Requirements, Polices, and Practices in the Commonwealth viii
Determining the Need for a Model Policy viii
Recommendations for a Model Policy in Virginia x
Monitor and Provide Input to FHWA on the MUTCD xii
1. INTRODUCTION OF HOUSE BILL 1841 1
1.1 House Bill 1841 (Chapter 130 of the Acts of Assembly, 2021 Special Session 1) Legislation Background 1
1.2 Crosswalks Background 1
1.3 HB 1841 WG Membership 2
1.4 HB 1841 WG Collaboration and Information Sharing 3
1.5 HB 1841 Working Group Meeting #1 – June 11, 2021 4
1.6 HB 1841 WG Meeting #2 – August 24, 2021 4
1.7 Post-Meeting Activities 5
2. COMMONWEALTH TRANSPORTATION NETWORK 7
2.1 Road Ownership and Maintenance in Virginia 7
2.2 VDOT and the Transportation System in the Commonwealth of Virginia 8
Traffic Control Device Policies by Jurisdiction and Agency 8
Number of Virginians with Vision and Mobility Impairments 9
Pedestrian Crash Statistics in Virginia 9
Planning-Level Cost Estimates for Crosswalks 10
3. CURRENT GOVERNING REQUIREMENTS, POLICIES, AND PRACTICES IN THE COMMONWEALTH 11

3.1 Introduction to Current Governing Requirements 11
Summary of Governing Requirements 11
3.2 Federal Requirements 13
Code of Federal Regulations on Traffic Control Devices 13
Manual on Traffic Control Devices (MUTCD) 13
Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Public Right-of-Way Accessibility Guidelines (PROWAG) 16
3.3 Code of Virginia and Virginia Administrative Code Requirements 17
Code of Virginia and the MUTCD 18
Virginia Supplement to the MUTCD 18
Size, Design, and Color of Signs, Signals, and Markings Erected by Local Authorities 20
Definition of a Crosswalk 20
Driver and Pedestrian Responsibilities at Crosswalks 21
Regulation of Traffic by Localities 22
Localities and Curb Ramp Design 23
3.4 VDOT Policies and Practices 23
Virginia Supplement to the MUTCD 24
VDOT IIM-TE-384 Pedestrian Crossing Accommodations at Unsignalized Locations 24
IIM-LD-218.4 Sidewalk / Crosswalk Pavers: Guidelines for the Use of Solid Paver Units 26
VDOT Practices 29
3.5 Local Agency Policies and Practices 31
4. LITERATURE REVIEW: CROSSWALKS AND PEDESTRIANS WITH NO/LOW VISION 32
4.1 Effectiveness of High-Visibility vs. Basic Crosswalk Markings 32
4.2 Safety Effects of Marked Crosswalks 33
4.3 Color and Contrast of Curb Ramp Detectable Warning Surfaces 33
4.4 Wayfinding Guidance to Pedestrians with No Vision or Low Vision 33
4.5 Crosswalk Placement and Crosswalk Art/Decorative Crosswalks 33
4.6 Other Emerging Research 34

5. HB 1841 REQUIREMENT #1: Determining the Need for a Model Policy on Crosswalk Design and Installation in the Commonwealth 35
5.1 Process for Determining if a Model Crosswalk Policy is Needed 35
5.2 Model Crosswalk Policy Definition 35
Model Policy Definition Background 35
Model Policy Definition 37
Key Factors Affecting Crosswalk Decisions 38
5.3 Determination of Need for a Model Policy 39
Initial Survey Poll 39
Additional Survey Comments on Model Policy Definition 40
Working Group Meeting #2 Discussion 40
Final Straw Poll 41
5.4 Working Group Decision 41
6. HB 1841 REQUIREMENT #2: Recommendations for Model Policy on Crosswalk Design and Installation in the Commonwealth 42
6.1 Recommendations for Model Crosswalk Design and Installation Policy Content 42
User Groups in a Model Crosswalk Policy 42
Guiding Principles of a Model Policy 43
Specific Model Policy Elements to Include 45
6.2 Applicability to Transportation Agencies Other Than VDOT 46
6.3 How VDOT Will Apply Model Policy Recommendations 47
7. HB 1841 REQUIREMENT #3: Monitor and Provide Input to the U.S. Department of Transportation and the Federal Highway Administration for Updates to Crosswalk Designs in the *Manual on Uniform Traffic Control Devices* 48
7.1 MUTCD 11th Edition Status 48
7.2 Working Group Input to FHWA and USDOT on MUTCD Update 49
VDOT's Comments on the Notice of Proposed Amendment (NPA) 49
Other WG Organizations' NPA Comments 50
APPENDIX A – Virginia Acts of Assembly – 2021 Special Session I – Chapter 130 (House Bill 1841) 1
APPENDIX B – Definitions of Key Terms and Acronyms 1

APPENDIX C – Working Group Meeting Summaries 1
APPENDIX D – Working Group Meeting Surveys and Straw Polls 1
APPENDIX E – Working Group Meeting Presentations 1
APPENDIX F – Comments Received from Working Group Members 1
APPENDIX G – Literature Review Summary 1
APPENDIX H – Working Group Member Submissions to FHWA/USDOT Docket for Proposed Draft 11th Edition of the MUTCD 1
APPENDIX I – References: VDOT and other Agency Policies and Plans 1

EXECUTIVE SUMMARY

Introduction to HB 1841

HB 1841, introduced by Delegate Mark Keam, was enacted into law pursuant to the 2021 Special Session of the Virginia General Assembly (see Chapter 130 of the Acts of Assembly, 2021 Special Session 1). The legislation directs the Commissioner of Highways or his designee to convene a Working Group (WG) comprised of relevant stakeholders to determine if there should be model policies for the design and installation of crosswalks in Virginia. If the WG determines that model policies are needed, recommendations for content of the policies will be established by the WG with the goals of promoting statewide uniformity, maximizing pedestrian safety, all while considering the needs of people with disabilities that impair sight or mobility. Furthermore, the WG is directed to monitor and provide input to the U.S. Department of Transportation (USDOT) and Federal Highway Administration (FHWA) as updates for crosswalk designs are considered in the *Manual on Uniform Traffic Control Devices for Streets and Highways* (*MUTCD*). HB 1841 requires that a report on the WG's findings and recommendations be submitted to the Governor and the General Assembly by November 1, 2021.

According to the MUTCD, crosswalk markings provide guidance for pedestrians who are crossing roadways by defining and delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops. In conjunction with signs and other measures, crosswalk markings help to alert road users of a designated pedestrian crossing point across roadways at locations that are not controlled by traffic control signals or Stop or Yield signs. Finally, at non-intersection locations, crosswalk markings legally establish the crosswalk.

Establishing a crosswalk requires two decisions. The first decision is to determine the appropriate location for the crosswalk. The second decision is to determine what type of crosswalk markings to use. There are two classes of markings: basic/standard and high-visibility.

The WG represents a multitude of different organizations and perspectives, primarily the Virginia Department of Transportation (VDOT); transportation researchers; localities; advocacy organizations for persons with disabilities; constituents, including those with disabilities; and Delegate Keam. HB 1841 required that the Virginia Association of Counties (VACo) and the Virginia Municipal League (VML) be included as part of the WG with the remainder composed of "relevant stakeholders."

These WG members represent a broad spectrum of advocacy, transportation, and other government agencies. Additionally, VDOT provided several technical advisors to the WG from Traffic Engineering Division, Transportation and Mobility Planning Division, Location and Design Division, Government and Legislative Affairs Division, and several contractors. These technical advisors assisted in the development of the WG's deliverables, provided input and technical support for the WG's activities, and provided logistical support for the WG process. The WG was intended to bring various stakeholders with diverse perspectives together to collaboratively respond to the topics within HB 1841.

The full WG met to collaborate on June 11, 2021 and August 24, 2021. During each of these meetings there was an open discussion to foster collaboration and allow the entire WG to provide input into this process. The purpose of the June 11, 2021 meeting was primarily to set the course for the WG's activities and discuss how best to meet all HB 1841 requirements. The August 24, 2021 meeting's purpose was to discuss and refine the model policy definition and formulate the WG's response to the questions posed by the General Assembly in HB 1841. A straw poll was conducted at the second WG meeting and the results indicated support for a model crosswalk policy in Virginia.

Commonwealth Transportation System

VDOT maintains most roadways outside of cities within Virginia, with Arlington and Henrico Counties being the only counties that maintain their own roadways. In cities and larger towns, the localities maintain most roadways. Since VDOT maintains a large proportion of the roadways in Virginia, VDOT involvement is key to any statewide policy implementation. It is important to note that localities and other transportation agencies who are maintaining their own roads have autonomy over their roadways. While they are required to follow Federal traffic control device policies and requirements set by state law, they are free to develop their own business practices and policies for items left up to the individual transportation agency.

Literature Review on Crosswalks and Pedestrians with No/Low Vision

Virginia Transportation Research Council (VTRC) conducted a literature review that summarizes published studies, articles, and reports, along with research in progress, for several topics related to crosswalk design. The core topic of the literature review was on the effectiveness of high-visibility crosswalk marking styles compared to that of basic marking styles, and the full literature review can be found in Appendix G of this report.

Current Governing Requirements, Polices, and Practices in the Commonwealth

As mentioned above, there is a hierarchy of requirements applicable to a transportation agency. Federal requirements, including but not limited to the MUTCD, and the Americans with Disabilities Act, apply broadly across all roadways in the United States. Requirements set in the *Code of Virginia* and the Virginia Administrative Code also apply broadly across public roadways in Virginia, regardless of who maintains them. VDOT has its own policies that apply only to VDOT-maintained roadways in most cases, though they can apply to locality-maintained roadways when funding comes from or through VDOT. Localities maintaining their own roads have their own agency-level policies.

With respect to most standard traffic control devices (including crosswalks), federal and state requirements generally specify the design of the device, while transportation agencies decide when and where to apply a device. The agency's decisions are based on its available resources, business practices, and location context, which can vary significantly across agencies. VDOT's transportation-agency-level guidelines are based on significant research and data-analysis and directthe expenditure of funds where needs are the greatest. VDOT partners with localities often to achieve common goals, but it is important to note that VDOT's business practices do not apply to other agencies outside of VDOT.

Determining the Need for a Model Policy

The first requirement in HB 1841 is for the WG to "determine whether there should be model policies for crosswalk design and installation in the Commonwealth." The WG' consensus was that there should be such model policies.

The WG came to this consensus after carefully considering the definition of a model policy. For the purposes of HB 1841, the WG defined a model policy as:

> *A policy document outlining a consistent decision-making framework, established by each road-maintaining agency, for determining when and where to install marked crosswalks, what marking pattern to use for each crosswalk, and what other design elements to install in conjunction with the crosswalk. A model policy document also identifies who is authorized to make crosswalk decisions within the agency.*

Furthermore, the WG determined that a road agency's policy should:

- Be clearly written and easily understandable by planners, designers, decision-makers, and the public.
- Be consistent with federal and state laws and regulations regarding crosswalks, including the federal MUTCD and applicable sections of the *Code of Virginia*.
- Be periodically updated as necessary to reflect changes in state/federal requirements, evolving national standards/best practices, and/or feedback from staff, consultants, or constituents, including those with disabilities that impair sight or mobility.
- Reflect and promote the application of engineering judgment in consideration of:
    - Usability of the crosswalk by those with vision, mobility, or other impairments.
    - Awareness of local context including geography, land-use, and community preferences.
    - The practicality of available resources for crosswalk management and maintenance including workforce, funding, equipment, contracting, and scheduling.
    - Location-specific factors such as traffic volumes, crossing distance, crossing vehicle speeds, and/or others as identified by the agency based on common practices, research, and experience.
- Be a subject of training and outreach to crosswalk decision makers to ensure the policy is correctly and consistently applied.

The following key factors affecting crosswalk decisions were identified:

- State and federal requirements
- Crash risk
- Usage and context
- Equity
- Placemaking
- Constraints
- Prioritization
- Modal emphasis

After carefully discussing the model policy definition in detail and WG members providing feedback and commentary, the WG’s consensus is that there should be a model crosswalk policy in Virginia.

Recommendations for a Model Policy in Virginia

The second requirement in HB 1841 is for the WG to “establish recommendations for such model policies” if it was determined that model policies for design and installation of crosswalks should be established. The WG recommended that the following items be included in any model policy developed in the future.

A model policy for design and installation of crosswalks must take into account different types of users of crosswalks and their specific needs, including:

- Children and Young Pedestrians
- Older Pedestrians
- Blind Pedestrians
- Pedestrians with Low Vision (whose needs are different than blind pedestrians)
- Pedestrians with Hearing Impairments
- Pedestrians with both Visual and Hearing Impairments
- Pedestrians with Mobility Impairments
- Pedestrians with Cognitive or Intellectual Impairments
- Impaired or Distracted Pedestrians
- Transit Users

In addition to pedestrians, vehicle drivers are also “users” of crosswalks to the extent that crosswalks impose legal requirements on them. To effectively serve this function, a crosswalk must be visible to drivers sufficiently far in advance for them to stop if a pedestrian is present in the crosswalk. Thus, enhanced measures (e.g. high-visibility marking patterns, signs, advance warning, pedestrian signals) are often appropriate as traffic volumes, roadway speeds, and roadway widths increase.

Operators of bicycles, scooters, and other small mobility devices are another road user group that must be considered. Sometimes they operate like pedestrians (e.g. riding on a trail or walking or riding a bike across a crosswalk), while at other times they operate like motor vehicles (e.g. when riding in the street, a cyclist is required to yield to a pedestrian in a crosswalk).

Development of detailed policies and design standards for a model policy was beyond the scope of this project, however guiding principles that guide the development of a model policy have been developed by the WG. They are outlined below.

- Pedestrian safety, equity, and accessibility should be the overarching objectives of a model policy.
- There must be a holistic consideration of mobility and safety needs of pedestrians, drivers, and other road users in crosswalk design.
- Complete uniformity in crosswalk design is neither necessary nor desirable, but uniformity in decision-making processes for crosswalk implementation is desirable.
    - The crosswalk designs should be as consistent as possible within similar contexts.
    - Monitor the results of ongoing research and potential future FHWA rulemaking changes regarding elements such as artistic or decorative designs.
- Fiscal responsibility is important in order to provide the greatest benefit to the largest number of road users.
    - Fiscal responsibility will likely involve some form of prioritization of improvement locations to keep other transportation agency initiatives moving forward while crosswalks are implemented.
    - Transportation agencies must consider the full life-cycle costs of their crosswalks, including future maintenance, and ensure that there is sufficient funding for maintenance of existing crossings (including their accessibility features). Devices that are not sufficiently maintained are particularly challenging for users with disabilities.
- The model policy should be a recommendation for transportation agencies, not a requirement.
- Lastly, agencies should periodically reevaluate their policies in response to changing crash trends, changes in land use and demographics, in response to new research, to adapt to new technologies, and/or in response to feedback from planners, designers, maintenance staff, and constituents (including those with disabilities that impair vision and/or mobility).

Based on the guiding principles and user groups defined above, a model policy for crosswalk design and implementation should contain the following elements:

- An introduction stating the agency's commitment to providing safe and equitable transportation options to various user groups of all ages and abilities.
- A designation of a specific position, office or entity within the agency that is responsible for consistent implementation of, and monitoring compliance with, the policy.

- A scope defining where, and to what crossing types, the policy applies. It is recommended that the policy apply to all signalized, uncontrolled, and mid-block crossing locations.
- A process defining criteria for selecting appropriate locations for crosswalks. This includes safety-based requirements such as minimum sight distance and current and potential pedestrian volumes, in addition to criteria to locate crosswalks along pedestrian desire lines. Context-based minimum and maximum distances from other crosswalks should be specified to avoid location of crosswalks too closely together such that there are traffic operational issues or too far from one another so as not to provide adequate crossing opportunities for pedestrians.
- Criteria for defining when high-visibility markings are used and when basic markings are used. These might include, but are not limited to, proximity to certain land use types, roadway characteristics such as speed limit, and traffic characteristics such as average daily volumes.
- Criteria for installation and maintenance of brick pavers, stamped patterns, or crosswalk art/decorative crosswalk that conform to MUTCD requirements and that will not result in a pattern that could be confusing or disorienting to those with partial vision impairment. Members of the WG articulated specific concerns regarding how crosswalk art/decorative crosswalk that is not compliant with the MUTCD may be detrimental to those with low vision.
- A toolbox of additional countermeasures that may be desirable or necessary for a given crosswalk, based on factors including roadway width, presence of a median, roadway speed limit, pedestrian volume, and traffic volume.
- List of accessibility features required, including accessible pedestrian signals, curb ramps, and/or detectable warning surfaces with references to any requirements associated with those devices.
- A list of specific effective dates for requirements located within the body of the policy.
- A protocol for citizens to request new crosswalks, request maintenance on existing crosswalks, and report concerns with crosswalks. This protocol should include procedures for keeping the citizen informed on the status of their request periodically until the request has been resolved. Many agencies have a standard system for this such as the 311 system in cities or the my.vdot.virginia.gov website.

Monitor and Provide Input to FHWA on the MUTCD

The third requirement in HB 1841 is for the WG to “monitor and provide input to the U.S. Department of Transportation and the Federal Highway Administration as updates to

crosswalk designs in the *Manual on Uniform Traffic Control Devices for Streets and Highways* [MUTCD] are considered."

FHWA published a new Notice of Proposed Amendments (NPA) in the *Federal Register* in December 2020 with a proposed draft of the 11th Edition of the MUTCD. This version was supplied for public comment with a formal comment process and comments due to FHWA by May 14, 2021. The requirements in HB 1841 did not take effect until after this comment deadline, but several stakeholders from the WG, including VDOT, performed very thorough reviews of the proposed new MUTCD content and provided comments to the FHWA comment docket.

1. INTRODUCTION OF HOUSE BILL 1841

1.1 House Bill 1841 (Chapter 130 of the Acts of Assembly, 2021 Special Session 1) Legislation Background

HB 1841, introduced by Delegate Mark Keam, was enacted into law pursuant to the 2021 Special Session of the Virginia General Assembly (see Chapter 130 of the Acts of Assembly, 2021 Special Session 1).

The legislation directs the Commissioner of Highways or his designee to convene a Working Group (WG) to determine if there should be model policies for the design and installation of crosswalks. The WG is to be comprised of relevant stakeholders, including the Virginia Municipal League and the Virginia Association of Counties. If the WG determines that model policies are needed, recommendations for content of the policies will be established by the WG with the goals of promoting statewide uniformity, maximizing pedestrian safety, all while considering the needs of people with disabilities that impair sight or mobility. Furthermore, the WG is directed to monitor and provide input to the U.S. Department of Transportation (USDOT) and Federal Highway Administration (FHWA) as updates for crosswalk designs are considered in the *Manual on Uniform Traffic Control Devices for Streets and Highways* (*MUTCD*). HB 1841 requires that a report on the WG's findings and recommendations be submitted to the Governor and the General Assembly by November 1, 2021. This report has been developed and is offered in response to HB 1841.

HB 1841 was the result of input from a group of Delegate Keam's constituents in the 35th District in Northern Virginia. Specifically, the request originated from members of Girl Scout Troop 1673, a Cadette Troop located in Vienna. They had concerns that some of Virginia's crosswalks do not adequately accommodate pedestrians with vision or mobility impairments. Another concern they had was that crosswalks are applied differently and inconsistently throughout the Commonwealth, depending on the transportation agency responsible for maintaining specific roadways.

1.2 Crosswalks Background

According to the MUTCD, crosswalk markings provide guidance for pedestrians who are crossing roadways by defining and delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops. In conjunction with signs and other measures, crosswalk markings help to alert road users of a designated pedestrian crossing point across roadways at locations that are not

controlled by traffic control signals or Stop or Yield signs. Finally, at non-intersection locations, crosswalk markings legally establish the crosswalk.

A crosswalk can be formally defined in two ways. The MUTCD and *Virginia Supplement to the MUTCD* have a definition, which is the same in both documents, and can be found in Section 3.2 of this report in the MUTCD subsection. The *Code of Virginia* has a similar, but distinct definition of a crosswalk that can be found in Section 3.3 of this report in the Definition of a Crosswalk subsection.

Establishing a crosswalk requires two fundamental decisions. The first decision is to determine the appropriate location for the crosswalk. As mentioned above, a marked crosswalk will guide pedestrians to a crossing location and help alert other road users that there may be a pedestrian crossing. A transportation agency seeks to encourage pedestrian crossings only at locations where a pedestrian can cross safely. At locations between intersections, a marked crosswalk is required if a legal crossing is to be established. The second decision is to determine what type of crosswalk markings to use. There are two classes of markings: standard and high-visibility. Standard markings are generally two parallel lines (often referred to as transverse lines in technical documents), while high-visibility crosswalks can be longitudinal lines (bars perpendicular to the pedestrian travel path, often called “piano key” crosswalks), bar pairs (a pair of smaller bars perpendicular to the pedestrian travel path), zebra (two parallel lines with diagonal bars between them), or ladder (similar to zebra but with the bars perpendicular to the parallel lines). Each crosswalk type has the same legal meaning in Virginia.

1.3 HB 1841 WG Membership

The WG represents a multitude of different organizations and perspectives, primarily the Virginia Department of Transportation (VDOT); transportation researchers; localities; advocacy organizations for persons with disabilities; constituents, including those with disabilities; and Delegate Keam. HB 1841 required that the Virginia Association of Counties (VACo) and the Virginia Municipal League (VML) be included as part of the WG with the remainder composed of “relevant stakeholders.”

The organizations that have been represented at the WG meetings are:

- Delegate Keam and Staff
- Girl Scout Troop 1673 (both Troop leaders and the individual Girl Scouts)
- Virginia Association of Counties (VACo)

- Virginia Municipal League (VML)
- American Federation for the Blind, Virginia Chapter
- National Federation of the Blind, Virginia Chapter
- American Council of the Blind of Virginia (ACB-VA)
- American Planning Association, Virginia Chapter
- Virginia Department for the Blind and Vision Impaired (DBVI)
- Virginia Department of Aging and Rehabilitative Services (VDARS) (invited)
- City of Richmond
- City of Falls Church
- City of Alexandria
- Virginia Transportation Research Council (VTRC)
- Virginia Department of Transportation (VDOT)

These WG members represent a broad spectrum of advocacy, transportation, and other government agencies. Additionally, VDOT provided several technical advisors to the WG from Traffic Engineering Division, Transportation and Mobility Planning Division, Location and Design Division, Government and Legislative Affairs Division, and several contractors. These technical advisors assisted in the development of the WG's deliverables, provided input and technical support for the WG's activities, and provided logistical support for the WG process.

The WG was intended to bring various stakeholders with diverse perspectives together to collaboratively respond to the topics within HB 1841.

All communications with WG members were designed to be fully accessible for WG members who are vision-impaired and rely on screen readers. For surveys, participants were also afforded an opportunity to submit their responses through other means if they had difficulty using online survey platforms.

1.4 HB 1841 WG Collaboration and Information Sharing

The full WG met to collaborate together on June 11, 2021 and August 24, 2021. Both meetings were held virtually as a result of the ongoing COVID-19 pandemic. Each of the meetings had a set agenda with open discussion periods between the assigned speakers. The open discussion portions were the most important aspects of these meetings, fostering collaboration and allowing the entire WG to provide input into this process.

The purpose of the June 11, 2021 meeting was primarily to gather and introduce the WG members to each other, set the course for the WG's activities, and discuss how

best to meet all HB 1841 requirements. The August 24, 2021 meeting's purpose was to discuss and refine the model policy definition, and formulate the WG's response to the questions posed by the General Assembly in HB 1841.

VDOT distributed a survey to all WG participants prior to each meeting, and provided PowerPoint presentations to facilitate discussion. The group's documents were posted to a shared website so that the entire WG had access to all of the group's working documents and key resources.

In addition to the two full WG meetings, surveys and email communications were used to keep the WG members informed and engaged throughout the process. All WG materials (agendas, survey results, presentations, and meeting summaries) are included in the Appendix. A summary of the two WG Meetings follows.

1.5 HB 1841 Working Group Meeting #1 – June 11, 2021

The first meeting of the WG was held virtually on Friday, June 11, 2021 from 9:00 a.m. to 11:00 a.m. A full summary of WG Meeting #1 can be found in Appendix C.

Prior to this meeting, a survey was sent electronically on June 9, 2021 to WG members asking them several questions related to the topics contained in HB 1841. The survey questions, responses, and an overview of general themes from the responses can be found in Appendix D.

The WG meeting began with introductions and opening remarks from Delegate Keam, VDOT's State Traffic Engineer, and VDOT's Civil Rights Division Administrator. Background information was presented by VDOT and by the Ffile members of the Girl Scout Troop. Information about completed and ongoing research was presented by the Virginia Transportation Research Council. Several group discussions also took place, and closing remarks followed a discussion of the project schedule, timeline, and deliverables. Details of the meeting activities can be found in the summary in Appendix C, and the meeting presentation can be found in Appendix E.

1.6 HB 1841 WG Meeting #2 – August 24, 2021

The second meeting of the WG was held on Tuesday, August 24, 2021 from 1:00 p.m. to 3:00 p.m. virtually. A full summary of WG Meeting #2 can be found in Appendix C.

A survey and additional supporting materials were sent to WG members on August 3, 2021 to review prior to the meeting (see Appendix D). The survey was sent electronically and all other files were shared on a file sharing website. The files shared with the WG via the file sharing site included:

- Draft definition of a Model Crosswalk Policy
- Annotated outline of this report, with a description of each section's content
- Literature review of crosswalk design and effectiveness
- Text of HB 1841
- WG Meeting #1 presentation slides
- WG Survey #1 responses
- WG Survey #2 questions

The primary focus of the second WG survey was on the definition of a Model Policy that was provided to the WG members, and if, based on the provided definition, there should be a Model Policy established in Virginia. The detailed survey results can be found in Appendix D.

The WG meeting began with introductions and opening remarks from Delegate Keam and VDOT's Civil Rights Division Administrator. An overview of where the WG stood with respect to deliverables and activities was presented, and feedback provided by the WG members was shared with the group. The majority of the meeting was devoted to presenting proposed content for this WG report and soliciting feedback on that content. A single-question poll was asked to determine if there should be a Model Crosswalk Policy in Virginia. The poll results were:

- Nine responses in favor of a Model Crosswalk Policy.
- One "I don't know" response.

A more detailed description of the meeting and WG feedback can be found in Appendix C, and the WG meeting presentation can be found in Appendix E.

1.7 Post-Meeting Activities

Following the WG meetings, draft report content based on WG input from the various activities described above was developed and sent to the WG members for review and comments. These WG comments can be found in Appendix F. VDOT reviewed all comments and made edits to the report accordingly for all comments within the scope of the report. VDOT also received comments that were outside the scope of the HB 1841

study, and if so, they were addressed in a separate document to share with the commentor. Those out-of-scope comments were not included as they were not related to the topics discussed in the report.

2. COMMONWEALTH TRANSPORTATION NETWORK

This section summarizes background facts and statistics of the transportation network in Virginia. The purpose of this section is to frame the discussion of Virginia's pedestrian crossings in subsequent sections. In HB 1841, the WG was charged with determining if a Model Crosswalk Policy is needed and developing recommendations for such a Model Policy. In order to develop useful and realistic Model Policy recommendations to solve a problem, the WG first needed to understand the scale of the problem.

2.1 Road Ownership and Maintenance in Virginia

Most Virginia roads are owned and maintained by either VDOT or a locality:

- Cities: Cities typically own, operate, and maintain roads within their boundaries, with the exception of interstate highways and some limited-access highways which are VDOT maintained. VDOT retains some control and funding responsibilities on some city-maintained roads that are part of Virginia's primary highway system (i.e. numbered roadways). VDOT also maintains some roads within city limits that are part of state facilities (e.g. public universities).
- Counties: VDOT owns, operates, and maintains most roads in counties, except for Arlington and Henrico Counties. Note that this makes VDOT somewhat unique among state DOTs because in most other states, secondary roads and subdivision streets are maintained at the local level.
    - In Arlington and Henrico Counties, secondary roads are maintained by the County while primary roadways and interstates are maintained by VDOT.
    - Some counties in densely populated parts of the state have a county-level DOT even though they do not own their roadways. These county DOTs work closely with VDOT to design, fund, and implement improvements on VDOT roadways, but VDOT remains the ultimate decision-making authority and is responsible for ongoing maintenance. There are a small number of exceptions to this, such as some VDOT districts assigning installation and maintenance responsibilities for some county-requested pedestrian crossing improvements, such as Rectangular Rapid Flashing Beacons (RRFBs).
- Towns: In most small Towns (population under 3,500) VDOT maintains all roads, while Towns over 3,500 population typically maintain their own roads

In addition to localities, there are other entities that maintain public roadways in Virginia. These include:

- Colleges and universities
- Park services/authorities, including the National Park Service
- Toll road authorities and operators

2.2 VDOT and the Transportation System in the Commonwealth of Virginia

VDOT operates the third-largest state-maintained highway system in the country with 57,867 miles of state-maintained roadways in its network. A breakdown of Virginia's state-maintained roadway network is as follows:

- Interstate: 1,118 miles of freeways that connect states and major cities
- Primary: 8,111 miles of freeways, highways, and local roadways that connect cities and towns with each other and with interstates
- Secondary: 48,305 miles of local connector roads
- Frontage: 333 miles of frontage roads that parallel major roadways and provide access to adjacent properties

A separate system includes 10,561 miles of urban streets maintained by cities and towns with the help of state funds.

Note that Henrico County (1,279 miles) and Arlington County (359 miles) maintain their own roads with VDOT funds. Additionally, 39 miles of toll roads in Virginia are maintained by others.

Traffic Control Device Policies by Jurisdiction and Agency

VDOT can implement policies and processes to use on its own roadways, but local agencies are responsible for setting policies and processes on their roadways as long as they align with state law and federal policies. To better establish a more consistent network of traffic control devices, VDOT seeks to forge relationships with the localities to share information and best practices where localities can learn from VDOT and from each other, and VDOT can learn from the localities.

Crosswalks and their associated curb ramps are generally owned and maintained by the agency that maintains the crossed roadway segment. At traffic signals on VDOT-maintained roadways, VDOT generally maintains the signal and all associated

crosswalks, curb ramps, and pedestrian signal equipment, even if some of the individual road segments leading to that traffic signal are not VDOT-maintained.

VDOT's crosswalk system includes the following estimated figures:

- 32,000 marked crosswalks that have a $35 million replacement value
- 80,000 curb ramps

The number of crosswalks outside the VDOT system is unknown, however it is estimated that there are many thousands of crosswalks given the comparatively more urban nature of the non-VDOT system.

Number of Virginians with Vision and Mobility Impairments

According to the Centers for Disease Control and Prevention, approximately 1.6 million adults in Virginia (25% of Virginians aged 18+) have some type(s) of disability. Of those, approximately 200,000 adults have mobility impairment (defined as having serious difficulty walking or climbing stairs), while 65,000 have vision impairment (defined as being blind or having serious difficulty when seeing, even when wearing glasses).

Pedestrian Crash Statistics in Virginia

In 2019, VDOT's Traffic Engineering Division completed a statewide Virginia Pedestrian Crash Assessment to understand the factors that contribute to pedestrian crashes, to identify crash trends over time, and to inform programming and funding decisions that support pedestrian safety in Virginia.

According to the Virginia Pedestrian Crash Assessment, the distribution of Virginia's pedestrian injury crashes by crossing type was as follows:

- 21% - Mid-block locations (i.e., locations not at a street intersection)
- 27% - Signalized intersections
- 42% - Unsignalized intersections

Also, 57% of pedestrian injury crashes and 68% of fatal pedestrian crashes occurred at locations without a marked crosswalk.

Planning-Level Cost Estimates for Crosswalks

VDOT has estimated the cost of an average-length (approximately 60 ft.) crosswalk with thermoplastic (high-durability) marking material. These crosswalk installation cost estimates are for planning purposes and include materials, labor, and traffic control, and the cost estimates do not include installation of curb ramps, detectable warning surfaces, and artistic elements:

- Parallel lines crosswalk (basic/standard crosswalk): $900
- Piano-key crosswalk (high-visibility crosswalk): $1,800

The cost for a high-visibility crosswalk cited above is for the piano-key marking pattern. There are some other types of high-visibility crosswalk marking patterns, such as zebra, that could have higher estimated costs than the piano-key crosswalk. Crosswalks with additional artistic elements, such as pavers, brick crosswalks, or crosswalk art/decorative crosswalk, will have significantly higher costs than any of the types described above.

3. CURRENT GOVERNING REQUIREMENTS, POLICIES, AND PRACTICES IN THE COMMONWEALTH

3.1 Introduction to Current Governing Requirements

This section summarizes state and federal laws, mandates, and regulations that affect crosswalk design and installation in the Commonwealth. There is a hierarchy of crosswalk design and installation policies at the Federal, state, and agency levels. These governing requirements form the basis for the scope of a Model Crosswalk Policy and therefore set the stage for later sections of this report. Requirements at each level of governance (Federal, State, and agency) have different effects on a potential Model Crosswalk Policy.

Summary of Governing Requirements

The hierarchy of requirements can be seen in Table 1 below. Each requirement described in this section is shown in the table below so that the reader can visualize the hierarchy and see how requirements relate to one another.

Table 1: Summary of Governing Requirements, Guidelines and Practices for Crosswalks and Curb Ramp Design by Level

Governing Requirements	**For Crosswalks**	**For Curb Ramp Design**
Federal/ National Level	• Code of Federal Regulations (23 CFR 655.603) • Manual on Traffic Control Devices (MUTCD) • Federal/national guidance documents are also available to assist agencies in developing their own policies on certain issues or that may be used as supplements to existing policies FHWA's *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* or NACTO's *Urban Street Design Guide*	• Americans with Disabilities Act Accessibility Guidelines (ADAAG) • Public Right-of-Way Accessibility Guidelines (PROWAG)

State-Level	• *Code of Virginia* § 46.2-830 (MUTCD) • Virginia Administrative Code 24VAC30-315-10 (Virginia Supplement to the MUTCD) • *Code of Virginia* § 46.2-1312 (Size, Design, and Color of Signs, Signals, and Markings Erected by Local Authorities) • *Code of Virginia* § 46.2-100 (Definition of Crosswalk) • *Code of Virginia* § 46.2-924 (Driver and Pedestrian Responsibilities at Crosswalks) • *Code of Virginia* § 15.2-2028 (Regulation of Traffic by Localities) • *Code of Virginia* § 33.2-274 (Regulation of Through Traffic in Residence Districts)	• *Code of Virginia* §15.2-2021 (Localities and Curb Ramp Design)
VDOT-Level	• Virginia Supplement to the MUTCD • IIM-TE-384 (Pedestrian Crossing Accommodations at Unsignalized Locations) • IIM-LD-218.4 (Sidewalk / Crossing Pavers: Guidelines for the Use of Solid Paver Units) • VDOT Standard Drawings (PM-3) • Pedestrian Safety Action Plan (PSAP)* • Highway Safety Improvement Program (HSIP)* • Strategic Highway Safety Plan (SHSP)*	• VDOT Standard Drawings (CG-12)
Local-Level	• Locality-specific policies and practice (must be consistent with Federal and State-Level requirements)	• *Code of Virginia* § 15.2-2021 (Localities and Curb Ramp Design)

*Denotes items that are best practices and not formal VDOT policy or standards

3.2 Federal Requirements

Federal requirements generally apply broadly across all public roadways in the United States, including VDOT- and locality-maintained roadways. These requirements include Federal laws passed by Congress and signed by the President, as well as Federal rules passed by Federal government agencies through the Rulemaking process. Compliance with these laws and rules is mandatory in order for a state to avoid a loss of Federal highway funding.

Code of Federal Regulations on Traffic Control Devices

Relevant provisions of federal regulations (23 CFR 655.603), set out below, specify that the national *MUTCD* and/or the state MUTCD is the standard for all traffic control devices installed on any road network:

a) *National MUTCD. The MUTCD approved by the Federal Highway Administrator is the national standard for all traffic control devices installed on any street, highway, or bicycle trail open to public travel in accordance with 23 U.S.C. 109(d) and 402(a).*
b) *State or other Federal MUTCD. Where State or other Federal agency MUTCDs or supplements are required, they shall be in substantial conformance with the National MUTCD. Substantial conformance means that the State MUTCD or supplement shall conform as a minimum to the standard statements included in the National MUTCD.*

Manual on Traffic Control Devices (MUTCD)

The Frequently Asked Questions page of FHWA's MUTCD website frequently asked questions page clarifies the purpose of the MUTCD and the responsibilities of state and local transportation agencies to decide which traffic control devices to select and install as shown in the following paragraph below:

> *FHWA publishes the MUTCD, which contains all national design, application, and placement, standards, guidance, options, and support provisions for traffic control devices. The purpose of the MUTCD is to provide uniformity of these devices, which include signs, signals, and pavement markings, to promote highway safety and efficiency on the Nation's streets and highways. The individual State and local highway agencies (not the FHWA) select, install,*

> *operate, and maintain all traffic control devices on all public roadways (including the interstate and the U.S. numbered systems) nationwide.*

Thus, state and local transportation agencies have flexibility in the selection and application of traffic control devices provided the decisions are made within the provisions of the MUTCD.

Section 1A.13 of the MUTCD defines a crosswalk as:

> *(a) that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line; (b) any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might be supplemented by contrasting pavement texture, style, or color.*

Section 3B.18 of the MUTCD addresses crosswalks if a transportation agency chooses to install one.

The only Standard in Section 3B.18 of the MUTCD is in Paragraph 4, set forth below:

> *When crosswalk lines are used, they shall consist of solid white lines that mark the crosswalk. They shall not be less than 5 inches or greater than 24 inches in width.*

According to the definitions in Section 1A.13 of the MUTCD, a Standard is “a statement of required, mandatory, or specifically prohibited practice regarding a traffic control device.” Guidance, Option, and Support statements within the MUTCD are not required practices, and deviation from these statements can be made on the basis of engineering judgement exercised by a licensed Professional Engineer. Inclusion of Guidance, Option, and Support statements, in the MUTCD offers transportation agencies a significant amount of flexibility to make their own decisions regarding traffic control device usage and placement.

Aside from Paragraph 4 described above, the remainder of the content in Section 3B.18 of the MUTCD is Guidance, Option, or Support statements, which, as noted above, are

not required practices. The MUTCD specifies what crosswalk markings can be applied, but it does not dictate when or where one marking pattern (e.g. standard, high-visibility) is to be used as compared to another, it only specifies how to mark after the marking pattern has been selected. In terms of where crosswalks should be located, Paragraph 8 in Section 3B.18 of the MUTCD offers the following guidance:

> *Crosswalk lines should not be used indiscriminately. An engineering study should be performed before a marked crosswalk is installed at a location away from a traffic control signal or an approach controlled by a STOP or YIELD sign.*

Additionally, FHWA sometimes issues Official Interpretations, which are interpretations or clarifications of the MUTCD used in unique circumstances. According to the FHWA Official Interpretation FAQ, interpretations "include a consideration of the application and operation of standard traffic control devices, official meanings of standard traffic control devices, or the variations from standard device designs." It is important to note that Official Interpretations do not set new policy, but rather interpret or clarify the meaning of existing policy statements in the MUTCD.

FHWA has issued Official Interpretation 3(09)-24(I) that establishes the parameters under which agencies may install aesthetic treatments or crosswalk art. Generally, crosswalks are only legally established if the aesthetic treatment is bounded on both sides by white retroreflective lines meeting the requirements of MUTCD Chapter 3B, and the aesthetic treatment must be a subdued-colored (red, rust, brown, clay, etc.) repeating pattern (e.g. lattice, brick, or herringbone) that is nonreflective and provides good contrast with the bounding white crosswalk lines.

All transportation agencies, including local agencies, must follow the MUTCD. The FHWA MUTCD Knowledge Overview page states that:

> *The MUTCD is the law governing all traffic control devices. Non-compliance with the MUTCD ultimately can result in the loss of federal-aid funds as well as in a significant increase in tort liability.*

There is no formal enforcement mechanism associated with the MUTCD except the potential for loss of federal-aid highway funds as described above. In general, traffic control devices that do not comply with the current edition of the MUTCD but were compliant with a previous edition when originally installed can remain until the end of their useful service life, at which time they are to be upgraded to a compliant device. Newly installed devices must comply with the current edition of the MUTCD.

The proposed 11th Edition of the MUTCD is not yet in effect, and it may change prior to being issued. A draft of this new MUTCD was released in December 2020 as part of a Notice of Proposed Amendments from FHWA. The proposed MUTCD draft gives insight into FHWA's direction on traffic control devices. If adopted as-is, the new MUTCD would have a separate section on high-visibility crosswalk marking patterns. It does not establish requirements for when or where high-visibility marking patterns must be used, but it doesprovide specific detail for how the markings are applied to the roadway, when used. The allowable high-visibility marking types in the proposed draft 11th Edition of the MUTCD are: piano keys, bar pairs, and ladder.

Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Public Right-of-Way Accessibility Guidelines (PROWAG)

The Americans with Disabilities Act of 1990 (ADA) is a Federal-level civil rights law that prohibits discrimination based on disability. Under the ADA, public accommodations such as pedestrian crossings must be accessible regardless of the user's disability status. The ADAAG and PROWAG are more detailed design standards that provide details of how persons with disabilities are to be accommodated. The ADAAG is an older (from 2004), more general standard that covers accessibility in many settings, but does not fully cover public rights-of-way. PROWAG was developed to address that gap and specifically covers how pedestrians with disabilities are to be accommodated at crossings of roadways.

There is no explicit policy requirement or guidance on when crosswalks shall or should be installed per the ADAAG and PROWAG. In the ADAAG Standards and PROWAG, however, there are detailed technical requirements on the design and placement of curb ramps, detectable warning surfaces, and other elements that make the built environment accessible to users with disabilities.

It is important to note that PROWAG has not officially been adopted by the US Access Board at the federal level. The proposed rules were issued as a Notice of Proposed Amendment in 2011, but as of the date of this report, the US Access Board has not yet issued a Final Rule. PROWAG can be considered a best practice that could be followed for areas not fully addressed by the present ADAAG standards.

Below are detailed design guidelines in the ADAAG (in effect) and PROWAG (proposed guidelines/best practices, but not yet formally adopted by the Federal government). These guidelines cover design elements of pedestrian crossings, specifically where a pedestrian pathway meets a roadway, such as at a curb ramp.

ADAAG Standards

- 406.8 Detectable Warnings. A curb ramp shall have a detectable warning complying with 705. The detectable warning shall extend the full width of the curb ramp (exclusive of flared sides) and shall extend either the full depth of the curb ramp or 24 inches (610mm) deep minimum measured from the back of the curb on the ramp surface.

PROWAG

- R208.1 Where Required. Detectable warning surfaces complying with R305 shall be provided at the following locations on pedestrian access routes and at transit stops:
  1. Curb ramps and blended transitions at pedestrian street crossings;
  2. Pedestrian refuge islands;
  3. Pedestrian at-grade rail crossings not located within a street or highway;
  4. Boarding platforms at transit stops for buses and rail vehicles where the edges of the boarding platform are note protected by screens or guards; and
  5. Boarding and alighting areas at sidewalk or street level transit stops for rail vehicles where the side of the boarding and alighting areas facing the rail vehicles is not protected by screens or guards.
- R305.1.4 Detectable warning surfaces shall extend 610 mm (2.0 ft) minimum in the direction of pedestrian travel. At curb ramps and blended transitions, detectable warning surfaces shall extend the full width of the ramp run (excluding any flared sides), blended transition, or turning space. At pedestrian at-grade rail crossings not located within a street or highway, detectable warnings shall extend the full width of the crossing. At boarding platforms for buses and rail vehicles, detectable warning surfaces shall extend the full length of the public use areas of the platform. At boarding and alighting areas at sidewalk or street level transit stops for rail vehicles, detectable warning surfaces shall extend the full length of the transit stop.

3.3 Code of Virginia and Virginia Administrative Code Requirements

Requirements in the *Code of Virginia* are state-level mandates that generally apply across all public roadways in the Commonwealth of Virginia, including VDOT-maintained and locality-maintained roadways. These requirements establish consistent “rules of the road,” establishing clear expectations for both vehicle operators and pedestrians at a crosswalk.

Regulations inthe Virginia Administrative Code relating to the MUTCD are promulgated by and are subject to amendment by the Commonwealth Transportation Board (CTB).

Code of Virginia and the MUTCD

The *Code of Virginia* § 46.2-830 states in part: *The Commissioner of Highways may classify, designate, and mark state highways and provide a uniform system of traffic control devices for such highways under the jurisdiction of the Commonwealth. Such system of traffic control devices shall correlate with and, so far as possible, conform to the system adopted in other states.*

This *Code* section reiterates the federal requirement in 23 CFR 655.603 that the MUTCD applies to all public roads in Virginia and other states. Note that § 46.2-830 applies to all highways under the jurisdiction of the Commonwealth, which would include both VDOT- and locally-maintained roads.

Virginia Supplement to the MUTCD

A regulation in the Virginia Administrative Code (24VAC30-315-10) also identifies the *Virginia Supplement to the MUTCD* as the standard for traffic control devices on all highways under the jurisdiction of VDOT:

> B. *The 2009 MUTCD dated December 2009 shall be the standard for all highways under the jurisdiction of the Virginia Department of Transportation, with the following exceptions: (i) the Virginia Supplement to the 2009 MUTCD (2011 Edition) contains standards and guidance that exceed minimum federal requirements concerning traffic control devices and presents additional pertinent traffic control parameters not addressed by the 2009 MUTCD and (ii) the Virginia Department of Transportation uses the Virginia Work Area Protection Manual (WAPM) (2011 Edition), which is a part of the Virginia Supplement to the 2009 MUTCD (2011 Edition), instead of the 2009 MUTCD Part 6, Temporary Traffic Control. All signs, signals, pavement markings, and other traffic control devices under the jurisdiction of the Virginia Department of Transportation shall conform accordingly.*

The *Virginia Supplement to the MUTCD* applies to all VDOT-maintained roadways and, similar to the MUTCD, contains information about how to apply traffic control devices after a decision has been made to utilize a specific device. The *Virginia Supplement to the MUTCD* also contains some information specific to VDOT's procedures and

practices and in some cases, provides additional information regarding when or where to place a specific traffic control device. Localities have the option of adopting the *Virginia Supplement to the MUTCD*, but they are not bound by content related to VDOT practices and internal agency policies.

On VDOT-maintained roadways, crosswalks shall be installed following Section 3B.18 of the *Virginia Supplement to the MUTCD* and any relevant VDOT Instructional and Informational Memoranda (IIM).

The Introduction to the *Virginia Supplement to the MUTCD* provides information related to the document's applicability to localities. 24VAC30-315-10 does not mandate that localities who maintain their own roads (e.g. cities, large towns, and Arlington and Henrico Counties) adopt the *Virginia Supplement to the MUTCD,* but VDOT encourages localities to do so in order to promote uniformity of traffic control devices throughout the Commonwealth. The relevant text from the Introduction is as follows:

> *All localities shall, by Title 23 of the Code of Federal Regulations and by § 46.2-1312 of the Code of Virginia, follow the provisions of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) as adopted by the FHWA and the CTB.*
>
> *Localities, as described in [the next paragraph], are excluded from the requirement to apply the provisions set forth in the Supplement.*
>
> *Counties and independent cities and towns that maintain their own roadways may recognize the content of the Supplement and the "Virginia Work Area Protection Manual" as official guidance on the subject. A local jurisdiction may choose to adopt the Supplement and/or the "Virginia Work Area Protection Manual." Adopting only one of the publications does not require that the locality adopt the other publication. If this Supplement is adopted by a local jurisdiction, then all references to the "State Traffic Engineer" within this document may be interpreted to mean the maintaining authority's person responsible for traffic control devices.*
>
> *This option shall apply only to roadways under the maintenance of these localities and for private roads open to public travel within the boundaries of these localities.*

If not adopting the *Virginia Supplement to the MUTCD*, the agency must still comply with the national MUTCD per the US Code and the *Code of Virginia*. Additionally, the *Code of Virginia* § 46.2-1312 requires that certain aspects of traffic control device design match VDOT's standards (see next subsection). FHWA may require compliance with the *Virginia Supplement* on Federally-funded local roadway projects, even if the locality has not formally adopted the *Virginia Supplement*.

Size, Design, and Color of Signs, Signals, and Markings Erected by Local Authorities

The *Code of Virginia* §46.2-1312 states that: *Traffic signs and traffic signals and markings placed or erected by local authorities pursuant to this title shall conform in size, design, and color to those erected for the same purpose by the Department of Transportation.*

In the context of crosswalks, this requires localities in Virginia to be consistent with VDOT practice in elements of crosswalk design or more specifically the marking pattern – elements such as dimensions, color, and size – when a locality has made a determination to install a crosswalk. For such attributes, VDOT's requirements are in compliance with the federal requirements in the MUTCD (see Section 3.4). This *Code* section does not require a locality to follow VDOT practice to decide under what conditions a crosswalk is to be implemented, nor does it require localities to follow VDOT practice in deciding what type of crosswalk to implement (e.g., high-visibility or basic).

Definition of a Crosswalk

The *Code of Virginia* § 46.2-100 defines a crosswalk as follows:

> *"Crosswalk" means that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traversable roadway; or any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface.*

Note that, according to this definition, a crosswalk can be unmarked. At locations where there is sidewalk on both sides of the road, then a crosswalk exists at the connection of the lateral lines of those sidewalks, even in the absence of pavement markings.

Driver and Pedestrian Responsibilities at Crosswalks

The *Code of Virginia* § 46.2-924 defines driver and pedestrian responsibilities at crosswalks as follows:

A. *The driver of any vehicle on a highway shall yield the right-of-way to any pedestrian crossing such highway by stopping and remaining stopped until such pedestrian has passed the lane in which the vehicle is stopped:*
    1. *At any clearly marked crosswalk, whether at midblock or at the end of any block;*
    2. *At any regular pedestrian crossing included in the prolongation of the lateral boundary lines of the adjacent sidewalk at the end of a block; or*
    3. *At any intersection when the driver is approaching on a highway where the speed limit is not more than 35 miles per hour.*

B. *When a vehicle is stopped pursuant to subsection A, the driver of any other vehicle approaching from an adjacent lane or from behind the stopped vehicle shall not overtake and pass such stopped vehicle.*

C. *Notwithstanding the provisions of subsection A, at intersections or crosswalks where the movement of traffic is being regulated by law-enforcement officers or traffic control devices, the driver shall yield according to the direction of the law-enforcement officer or device.*

    No pedestrian shall enter or cross an intersection in disregard of approaching traffic.

    The drivers of vehicles entering, crossing, or turning at intersections shall change their course, slow down, or stop if necessary to permit pedestrians to cross such intersections safely and expeditiously.

    Pedestrians crossing highways at intersections shall at all times have the right-of-way over vehicles making turns into the highways being crossed by the pedestrians.

D. *The governing body of Arlington County, Fairfax County, Loudoun County and any town therein, the City of Alexandria, the City of Fairfax, the City of Falls Church, and the Town of Ashland may by ordinance provide for the installation and maintenance of highway signs at marked crosswalks specifically requiring operators of motor vehicles, at the locations where such signs are installed, to yield the right-of-way to pedestrians crossing or attempting to cross the highway. Any operator of a motor vehicle who fails at such locations to yield the right-of-way to pedestrians as required by such signs shall be guilty of a traffic infraction punishable by a fine of no less than $100 or more than $500. The Department of Transportation shall develop criteria for the design, location, and installation of*

such signs. The provisions of this section shall not apply to any limited access highway.

E. *Where a shared-use path crosses a highway at a clearly marked crosswalk and there are no traffic control signals at such crossing, the local governing body may by ordinance require pedestrians, cyclists, and any other users of such shared-used path to come to a complete stop prior to entering such crosswalk. Such local ordinance may provide for a fine not to exceed $100 for violations. Any locality adopting such an ordinance shall install and maintain stop signs, consistent with standards adopted by the Commonwealth Transportation Board and to the extent necessary in coordination with the Department of Transportation. At such crosswalks, no user of such shared-use path shall enter the crosswalk in disregard of approaching traffic.*

F. *A locality adopting an ordinance under subsection E shall coordinate the enforcement and placement of any stop signs affecting a shared-use path owned and operated by a park authority formed under Chapter 57 (§ 15.2-5700 et seq.) of Title 15.2 with such authority.*

Regulation of Traffic by Localities

The *Code of Virginia* § 15.2-2028 grants localities the authority to regulate and control vehicular and pedestrian traffic as shown below:

> *Every locality may regulate and control the operation of motor and other vehicles and the movement of vehicular and pedestrian travel and traffic on streets, highways, roads, alleys, bridges, viaducts, subways, underpasses and other public rights-of-way and places, provided such regulations shall not be inconsistent with the provisions of Chapter 13 (§ 46.2-1300 et seq.) of Title 46.2.*

It is noted that § 15.2-2028 is generally limited by § 15.2-2000, which provides that nothing in the Chapter (which includes § 15.2-2028) applies to any highway, road, street or other public right-of-way which constitutes a part of any system of state highways.

Subject to the condition of VDOT approval noted below, the *Code of Virginia* § 33.2-274 arguably grants localities the authority to apply and install traffic control devices in residence districts, including on VDOT's secondary roadways:

> *Nothing in this title shall be construed to prevent the application and installation of traffic control measures to reduce the negative effects of traffic through residential areas on any component of the secondary highway system that meets*

> *the definition of "residence district" in the Code of Virginia § 46.2-100, even if such component also provides access to a "business district" as defined in the same section. Installation of traffic control measures on any state-maintained highway shall be approved by the Department prior to installation.*
>
> *Furthermore, nothing in this title shall be construed to prevent the acceptance by the Department of private financing for the application and installation of traffic control measures if and when such measures meet the Department's standards.*

In the context of crosswalks, these *Code* sections grant localities the authority to determine under what conditions to install a crosswalk and what marking pattern to use on roads they maintain. However the size, color, and shape of any installed crosswalk, once the pattern type is chosen, is regulated by the *Code of Virginia* § 46.2-1312 as described previously.

Localities and Curb Ramp Design

For purposes of curb ramps, the *Code of Virginia* § 15.2-2021 requires localities to use VDOT's Road and Bridge Standards, stating that:

- *Notwithstanding the provisions of subsection A of the Code of Virginia § 15.2-2000, every locality requiring curbs along its streets that incorporate accessible routes for pedestrian use, such as existing or proposed sidewalks, shall require that curb ramps be constructed at intersections for use by persons with mobility impairments. The ramps shall comply with the Virginia Department of Transportation's Road and Bridge Standards. Local option, variance, or waiver of these standards is prohibited.*

The Standard Drawing referenced in the *Code of Virginia* § 15.2-2021 is Standard CG-12, which sets forth VDOT's detailed design requirements for curb ramps. The various components of curb ramps – Detectable Warning Surface placement and details, widths, landing and ramp areas, allowable slopes, etc. are all in conformance with ADAAG and PROWAG. VDOT requirements for Detectable Warning Surface color are shown in Section 504.02(i) of the 2020 VDOT Road and Bridge Specifications.

3.4 VDOT Policies and Practices

VDOT is the owner and operator of the third-largest state highway system in the United States, and as such has a robust number of agency policies and practices in place,

typically in the form of Instructional and Informational Memoranda (IIMs) issued by various VDOT divisions and approved by the Chief Engineer, Chief of Maintenance and Operations, or an equivalent executive-level leadership position. These policies and practices are based on VDOT's business practices and available resources and are generally applicable only to VDOT-maintained roadways. In some cases, VDOT policies may apply to locally-maintained roadway projects funded with certain sources of state and/or Federal funds. Since these are internal Department policies and practices, VDOT may modify, alter, replace, or rescind these policies and practices.

Virginia Supplement to the MUTCD

The *Virginia Supplement to the MUTCD* does not contain any explicit policy requirements on when crosswalks shall or should be installed, nor does it restrict use of any common basic or high-visibility crosswalk marking pattern. Section 3B.18 of the *Virginia Supplement* contains a copy of the federal MUTCD policy on crosswalks with one additional Support statement in Paragraph 19 as follows:

> *Information regarding guidelines and recommendations for crosswalk markings can be found in VDOT's "Guidelines for the Installation of Marked Crosswalks."*

The VDOT IIM-TE-384 Pedestrian Crossing Accommodations memorandum (described below) replaced the *VDOT Guidelines for the Installation of Marked Crosswalks in 2016.* The *Virginia Supplement to the MUTCD* will be updated to reflect this in its next revision; in the interim, notification of the applicability of superseding policies is in VDOT's Virginia Supplement to the 2009 MUTCD Revision #1: Frequently Asked Questions document.

VDOT IIM-TE-384 Pedestrian Crossing Accommodations at Unsignalized Locations

VDOT IIM-TE-384 provides additional standards and guidance on when marked crosswalks should be installed and the associated crosswalk marking pattern to be used at unsignalized locations. Most content of the IIM is only guidance statements (recommended, but not required practice), and the IIM calls for additional engineering judgment and engineering study before marked crosswalks are installed at unsignalized locations. Excerpted marked crosswalk policies from the IIM are summarized below:

General

- *Marked crosswalks should not be installed at the intersection of two low-speed roadways functionally classified as "local", such as at the intersection of two subdivision streets.*
- *Marked crosswalks should not be installed where neither pedestrian facilities nor pedestrian-oriented attractors/generators are present on both sides of the crossing.*

When to Install Marked Crosswalks Across Stop-Controlled or Yield-Controlled Approaches

- *Marked crosswalks should be installed if pedestrian facilities or pedestrian-oriented attractors/generators exist on both sides of the crossing and any of the following statements are true, unless precluded by the recommendations in Section 5.1 or the Regional Traffic Engineer approves an exception to this recommendation (see IIM-TE-384 for full details).*

When to Install Mid-Block Marked Crosswalks or Marked Crosswalks Across Uncontrolled Approaches

- *An engineering study shall be performed before crosswalk markings are installed across uncontrolled locations (which includes both crosswalks at mid-block locations and crosswalks across uncontrolled intersection approaches) (see IIM-TE-384 for full details).*

Crosswalk Marking Patterns

- *Standard crosswalks should be used for all marked crosswalks except at locations meeting the criteria for high-visibility crosswalks.*
- *High-visibility crosswalks shall be installed at locations where any of the following conditions exist:*
    - *The crossing is at an uncontrolled roadway approach and meets Condition C of the selection chart in Table 2 of the IIM (generally roadways with higher speeds, higher vehicle traffic volumes, and wider roadways),*
    - *The crossing is located across a multilane roundabout approach or exit from a multi-lane roundabout,*
    - *The crossing is part of a shared use path and crosses an uncontrolled roadway approach with a speed limit > 25 mph, or*
    - *The crosswalk is part of a Pedestrian Hybrid Beacon (PHB) crossing.*
- *High-visibility crosswalks should be installed where all of the following exist:*
    - *The speed limit is > 25 mph,*
    - *The crossing is across an uncontrolled roadway approach, and*
    - *One or more of the following special conditions apply:*

  - *The crossing meets Condition B of the selection chart in Table 2 of the IIM (lower speeds, traffic volumes, and roadway widths, but not lowest category),*
  - *The crossing is not illuminated by nearby roadway lighting,*
  - *Engineering judgment determines that the pedestrian crossing volume is expected to be very high (expected to have pedestrian activity during most daytime 15-minute periods when weather conditions are conducive to walking, based on local knowledge and site context),*
  - *The crossing is part of a walking route approximately ¼ mile or less between a residential development of moderate or heavy density and a school or recreational area,*
  - *The crossing is connected by pedestrian facilities to a rail transit stop or major bus transfer station within walking distance of approximately ¼ mile or less,*
  - *The crosswalk is within a downtown Central Business District area, or*
  - *The crosswalk is in a location where the surrounding land use is indicative of walking as a transportation mode.*
- *High-visibility crosswalks may also be installed where engineering judgment determines that they are necessary to increase driver recognition distance to help compensate for other factors such as roadway geometry, visual clutter in the surrounding environment, crash history, and/or traffic and pedestrian volume patterns.*

VDOT is currently developing a companion document to IIM-TE-384 that governs policy regarding establishment of pedestrian accommodations at signalized intersections.

IIM-LD-218.4 Sidewalk / Crosswalk Pavers: Guidelines for the Use of Solid Paver Units

VDOT's IIM-LD-218.4 provides information about the use of sidewalk and crosswalk pavers within the VDOT right-of-way. This includes pavers (e.g. brick), thermoplastic patterned inlays, textured asphalt, or colored asphalt/non-standard products. Relevant provisions include:

- A Locality may request the installation of paver units, thermoplastic patterned inlays, asphalt texturing or coloring, and/or non-standard pavement products within VDOT right of way.
- Paver units, thermoplastic patterned inlays, asphalt texturing and coloring products shall be installed in accordance with VDOT and ADA design requirements.

- On roadways within VDOT's system, the incremental cost for paver units, thermoplastic patterned inlays, asphalt texturing or coloring, or other non-standard pavement materials included in a VDOT construction project will be incurred by the requesting entity; VDOT will participate at the normal project participation rate for standard materials only. Cost for such installations on roadways outside VDOT's system will be incurred by the entity requesting the installation.
- VDOT will not be responsible for the repair or replacement of damaged paver units or other non-standard pavement materials or treatments located within the right of way on VDOT maintained roadways. VDOT will only be responsible for ordinary roadway maintenance (snow clearing or debris clearing). The locality will be responsible for the replacement of all pavers should the locality decide that it no longer wants pavers and/or other non-standard materials.
- Cities shall be responsible for the repair and maintenance of paver units, thermoplastic patterned inlays, asphalt-textured and colored surfaces within the City Corporate Limits, once a project is accepted by the City. Applications of thermoplastic patterned inlays, asphalt-textured and colored surfaces outside the City Corporate Limits shall be maintained by the Local Governing Body.
- VDOT's sidewalk/crosswalk design details using paver units intends to comply with ADA requirements by attempting to prevent any incidental settlement to occur that would cause a change in elevation between paver units of more than ¼".

As noted previously, all aesthetic treatments and crosswalk art/decorative crosswalk must comply with Official Interpretation 3(09)-24(I) Standard Drawings.

VDOT's Road and Bridge Standard Drawings includes the following:

- Standard Drawing PM-3 (Figure 1) sets forth VDOT's marking pattern requirements for typically used basic and high-visibility crosswalks.
- As noted previously, Standard Drawing CG-12 (Figure 2) sets forth design requirements for curb ramps and detectable warning surfaces.

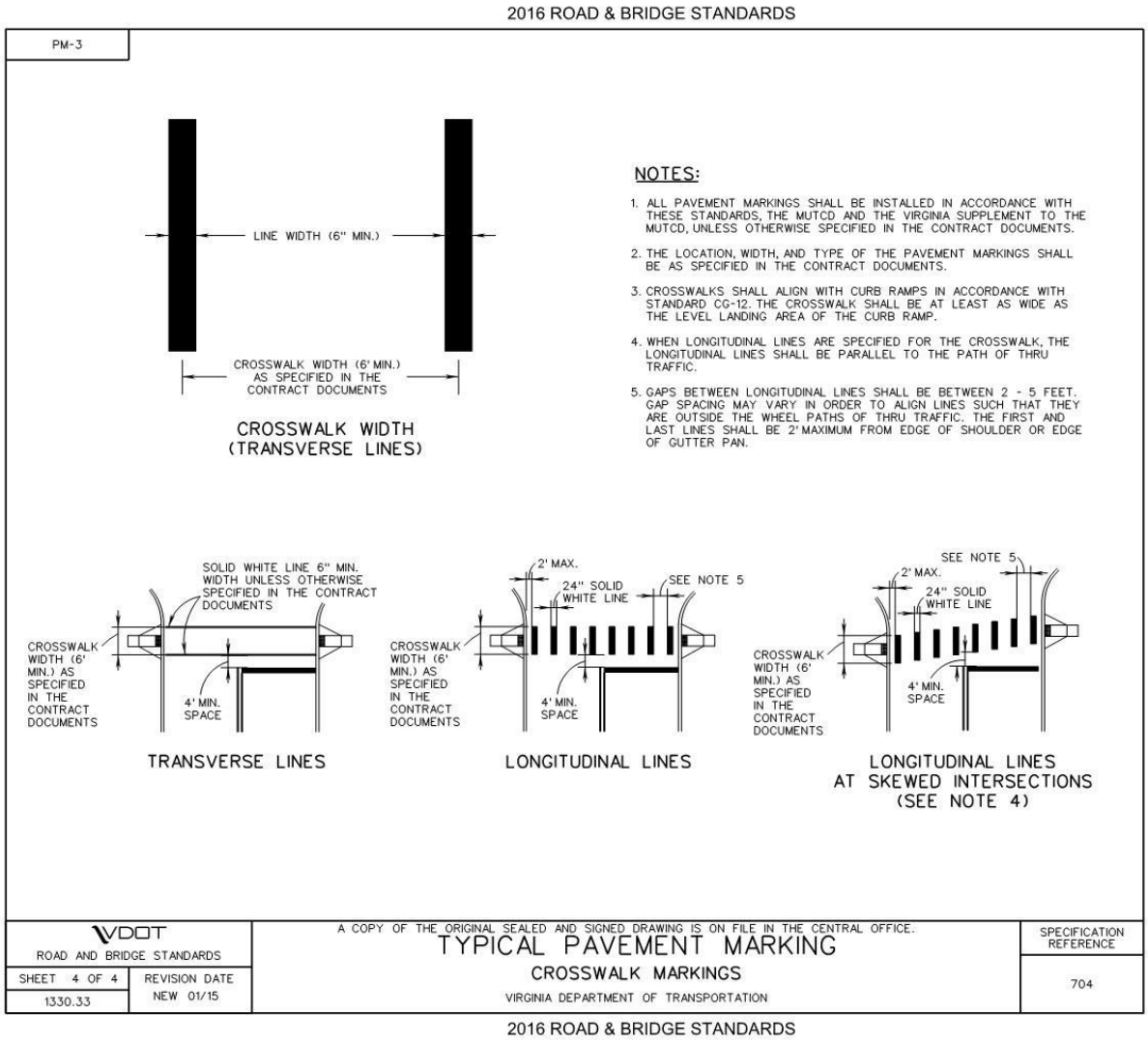

Figure 1: VDOT's 2016 Road and Bridge Standards PM-3 drawings showing typical pavement marking patterns for crosswalks, including transverse (parallel) lines, longitudinal lines (piano keys), and longitudinal lines at skewed intersections. Only one page of PM-3 drawing (Sheet 4 of 4) is shown in this figure and the remaining PM-3 pages can be found in VDOT's 2016 Road and Bridge Standards.

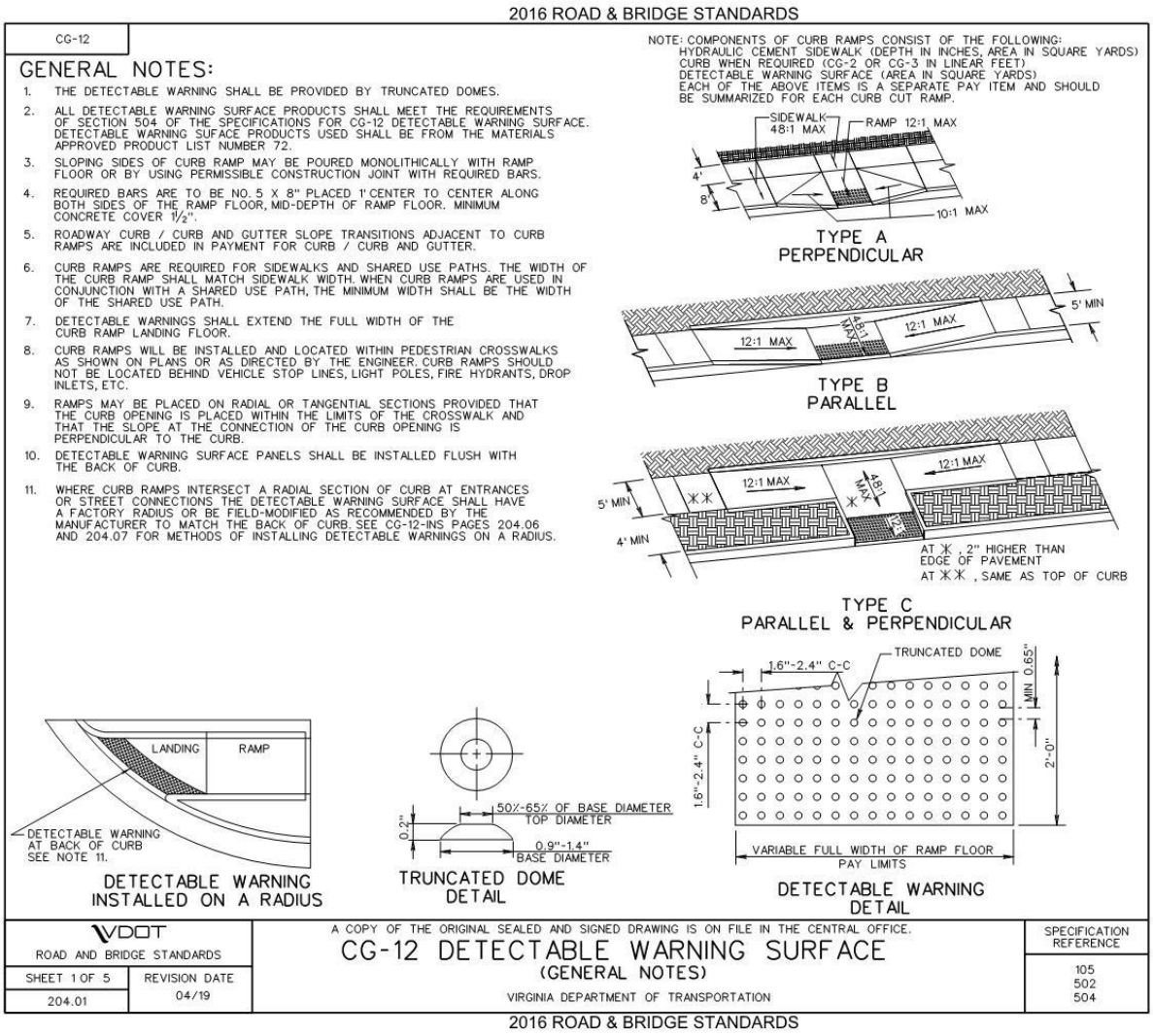

Figure 2: VDOT's 2016 Road and Bridge Standards, CG-12 Detectable Warning Surface, standard drawing shows the engineering design details of three different types of curb ramps, as well as detectable warning surface details. Only one sheet of CG-12 drawing (Sheet 1 of 5) is shown in this figure and the remaining CG-12 pages can be found in VDOT's 2016 Road and Bridge Standards.

VDOT Practices

There are several best practices that VDOT uses to determine where to allocate resources to pedestrian crosswalks. These documents are not formal Department policy, but rather serve to guide the allocation of resources within VDOT's business practices. The following three documents are best practices and not formal policies.

Pedestrian Safety Action Plan (PSAP)

In early 2018, VDOT developed the Pedestrian Safety Action Plan (PSAP), which is a comprehensive evaluation focusing on sites where safety countermeasures should be considered to improve pedestrian safety. The PSAP process included identifying and addressing all public road segments in the Commonwealth with a history of pedestrian safety crashes along with proactively addressing pedestrian crash risk through the identification of priority corridors. VDOT also developed a complementary PSAP report to document the process VDOT followed to complete the PSAP evaluation, review current pedestrian policies, and identify and address pedestrian safety concerns through a data-driven approach. This PSAP report was recommended to local, regional, and state agencies for their review to identify and implement potential countermeasures, update design policies, and supplement other state pedestrian safety initiatives.

Highway Safety Improvement Program (HSIP)

The Highway Safety Improvement Program (HSIP) is a Federal-aid program with a purpose of achieving reductions in traffic fatalities and serious injuries on all public roads. HSIP uses a data-driven, strategic approach to improving safety with a focus on performance.

Transportation agencies apply for HSIP funding for projects that have demonstrated crash reduction and safety benefits. VDOT has identified safety improvements that are implemented on a systemic basis, and those include pedestrian crossing upgrades. These projects are often funded through HSIP. The improvements identified in the PSAP can also be implemented with HSIP funding.

Virginia's Strategic Highway Safety Plan and the Five Es of Transportation Safety

The *Arrive Alive* Strategic Highway Safety Plan (SHSP) has been guiding Virginia with a "Toward Zero Deaths" goal since 2006. This plan is a multi-agency, comprehensive, data-driven approach to reduce fatalities and serious injuries on all public roads and has evolved and matured with the advancement of safety planning techniques. Through public meetings and outreach, the plan presents a coordinated framework for addressing the most serious traffic safety problems. It includes statewide goals and critical emphasis areas and was developed in consultation with Federal, state, regional, and local stakeholders from throughout the Commonwealth.

Engineering policies and designs mentioned in this section of the report are in the "Engineering" category. However, it must be acknowledged that engineering improvements alone cannot bring Virginia "Toward Zero Deaths" (whether for crashes in general or pedestrian-involved crashes specifically); the other "E"s are also critical components of this goal.

The SHSP identifies the "five E's" of safety, and the stakeholder partners primarily responsible for each "E":

- Engineering: highway design, traffic, maintenance, operations, and planning professionals
- Enforcement: state and local law enforcement agencies
- Education: prevention specialists, communications professionals, educators, and citizen advocacy groups
- Emergency response: first responders, paramedics, fire, and rescue
- Everyone: all road users that drive, walk, or ride along roadways

The States are required to update their SHSPs every five years. The current SHSP expires in 2021, and VDOT and other partner state agencies are currently working to develop the 2022-2027 SHSP.

3.5 Local Agency Policies and Practices

Similar to VDOT, local transportation agencies often issue their own policies and develop their own practices related to their transportation systems, with larger agencies often having more robust policies than smaller ones. These policies cover many of the same areas that are covered by VDOT's policies and can be tailored to each agency's business practices, available resources, and local context. In some cases, local transportation agencies may choose to adopt VDOT's policies to apply in their jurisdictions. Although local agencies are not bound to follow VDOT policies, they still must follow any Federal requirements or requirements in the *Code of Virginia* as described above.

Local agencies can adopt their own policies and practices because they retain ownership, decision-making authority, and maintenance responsibilities for their roadways. VDOT does not have the ability or authority to control the specific details of local agency policies and practices.

4. LITERATURE REVIEW: CROSSWALKS AND PEDESTRIANS WITH NO/LOW VISION

This section provides a high-level summary of the literature review that was conducted by the Virginia Transportation Research Council (VTRC) for the HB 1841 effort. Additional details can be found in the literature review summary document contained in the Appendix G of this report.

4.1 Effectiveness of High-Visibility vs. Basic Crosswalk Markings

Studies looking at specific marking styles have had mixed results, partly because of the difficulty in isolating the effect of crosswalk marking style from other features, such as signs, signals, and geometric details, at a crossing. Studies have also used various measures of effectiveness, including crosswalk visibility as stated by drivers, traffic speeds, crash outcomes, and driver yielding rates. In general, previous research reviews have concluded that high-visibility markings are more effective than basic markings in several ways.

High visibility crosswalks have generally been shown to increase the distance from which a driver is able to detect a crosswalk as compared to the basic marking pattern. Although this translates to additional time for the driver to reach a pedestrian, a large study analysis did not show a statistically significant difference in crash rates between the marking patterns. Two smaller studies conducted in cities did show crash reductions, so overall, the results suggest that context matters.

Driver yielding behavior at high-visibility crosswalk locations was higher than at basic crosswalk locations during the daytime, according to one study. Two other studies evaluated driver yielding but had limitations. An ongoing North Carolina study will have more robust results and will be released later this year.

There were no studies found that quantified crosswalk marking type and its effect on pedestrians with low vision, but anecdotal evidence in the studies cites a preference by people with low vision for ladder-style markings and concerns with brick-colored crosswalks.

FHWA is planning to release a guide to selecting crosswalk marking patterns based on safety, cost, and overall effectiveness, with a planned release date later this year.

4.2 Safety Effects of Marked Crosswalks

Although in some cases the presence of marked crosswalks was associated with reduced pedestrian crash risk, marked crosswalks (see Section 3.3 for definition of a crosswalk) alone do not necessarily reduce crashes in all situations. Higher-volume roads sometimes require additional features, such as median refuges. When a crosswalk is installed, the context of the crosswalk is important to consider. Overall, marked crosswalks were neither a cure nor a net negative for pedestrian safety.

An alternative measure of effectiveness is driver and pedestrian behavior. In one study, drivers generally reduced their speed more in the presence of marked crosswalks, but pedestrians did not have a statistically significant difference in their behavior (e.g. how much they checked for oncoming traffic before crossing).

4.3 Color and Contrast of Curb Ramp Detectable Warning Surfaces

Both detectable warning surface color and the color contrast with the adjacent surface are important for pedestrians with low vision. Studies have recommended yellow if one color was to be chosen. One study noted that if the transportation agency desires to use multiple colors, yellow was recommended for dark surfaces and orange-red was preferred for lighter surfaces such as concrete.

4.4 Wayfinding Guidance to Pedestrians with No Vision or Low Vision

People with low or no vision may encounter difficulties with the wayfinding tasks associated with street crossings. These tasks include locating the crosswalk, aligning to cross the street, initiating the crossing within crosswalk boundaries, and maintaining a heading to remain within the crosswalk for the duration of the crossing. Generally, curb ramp design, raised arrows on pushbuttons, and other physical treatments beyond crosswalk markings alone are the best ways to provide wayfinding guidance to pedestrians with low vision or no vision. Crossings that deviate from the typical signal-controlled intersection of two perpendicular streets complicate wayfinding tasks, and an accessibility assessment framework can help engineers evaluate these challenges.

4.5 Crosswalk Placement and Crosswalk Art/Decorative Crosswalks

On the topics of crosswalk placement details (e.g., whether crosswalks set back slightly from a corner are safer than those closer to a corner) and using crosswalk art/decorative crosswalks (e.g., patterns and colors ranging from brick to rainbow), there

is research ongoing, but results are not yet available. FHWA does have an official interpretation letter on the application of colored pavement. This Interpretation Letter 3(09)-24(I) – Application of Colored Pavement contains a section on colored pavement in crosswalks. The FHWA's position on the topic is that "subdued color" treatments between the legally marked parallel lines are acceptable so long as the treatments are not reflective and do not diminish the effectiveness of the parallel crosswalk lines needed to legally establish a marked crosswalk. Any pattern that degrades the contrast of those parallel lines with the adjacent pavement and crosswalk art/decorative crosswalk is not permissible.

4.6 Other Emerging Research

An active study under the Transit Cooperative Research Program will develop research-based guidance for Tactile Warning Surface Indicators (TWSI), including at intersections and crossings that are difficult to locate. The study's results are expected to be complete in spring 2023 and could advance standardization of TWSI, particularly guidance surfaces, in the U.S.

5. HB 1841 REQUIREMENT #1: Determining the Need for a Model Policy on Crosswalk Design and Installation in the Commonwealth

The first requirement in HB 1841 is for the WG to “determine whether there should be model policies for crosswalk design and installation in the Commonwealth.” The WG’s consensus waswas in the affirmative in response to this question. Recommendations for a Model Policy can be found in Section 6 of this report.

5.1 Process for Determining if a Model Crosswalk Policy is Needed

Section 1 of this report described the WG and the process followed to enable collaboration among the WG members. Two WG meetings were conducted, and two surveys were distributed among the WG members related to this question, with a final informal “straw poll” taken during the second WG meeting. The first WG meeting and survey focused on discussing how a model crosswalk policy should be defined for this effort. From the discussion and survey results, a model crosswalk policy definition was developed and shared with the WG. The second meeting and survey focused on answering the yes/no question “is a model crosswalk policy needed”, based on the proposed “model crosswalk policy” definition.

5.2 Model Crosswalk Policy Definition

Based on input and feedback from the first WG meeting, VDOT developed a proposed model policy definition for presentation and discussion at the second WG meeting. The WG was presented with the model policy definition and asked if a model policy was desired based on this definition. The WG concurred with that proposed definition, which is presented below, along with some background information about factors affecting crosswalk decisions. This background information is included here and was presented to the WG to frame the definition discussion by presenting the complexity of the crosswalk decision-making process, the key input factors, and the bounds and constraints of the decision-making process.

Model Policy Definition Background

Crosswalk decision-making is not a strictly quantitative, objective process; many locations present situations where judgment must be used because there is no single “correct” answer.

Crosswalk decisions must comply with State and Federal laws and regulations (see Summary in Section 3). Beyond that, the key factors affecting crosswalk decisions are (in no particular order):

- Crash risk: The crash risk and factors to mitigate that risk need to be considered.
- Usage and context: Crosswalk demand depends greatly on surrounding land use, context, and prevalence of other transportation modes.
- Equity: Investments can be prioritized where there is a higher concentration of residents who do not own vehicles and/or pedestrians with disabilities.
- Placemaking: Crosswalks can be a key component of streetscape improvement projects or other initiatives to promote economic vitality and sense of community. Placemaking is a multi-faceted approach to the planning, design, and management of public spaces. A streetscape is defined as the visual elements of a street.
- Constraints: Crosswalk decisions at individual locations are often affected by right-of-way, utility, or other practical constraints.
- Modal emphasis: A multimodal street network includes streets that emphasize different travel modes, and this, if designated, can inform crosswalk decisions. For example, for streets in more urban areas, crosswalk decisions are often closely related to decisions regarding transit and bicycle infrastructure.
- Prioritization: Agencies must have processes to prioritize investments with available budgets, in consideration of the above factors.

Additional details about these factors can be found in the Model Policy Definition subsection.

It is important for agencies to rely on data-driven decision-making, while allowing for a decision-making process that fully considers these factors (which vary across the state) and does not constrain an agency into making less-than-ideal choices. Crosswalk planning, design, and installation decision-makers should consider these factors in conjunction with the application of engineering judgment. Decision-makers should strive to make informed decisions based on all of these factors.

A model policy should define the key components that are to be considered in each agency's adopted crosswalk policy. Each agency should have a crosswalk installation policy that establishes expectations on the use of judgment, and clearly identifies both the specific crosswalk installation factors to be considered, and the position, office or entity within the agency ultimately authorized to make crosswalk decisions. Having a single position(s) or office ultimately responsible for decision-making will promote

consistency in the application of engineering judgment within that jurisdiction. Local road agencies could choose to simply adopt VDOT policies or establish their own internal policies/best practices that best fit the needs of their jurisdiction as long as they are in compliance with state/federal requirements.

Model Policy Definition

For the purposes of HB1841, a model policy is defined as:

> *A policy document outlining a consistent decision-making framework, established by each road-maintaining agency, for determining when and where to install marked crosswalks, what marking pattern to use for each crosswalk, and what other design elements to install in conjunction with the crosswalk. A model policy document also identifies who is authorized to make crosswalk decisions within the agency.*

A road agency's policy should:

- Be clearly written and easily understandable by planners, designers, decision-makers, and the public.
- Be consistent with federal and state laws and regulations regarding crosswalks, including the federal MUTCD and applicable sections of the *Code of Virginia*.
- Be periodically updated as necessary to reflect changes in state/federal requirements, evolving national standards/best practices, and/or feedback from staff, consultants, or constituents, including those with disabilities that impair sight or mobility.
- Reflect and promote the application of engineering judgment in consideration of:
    - Usability of the crosswalk by those with vision, mobility, or other impairments.
    - Awareness of local context including geography, land-use, and community preferences.
    - The practicality of available resources for crosswalk management and maintenance including workforce, funding, equipment, contracting, and scheduling.
    - Location-specific factors such as traffic volumes, crossing distance, crossing vehicle speeds, and/or others as identified by the agency based on common practices, research, and experience.

- Be a subject of training and outreach to crosswalk decision-makers to ensure the policy is correctly and consistently applied.

Key Factors Affecting Crosswalk Decisions

Further details of the key factors affecting crosswalk decisions identified previously are as follows:

- State and federal requirements: All new crosswalk construction must be in compliance with applicable state and federal laws and requirements, including ADA requirements. These requirements are summarized in Section 3.
- Crash risk: Many factors affect the risk that a pedestrian will be struck when utilizing the crosswalk, and the risk that the crash will result in serious injury or fatality. The factors that the road agency should consider include roadway factors (length of crossing, sight distance, etc.) and traffic factors (volumes, speeds, intersection control type, etc.). For many crossings at higher-risk locations, crosswalks may need to be coupled with other appropriate engineering countermeasures (flashing beacons, lighting, median refuge islands, etc.) to mitigate that risk.
- Usage and context: The degree of usage of a crosswalk depends on numerous factors such as the surrounding land use, connectivity to the greater sidewalk/shared use path network, proximity to transit stops, prevalence of trucks and other large vehicles, potential conflict between bicycle and pedestrian modes where bicycle facilities are present, among others. Each crossing's unique context should be considered.
- Equity: Agencies may prioritize crosswalk investments in locations with a high proportion of residents who do not own their own vehicles, and/or crosswalks that are likely to serve a higher proportion of young, elderly, vision-impaired, and/or mobility-impaired pedestrians (schools, nursing homes, etc.). The pedestrian network, including crosswalks, can also be a critical means of connecting people with jobs.
- Placemaking: Localities often consider crosswalks as a key component of streetscaping enhancements or other initiatives to improve the economic vitality or sense of community. In recent years many agencies have begun to promote crosswalk art/decorative crosswalks. Such installations must be MUTCD-compliant and need to consider whether the art will adversely impact the navigation task for pedestrians with partial vision impairment.
- Constraints: At many intersections, constraints such as available right-of-way, utilities, surrounding topography, excessive congestion and multiple turn lanes, can make it challenging to accommodate all crosswalks, their

accompanying curb ramps, and other associated crosswalk treatments (warning beacons, etc.). For example, crosswalk length and placement are also affected by the need to accommodate the turning radii of buses, fire trucks, or tractor-trailers.

- Modal emphasis: In a multimodal street network, some streets might emphasize walking and transit, with wide sidewalks and frequent crosswalks, while others might prioritize through traffic and freight but accommodate occasional pedestrian travel. Decisions about crosswalk placement are also interrelated with decisions about transit stop placement and bicycle facility (bicycle lanes, shared use paths, etc.) design. These policy decisions are typically made at the local level and may be documented in a plan or policy such as a Multimodal System Plan. If the roadway is part of VDOT's network, the locally made decision requires VDOT's review and approval.
- Prioritization: Given that no agency has unlimited budget or personnel and equipment resources, agencies often must prioritize crosswalk investments based on degree of crash risk, and/or where usage/context, equity, placemaking, or modal emphasis considerations point to the need for a more robust level of investment.

5.3 Determination of Need for a Model Policy

Initial Survey Poll

The draft definition of a model policy described above was distributed to the WG for review and comment on August 3, 2021. A pre-meeting survey was conducted with the following question asked:

> *Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?*

The survey was distributed to the initial twelve external members of the WG, and eight responses were received back. Of those responses, six respondents answered "Yes" to the question posed above. To ensure the WG's consistent and accurate understanding of the definition throughout the duration of the study, VDOT decided to place a heavy focus on discussion of the proposed model policy definition at the second WG meeting to describe what a model policy is and is not. To note, there were additional external members of the WG that were added after the initial survey poll was conducted.

Additional Survey Comments on Model Policy Definition

Regarding the model policy definition, the survey also asked respondents if they concurred as-is, did not concur, or concurred with comments. The results were as follows:

- Concur – 2
- Concur with comments – 5
- Do not Concur – 1

Some of the comments received include the following:

- Prefer best practices document instead of a policy, with guidance from the state, and the localities making final decisions.
- Model policy should be non-mandatory in nature.
- Phrase “Model Crosswalk Policy” is problematic.
- Different markings may be appropriate for different crosswalks.
- When there is doubt as to which marking pattern to use, default to high-visibility.
- Believe citizens’ needs are represented in definition.
- Traffic flow should not be an element of a model policy since the policy should cover whatever is needed to accommodate low-vision users.

Additionally, the survey included a question asking whether the Model Policy definition promotes the goals of HB 1841. Three respondents explicitly answered yes, while others did not express a firm yes or no opinion.

Working Group Meeting #2 Discussion

A focus of the second WG meeting was discussing the definition of a model policy to ensure everyone in attendance understood what was being proposed. Background information was presented with a focus on the various key factors that go into the not-strictly-quantitative crosswalk decision-making process. It was stressed that a model policy defines key elements that should be included in a transportation agency’s policy, with a focus on informed decision-making. Limitations of the model policy were also discussed, including that it would not contain specific engineering criteria or a universal design for all crosswalks.

The proposed definition of a model policy was presented, and the floor opened for discussion among the WG members.

WG input on the key factors affecting decision-making included:

- Questions about how a model policy would be enforced
- Question about why funding for the high-visibility crosswalk type at every intersection is not available
- Request to include stakeholder input into the model policy – e.g. feedback from citizens on when an intersection needs improvements

WG input on the definition of a model policy included:

- Flexibility for localities is needed
- Question about how existing crosswalks would be covered under a model policy
    - Response was that generally, policy would apply to new or reconstructed crosswalks – applying retroactively is not possible due to cost constraints
- Stakeholder input is a necessary component of the decision-making process
- Smaller localities may have limited resources to address crosswalk deficiencies

Final Straw Poll

Following the discussion and after all WG members had an opportunity to provide input, a final straw poll was conducted live during the meeting to ask the following question: "Should there be a model crosswalk policy in Virginia?"

Out of the twelve attendees at the second WG meeting (excluding VDOT employees and consultants), the results were:

- Yes – 9
- I don't know – 1
- No – 0
- Did not answer – 2

5.4 Working Group Decision

After discussing the model policy definition in detail and WG members providing feedback and commentary, the WG's consensus was that there should be a model crosswalk policy in Virginia.

6. HB 1841 REQUIREMENT #2: Recommendations for Model Policy on Crosswalk Design and Installation in the Commonwealth

The second requirement in HB 1841 is for the WG to "establish recommendations for such model policies" if it was determined that model policies for design and installation of crosswalks should be established. This section of the report will describe the WG's recommendations for a model crosswalk policy that can be applied throughout the Commonwealth.

Given that the WG determined that model crosswalk policies should be established, a discussion of model policy elements occurred during the second WG meeting, and the recommendations below take into account the WG's feedback.

6.1 Recommendations for Model Crosswalk Design and Installation Policy Content

The WG's recommendations for a crosswalk design and installation model policy are summarized below by topic area. It is critical to note that as directed by HB 1841's wording, the WG did not develop the model policy content itself, but rather made recommendations for content to be developed in the future. The recommendations are for a model policy that will inform policy-writers at transportation agencies and government officials of the content that should be included and factors that should be considered within an individual agency's policy. The user groups to be considered in a model policy, guiding principles for a model policy, and specific elements to include in a model policy are covered in the following subsections.

User Groups in a Model Crosswalk Policy

A model policy for design and installation of crosswalks must take into account different types of users of crosswalks and their specific needs. Pedestrians of all ages and abilities, including pedestrians with vision or mobility impairments, are the most obvious users of crosswalks. Below are some of the different categories of pedestrians that should be accounted for in a model policy.

- Children and Young Pedestrians
- Older Pedestrians
- Blind Pedestrians
- Pedestrians with Low Vision (whose needs are different than blind pedestrians)

- Pedestrians with Hearing Impairments
- Pedestrians with both Visual and Hearing Impairments
- Pedestrians with Mobility Impairments
- Pedestrians with Cognitive or Intellectual Impairments
- Impaired or Distracted Pedestrians
- Transit users

In addition to pedestrians of varying abilities with diverse needs, vehicle drivers are also "users" of crosswalks in that crosswalks impose legal requirements on drivers and thus drivers must be able to detect and react to them accordingly. To do this, a crosswalk must be visible to drivers sufficiently far in advance for them to stop if a pedestrian is present in the crosswalk. Thus, more measures (e.g. high-visibility marking patterns, signs, advance warning, pedestrian signals) are often appropriate as traffic volumes, roadway speeds, and roadway widths increase.

Operators of bicycles, scooters, and other small mobility devices are another road user group that must be considered. Sometimes they operate like pedestrians (e.g. riding on a trail or walking or riding a bike across a crosswalk), while at other times they operate like motor vehicles (e.g. when riding in the street, a cyclist is required to yield to a pedestrian in a crosswalk).

Additionally, crosswalk decisions are often closely related to transit stop placement decisions (particularly bus stops), in order to facilitate pedestrian access to the transit stops on both sides of the street, and to minimize risk of conflict between pedestrians and transit vehicles.

A model crosswalk policy will need to account for all of these different user groups to optimize recommendations that support a transportation system that works for all users. Many user groups rely heavily on walking for their transportation needs, and many others will walk as part of a transit, bicycle, or rideshare trip, and transportation system decisions should consider their safety, mobility, and comfort.

Guiding Principles of a Model Policy

A crosswalk design and installation model policy should carefully and thoughtfully account for the diverse user groups described above. It is beyond the scope of HB 1841 to develop detailed policies and design standards for a model policy; however, guiding principles that provide direction for the development of a model policy have been developed by the WG. It is the hope of the WG that setting guiding principles will

ultimately lead to policies that work to provide a safe, equitable, and usable pedestrian crossing system for all Virginians, regardless of their age and ability levels.

The guiding principles that were developed by the WG for a model crosswalk design and installation policy are outlined below.

- Pedestrian safety, equity, and accessibility should be the overarching objectives of a model policy. The end result of a transportation agency implementing the model policy should be to improve safety of pedestrians and increase equitable access to destinations via the pedestrian network for all user groups.
- There must be a holistic consideration of mobility and safety needs of pedestrians, drivers, and other road users in crosswalk design. Crosswalks are a traffic control device that communicates to drivers in addition to pedestrians, and crosswalks must be visible to drivers to encourage proper yielding behavior.
- Complete uniformity in crosswalk design is neither necessary nor desirable, but uniformity in decision-making processes for crosswalk implementation is desirable. Different crosswalk designs are necessary for different contexts, such as rural roads with higher speeds vs. urban residential streets with slower speeds. However:
    - The crosswalk designs should be as consistent as possible within similar contexts.
    - Results of ongoing research and potential future FHWA rulemaking changes regarding elements such as artistic or decorative designs should be monitored.
- Fiscal responsibility is important in order to provide the greatest benefit to the largest number of road users. Government transportation agencies that use the most cost-effective solutions will have more funds to be able to implement additional improvements.
    - Fiscal responsibility will likely involve some form of prioritization of improvement locations to keep other transportation agency initiatives moving forward while crosswalks are implemented.
    - Transportation agencies must consider the full life-cycle costs of their crosswalks, including future maintenance, and ensure that there is sufficient funding for maintenance of existing crossings (including their accessibility features). Devices that are not sufficiently maintained are particularly challenging for users with disabilities.
- The model policy should be a recommendation for transportation agencies, not a requirement. VDOT has limited legal authority to force localities to follow VDOT policies for locally-maintained roads, and moreover all Virginians benefit from VDOT having a good working relationship with its locality partners that relies on

cooperation rather than mandates to the extent feasible. National-level standards that localities are required to follow, such as the MUTCD, are sufficient to ensure basic uniformity without the need to enforce additional state-level mandates.

- Lastly, agencies should periodically reevaluate their policies in response to changing crash trends, changes in land use and demographics, in response to new research, to adapt to new technologies, and/or in response to feedback from planners, designers, maintenance staff, and constituents (including those with disabilities that impair vision and/or mobility). New technologies for accessible pedestrian signals, research on the effectiveness of crossing treatments, and new devices to guide pedestrians through a crossing that can enhance the usability of the crossings by different user groups will likely emerge.

Specific Model Policy Elements to Include

Based on the guiding principles and user groups defined above, a model policy for crosswalk design and installation should contain the following elements:

- An introduction stating the agency's commitment to providing safe and equitable transportation options to various user groups of all ages and abilities.
- A designation of a specific position, office or other entity within the agency that is responsible for consistent implementation of and monitoring compliance with the policy.
- A scope defining where, and to what crossing types, the policy applies. It is recommended that the policy apply to all signalized, uncontrolled, and mid-block crossing locations.
- Criteria defining a process for selecting appropriate locations for crosswalks. This includes safety-based requirements such as minimum sight distance and current and potential pedestrian volumes, in addition to criteria to locate crosswalks along pedestrian desire lines. Context-based minimum and maximum distances from other crosswalks should be specified to avoid crosswalks located too closely togethersuch that there are traffic operational issues or too far from one another so as not to provide adequate crossing opportunities for pedestrians.
- Criteria for defining when high-visibility markings are used and when basic markings are used. These might include, but are not limited to, proximity to certain land use types, roadway characteristics such as speed limit, and traffic characteristics such as average daily volumes.
- Criteria for installation and maintenance of brick pavers, stamped patterns, or crosswalk art/decorative crosswalks that conform to MUTCD requirements and will not result in a pattern that could be confusing or disorienting to those with partial vision impairment. There were specific concerns from the WG about how

crosswalk art/decorative crosswalk that is not compliant with the MUTCD may be detrimental to those with low vision.

- A toolbox of additional countermeasures that may be desirable or necessary for a given crosswalk, based on factors including roadway width, presence of a median, roadway speed limit, pedestrian volume, and traffic volume.
- A list of accessibility features required, including accessible pedestrian signals, curb ramps, and/or detectable warning surfaces with references to any requirements associated with those devices.
- A list of specific effective dates for requirements located within the body of the policy.
- A protocol for citizens to request new crosswalks, request maintenance on existing crosswalks, and report concerns with crosswalks. This protocol should include procedures for keeping the citizen informed on the status of their request periodically until the request has been resolved. Many agencies have a standard system for this such as the 311 system in cities or the my.vdot.virginia.gov website.

6.2 Applicability to Transportation Agencies Other Than VDOT

As detailed in Section 3, local transportation agencies other than VDOT own, operate, and maintain many transportation facilities with pedestrian crossings. This will not change with a model crosswalk policy, and those transportation agencies will continue to have crosswalk decision-making responsibilities on their roadway network. The WG members from VACo, VML, and local transportation agencies repeatedly and strongly emphasized a need for flexibility due to their available resources, widely variable crosswalk settings, and various types of constraints, including fiscal constraints and the need to retain funding for other important safety programs. Similarly, the WG members representing crosswalk users, including users who are blind or have low vision, strongly emphasized the need for compliance with the MUTCD (including the minimum requirement to use white crosswalk lines to outline the edges of a textured surface crosswalk). They also emphasized the expectation that crosswalk decision-makers be knowledgeable about the needs of all who will be using a given crosswalk and give meaningful consideration to elements that address those needs.

The model policy recommendations do not include a recommendation for a policy mandate. Rather, deviations, when appropriate, are to be expected, including those made for the previously noted reasons and constraints. Presenting the model policy as a recommendation, will retain the desired local flexibility and not impose new mandates. However, the model policy recommendations will serve as an important resource for local transportation agencies to use as they develop new or update existing crosswalk

design and installation policies/practices. Thanks to the efforts of the stakeholders that brought this legislation forward, the model policy recommendations will promote more informed decision-making, implementation of technical best practices, and enhanced uniformity across the Commonwealth's transportation system. This should result in a sustainable crosswalk system that will benefit all road users, including those with sight and mobility disabilities.

6.3 How VDOT Will Apply Model Policy Recommendations

VDOT currently has several policies, practices, and initiatives (detailed previously in Section 3) in place or underway that collectively address the model policy recommendations. These include VDOT's policy (IIM-TE-384) for crosswalks at unsignalized intersections, the Pedestrian Safety Action Plan, and policies/design standards for curb ramps and Accessible Pedestrian Signals.

Again, thanks to the efforts of the stakeholders that brought this legislation forward, VDOT will use the feedback from the WG as captured in this report to guide future revisions to these policies, practices, and initiatives. As recommended by the current Pedestrian Safety Action Plan, VDOT is already in the process of updating its policy for unsignalized crossings and developing a policy for signalized crossings. The recommendations of this report will be a critical resource in these efforts.

7. HB 1841 REQUIREMENT #3: Monitor and Provide Input to the U.S. Department of Transportation and the Federal Highway Administration for Updates to Crosswalk Designs in the *Manual on Uniform Traffic Control Devices*

The third requirement in HB 1841 is for the WG to "monitor and provide input to the U.S. Department of Transportation and the Federal Highway Administration as updates to crosswalk designs in the *Manual on Uniform Traffic Control Devices for Streets and Highways* [MUTCD] are considered."

Since 1935, the MUTCD has acted as the national standard for traffic control devices on all roadways open to public travel in the United States. It is published by the FHWA. The current edition of the MUTCD that is in effect is the 2009 Edition with Revisions 1 and 2 incorporated (the 10th Edition). VDOT and local road agencies are required to abide by the MUTCD as per the Code of Federal Regulations and the *Code of Virginia*, as described in Section 3.

As described in earlier sections of this report, the MUTCD generally defines how a traffic control device is implemented after a decision has been made to use the device. Decisions about when a particular device is used are left to the transportation agency that manages the facility in question.

7.1 MUTCD 11th Edition Status

The next edition of the MUTCD is being referred to as the 11th Edition of the MUTCD. A NPA for the 11th Edition was published in the Federal Register on December 14, 2020. FHWA accepted comments through May 14, 2021.

As of the writing of this report, there have been no additional opportunities for comment, and no further updates from FHWA on the status of a new MUTCD, since May 14, 2021. FHWA must analyze over 26,000 submitted comments before finalizing and issuing the 11th Edition (i.e. before publishing a Final Rule in the Federal Register implementing a new MUTCD). Therefore, the draft 11th Edition of the MUTCD that was distributed as part of the NPA is not currently in effect for use by transportation agencies.

It is not clear when the 11th Edition will be finalized and published as a Final Rule. Given the volume of comments submitted, it is anticipated that a Final Rule will not be

issued until mid-2022 at the earliest, but this is not guaranteed and a Final Rule could come sooner or later. In the NPA, FHWA proposed to give transportation agencies up to two years to adopt a new MUTCD (which is consistent with FHWA's approach for previous MUTCD updates). Should this adoption deadline remain in the final published 11th Edition, then VDOT would likely not have a new Virginia-specific MUTCD until 2024 at the earliest.

7.2 Working Group Input to FHWA and USDOT on MUTCD Update

HB 1841 had an effective date of July 1, 2021, which was after the May 14, 2021 close of the commenting period for the NPA. Therefore this WG could not submit comments to FHWA directly. However, VDOT and several WG member agencies submitted their individual comments to FHWA during the commenting period. Those comments are summarized below; the detailed comments are included in Appendix H.

VDOT's Comments on the Notice of Proposed Amendment (NPA)

VDOT thoroughly reviewed the draft 11th Edition of the MUTCD and submitted a detailed set of comments on the NPA to FHWA.

As a state-level DOT, VDOT recognizes its inherent responsibility to support all citizens of the Commonwealth, and therefore the Department took a broad and diverse viewpoint when developing comments on the NPA. VDOT understands that the transportation system must serve a diversity of modes, user groups, and ability levels, including persons with disabilities. VDOT's comments to the NPA reflected that philosophy.

VDOT submitted a letter and detailed comments to the docket on May 12, 2021. The letter supported the NPA in general given the significant proposed improvements to the existing 2009 MUTCD. Further, VDOT encouraged FHWA to move forward with the process of finalizing the rulemaking and to commit to more frequent updates to the MUTCD in the future to accommodate the expanding body of knowledge and emerging topics related to traffic control devices. Finally, the letter cited comments that were attached, which covered specific items within the NPA that had fiscal, procedural, and programmatic impacts to the management of traffic control devices in Virginia.

The attachment to VDOT's letter had approximately 120 comments related to a wide variety of MUTCD topics. Comments relevant to the topics within HB 1841 include the following:

- Suggesting that the MUTCD make clear that road users including pedestrians have varying abilities.
- Supporting the inclusion of new MUTCD language emphasizing the qualifications of MUTCD users, and that decisions related to traffic control devices be made by an engineer or those acting under the authority of an engineer, based on sound engineering judgement.
- Recommending a change to wording to clarify that crosswalk markings are required at all non-intersection crossings in order to establish that a crossing exists.
- Supporting the NPA's proposed changes in Section 3C.02 of the MUTCD, which establishes criteria that should be considered in an engineering study for installation of a marked crosswalk, and further recommending that "density and proximity of pedestrian and bicycle traffic generators" be added to the list.
- Recommending changes to the terminology used for different crosswalk types to allow the MUTCD to be better understood by those outside the traffic engineering community, as well as to reduce ambiguity.

Other WG Organizations' NPA Comments

In addition to VDOT's comments, other WG members also submitted comments to FHWA for the MUTCD NPA.

Members of Girl Scout Troop 1673 submitted the following crosswalk-related comments to FHWA:

- All crosswalks shall be one of the high-visibility types: zebra, continental, or ladder.
- All crosswalks shall have detectable warning surfaces at either end.
- "Creative" or artistic crosswalk markings shall be disallowed.
- On-street parking near crosswalks shall be prohibited.
- Marking materials that have the least environmental impact should be studied.

The American Council of the Blind also submitted the following crosswalk-related comments to FHWA:

- Accessible Pedestrian Signals (APS) shall be required for all new or altered signals with pedestrian accommodations.
- APS shall be required whenever a Leading Pedestrian Interval (LPI) is activated.

- Communities shall have Transition Plans to identify how to transition to 100% APS within a reasonable period of time.
- Citizen requests for blind accommodations must be immediately prioritized.
- Rectangular Rapid Flashing Beacons (RRFBs) should not be allowed since they discriminate against deafblind (since no vibrotactile arrow is provided).
- Pedestrian Hybrid Beacons shall have accessible pedestrian signals.
- Accessible pedestrian signals should not require an engineering study in order to be installed.

Although coordinating responses within the WG would have been the ideal way to respond to the NPA, given the May 14, 2021 deadline imposed by FHWA, WG members responded independently in order to meet the timeline. The result was still a robust response to FHWA's NPA for the MUTCD by multiple WG members. Although no further opportunities to provide input to the MUTCD development process were expected prior to the November 1, 2021 due date of this report, the WG monitored the FHWA's MUTCD web site to ensure that this was the case.

APPENDIX A – Virginia Acts of Assembly – 2021 Special Session I – Chapter 130 (House Bill 1841)

CHAPTER 130

An Act to direct the Department of Transportation to convene a working group to determine model policies for crosswalk design; report.

[H 1841]

Approved March 18, 2021

Be it enacted by the General Assembly of Virginia:

1. *§ 1. The Commissioner of Highways or his designee shall convene a working group with relevant stakeholders, including the Virginia Association of Counties and the Virginia Municipal League, to determine whether there should be model policies for crosswalk design and installation in the Commonwealth and, if so, establish recommendations for such model policies. Any such policies shall promote statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility. The working group shall monitor and provide input to the U.S. Department of Transportation and the Federal Highway Administration as updates to crosswalk designs in the Manual on Uniform Traffic Control Devices for Streets and Highways are considered. The working group shall submit to the Governor and the General Assembly a report on its findings and recommendations by November 1, 2021.*

APPENDIX B – Definitions of Key Terms and Acronyms

Definitions

Accessible Pedestrian Signals: a device that communicates information about pedestrian signal timing in non-visual format such as audible tones, speech messages, and/or vibrating surfaces. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Basic/Standard Crosswalk: crosswalks generally marked using two parallel lines (often referred to as transverse lines). (Source: Section 6.2 in the IIM-TE-384 Pedestrian Crossing Accommodations at Unsignalized Locations)

Commonwealth Transportation Board: The Commonwealth Transportation Board (CTB) consists of 17 members appointed by the governor. The board oversees transportation projects and initiatives for the Commonwealth of Virginia. (Source: CTB)

Crosswalk: (a) that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway, and in the absence of a sidewalk on one side of the roadway, the part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line; (b) any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might be supplemented by contrasting pavement texture, style, or color. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Crosswalk: part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traversable roadway; or any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface. (Source: *Code of Virginia* § 46.2-100)

Curb Ramp: a ramp that cuts through or is built up to the curb. Curb ramps can be perpendicular or parallel, or a combination of parallel and perpendicular ramps. (Source: Section R105.5 in PROWAG)

Detectable Warning Surfaces: detectable warning surfaces consist of small truncated domes built in or applied to a walking surface that are detectable underfoot. On pedestrian access routes, detectable warning surfaces indicate the boundary between pedestrian route and a vehicular route where there is a flush rather than a curbed

connection for pedestrians who are blind or have low vision. (Source: Section R208 in PROWAG)

Engineering Judgment: the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in applicable technical resources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Engineering Study: the comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in applicable technical resources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. An engineering study shall be performed by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. An engineering study shall be documented. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

High-visibility Crosswalk: crosswalks marked using longitudinal lines (bars perpendicular to the pedestrian travel path, often called “piano key” crosswalks), bar pairs (a pair of smaller bars perpendicular to the pedestrian travel path), zebra (two parallel lines with diagonal bars between them), or ladder (similar to zebra but the bars are perpendicular to the parallel lines). (Source: Section 6.2 in the IIM-TE-384 Pedestrian Crossing Accommodations at Unsignalized Locations)

Intersection: intersection is defined as follows (Source: Section 1A.13 in the Virginia Supplement to the MUTCD):

a. The area embraced within the prolongation or connection of the lateral curb lines, or if none, the lateral boundary lines of the roadways of two highways that join one another at, or approximately at, right angles, or the area within which vehicles traveling on different highways that join at any other angle might come into conflict.
b. The junction of an alley or driveway with a roadway or highway shall not constitute an intersection, unless the roadway or highway at said junction is controlled by a traffic control device.

c. If a highway includes two roadways that are 30 feet or more apart (see definition of Median), then every crossing of each roadway of such divided highway by an intersecting highway shall be a separate intersection.
d. If both intersecting highways include two roadways that are 30 feet or more apart, then every crossing of any two roadways of such highways shall be a separate intersection.
e. At a location controlled by a traffic control signal, regardless of the distance between the separate intersections as defined in (c) and (d) above:
    1. If a stop line, yield line, or crosswalk has not been designated on the roadway (within the median) between the separate intersections, the two intersections and the roadway (median) between them shall be considered as one intersection;
    2. Where a stop line, yield line, or crosswalk is designated on the roadway on the intersection approach, the area within the crosswalk and/or beyond the designated stop line or yield line shall be part of the intersection; and
    3. Where a crosswalk is designated on a roadway on the departure from the intersection, the intersection shall include the area extending to the far side of such crosswalk.

Intersection: (i) the area embraced within the prolongation or connection of the lateral curblines or, if none, then the lateral boundary lines of the roadways of two highways that join one another at, or approximately at, right angles, or the area within which vehicles traveling on different highways joining at any other angle may come in conflict; (ii) where a highway includes two roadways 30 feet or more apart, then every crossing of each roadway of such divided highway by an intersecting highway shall be regarded as a separate intersection, in the event such intersecting highway also includes two roadways 30 feet or more apart, then every crossing of two roadways of such highways shall be regarded as a separate intersection; or (iii) for purposes only of authorizing installation of traffic-control devices, every crossing of a highway or street at grade by a pedestrian crosswalk. (Source: *Code of Virginia* § 46.2-100)

Leading Pedestrian Interval: low-cost adjustments to signal timing to increase pedestrian safety at signalized intersections. A leading pedestrian interval gives pedestrians a typical 3- to 7-second head start before vehicles in the parallel direction are given the green signal indication. (Source: FHWA-SA-19-040, Leading Pedestrian Interval Countermeasure Tech Sheet)

Median: the area between two roadways of a divided highway measured from edge of traveled way to edge of traveled way. The median excludes turn lanes. The median width might be different between intersections, interchanges, and at opposite

approaches of the same intersection. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Pedestrian: a person on foot, in a wheelchair, on skates, or on a skateboard. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Pedestrian Facilities: a general term denoting improvements and provisions made to accommodate or encourage walking. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Pedestrian Hybrid Beacon: a special type of hybrid beacon used to warn and control traffic at an unsignalized location to assist pedestrians in crossing a street or highway at a marked crosswalk. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Placemaking: Placemaking is a multi-faceted approach to the planning, design, and management of public spaces. Put simply, it involves looking at, listening to, and asking questions of the people who live, work and play in a particular space, to discover their needs and aspirations. This information is then used to create a common vision for that place. The vision can evolve quickly into an implementation strategy. (Source: FHWA-HOP-12-004, The Role of Transportation Systems Management & Operations in Supporting Livability and Sustainability)

Pushbutton: a button to activate a device or signal timing for pedestrians, bicyclists, or other road users. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Rectangular Rapid Flashing Beacons: user-actuated amber light-emitted diodes (LEDs) that supplement warning signs at unsignalized intersections or mid-block crosswalks. (Source: VTRC 15-R22, Evaluation of a RRFB System at the Belmont Ridge Road and W&OD Trail Mid-Block Crosswalk)

Roadway: that portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes, but exclusive of the sidewalk, berm, or shoulder even though such sidewalk, berm, or shoulder is used by persons riding bicycles or other human-powered vehicles. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Roadway: portion of a highway improved, designed, or ordinarily used for vehicular travel, exclusive of the shoulder. A highway may include two or more roadways if divided by a physical barrier or barriers or an unpaved area. (Source: Code of Virginia § 46.2-100)

Shared-Use Path: a bikeway outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths are also used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers) and other authorized motorized and non-motorized users. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Shared-Use Path: a bikeway that is physically separated from motorized vehicular traffic by an open space or barrier and is located either within the highway right-of-way or within a separate right-of-way. Shared-use paths may also be used by pedestrians, skaters, users of wheel chairs or wheel chair conveyances, joggers, and other nonmotorized users and personal delivery devices. (Source: Code of Virginia § 46.2-100)

Sidewalk: that portion of a street between the curb line, or the lateral line of a roadway, and the adjacent property line or on easements of private property that is paved or improved and intended for use by pedestrians. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Sidewalk: the portion of a street between the curb lines, or the lateral lines of a roadway, and the adjacent property lines, intended for use by pedestrians. (Source: Code of Virginia § 46.2-100)

Sign: any traffic control device that is intended to communicate specific information to road users through a word, symbol, and/or arrow legend. Signs do not include highway traffic signals, pavement markings, delineators, or channelization devices. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Streetscape: A streetscape is defined as the visual elements of a street. This includes everything from the road, adjoining buildings, sidewalks, street furniture, trees and open spaces that combine to form a street's character and make it unique. (Source: Updating the Streetscape Manual, National Capital Planning Commission)

Traffic Control Device: a sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, private road open to public travel, pedestrian facility, or shared-use path by authority of a public agency or official having jurisdiction, or, in the case of a private road open to public travel, by authority of the private owner or private official having jurisdiction. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Traffic Control Device: a sign, signal, marking, or other device used to regulate, warn, or guide traffic placed on, over, or adjacent to a street, highway, private road open to public travel, pedestrian facility, or shared-use path by authority of a public agency or official having jurisdiction, or in the case of a private road open to public travel, by authority of the private owner or private official having jurisdiction. (Source: Code of Virginia § 46.2-100)

Transverse Markings: pavement markings that are generally placed perpendicular and across the flow of traffic such as shoulder markings; word, symbol, and arrow markings; stop lines; crosswalk lines; speed measurement markings; parking space markings; and others. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Vehicle: every device in, upon, or by which any person or property can be transported or drawn upon a highway, except trains and light rail transit operating in exclusive or semi-exclusive alignments. Light rail transit equipment operating in a mixed-use alignment, to which other traffic is not required to yield the right-of-way by law, is a vehicle. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Vehicle: every device in, on or by which any person or property is or may be transported or drawn on a highway, except personal delivery devices and devices moved by human power or used exclusively on stationary rails or tracks. For the purposes of Chapter 8 (§ 46.2-800 et seq.), bicycles, electric personal assistive mobility devices, electric power-assisted bicycles, motorized skateboards or scooters, and mopeds shall be vehicles while operated on a highway. (Source: Code of Virginia § 46.2-100)

Vibrotactile Pedestrian Device: an accessible pedestrian signal feature that communicates, by touch, information about pedestrian timing using a vibrating surface. (Source: Section 1A.13 in the Virginia Supplement to the MUTCD)

Acronyms

ACB-VA: American Council of the Blind of America

ADA: The Americans with Disabilities Act of 1990

ADAAG: Americans with Disabilities Act Accessibility Guidelines

CTB: Commonwealth Transportation Board

DBVI: Virginia Department for the Blind and Vision Impaired

FHWA: Federal Highway Administration

HB 1841: House Bill 1841

HSIP: Highway Safety Improvement Program

IIM: VDOT Instructional and Informational Memoranda

LPI: Leading Pedestrian Interval

MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways

NPA: Notice of Proposed Amendments

PHB: Pedestrian Hybrid Beacon

PROWAG: Public Right-of-Way Accessibility Guidelines

PSAP: Pedestrian Safety Action Plan

RRFB: Rectangular Rapid Flashing Beacons

SHSP: Strategic Highway Safety Plan

TWSI: Tactile Warning Surface Indicator

USDOT: United States Department of Transportation

VACo: Virginia Association of Counties

VDARS: Virginia Department of Aging and Rehabilitative Services

VDOT: Virginia Department of Transportation

VML: Virginia Municipal League

VTRC: Virginia Transportation Research Council

WAPM: Virginia Work Area Protection Manual

WG: Working Group

APPENDIX C – Working Group Meeting Summaries

Summary of Working Group Meeting #1 – June 11, 2021

HB 1841 Working Group
Meeting #1 Summary - June 11, 2021

Attendees	
Delegate Mark Keam - Virginia House of Delegates	Mark Cole – VDOT Traffic Engineering Division
Janine Gaspari - Delegate Keam's office	Bret Galloway – VDOT Traffic Engineering Division
Peggy Borst - Girl Scout Troop 1673	Emmett Heltzel – VDOT Location & Design Division
Member #1 - Girl Scout Troop 1673	
Lisa Assaly - Girl Scout Troop 1673	Ning Li – VDOT Traffic Engineering Division
Member #2 - Girl Scout Troop 1673	Marc Lipschultz – VDOT Traffic Engineering Division
Member #3 - Girl Scout Troop 1673	Jo Anne Maxwell – VDOT Governance & Legislative Affairs Division
Member #4 - Girl Scout Troop 1673	Sean Becker – VDOT Traffic Engineering Division
Doug Powell - American Council of the Blind, VA Chapter (formerly Old Dominion Council for the Blind)	John Bolecek – VDOT Transportation & Mobility Planning Division
Steve Gleason - American Planning Association Virginia Chapter	Shane Sawyer – VDOT Transportation & Mobility Planning Division
Melanie Hughes - Virginia Department of Blind and Vision Impaired (DBVI)	Nhan Vu – VDOT Northern Virginia District
Domonique Lawless - National Federation of the Blind, VA Chapter	Keith Wandtke – VDOT Governance & Legislative Affairs Division
Mike Sawyer - City of Richmond	Cortley West – VDOT Civil Rights Division
Jeremy Bennett - Virginia Association of Counties (VACO)	Nathaniel Cooper - Spy Pond Partners
Mitchell Smiley - Virginia Municipal League (VML)	Ritchie Robbins - Spy Pond Partners
Peter Ohlms - Virginia Transportation Research Council (VTRC)	Michelle Cavucci - VHB
Raymond Khoury - Virginia Department of Transportation (VDOT) Traffic Engineering Division	Dana Slone - VHB
Sandra Norman – VDOT Civil Rights Division	Mike Tantillo - VHB
Van Nguyen – VDOT Traffic Engineering Division	

Agenda
Introduction and Welcoming Remarks
VDOT Presentation
Presentation by Girl Scout Troop 1673
Group Discussion

Complete or Ongoing Research
Highway Safety and Accessibility
Next steps
Final Thoughts

Discussion Summary

Introduction and Welcoming Remarks

Ritchie Robbins facilitated the session.

Delegate Keam offered some opening remarks:

- This bill originated from outreach by Girl Scouts Troop 1673 to Delegate Keam. Troop 1673 suggested Virginia have a uniform code for sidewalks and crosswalks that are accessible to people with visual impairments
    - A uniform code does not necessarily mean the same crossing design, as this may not be logical, but it could instead lead to a uniform process
- Goal is for stakeholders, inside and outside government, to share ideas on how to ensure the sidewalks are as safe as they can be
- If there is any state legislative role, I'm happy to participate
- Rather than create mandates, this effort should result in standards and best practices on how Virginia road agencies can incorporate the needs of the visually impaired
- Timely effort with updates to the Manual on Uniform Traffic Control Devices (MUTCD)
- If this effort identifies a need for any budget recommendations, the November 1st deadline allows enough time to incorporate in advance of next year's legislative session

Raymond Khoury (VDOT's State Traffic Engineer) added:

- We have a team of experts who are here to listen, learn, and offer support

Sandra Norman (VDOT's Civil Rights Division Administrator) added:

- We are so excited to hear the young voices and diversity of thoughts from our community
- We are here to work with you in partnership

Van Nguyen (VDOT's Assistant State Traffic Engineer) added:

- As a former Girl Scout, I couldn't be more proud of this group of girls from Troop 1673!
- Thanks to everyone for participating, and hopefully some of the Girl Scouts will be inspired to join VDOT!

VDOT Presentation

- Ritchie walked through the presentation, giving background on HB1841 and Virginia's crosswalks.
- VDOT is committed to providing a safe and inclusive transportation system for users of all abilities

- Marc Lipschultz (VDOT) presented on some general details and terminology regarding crosswalks and crosswalk marking patterns.
- Van outlined the charge of the working group: evaluate whether Virginia should have a model crosswalk policy and, if so, establish recommendations for such a policy.
- The Working Group must complete the recommended report by September 2021 so it can be reviewed by the Commissioner's and Secretary's Offices, and ultimately transmitted to the General Assembly by the 11/1/21 deadline.

Presentation by Girl Scout Troop 1673

Peggy Borst introduced Girl Scout Troop 1673 and explained that the impetus behind their advocacy was when Ms. Borst started showing symptoms of Usher's Syndrome (a genetic disorder that leads to progressive deafness and vision impairment), impacting her ability to safely cross the street. The Girl Scout Troop representatives presented their findings to the working group.

- Background
  - Virginia had 761 traffic fatalities, 121 of which were pedestrians in 2016 (14 pedestrian fatalities in Fairfax county)
  - FHWA report concluded zebra or piano key (aka "continental") patterns are the most visible to drivers
  - Troop 1673 noted that many VDOT crosswalks just use the basic crosswalk pattern
  - Need to understand differing user needs – painted crosswalks work for some, however those who use canes to navigate may need some sort of raised edge
- Proposal
  - After hearing the feedback to the original version of HB 1841, Girl Scout Troop 1673 now proposes that a high-visibility marking pattern (either zebra, ladder, or piano keys/continental) be the standard marking pattern for all crosswalks, and detectable warning surface tiles must have a color that contrasts with the surrounding surface
- Potential Issues
  - Funding
    - While there is a big price disparity between different crosswalk types, Troop 1673 believes saving lives is worth any cost
  - Types
    - Troop 1673 recommends avoiding decorative crosswalks that will be difficult for those with partial vision impairment to detect
  - Environment
    - Use pavement marking materials that minimize environmental impacts
- Conclusion
  - Low vision community numbers will double by 2030; about 180,000 in Virginia have low vision.
  - Roads should be designed with everyone in mind.
  - Thank you for considering high-visibility crosswalks for your cities and towns

Group Discussion

Members of the working group offered their perspectives on the issues:
Jeremy Bennett (VACO)

- Arlington County primarily uses the piano key marking pattern.
- Any recommendation should take in mind any fiscal impact and any changes to the future federal guidance
- Localities need autonomy and flexibility to balance community vitality and vehicular and pedestrian needs

Mitchell Smiley (VML)

- Member agencies have put something of a pause on changes to crosswalk policy pending FHWA's finalization of a new MUTCD.
- Strong desire to maintain local autonomy for design purposes
- Applying paint to cobblestone or brick crosswalks may be problematic
- When vehicle miles traveled (VMT) went down during COVID and pedestrian crashes didn't go down, that was concerning. There is a lot of interest in better understanding fatalities: why are they happening and what can be done to reduce them from a design perspective. For example, increasing vehicle front heights may increase the severity of the outcome of a crash.

Melanie Hughes (Orientation and Mobility specialist at DBVI)

- There is a broad range of low vision, and a difference between low vision and no vision, which means there is a broad range of needs
- In favor of high-visibility crosswalks (visibility from driver and ped perspective)
- In favor of piano key lines that are perpendicular to the pedestrian travel path – reason is that those lines help orient low-vision individuals and show them where to go.
- If crosswalk lines are thick, they are able to be felt under foot
- Black on white contrast is easiest for vision-impaired people to detect
- Detectable warnings that are contrasting in color are important, and contrast in material to the sidewalk can provide audible cues when tapped with a cane
- Crosswalks are for safety, not decoration, and thus decorative crosswalks should be discouraged
- Tactile devices, high-contrast, and audio beaconing through APS are important, but particularly important for wayfinding at skewed or angled crosswalks (not perpendicular to vehicular travel path)

Domonique Lawless (National Federation of the Blind)

- I'm a blind person and an orientation and mobility instructor
- Blindness is a spectrum – we may not find a perfect, one size fits all solution. But I think we can find a good solution
- Glad disability community is included in discussion
- I use my ears a tremendous amount, and what I feel under my cane
- High contrast is important for the blind community
- Having a well-defined curb/curb cut to line up for the intersection is important

- Hope to have a uniform APS crossing sound (one that birds can't copy!)

Doug Powell (American Federation of the Blind)

- In awe of the Girl Scouts' advocacy efforts.
- We've been working on APS for a few years. We want to come up with a model that will allow flexibility for different intersection environments but will also provide a consistent and predictable set of cues for a vision-impaired person at an intersection.
- Sidewalks that end without coming to an intersection are a related problem. What is a blind person supposed to do when the sidewalk ends in the middle of the block? There should be a requirement that an accommodation is provided (such as a curb ramp) to allow them to cross the street mid-block where the sidewalk ends.

Steve Gleason (American Planning Association, Virginia Chapter)

- In response to Doug's question about sidewalks ending mid-block: often the sidewalks end at a property line due to sporadic development, and localities mar difficulty find it costly o to extend that sidewalk to a logical endpoint
- Hopeful that the working group will look at neighborhood context to help define standards for high visibility crosswalks, e.g., an intersection near senior housing

Mike Sawyer (City of Richmond)

- 6,500 intersections in Richmond
- 500 high-visibility crosswalks with "piano key" (continental) patterns at signalized intersections (no zebra)
- The City uses basic crosswalk marking pattern at unsignalized intersections, with the exception of about 100 crosswalks that are near schools. When deciding whether to stripe an unsignalized crosswalk, the City looks at availability of gaps in traffic.
- The City is limited in the staff available on its pavement marking crews.
- Most crashes happen at the signalized intersections, which is why they are given more focus
- 40 serious injuries/fatalities in 2010; dropped to 23 in 2020

Open Discussion

- Delegate Keam asked about the process Cities use to comply with regulations from the various federal, state, and local levels
- In response to Delegate Keam's question, Mitchell Smiley replied that there aren't currently conflicts so he is not sure how it works
- Lisa Assaly asked if it is true that VDOT could prohibit the installation of high visibility crosswalks even if the locality wants to install it
- According to Van Nguyen, localities have autonomy on which type of crosswalk marking pattern they install for roads they maintain. VDOT's policies apply to VDOT-maintained roads only.

Completed or Ongoing Research

Peter Ohlms from the VA Transportation Research Council (VDOT's research arm) presented a summary of known completed or ongoing research.

- Summary
  - Marked crosswalks don't reduce crashes by themselves, but can lead to safer behavior by both drivers and pedestrians
  - High-visibility marking patterns are more visible to drivers and may reduce crashes, but it is sometimes necessary to supplement the high-visibility crosswalk with additional safety treatments, such as warning signs or flashing beacons, in order to induce proper driver stopping behavior
  - Yellow is a good color for detectable warning surfaces
  - Crosswalk markings are not the only wayfinding aid to help pedestrians with low vision cross the street while remaining within the marked crosswalk
- More Research Needed
  - Effects of decorative crosswalks (FHWA study underway)
  - Usability of different marking styles by pedestrians with low vision
  - Applicability of technology solutions

Highway Safety and Accessibility

Mark Cole, State Highway Safety Engineer from VDOT presented on safety:

- Pedestrian crash assessment – most recently updated 2020
  - 90% of pedestrian fatalities occur when crossing the road
  - For 70% of crashes resulting in a pedestrian death, there was no marked crosswalk with 500 feet
- Pedestrian Safety Action Plan (PSAP)
  - 1. VDOT policy recommendations to ensure pedestrian safety
  - 2. Safety analysis to determine which specific road locations pose the greatest risk for pedestrians
  - 3. Pedestrian safety countermeasure toolbox
  - Online Mapping Tool – we flagged routes as pedestrian priority corridors
- Current projects
  - Fall 2018 - $8M for pedestrian crossing projects at 25 PSAP locations
  - Fall 2019 - $25M for PSAP improvements
  - Summer 2021 – pedestrian pilot project on suburban arterials (5-10 locations)

Ritchie presented slides on accessibility and VDOT's ADA Transition Plan.

Next Steps

Van walked through the next steps for the working group.

- June-July
  - VDOT will begin to develop draft recommendations & report outline
  - Continued stakeholder engagement
- August
  - Second Working Group meeting
- September
  - Finalize report based on Working Group input
- October
  - Report approval by VDOT's executive leadership

- November 1, 2021
  - Deadline for transmittal to Governor and General Assembly

Final Thoughts

- Steve Gleason
  - We also have trails in Northern Virginia – should special markings or considerations for major trail crossings be included in a model policy?
- Jeremy Bennett
  - Model policy should be recommendations and guidance that provide flexibility for localities, keeping safety at the forefront
- Mitchell Smiley
  - The flexibility is key
- Doug Powell
  - One key to success of APS project has been ongoing communication between VDOT and stakeholder groups. That will be key to this effort as well.
- Domonique Lawless
  - Excited to create a solution that will be accessible for all people
- Melanie Hughes
  - Is not currently aware of any research specifically related to the usability of high-visibility crosswalks for people with low vision, but will continue searching
  - Looking forward to progress on this important topic
- Lisa Assaly
  - Thanks to everyone – equality is the key so we can all be part of this community together
- Delegate Keam
  - Thanks to everyone. Appreciate having new stakeholders enter the conversation
  - Given the magnitude of the issues – our goal is to come up with a path and a reasonable set of uniform policies that our commonwealth follows
  - We want to center the needs of users with low vision
- Van Nguyen
  - Thanks to everyone – we have our direction
  - We will continue with the open communication
- Sandra Norman
  - Loved the diversity of thoughts today
  - VDOT is committed to consideration of equity in all VDOT activities

Summary of Working Group Meeting #2 – August 24, 2021

HB 1841 Working Group (WG) Meeting #2
August 24, 2021, 1:00 pm (virtual meeting)
Notes prepared by Nat Cooper

Attendees	
Doug Powell - American Council of the Blind, VA Chapter	Mark Cole - VDOT
Megan Oleynik – City of Alexandria	Shane Sawyer - VDOT
Sarah Taylor – City of Alexandria	Emmett Heltzel - VDOT
Melanie Hughes - DBVI	Raymond Khoury - VDOT
Mark Keam - Delegate Keam	Ning Li - VDOT
Cindy Mester – City of Falls Church	Marc Lipschultz - VDOT
Kerri Oddenino – City of Falls Church	Jo Anne Maxwell - VDOT
Peggy Borst - Girl Scout Troop 1673	Vanloan Nguyen - VDOT
Member #1 - Girl Scout Troop 1673	Sandra Norman - VDOT
Lisa Assaly - Girl Scout Troop 1673	Nhan Vu - VDOT
Member #2 - Girl Scout Troop 1673	Keith Wandtke - VDOT
Member #3 - Girl Scout Troop 1673	Cortley West - VDOT
Member #4 - Girl Scout Troop 1673	Ritchie Robbins – VDOT
Domonique Lawless - National Federation of the Blind, VA Chapter	George Rogerson – VDOT
Marshall Herman – Office of the Secretary of Transportation	Jason Oldham – VDOT
Mike Sawyer – City of Richmond	Peter Ohlms – VTRC
Nat Cooper – Spy Pond Partners	Michelle Cavucci - VHB
Jeremy Bennett - VACO	Mike Tantillo - VHB
Sean Becker - VDOT	Mitchell Smiley - VML
John Bolecek - VDOT	

Agenda
Introduction and Welcoming Remarks
Background and Work to Date
Communication for Safety
Draft Working Group Report Review
Literature Review
Draft Model Policy
Group Discussion – Elements of a Model Policy

Discussion Summary

Introduction and Welcoming Remarks

The meeting began with welcoming remarks from Delegate Keam and Sandra Norman, thanking everyone for the participation and input.

Michelle Cavucci led the majority of the presentation and began with VDOT's commitment: "VDOT is committed to this task as well as designing, installing, maintaining, and operating a safe and inclusive transportation system for all users of all abilities".

Background and Work to Date

Background

HB 1841 requires the following:

- Convene a working group
- Determine whether there should be model policies for crosswalks
    - If so, establish recommendations for such model policies
        - Any such policies shall
            - promote statewide uniformity
            - maximize pedestrian safety
            - consider the needs of people with disabilities that impair sight or mobility
- Monitor and provide input to the Federal Highway Administration (FHWA) on the new Manual on Uniform Traffic Control Devices (MUTCD)
- Submit report to the Governor and General Assembly by November 1, 2021

Work to date

- Initial Working Group (WG) survey: June 9, 2021
- Working Group (WG) meeting 1: June 11, 2021
- WG survey #2: August 2021
- Draft documents developed and distributed by VDOT to the WG members:
    - Model policy definition
    - Annotated outline of HB1841WG report
    - Literature review of crosswalk design and effectiveness
- VDOT has completed drafts of Sections 1-4 of WG report

To Do

- August
    - Prepare summary of meeting
    - Complete initial draft report based on WG input
- September
    - Distribute draft report for WG review
    - Finalize report based on WG feedback and input
- October
    - Report approval by VDOT's executive leadership
- November 1, 2021: deadline for transmittal

Survey responses

- 6 of 8 respondents said Yes, Virginia should have a model policy
- 4 of 8 submitted comments to FHWA on the draft MUTCD

Communication for Safety

- Marshall Herman is part of the Governor's Executive Leadership Team for Highway Safety (GELTHS), which includes VDOT, DMV, State Police, Department of Health, and Department of Education.

- The group shares coordinated social media posts, including a recent successful post about crosswalk safety
- GELTHS uses a range of emojis to broaden representation in safety-related posts
    - Doug Powell added that there are emojis of a guide dog, and of a white cane
    - White Cane Safety Day occurs on October 15 – GELTHS could coordinate a social media campaign tied to that day

Draft Working Group Report Review

Overall Outline:

1. Introduction of HB 1841
2. Commonwealth transportation network
3. Current governing requirements
4. Literature review
5. Requirement 1. Model policy
6. Requirement 2. Recommendations
7. Requirement 3. MUTCD comments
8. Acknowledgments

Mike Tantillo presented more details on each section. Comments included the following:

- GS: why don't some cities have to follow the MUTCD?
    - All localities must follow MUTCD (as required by the Code of Federal Regulations and the Code of Virginia) for all new installations and modification activities. They are not legally required to follow the Virginia Supplement to the MUTCD, but may choose to adopt the VA Supplement in order to further improve consistency between VDOT vs. locality roads.
- GS: Brick crosswalks aren't allowed but we see some brick crosswalks; why is that?
    - The MUTCD allows for brick crosswalks, as long as there is white reflective lines on both sides. VDOT is aware that there are some existing locally-maintained crosswalks that have noncompliant crosswalks, such as brick crosswalks that use granite pavers instead of reflective white lines to edge the bricks. It is important to note that the crosswalks may have been compliant with the MUTCD at the time they were installed, and typically the MUTCD allows existing noncompliant devices to remain until the end of their useful life. In the case of crosswalks and other pavement markings, this often means that existing noncompliant crosswalks are required to become MUTCD-compliant the next time the brick/granite block area is replaced.[1]
- Domonique Lawless: How do we get more alignment and consistency between localities and across the state?
    - This effort is a great place to start.

Literature Review

[1] Subsequent to the meeting, VDOT investigated and determined that the language requiring white lines demarking the boundaries was added with the 2009 edition to the MUTCD. There was no explicit mandate to proactively replace crosswalks installed prior to Virginia's official adoption of the 2009 MUTCD in 2011.

Peter Ohlms presented a summary of findings from the literature review, which was shared with the working group. The summary included the following topics:

- Effectiveness of high visibility vs basic crosswalk markings
- Effectiveness of marked vs unmarked crosswalks
- Color and contract of curb ramp detectable warnings
- Wayfinding guidance to pedestrians with no or low vision
- Crosswalk placement and decorative crosswalks

Draft Model Policy

Mike Tantillo presented the draft model policy definition.

- Crosswalk decision-making is not strictly quantitative; many locations require judgement
- Key factors impacting decisions
    - State & federal requirements
    - Crash risk
    - Usage and context
    - Equity
    - Placemaking
    - Constraints
    - Prioritization
    - Modal emphasis
- What is a model policy?
    - Informed decision-making process for agencies
    - Defines key elements that should be included in each individual agency's crosswalk policy

Comments included the following:

- GS: If a model policy is enforced, how would it be enforced?
    - VDOT will respond with a written answer after the meeting.
- Domonique Lawless: Why is it not possible to have adequate funding for the optimal crosswalks for each intersection?
    - DOTs and cities and towns have a variety of transportation needs and divide the limited funding as best they can. Decisions regarding the amount of transportation funding, such as state gas tax rates and federal transportation policy, are beyond the scope of this Working Group and are decisions made at the state and federal elected leadership level, not by VDOT staff.
- Doug Powell: Another key factor in a model policy should be stakeholder input. Also means feedback from stakeholders when a particular intersection doesn't feel safe for citizens.

<u>Model Policy Definition:</u>

- A policy document outlining a consistent decision-making framework, establish by each road-maintain agency for determining when and where to install marked crosswalks, what marking pattern to use, and what other design elements to install in conjunction with the crosswalk. Also identifies who is authorized to make decision within an agency
- Policy should:

- Be clearly written and easily understandable
- Be consistent with federal and state laws and regulations
- Be periodically updated as necessary
- Reflect and promote the application of engineering judgement

Comments included:

- The recommended model policy should include flexibility for localities
- When a model policy is implemented, what about existing crosswalks?
  - The policy would govern future crosswalk decisions, but wouldn't require changes for existing crosswalks until the next road construction activity that impacts those crosswalks (which often occurs with the next repaving).
  - Sarah Taylor: Big difference between updating crosswalks on the paving schedule and changing crosswalks during any routine maintenance
  - Doug Powell: Hopefully the stakeholder input would also impact the decision-making also. E.g. if there's a new nursing home built the needs of the intersection would change dramatically.
  - Cindy Mester: Localities will have a number of other opportunities for input. Also, we can't apply policy retroactively because of cost.
  - Sarah Taylor: some of Virginia's smaller localities might have fewer staff and resources to be able to comprehensively address crosswalk deficiencies.

Following the discussion, an additional poll was conducted live during the meeting to ask "Should there be a model crosswalk policy in Virginia?"

- 9 votes Yes
- 1 vote I Don't Know

Group Discussion – Elements of a Model Policy

- Jeremy Bennett:
  - We like the flexibility to respond to the needs of our community.
    - Mitchell Smiley and Megan Oleynik agreed that flexibility is important
  - For the sentence: *For many crossings at higher-risk locations, crosswalks should or must be coupled with other engineering countermeasures (flashing beacons, lighting, median refuge islands, etc.) to mitigate that risk*, "should or must be coupled …" should be changed to just read "should be coupled …"
- Peggy Borst: Is there a way for visually impaired people to be registered so that road agencies can know where they live and prioritize improvements based on that data.
  - Delegate Keam: Legislation passed a few years ago allowed for state IDs to designate someone as vision-impaired; even though most vision-impaired people cannot drive, they can still be issued a state ID that is not a driver's license.
  - Ritchie Robbins: This is very helpful. VDOT has previously examined census data to find concentrations of people with visual impairments,.
  - Cindy Mester: Some localities, such as City of Falls Church, have voluntary systems for persons with disabilities need or medical issues dependent on

electricity can register with our Police Dispatch. Also as just noted can request the specialty signage.
    - Doug Powell: Self-identifying disabilities is important. Some people may not want to be on a register. FEMA may also have a data set about people with disabilities.
    - Domonique Lawless: Smart 911 – you can register
- Mike Sawyer: In the elements of a model policy framework, I think it is important to emphasize with strong, direct language how detrimental "crosswalk art" is to people with low vision
    - Melanie Hughes agreed
- Melanie Hughes:
    - Needs of people with low vision can be very different from needs of people with no functional vision.

Action Items:	**Person Responsible (Target Date)**
Prepare summary of meeting	VHB (early September)
Complete and distribute initial draft report based on WG input	VHB and VDOT (early September)
WG review of draft report	WG members (mid September)
Finalize WG report based on WG review	VHB and VDOT Staff (end of September)
Approve WG report for transmittal to General Assembly	VDOT Executive Leadership (October)

APPENDIX D – Working Group Meeting Surveys and Straw Polls

Working Group Survey Number 1

Survey Questions:

1. HB 1841 asks the Working Group to determine whether there should be "model policies for crosswalk design and installation in the Commonwealth". What does a "model crosswalk policy" mean to you? Do you believe one is needed, and if so why?

2. HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "promote statewide uniformity". How would such a model crosswalk policy promote that goal?

3. HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "maximize pedestrian safety". How would such a model crosswalk policy promote that goal?

4. HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "consider the needs of people with disabilities that impair sight or mobility". How would such a model crosswalk policy promote that goal?

5. What are your top three goals for Virginia's crosswalks? [Goal #1 (top rank)]

   What are your top three goals for Virginia's crosswalks? [Goal #2]

   What are your top three goals for Virginia's crosswalks? [Goal #3]

6. Do you have other goals for Virginia's Crosswalks that weren't listed in the previous question?

7. Please input your name, e-mail address, and who you represent (optional)

Common Themes from Survey Responses:

- Although crosswalk consistency (safe and predictable cues) is very helpful for pedestrians, transportation agencies need some flexibility. Therefore, a recommendation for a model policy is more desirable than a requirement.

    - Question about liability for localities that do not follow model policy.
    - Some WG members felt that the safest design should be used everywhere.
    - Other members felt that complete uniformity is not necessary if the design context varies, and this could be based on speeds, volumes, urban vs. rural, roadway width, adjacent land uses, etc.
- Safety should be the top priority when developing a model policy.
    - The culture of driver/pedestrian interaction needs to change.
    - Many urban crossings likely need to be updated.
    - Pedestrians and drivers should never have to wonder what to do and where to stop due to ambiguous roadway messages.
- Various techniques can be included in a model policy to take into account the needs of pedestrians with disabilities.
    - Contrasting colors, especially the tactile warning surfaces, are needed to help low-vision pedestrians.
    - Maintenance needs to be prioritized, as devices that are faded and difficult to see will result in both drivers and low-vision pedestrians missing them.
    - Tactile features, whether intentional (truncated domes) or unintentional (thick marking material that can be felt by a cane) are helpful to blind and low-vision pedestrians.
    - A checklist for designers was suggested.
- In the question about the top three goals for Virginia's crosswalks, everyone listed "minimize crash risk for all pedestrians."
    - Equitable treatment of all pedestrians was also a popular choice.
    - Uniformity of best practices and design was also a popular choice.
- Funding for improvements is something that is needed – a separate budget line item.
- Education and enforcement are also important.

Anonymized individual responses can be found on the following pages.

Q1: HB 1841 asks the Working Group to determine whether there should be "model policies for crosswalk design and installation in the Commonwealth". What does a "model crosswalk policy" mean to you? Do you believe one is needed, and if so why?	Q2: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "promote statewide uniformity". How would such a model crosswalk policy promote that goal?	Q3: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "maximize pedestrian safety". How would such a model crosswalk policy promote that goal?	Q4: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "consider the needs of people with disabilities that impair sight or mobility". How would such a model crosswalk policy promote that goal?	Q5: What are your top three goals for Virginia's crosswalks? [Goal #1 (top rank)]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #2]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #3]	Q6: Do you have other goals for Virginia's crosswalks that weren't listed in the previous question?	Q7: Please input your name, email address, and who you represent (optional)
No, localities already use National standards.	I don't believe uniformity is necessary. In fact it could be counterproductive as sidewalk design is heavily reliant on the context of the location and uniformity should not impede various solutions depending on the context.			Prioritize spending of taxpayer dollars so as to provide the greatest benefits for all road users	Minimize crash risk for all pedestrians	Find the appropriate balance between accommodating crosswalk users without excessive impacts to vehicular operations.		
State of the art or practice,; practical, but with a method to consider and approve exceptions,; broad, but not necessarily universal application	Don't know that I can intuitively and completely answer that question, but the process of arriving at an answer should start with agreement on the definition of "statewide uniformity" for purposes of this work.	Begin first by defining pedestrian safety, how it will be measured, and what we can consider to be practical metrics that demonstrate a crosswalk meets an acceptable measurement of pedestrian safety. It should be noted that "absolute" safety may not be achievable.	I would refer to the answer to Q3 above for a similar approach.	Minimize crash risk for all pedestrians	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Find the appropriate balance between accommodating crosswalk users without excessive impacts to vehicular operations.	Since we could only provide three choices, I would cite uniformity of best practices whether VDOT or locality maintained as a goal. Outside those listed I do not have others to suggest at this time.	
A model crosswalk policy should (ideally) help planners and engineers make decisions related to crosswalk design and installation that can support walkable communities, maximize safety for all road users, and balance competing objectives. It might be as simple as unifying, finishing, and implementing various I&IMs that have been in development.	"Statewide uniformity" should not necessarily mean that the same crosswalk marking style is used statewide, because context matters. Rather, the policy should promote a uniform decision-making process regarding crosswalk design and installation that consistently supports walkable communities, maximizes safety for all road users, and balances competing objectives in different contexts. Improved training for and oversight of localities in terms of crosswalk markings and curb ramp requirements could also be incorporated.	Some possible ways: (1) Continue to consider context when determining whether to mark a crosswalk - meaning that sometimes a crosswalk should not be marked until funding is found for additional treatments such as RRFBs. (2) Specify that high-visibility crosswalks shall be used where vehicles do not have a signal or Stop sign. (3) Apply any changes uniformly as part of the resurfacing program. (4) Develop and maintain a crosswalk inventory. (5) Use traffic volumes and past experience to project how quickly crosswalk markings will deteriorate to support a maintenance program to refresh markings between resurfacing cycles.	Research is not particularly clear that any one type of crosswalk marking is better for people with low vision, but deteriorated markings are harder for everyone to detect. Using traffic volumes and past experience to project how quickly crosswalk markings will deteriorate to support a maintenance program to refresh markings between resurfacing cycles will promote the goal of considering the needs of people with disabilities. Additionally, continuing to implement existing VDOT processes for curb ramp improvements and APS furthers this goal.	Provide crosswalk users direct travel paths with minimal wait times	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Minimize crash risk for all pedestrians	All of those goals will need to be considered.	

Q1: HB 1841 asks the Working Group to determine whether there should be "model policies for crosswalk design and installation in the Commonwealth". What does a "model crosswalk policy" mean to you? Do you believe one is needed, and if so why?	Q2: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "promote statewide uniformity". How would such a model crosswalk policy promote that goal?	Q3: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "maximize pedestrian safety". How would such a model crosswalk policy promote that goal?	Q4: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "consider the needs of people with disabilities that impair sight or mobility". How would such a model crosswalk policy promote that goal?	Q5: What are your top three goals for Virginia's crosswalks? [Goal #1 (top rank)]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #2]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #3]	Q6: Do you have other goals for Virginia's crosswalks that weren't listed in the previous question?	Q7: Please input your name, email address, and who you represent (optional)
VDOT has more guidance available for uncontrolled intersections than controlled. It would be nice to have more guidance on when to install high visibility cross walks (continental or bar pair). It would also be good to know if VDOT wants push the bar pair design if life cycle cost is less and performance is similar to continental. I also think model policy should include other challenges for pedestrian safety such as poor intersection sight distance at many locations. Multi-lane challenges, etc.. We need to do some educated with this model policy.	Similar to TE Memos and IIMs. Guidance should be based on speed, lanes, volume, functional class, poppulation density, other criteria.... Criteria should be used to assign a score that will help prioritze locations needing additional treatments. We cant fix every location tomorrow.	The policy will likely recommend upgrading many urban crossings and populated areas and there will be an increased upfront and life cycle cost for cross walks. The policy will help to identify/prioritize locations by a scoring method. Additional funding requests from Districts should be expected and will ultimately point to the model policy for justifying operations maintenance budget increase.	The model policy will help to identify/prioritize APS/ramp locations.	Minimize crash risk for all pedestrians	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Find the appropriate balance between accommodating crosswalk users without excessive impacts to vehicular operations.	I do think it would help VDOT region operations directors to have a line item in their budgets for pedestrian safety enhancements that could be applied to new and existing pedestrian crossing signing, striping, and pedestrian safety device maintenance (RRFB, PHB, Midblock Signal, Accessible Pedestrian Systems).	
A model crosswalk is one that provides the most visibility to all users in order to ensure safety and eliminate confusion and/or ambiguity. In this case, we believe model crosswalks to be high-visibility crosswalks with detectable warning surface tiles.	We believe that crosswalk design should be the safest possible across the state. There will be no learning curve from one county to the next as people will know what to expect.	A pedestrian or driver should never have to wonder what to do at a crosswalk. They should not have to guess where to stop or walk. Colors, nonconforming patterns could not only distract drivers, but confuse pedestrians. High visibility crosswalks are seen from farther away, allowing drivers enough time to stop. They also let those that may need more assistance cross the road more efficiently and safely.	While our troop can only speak to those with low vision, better marked crosswalks provide sufficient warning of crosswalk approach and provide clear markings when walking across a street. Those with low vision may be fine with paint, but those who are blind may need a texture differentiation with the crosswalk as well. Providing a highly contrasted and visible crosswalk and detectable warning surface tiles will better serve approx. 180k Virginians with low vision.	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Minimize crash risk for all pedestrians	Uniformity of best practices and design for all crosswalks, whether VDOT- or locality-maintained		
I view the HB term “model policy” as a design recommendation rather than standard required by code. In this sense, it appears the intent is to describe a vision for what the ideal design standard should be to support a safe crosswalk and recognizes specific crosswalk details can and will likely need to vary . What maybe allowed in the VDOT right-of-way will likely be different than what is allowed in a Town or City that maintains their own streets and therefore are not required to comply with VDOT roadway standards. Same applies to private streets. Yes I believe a model crosswalk policy is needed to establih best practices that can be applied across all jursdicttions in VA	The model crosswalk policy could promote uniform standards based on site context. For example looking at the characteristics based on rural, urban, suburban intersections and adjacent land uses not just traffic volumes.		The policy could promote by needs of people with disabilities that impair sight or mobility by raising awareness early design process , perhaps developing a checklist that asks the engineer to consider factors such as the number of lanes the pedestrian has to cross and the timing of the ped light, sight distance, exisitn road condtions, etc. to inform a better design solution.	Minimize crash risk for all pedestrians	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Enhance the vitality of the communities in which they are situated	consider the needs of cylists and walkers that are crossing the street	

Q1: HB 1841 asks the Working Group to determine whether there should be "model policies for crosswalk design and installation in the Commonwealth". What does a "model crosswalk policy" mean to you? Do you believe one is needed, and if so why?	Q2: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "promote statewide uniformity". How would such a model crosswalk policy promote that goal?	Q3: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "maximize pedestrian safety". How would such a model crosswalk policy promote that goal?	Q4: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "consider the needs of people with disabilities that impair sight or mobility". How would such a model crosswalk policy promote that goal?	Q5: What are your top three goals for Virginia's crosswalks? [Goal #1 (top rank)]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #2]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #3]	Q6: Do you have other goals for Virginia's crosswalks that weren't listed in the previous question?	Q7: Please input your name, email address, and who you represent (optional)
No, localities already use National standards.	I don't believe uniformity is necessary. In fact it could be counterproductive as sidewalk design is heavily reliant on the context of the location and uniformity should not impede various solutions depending on the context.			Prioritize spending of taxpayer dollars so as to provide the greatest benefits for all road users	Minimize crash risk for all pedestrians	Find the appropriate balance between accommodating crosswalk users without excessive impacts to vehicular operations.		
When a pedestrian with sight approaches an intersection, they can see what type of intersection it is and analyze how to safely cross. A pedestrian who is blind or has low vision needs nonvisual cues to help them cross safely. In my mind, a model crosswalk policy would set guidelines for differing types of crossings so all pedestrians would have safe, consistent, and predictable cues to help negotiate different environmental situations.	As stated above, the policy would set up guidelines consistent with differing environmental situations across the Commonwealth. When installations are being created or renovated, the guidelines would be used for installation so that pedestrians could understand the same cues anywhere in the Commonwealth.	The policy must give pedestrian safety considerations the highest priority over other perceived inconveniences to motorists or aesthetics.	Just as curb cuts with truncated dome warnings have proliferated, so must there be nonvisual, tactile cues to guide blind and low vision pedestrians safely across the street and directly to the sidewalk on the other side of the intersection.	Minimize crash risk for all pedestrians	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Uniformity of best practices and design for all crosswalks, whether VDOT- or locality-maintained	If the Commonwealth does not mandate sidewalks on both sides of streets, then we must find a solution for all pedestrians when they reach the end of a sidewalk that does not terminate at an intersection.	
Yes I do believe one is needed because of the inconsistent methods of painting crosswalks and how important they are for visibility from both the driver and the pedestrian view points. A model policy means that shortcuts cannot be taken such as painting two thin parallel lines, that there must be a 'ladder' style crosswalk.		by establishing parameters for crosswalks that are based on maximum visibility for drivers and pedestrians instead of cost or maintenance concerns.	by requiring high visibility (meaning high contrast black and white with no other colors) and parallel/perpendicular lines (not diagonal lines or other designs, such as ads or art in crosswalks); also, being tactile--able for the edges to be felt underfoot or with a white cane to help prevent veering off the crosswalk. As well by having the "rungs" of the ladder be perpendicular to the path of pedestrian travel. The 3-D crosswalks are interesting because they look fairly normal to pedestrians but turn into very high visibility crosswalks from the driver's perspective.	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment	Minimize crash risk for all pedestrians	Uniformity of best practices and design for all crosswalks, whether VDOT- or locality-maintained	no	
Design and implementation should be consistent across the Commonwealth, but it should not be overly prescriptive. Proper planning and engineering is still critical to site and context-specific implementation.	Primarily through which type of crosswalk is used in which context, along with treatments needed to augment the crosswalks based on site-specific conditions. E.g. transverse lines vs. continental/ladder style, R1-6 signage, gateway treatments (currently experimental), RRFB's or other features needed under certain conditions, as well as the appropriateness of each based on conditions and context.	This is where the legislation completely misses the mark. One of the primary shortcomings in pedestrian safety is our poor safety culture, including the widespread failure of drivers to stop or yield to pedestrians. Education and enforcement are sorely lacking, and without those E's the engineering component will have limited impact.	This also reflects a failure of understanding by legislators that attempt to mandate things that are outside of their expertise. This gets much more into signal design and operation including APS, LPI's site-specific assessments, dual lane roundabout design, etc. It also requires consideration of the design and retrofit of ADA-compliant infrastructure, most notably urban retrofits. There is a vast failure among designers and construction firms, as well as state and local government staff on proper ADA design. A notable yet very basic example is the common misapplication of detectable warning surfaces at driveways.	Minimize crash risk for all pedestrians	Provide crosswalk users direct travel paths with minimal wait times	Uniformity of best practices and design for all crosswalks, whether VDOT- or locality-maintained	As noted, education and enforcement are imperative for actual safety and accessibility enhancements.	

Q1: HB 1841 asks the Working Group to determine whether there should be "model policies for crosswalk design and installation in the Commonwealth". What does a "model crosswalk policy" mean to you? Do you believe one is needed, and if so why?	Q2: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "promote statewide uniformity". How would such a model crosswalk policy promote that goal?	Q3: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "maximize pedestrian safety". How would such a model crosswalk policy promote that goal?	Q4: HB 1841 states that if the Working Group determines there should be a model policy for crosswalk design and installation, the model policy shall "consider the needs of people with disabilities that impair sight or mobility". How would such a model crosswalk policy promote that goal?	Q5: What are your top three goals for Virginia's crosswalks? [Goal #1 (top rank)]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #2]	Q5: What are your top three goals for Virginia's crosswalks? [Goal #3]	Q6: Do you have other goals for Virginia's crosswalks that weren't listed in the previous question?	Q7: Please input your name, email address, and who you represent (optional)
A model crosswalk policy means that it is optional and not a standard. It represents a best practice and a training tool for practitioners. There can be multiple models for various context (rural, suburban, urban). A liability question for the AG's office would be if there is any additional liability to having a Commonwealth model and a locality does not follow it. At the local level, we attempt to treat all like intersections the same way such that there is no exposure in the court system (e.g. we can state that we use a ladder crosswalk for all signalized crossings or school crossings; transverse only lines for uncontrolled intersections, etc.)	The proposed policy needs to determine whether context (e.g. rural, urban, or suburban) changes outcomes or if there is a need for multiple models. At the local level, we attempt to treat all like intersections the same way such that there is no exposure in the court system (e.g. we will not mark a crosswalk only if there aren't enough gaps in traffic; there may be a need for additional measures where gaps are not available in under one minute.) If there are multiple models, it should have "minimum" and "desirable" designations based upon context. Overall crosswalk maintenance issues need to be front and center on any model (i.e. we have 6,500 intersections with 500 traffic signal controlled and we can afford to mark and maintain all of them.. So how do we prioritize installation and maintenance using an asset management approach.)	Using the Commonwealth's Pedestrian Safety Action Plan, the Department should determine which streets are likely to have a pedestrian crash and focus crossing improvements at those locations (e.g. including crosswalks and other proven pedestrian safety countermeasures)	People with low vision or visually impairments need the Department to limit crosswalk art and street murals where traffic conflicts exist. The following is summarized from Ms. Billie Louise "Beezy" Benton (Director of Research, Accessible Design for the Blind), has provided the following guidance: The large majority of people with reduced vision are over the age of 60, and many have additional disabilities such as diabetes, which commonly results in peripheral neuropathy, making it harder to detect differences in texture and slope. They are also likely to have reduced attentional visual fields, so they may have difficulty perceiving the gestalt of the corner and determining where the curb line, curb ramps and crosswalks are likely to be located so they can systematically look for them. They are likely to have reduced contrast sensitivity and impaired color vision, making it more difficult to see where detectable warnings and markings are located. The requirement for high visual contrast between detectable warnings and adjoining surfaces should be taken very seriously. Some vision disabled pedestrians identify crossing locations primarily by looking for rectangles that contrast with the pavement. Numerous contrasting rectangles and art which abut to the detectable warnings or pavement markings greatly reduces conspicuity of the detectable warnings or markings they rely on. If artwork is to be incorporated into paving at crossings, a primary design consideration needs to be that the artwork enhances conspicuity of all features that are relevant for wayfinding and safety. Furthermore, consideration needs to be given to the effect of light, and the specific luminaries that illuminate the crossing areas. Different types of lighting change perceived colors in sometimes surprising ways, enhancing some contrasts and obscuring others. Curb ramps, detectable warnings, markings and curbs need to be conspicuous in all lighting conditions. Pedestrians with reduced vision vary greatly in the nature of their vision and how they use it. Some people will have reduced visual fields, some will have reduced visual acuity, and many will have some combination of the two. Some will have constricted visual fields, while retaining relatively good central vision; locating a target such as a detectable warning or markings in a complex array will be very hard for them, and they may miss seeing it. Diabetes, macular degeneration, and glaucoma, very common causes of vision loss in older people, all result in visual field impairments, very often in the central field, where visual acuity is best. They may think they see a detectable warning or marking but then have trouble actually finding it. Vision for the same person may vary significantly throughout the day. Unexpected changes in contrast may look like a hole or change in level, resulting in anxiety, slow and cautious travel, and increased likelihood of stumbles or missteps. Consistency in visual cues for wayfinding and safety is extremely important. The onset of reduced vision that may accompany aging is often gradual and may not become a problem that is recognized until it is quite advanced. The aging person who is losing vision may or may not seek assistance or training and may not use a long cane. At crossing locations, where risks are high because of the presence of vehicular traffic, wayfinding and safety should always be the primary considerations.	Minimize crash risk for all pedestrians	Provide crosswalk users direct travel paths with minimal wait times	Equitable treatment of all pedestrians including those with vision, mobility, or cognitive impairment		

Working Group Survey Number 2

Survey Questions:

1. Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?
    - Yes
    - No

2. Regarding the definition of a model crosswalk policy that was provided, do you:
    - Concur
    - Concur with Comments
    - Do Not Concur

3. Please provide any comments on this draft definition here:

4. Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

5. Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?
    - Yes
    - No
    - I'm Not Sure

6. Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

7. Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

Anonymized responses can be found on the following pages.

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, August 03, 2021 3:35:59 PM
Last Modified:	Tuesday, August 03, 2021 3:44:15 PM
Time Spent:	00:08:16
IP Address:	65.202.206.129

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

No

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur with comments

Page 2

Q3

Please provide any comments on this draft definition here:

The phrase "a model crosswalk policy" is problematic… There are multiple crosswalk policies across the Commonwealth. A best practices document would be useful as an example for jurisdictions to adopt as a model state of practice (e.g. such as what a good policy document would contain). Guidance from the state is good. Localities making the final requirements based upon their constraints and priorities is best for everyone as it encourages self determination and creates buy in at the local level.

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

Again, it should not be one model policy. It should be a model policy framework for localities to use if they see a benefit and that the locality could customize based upon their issues and context.

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

No

Page 4

Q6

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

Respondent skipped this question

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, August 03, 2021 4:15:36 PM
Last Modified:	Wednesday, August 04, 2021 9:33:01 AM
Time Spent:	17:17:25
IP Address:	166.67.255.245

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

Yes

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur with comments

Page 2

Q3

Please provide any comments on this draft definition here:

The actual two-sentence definition is good, although I'd add "for each crosswalk" after "what marking pattern to use" so the policy definition reinforces the idea that different markings might be appropriate at different crosswalks. Other comments to be emailed.

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

Yes - it covers most of the key factors

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

Yes

Page 4

Q6

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

[VDOT employee]

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

#3

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, August 05, 2021 10:10:08 AM
Last Modified:	Thursday, August 05, 2021 10:15:21 AM
Time Spent:	00:05:12
IP Address:	74.96.173.244

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

Yes

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur with comments

Page 2

Q3

Please provide any comments on this draft definition here:

I think that traffic flow should not matter because even though there is low traffic flow people with low vision should still be able to use a crosswalk!

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

I think it would because it makes the choices of crosswalk designs and colors limited and keeps people with low vision in the picture and makes sure they are considered with each decision regarding crosswalks.

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

Yes

Page 4

Q6

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

Respondent skipped this question

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

Respondent skipped this question

#4

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, August 16, 2021 3:32:42 PM
Last Modified:	Monday, August 16, 2021 4:15:26 PM
Time Spent:	00:42:43
IP Address:	50.245.226.17

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

Yes

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur with comments

Page 2

Q3

Please provide any comments on this draft definition here:

Any model policy should be non-mandatory in nature. Transportation agencies "may consider" would be appropriate language. The last sentence of the last paragraph of the "Background" section is perfect. Under "Crash Risk" on page 2 - we should strike "or must" in the last sentence.

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

I don't think listing factors that transportation agencies should take under consideration, while still retaining final authority is harmful.

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

No

Page 4

Q6

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

Respondent skipped this question

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

#5

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, August 17, 2021 9:54:38 AM
Last Modified:	Tuesday, August 17, 2021 9:55:42 AM
Time Spent:	00:01:04
IP Address:	65.202.247.226

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

Yes

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur

Page 2

Q3

Please provide any comments on this draft definition here:

Respondent skipped this question

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

yes

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

I'm not sure

Page 4

Q6

Respondent skipped this question

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

#6

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, August 17, 2021 8:54:39 PM
Last Modified:	Tuesday, August 17, 2021 8:59:53 PM
Time Spent:	00:05:13
IP Address:	107.77.203.81

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

Yes

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur with comments

Page 2

Q3

Please provide any comments on this draft definition here:

We believe that all citizens needs are represented in the model policy and where doubt might be assigned in the type the deferment should be with the higher visibility crosswalk

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

Leaving it to the locality should be the last option as crosswalk design is hard to enforce

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

Yes

Page 4

Q6

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

To FHWA in reference to Chapter 3C and Notice of Proposed Amendment (NPA) Item # 348:

While our Vienna, VA Girl Scout Cadette Troop 1673 advocates for those with low vision, we believe that crosswalks need to be safe for EVERYONE. In order to reduce injuries and fatalities, all crosswalks in the United States should be painted in a high-visibility pattern (continental, zebra, or ladder) with detectable warning surface tiles at both ends of the crosswalk (the surface tiles must contrast with the sidewalk). Transverse crosswalks should be omitted as they are difficult to see. A uniform, consistent high visibility pattern will help both drivers and pedestrians. We are not traffic engineers, but we have read studies that found that high-visibility continental/zebra markings are generally detected by drivers at about twice the distance as simple transverse markings. This gives drivers more time to react to pedestrian crossings. High-visibility continental/zebra markings, combined with detectable warning surfaces, are also easier for those with low vision to see so they know where they can cross the road safely.

Additionally, you must disallow parking near crosswalks. Not only does parking near crosswalks obstruct the crosswalk user's view, but the drivers may not see the people crossing. Also, creative crosswalks (ex. 3D crosswalks or Charlie Brown themed crosswalks) should be omitted as they are distracting and confusing.

Lastly, we would also like the U.S. to conduct a study to find the best possible crosswalk materials which will create the least environmental impact. A recommendation can then be made to the states on which material to use and why.

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

#7

INCOMPLETE

Collector: Web Link 1 (Web Link)
Started: Friday, August 20, 2021 2:06:07 PM
Last Modified: Friday, August 20, 2021 2:12:21 PM
Time Spent: 00:06:13
IP Address: 100.36.226.85

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

No

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Do not concur

Page 2

Q3

Please provide any comments on this draft definition here:

Previously provided in form of comment letter

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

See previously submitted letter

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

No

Page 4

Q6

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

Respondent skipped this question

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

Respondent skipped this question

#8

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Sunday, August 22, 2021 11:40:56 AM
Last Modified:	Sunday, August 22, 2021 11:52:38 AM
Time Spent:	00:11:41
IP Address:	108.28.44.156

Page 1

Q1

Based on feedback from the Working Group at the first meeting and responses to the first survey, VDOT has developed a draft definition of a model crosswalk policy that was e-mailed out on August 3. Based on this draft definition, should there be a model crosswalk policy in Virginia?

Yes

Q2

Regarding the definition of a model crosswalk policy that was provided, do you:

Concur

Page 2

Q3

Please provide any comments on this draft definition here:

Respondent skipped this question

Page 3

Q4

Do you think this definition of a model crosswalk policy would promote the goals of HB 1841: statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities that impair sight or mobility? Why or why not?

The only item I would add to the list of functions is a periodic review by stakeholders with and without disabilities to ensure current practices conform to current needs.

Q5

Did your organization submit comments to FHWA for the recent Notice of Proposed Amendments (NPA) for a new MUTCD?

Yes

Page 4

Q6

Respondent skipped this question

Can you please provide a link to those comments? Alternatively, the comments may be e-mailed to Mike Tantillo (VDOT Contractor) at: mtantillo@vhb.com

Page 5

Q7

Please enter your name if you wish to provide it. If not, your responses will remain anonymous.

Working Group Meeting #2 Straw Poll

Survey Question:

1. Based on the draft definition we just discussed, should there be a model crosswalk policy in Virginia?
    - Yes
    - No
    - I don't Know

Anonymized responses:

- Yes – 9
- No – 0
- I Don't Know – 1
- [Did not submit a response] – 2

APPENDIX E – Working Group Meeting Presentations

VDOT Presentation for Working Group Meeting #1 – June 11, 2021

HB 1841 WORKING GROUP – MEETING #1

June 11, 2021 9am-11am | Virtual Meeting

1

Agenda

9:00 Introductions
9:10 Welcoming Remarks
9:15 Background Information
9:25 Group Discussion
10:05 Relevant Ongoing/Completed Research
10:20 Current VDOT Practices
10:30 Path Forward

2

Quick Reminders

- Please stay muted except when speaking
- Call in using computer (not phone) if feasible
- There are two options to submit questions or comments:
  - Use "raise hand" feature Raise hand at any time, or
  - Post questions in the "chat" box
- We will be saving the "chat" box

3

Introductions & Welcoming Remarks

Introductions – please state:

- Your Name
- Who you represent

Opening remarks

- Vanloan Nguyen - VDOT
- Delegate Keam's Office

4

Introductions, Invitees & Opening Remarks

- Delegate Keam's Office
- Girl Scout Troop 1673
- VA Association of Counties (*VACO*)
- VA Municipal League (*VML*)
- American Federation for the Blind (*VA Chapter*)
- National Federation for the Blind (*VA Chapter*)
- American Council for the Blind (*VA Chapter*)
- Old Dominion Council of the Blind & Visually Impaired
- American Planning Association (*VA Chapter*)
- Dept. of the Blind & Vision Impaired (*DBVI*)
- VA Dept. of Aging & Rehabilitative Services (*VDARS*)
- City of Richmond
- VA Transportation Research Council (*VTRC*)
- VDOT

5

VDOT's Commitment

VDOT is committed to this task as well as designing, installing, maintaining, and operating a safe and inclusive transportation system for all users of all abilities.

6

Background | *Why Are We Here?*

HB 1841 was passed by the 2021 Special General Assembly and signed by the Governor (Chapter 130)

VDOT is directed to:

- Convene a Working Group (WG) with relevant stakeholders, including VACO and VML
- Determine whether there should be "*model policies for crosswalk design and installation in the Commonwealth*" that "*promote statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities*"
- Monitor and provide input to FHWA as MUTCD updates are considered
- Submit a report by November 1, 2021

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7

Background | *How Did We Get Here?*

- **HB 1841 was first introduced by Delegate Keam, due in part to advocacy by Vienna Girl Scout Troop 1673**
- **HB 1841 originally required:**
  - **All crosswalks shall use a "zebra" marking pattern**
  - **All curb ramps shall use red Detectable Warning Surfaces** (DWS, aka "truncated domes") **on light-colored surfaces and yellow DWS on dark-colored surfaces**
  - **Would have applied to all restriping activities immediately upon bill's effective date**
- **Bill was modified in Committee to instead require WG study, and then passed in the Special Session**

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8

Background | *Virginia's Crosswalks –Who Is Responsible? How Many Are There?*

- **Virginia's Highway System:**
  - **~68,500 miles of highway in Virginia**
  - **85% maintained by VDOT**
  - **15% maintained by Localities & Others (universities, etc.) - *more urbanized areas***
  - **VDOT, Localities & Others are responsible for their own crosswalks**
  - **Localities may establish their own policies & practices, so long as consistent with federal & state laws and regulations (e.g. MUTCD)**
- **VDOT's crosswalk system includes:**
  - **~ 32,000 (estimated) marked crosswalks**
    - $35 million (estimated) replacement value
  - **~ 80,000 (estimated) curb ramps**

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9

Background | *What's In a Road Crossing?*

Primary Elements

- **Pavement markings / crosswalks**
- **Landing areas** (detectable warning surfaces)

Other Elements

- **Curb ramps**
- **Signal components** (accessible pedestrian signals, pedestrian signal heads, phasing and timing)
- **Artistic/streetscape elements**
- **Warning/regulatory signs**
- **Beacons** (RRFBs or PHBs)
- **Street lighting** (nighttime illumination)
- **Traffic calming treatments** (e.g. corner bulbouts, raised crosswalks)

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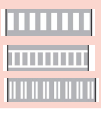
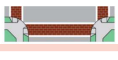
10

Background | *What Crossing Decisions Are There?*

1. **Unmarked or Marked Crossing?**
2. **If Marked, what pattern to use?**
3. **Provide detectable landing area**
   - Detectable warning surface must follow ADA and state law regarding design features (e.g. widths, no. of domes) and colors (§ 15.2-2021)

Basic	High Visibility	Artistic/Streetscape Elements
$900	$1800-3500	Varies
Simplest Installation	More Complex Installation, May Require Specialized Installation Equipment, Potential Slip Risk	
Basic 	**Piano key** "continental" "longitudinal bar" **Ladder** "perpendicular" **Double-paired** "bar pairs" 	 

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11

Background | *Crosswalk Marking Types*

Type	Notes
Unmarked	• Unmarked crosswalks exist at some locations as per § 46.2-100
Basic 	• $900 (approx.) for a 60-foot crosswalk
High-Visibility:	• $1800~$3500 (approx.) for a 60-foot crosswalk • Require longer duration to install
Piano key (aka "continental" or "longitudinal bar") 	
Ladder (aka "perpendicular")	
Double-Paired (aka "bar pairs") 	
Artistic/Streetscape elements  	• Additional cost and complexity • MUTCD governs allowable patterns; requires reflective white stripe border

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12

Background | *What About Other Elements of Crosswalk Safety?*

The 5 E's of Safety from Virginia Strategic Highway Safety Plan

Engineering
- Design of roadway, its associated features and the surrounding environment

Enforcement
- Ensuring all road users follow the law

Education
- Providing information & support to all road users to help them make good & informed choices

Emergency Response
- Providing medical services quickly & effectively when needed

Everyone
- "Arrive Alive" for every road user when they drive, walk, or ride.

13

Background | *What Is the Working Group's Charge?*

- **Target report completion: September 2021**
- **Focus on crosswalks and curb ramps as defined in the initial and current versions of the bill**
  - **Other related elements are important and can be added to our idea "parking lot"**
- **Any "Model policy" must conform to federal and VA Code laws and regulations**
  - **As directed by HB 1841, WG study may include recommendations to FHWA regarding the new MUTCD**
- **Stay away from getting too deep in technical details**

14

Group Discussion

15

VTRC Virginia Transportation Research Council

We Bring Innovation to Transportation

Crosswalk Design: Relevant Completed or Ongoing Research

HB 1841 Working Group Meeting #1, June 11, 2021

Peter Ohlms, AICP
peter.ohlms@vdot.virginia.gov

16

Overview

- This is a start: Research Library is searching for more studies
- Studies address various aspects of crosswalk design
  - Marked crosswalks vs. unmarked crossings
  - High-visibility markings vs. basic markings
- Research uses various measures of effectiveness
  - Behavior of drivers and pedestrians (stated vs. observed)
  - Crashes (sometimes specific types of crashes)
- Some studies are more rigorous than others
- Some findings are debated for years

17

Marked vs. Unmarked Crosswalks: Road User Behavior

- At marked crosswalks vs. unmarked crossings:
  - Drivers are more aware of pedestrians, reduce their speeds, and are more likely to yield
  - Pedestrians scan for traffic slightly more

Study Title	Year	Type
Pedestrian Crosswalk Case Studies: Sacramento, CA; Richmond, VA; Buffalo, NY; Stillwater, MN	2001	FHWA report
The Marked Crosswalk Dilemma: Uncovering Some Missing Links in a 35-Year Debate	2008	Conference paper

18

High-Vis Crosswalk Effectiveness

Are high-vis crosswalks more effective than basic ones?

- It depends on your measure of effectiveness!

Measure of Effectiveness	High-Vis More Effective?	Slide
Crosswalk visibility *to drivers*	Yes	20
Crashes *at intersections in big cities*	Probably yes	21
Crashes *generally*	Not by themselves	22
Driver yielding	Not clear	23

19

19

Crosswalk Visibility to Drivers

- High-visibility markings are more visible to drivers than standard markings
  - Similar detection distances: piano key, bar pair
  - Shorter distance, day and night, than for basic

Study Title	Year	Type
Crosswalk Marking Field Visibility Study	2010	FHWA report



20

20

Crashes at Intersections in Big Cities

New York

- Piano key crosswalks at intersections: 48% pedestrian crash reduction
- Unclear if the other sites were basic or unmarked

San Francisco school zones

- Intersections with piano key: 37% pedestrian crash reduction vs. basic

Study Title	Year	Type
Safety countermeasures and crash reduction in New York City—Experience and lessons learned	2013	Journal paper
Empirical Bayesian evaluation of safety effects of high-visibility school (yellow) crosswalks in San Francisco, California	2010	Journal paper

21

21

Crashes Generally

- Marked crosswalks alone don't reduce crashes: consider **context**
- On busier multi-lane streets: **higher** pedestrian crash rates at marked crosswalks vs. unmarked crossings
- Marking style wasn't predictive of crash outcomes overall

"At uncontrolled pedestrian crossing locations, installing marked crosswalks should not be regarded as a magic cure for pedestrian safety problems. However, marked crosswalks also should not be considered as a negative measure that will necessarily increase pedestrian crashes."

Study Title	Year	Type
Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines	2005	FHWA report

22

22

Driver Yielding Effects

National study (42 sites in 7 states)

- Driver yielding rates varied widely by site: 10% to 90%

Florida study (2 treatment & 2 control sites)

- Sites with high-visibility markings and an illuminated overhead sign had higher driver yielding than sites with basic markings

Note: Neither study isolated the effect of crosswalk marking type

Study Title	Year	Type
Improving Pedestrian Safety at Unsignalized Crossings	2006	NCHRP report
An Evaluation of High-Visibility Crosswalk Treatments—Clearwater, Florida	2001	FHWA report

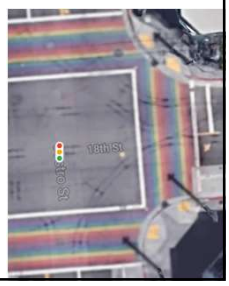
23

23

Decorative Crosswalks

FHWA research is underway: *Evaluation of Aesthetically Treated Crosswalks*

- Will study motorists' and pedestrians' recognition of and behavior at crosswalks
- Results expected in May 2022



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Detectable Warning Surface Colors

FTA study of an indoor transit station platform (24 participants)

- Tested 10 DWS/background surface pairs
- Yellow was readily detectable even at lower contrast levels

FHWA study of an outdoor unshaded site (50 participants)

- In-depth study of 13 DWS colors; recommended:
  - For agencies wanting two DWS colors: yellow for dark pavement and orange-red for lighter surfaces (e.g., concrete)
  - For agencies wanting a single standard DWS: yellow

Study Title	Year	Type
Detectable Warning Surfaces: Color, Contrast, and Reflectance	1994	FTA report
Visual Detection of Detectable Warning Materials by Pedestrians with Visual Impairments	2006	FHWA report

25

25

The Crossing Task: Wayfinding

Study of raised bar guidance surfaces

- Surfaces helped people find crosswalks and align to cross

NCHRP Guidebook

- Addresses pedestrians with vision disabilities
- Provides an assessment framework

Study Title	Year	Type
Wayfinding Problems for Blind Pedestrians at Noncorner Crosswalks: Novel Solution	2017	Journal paper
Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities: A Guidebook	2017	NCHRP report

26

26

Technology Solutions?

- FHWA's Pedestrian Technology Test Bed

27

27

Relevant Recommendations from Previous VTRC Studies

- 2004: Apply guidelines that were developed for installation of marked crosswalks
- 2020: Adopt a framework, share information about, and evaluate the value of a tool to improve bicycle and pedestrian facility inventories, prioritization processes, public outreach, and assessing pedestrian accessibility
- 2021: Monitor the ability to create/assemble a statewide crosswalk inventory

28

28

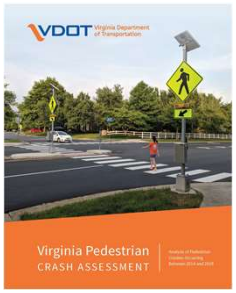
Research Summary

- Fairly clear:
  - Marked crosswalks don't reduce crashes by themselves but can lead to better driver and pedestrian behavior than unmarked crossings
  - High-visibility markings are more visible to drivers than basic markings and may reduce crashes at intersections in big cities but may not reduce crashes without additional treatments (context!)
  - Yellow is a good color for detectable warning surfaces
  - Crosswalk markings are not the only wayfinding aid
- Less clear / more research needed:
  - Effects of decorative crosswalks (research underway)
  - Usability of different marking styles by pedestrians with low vision
  - Applicability of technology solutions

29

29

Current VDOT Practices | *Pedestrian Crash Assessment*



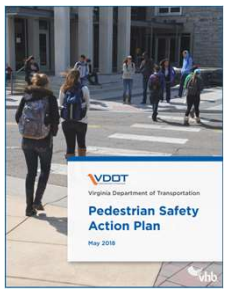
- **Analyzes pedestrian crashes**
- **First published in 2016**
  - **updated in 2017 and 2020**
- **Uses a variety of data sources to:**
  - **Understand common factors among crashes**
  - **Identify crash trends across time**

VDOT | https://www.virginiadot.org/business/resources/Final_Pedestrian_Study_Ped_Crash_Assessment.pdf

30

30

Current VDOT Practices | *Ped. Safety Action Plan (PSAP)*



3 Major Components:

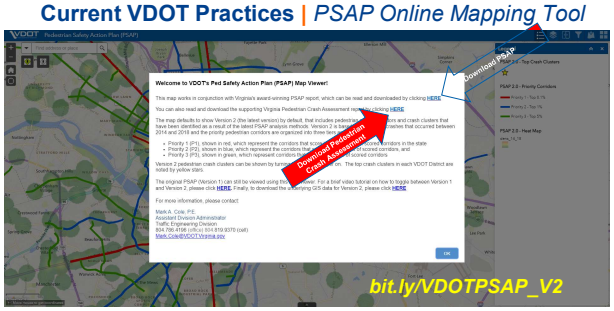
1 – VDOT Policy Recommendations to ensure pedestrian safety

2 – Safety Analysis to determine which specific road locations pose the greatest risk for pedestrians

3 – Pedestrian safety countermeasure toolbox

31

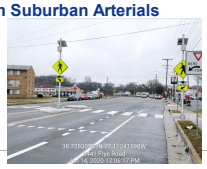
Current VDOT Practices | *PSAP Online Mapping Tool*



32

Current VDOT Practices | *PSAP Infrastructure Projects*

- Fall 2018 – Initial $8M for ped crossing projects at 25 PSAP locations
- Fall 2019 – Additional $25 Million approved for PSAP improvements
  - All VDOT signalized intersections on PSAP priority corridors will be evaluated to receive crosswalks and ped countdowns over a five –year period (approximately 600 intersections)
- Summer 2021 – Pedestrian Pilot Project on Suburban Arterials
  - 5 to 10 locations Total
  - Screening Criteria:
    - PSAP corridors
    - 40 mph plus posted speed
    - 15,000 plus AADT
    - 4 or more lanes



33

Current VDOT Practices | *Accessibility*

- ADA Transition Plan (April 2019)
  - Sets forth overall VDOT plan for addressing barriers to accessibility within the VDOT-maintained Right-of-Way
- APS is required for new or reconstructed traffic signals that have pedestrian accommodations
  - Proactive annual program to retrofit APS at stakeholder-identified priority locations

34

Current VDOT Practices | *Crosswalk Markings*

VDOT Crosswalk policy:

- A consistent framework for informed, thoughtful and holistic evaluation of an array of factors and a structure for crosswalk engineering decision-making.
- Recommends or mandates high visibility crosswalks and/or other elements at high speed, high volume and/or wide crossings.
- Decorative crosswalk materials, when used, are owned/maintained by localities.
- Brick, stamped concrete, etc. crossing surface must be edged by white reflective crosswalk lines.

35

Next Steps

- June-July:
  - VDOT will begin to develop draft recommendations & report outline
  - Continued stakeholder engagement (e-mails, surveys, etc.)
- August:
  - Second WG meeting where VDOT will present results of literature review and draft recommendations for your feedback and input
- September: finalize report based on WG input
- October: report approval by Executive leadership
- November 1, 2021: deadline for transmittal to Governor & General Assembly

36

VDOT Policy Hyperlinks

ADA Transition Plan (April 2019)

VDOT Accessible Pedestrian Signals Policy (IIM-TE-388)

VDOT Roles and Responsibilities ADA Compliance, Curb Ramp Assessments, and Curb Ramp Improvements Policy (IIM-TE-376.1)

VDOT Program for ADA Compliance of Department Right-of-Way Assets (IIM-TE-377/IIM-CR-5)

Guidelines for the Placement of Curb Ramps Policy (IIM-LD-55.17)

Pedestrian Crossing Accommodations at Unsignalized Intersections Policy (IIM-TE-384)

Crosswalk Paver Units/Crosswalk Art Policy (IIM-LD-218.3)

Federal MUTCD and Virginia Supplement to the MUTCD

Road & Bridge Standard Drawings (includes CG-12 curb ramp and PM-3 crosswalk details)

UVA Transportation Training Academy

Virginia Transportation Research Council

Pedestrian Safety Action Plan

Virginia Strategic Highway Safety Plan

37

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THANKS!

Vanloan.Nguyen@vdot.virginia.gov | (804) 786-2918

38

VDOT Presentation for Working Group Meeting #2 – August 24, 2021

HB 1841 WORKING GROUP – MEETING #2

August 24, 2021 1pm – 3pm | Virtual Meeting

1

Agenda

1:00 **Introductions and Welcoming Remarks**
1:15 **Background Information**
1:20 **Working Group Feedback**
1:30 **Draft Report Review – Background Sections**
Group Discussion on Governing Requirements
1:50 **Draft Report Review – HB 1841 Response Sections**
Group Discussion on Model Policy Definition and Recommendations
2:45 **Next Steps**
2:50 **Final Group Discussion and Closing Thoughts**

2

Quick Reminders

- Please stay muted except when speaking
- Call in using computer (not phone) if feasible
- There are two options to submit questions or comments:
  - Use "raise hand" feature Raise hand at any time, or
  - Post questions in the "chat" box
- We will be saving the "chat" box

3

Introductions & Opening Remarks

Introductions – please state:

- Your Name
- Who you represent

4

Introductions, Invitees & Opening Remarks

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- Girl Scout Troop 1673
- VA Association of Counties (*VACO*)
- VA Municipal League (*VML*)
- American Federation for the Blind (*VA Chapter*)
- National Federation of the Blind (*VA Chapter*)
- American Council of the Blind of Virginia (ACB-VA)
- American Planning Association (*VA Chapter*)
- Dept. of the Blind & Vision Impaired (*DBVI*)
- VA Dept. of Aging & Rehabilitative Services (*VDARS*)
- City of Richmond
- City of Falls Church
- City of Alexandria
- VA Transportation Research Council (*VTRC*)
- VDOT

5

Introductions & Opening Remarks

Opening remarks

6

VDOT's Commitment

VDOT is committed to this task as well as designing, installing, maintaining, and operating a safe and inclusive transportation system for all users of all abilities.

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7

Background | *Why Are We Here?*

HB 1841 was passed by the 2021 Special Session of the General Assembly and signed by the Governor (Chapter 130 of the 2021 Acts of Assembly)

- VDOT to convene a Working Group (WG) with relevant stakeholders
- Determine whether there should be "*model policies for crosswalk design and installation in the Commonwealth*" that "*promote statewide uniformity, maximize pedestrian safety, and consider the needs of people with disabilities*", and if so, provide recommendations for such
- Monitor and provide input to FHWA as MUTCD updates are considered
- Submit a report by November 1, 2021

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8

Background | *What Have We Accomplished To Date?*

- **Working Group Meeting #1: June 11, 2021**
  - **Pre-meeting Survey**
  - **Meeting Summary**
- **Working Group Survey #2: August 2021**
- **Documents Developed and Distributed for Review by WG**
  - **Model Policy Definition**
  - **Annotated Outline of HB 1841 WG Report**
  - **Literature Review of Crosswalk Design and Effectiveness (VTRC)**
- **VDOT has completed drafts of Sections 1 – 4 (background information)**

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9

Background | *What Do We Still Have To Accomplish?*

- **August:**
  - **Prepare summary of today's meeting**
  - **Complete initial DRAFT of entire report based on WG input**
- **September:**
  - **Distribute draft report for WG review**
  - **Finalize report based on WG feedback and input**
- **October: Report approval by Executive leadership**
- **November 1, 2021: Deadline for transmittal to Governor & General Assembly**

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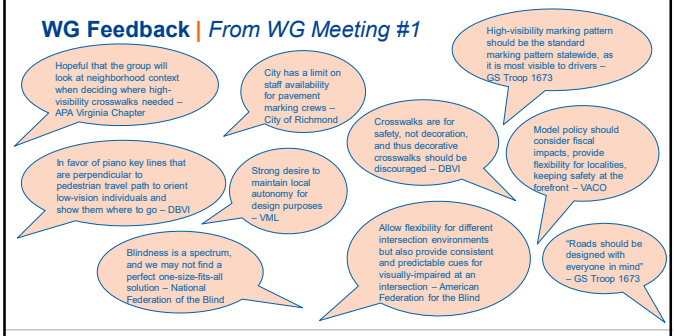
10

WG Feedback | *From WG Meeting #1*



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11

WG Feedback | *Survey Responses*

- **8 responses received**
  - **Additional comments from localities**
- **6 out of 8 think that Virginia should have a model policy**
- **4 out of 8 submitted comments to FHWA on the draft MUTCD**

"Any model policy should be non-mandatory in nature"

"There are multiple crosswalk policies across the Commonwealth. A best practices document would be useful as an example for jurisdictions to adopt as a model state of practice (e.g. such as what a good policy document would contain)" It should be a model policy framework for localities to use if they see a benefit and that the locality could customize based upon their issues and context."

"We believe that all citizens' needs are represented in the model policy"

"Leaving [decisions] to the locality should be the last option as crosswalk design is hard to enforce"

"…traffic flow should not matter because even though there is low traffic flow people with low vision should still be able to use a crosswalk!"

"The only item I would add to the list of functions is a periodic review by stakeholders with and without disabilities to ensure current practices conform to current needs"

"I think it would [meet goals of HB 1841] because it makes the choices of crosswalk designs and colors limited and keeps people with low vision in the picture and makes sure they are considered with each decision regarding crosswalks"

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12

Outreach

13

Outreach

VDOT @VaDOT · Aug 23, 2020 ···
#ShareTheRoad with others!
When driving near vulnerable road users, such as
remember to
Slow down
Be patient
Pass safely
Give extra room

14

WG Feedback | *This Meeting*

- Thank you for your prior feedback!
- Please share your thoughts throughout the meeting
  - Use chat box or "raise hand" feature
  - We want to hear what's on your mind so that the report best reflects the thoughts of this group
- We will be conducting a poll on the model policy definition
- Feedback from prior surveys and from today's meeting will be incorporated into the draft report

15

Draft Report Review | *Overview*

- Section 1: Introduction of HB 1841
- Section 2: Commonwealth Transportation Network
- Section 3: Current Governing Requirements*
- Section 4: Literature Review
- Section 5: HB 1841 Requirement #1 – Model Policy*
- Section 6: HB 1841 Requirement #2 – Recommendations*
- Section 7: HB 1841 Requirement #3 – MUTCD comments
- Section 8: Acknowledgements

Sections targeted for group discussion

16

Draft Report Review | *Section 1: Introduction of HB 1841*

- Background on legislation
- Working Group
  - Membership
  - Information sharing
  - Detailed description of WG meeting #1
  - Description of WG #2 based on today's discussion
- Would like feedback from WG members when we send out the draft report for review
  - Ensure that we captured everyone's input accurately

17

Draft Report Review | *Section 2: Commonwealth Transportation Network*

- Background on Virginia's transportation network to provide framework and context for the rest of the report
  - Roadway ownership and maintenance
  - VDOT and the transportation system
  - Traffic control device standards
  - Crosswalk system
  - Statistics on Virginians with disabilities
  - Pedestrian crash statistics
  - Planning-level costs for crosswalk marking types

18

Draft Report Review | *Section 3: Governing Requirements*

Federal Requirements – MUTCD, Americans with Disabilities Act

- Applicable to all Virginia crosswalks on publicly accessible roads
- Baseline requirements for devices, accessibility, & uniform "rules of the road"

Code of Virginia

- Defines "crosswalk" and other key terms
- Defines rights and duties of pedestrians and drivers at crosswalks

19

Draft Report Review | *Section 3: Governing Requirements*

VDOT Policies & Practices – including *Virginia Supplement to the MUTCD*

- Applicable to VDOT maintained highways and certain improvements funded with state/federal money
- Developed for broad application across third largest state highway system context based on VDOT's business practices & available resources

Local Agency Policies & Practices

- May develop their own or adopt VDOT's
- Developed based on each unique agency's business practices, available resources, and specific local context

20

Group Discussion | *Governing Requirements*

- Federal MUTCD, Americans with Disabilities Act
- Code of Virginia
- VDOT Policies & Practices – including Virginia Supplement to the MUTCD
- Local Agency Policies & Practices

21

Draft Report Review | *Section 4: Literature Review*

- **Based on the Literature Review summary posted to the SharePoint site**
- **Findings from the literature**
  - **Effectiveness of high-visibility vs. basic crosswalk markings**
    - Drivers can detect high-visibility crosswalks from greater distances
    - Mixed effectiveness when measured by pedestrian crash reductions: Two studies in major cities found substantial crash reductions, but a study with more sites and contexts found no relationship between marking style and overall crash outcomes.
    - Driver yielding is probably better at high-vis: three studies found improvements but had some limitations; active North Carolina study to be completed by December
    - New FHWA guide to selecting crosswalk marking patterns expected by December

22

Draft Report Review | *Section 4: Literature Review*

- **Findings from the literature (continued)**
  - **Effectiveness of marked vs. unmarked crosswalks**
    - Marked crosswalks *alone* do not necessarily reduce crashes (depends on context)
    - Behavior at marked crosswalks: probably better (driver); not worse (pedestrian)
  - **Color and contrast of curb ramp detectable warnings**
    - Both color and contrast matter. If a single color is desired, studies support yellow.
  - **Wayfinding guidance to pedestrians with no or low vision**
    - Curb ramp design, raised arrows on pushbuttons, and other physical treatments beyond crosswalk markings alone
  - **Crosswalk placement and decorative crosswalks**
    - Ongoing studies in other states: crosswalk placement details
    - Ongoing FHWA study: decorative crosswalks and pedestrians with low vision

23

Draft Model Policy Definition | *Background*

- **Crosswalk decision-making is not a strictly quantitative, objective process; many locations present situations where judgment must be used because there is no single "correct" answer.**
- **Key factors impacting crosswalk decisions (in no particular order)**
  - State & Federal Requirements
  - Crash Risk
  - Usage & Context
  - Equity
  - Placemaking
  - Constraints
  - Prioritization
  - Modal Emphasis

24

Draft Model Policy Definition | *Background*

- **Informed decision-making process for agencies**
  - Data-driven decision-making (prioritization)
  - Full consideration of key factors
  - Avoid constraints that result in less-than-ideal choices
  - Use of engineering judgement
  - Decisions based on available resources for implementation
- **Model policy defines key elements that should be included in each individual agency's crosswalk policy**
  - The approach gives the desired flexibility for localities
  - Acknowledges different built environments in different localities

25

Draft Model Policy Definition | *Background*

- **Recommended model policy limitations**
  - It is not a universal design for all crosswalks irrespective of context and location
  - It does not contain specific engineering criteria
- **Each agency can base their specific policies on the model policy**

26

Draft Model Policy Definition | *Proposed Definition*

For the purposes of HB1841, a model policy is defined as:

"A policy document outlining a consistent decision-making framework, established by each road-maintaining agency, for determining when and where to install marked crosswalks, what marking pattern to use, and what other design elements to install in conjunction with the crosswalk. A model policy document also identifies who is authorized to make crosswalk decisions within the agency."

27

Draft Model Policy Definition | *Proposed Definition*

A road agency's policy should:

- **Be clearly written and easily understandable**
- **Be consistent with federal and state laws and regulations**
- **Be periodically updated as necessary**
- **Reflect and promote the application of engineering judgement to consider:**
  - Usability of crosswalks by those with vision, mobility, or other impairments
  - Awareness of local context including geography, land-use, community preferences
  - Practicality of available resources for management and maintenance of crosswalks
  - Location-specific factors such as traffic volume, crossing distances, vehicle speeds, and/or others

28

Group Discussion | *Model Policy Definition*

"A policy document outlining a consistent decision-making framework, established by each road-maintaining agency, for determining when and where to install marked crosswalks, what marking pattern to use, and what other design elements to install in conjunction with the crosswalk. A model policy document also identifies who is authorized to make crosswalk decisions within the agency."

29

Model Policy Definition | *Poll Question*

- **Based on the draft definition we just discussed, should there be a model crosswalk policy in Virginia?**
  - **Yes**
  - **No**
  - **I'm not sure**
- **Please submit response via poll in Google Meets if possible**
  - **Can submit via chat box or e-mail too (Marc.Lipschultz@vdot.virginia.gov)**

30

Draft Report Review | *Section 5: HB 1841 Req. #1*

- **HB 1841 Requirement #1: Determine whether there should be model policies for crosswalk design and installation in the Commonwealth**
  - Model Policy Definition is key focus of this section
  - Section language will arrive at "yes" or "no" conclusion
- **This section will be drafted after this WG Meeting**
  - Input from group discussion
  - Input from pre-meeting and meeting surveys
- **Working Group decision on requirement #1**

31

Draft Report Review | *Section 6: HB 1841 Req. #2*

- **HB 1841 Requirement #2: Establish recommendations for such model policies (if the answer to Req. #1 is "Yes")**
  - Focus on elements to be included in Model Policy
- **Section 6 Content**
  - User groups in a Model Policy
  - Guiding principles of a Model Policy
  - Specific policy elements to include in a Model Policy
  - Applicability to transportation agencies other than VDOT
  - Adoption and implementation of a Model Policy

32

Draft Report Review | *Section 6: HB 1841 Req. #2*

- **User Groups in a Model Policy**
  - Pedestrians of all ages and abilities including pedestrians with vision or mobility impairments
  - Drivers and operators of vehicles
    - Motor Vehicles
    - Bicycles, Scooters, and other Small Mobility Devices

33

Draft Report Review | *Section 6: HB 1841 Req. #2*

- **Guiding Principles of a Model Policy**
  - Overarching objectives: safety, equity, accessibility
  - Balance in needs of pedestrians and vehicle drivers
    - Effective crosswalks need to be seen by both drivers and pedestrians
  - Not practical to implement a one-size-fits-all crosswalk design
  - Fiscal responsibility is important
  - Recommendation, not requirement
  - Agencies should adapt their policies as conditions change

34

Draft Report Review | *Section 6: HB 1841 Req. #2*

- **Elements to Include in a Model Policy**
  - Roles and responsibilities for agency decision-making
  - Scope of policy
  - Process for selection of crosswalk locations
  - Process for determining where high-visibility crosswalks should or shall be used
  - Installation of brick pavers, stamped patterns, crosswalk "art", etc.
  - Additional countermeasures needed for safe crossing
  - Required accessibility features
  - Effective dates

35

Group Discussion | *Elements of a Model Policy*

- Roles and responsibilities for agency decision-making
- Scope of policy
- Process for selection of crosswalk locations
- Process for determining pattern type (basic or high-visiblity)
- Installation of brick pavers, stamped patterns, crosswalk "art", etc.
- Additional countermeasures needed for safe crossing
- Required accessibility features
- Effective dates

- **What else would you like to include?**

36

Draft Report Review | *Section 7: HB 1841 Req. #3*

- **HB 1841 Requirement #3: Monitor and provide input to USDOT and FHWA as updates to the MUTCD considered**
- **Section 7 Content**
  - **Status of the 11th Edition of the MUTCD**
  - **Working Group member comments on the draft MUTCD**

37

Draft Report Review | *Section 7: HB 1841 Req. #3*

- **Status of the 11th Edition of the MUTCD**
  - **Draft released in December 2020**
  - **Public comment period through May 14, 2021**
- **Working Group comments on 11th Edition of the MUTCD**
  - **Individual member agencies submitted comments**
    - VDOT
    - Girl Scout Troop 1673
    - American Council of the Blind
    - Others?

38

Next Steps…

- **August:**
  - **Prepare summary of today's meeting**
  - **Complete initial DRAFT of entire report based on WG input**
- **September:**
  - **Distribute draft report for WG review**
  - **Finalize report based on WG feedback and input**
- **October: Report approval by Executive leadership**
- **November 1, 2021: Deadline for transmittal to Governor & General Assembly**

39

Group Discussion | *Closing Thoughts on Report/Next Steps*

40

VDOT Policy Hyperlinks

ADA Transition Plan (April 2019)

VDOT Accessible Pedestrian Signals Policy (IIM-TE-388)

VDOT Roles and Responsibilities ADA Compliance, Curb Ramp Assessments, and Curb Ramp Improvements Policy (IIM-TE-376.1)

VDOT Program for ADA Compliance of Department Right-of-Way Assets (IIM-TE-377/IIM-CR-5)

Guidelines for the Placement of Curb Ramps Policy (IIM-LD-55.17)

Pedestrian Crossing Accommodations at Unsignalized Intersections Policy (IIM-TE-384)

Crosswalk Paver Units/Crosswalk Art Policy (IIM-LD-218.3)

Federal MUTCD and Virginia Supplement to the MUTCD and Federal Docket for Draft 11th Edition of the MUTCD

Road & Bridge Standard Drawings (includes CG-12 curb ramp and PM-3 crosswalk details)

UVA Transportation Training Academy

Virginia Transportation Research Council

Pedestrian Safety Action Plan

Virginia Strategic Highway Safety Plan

SharePoint site with all HB 1841 Working Group Files

41

VDOT Virginia Department of Transportation

THANKS!

Vanloan.Nguyen@vdot.virginia.gov | (804) 786-2918

42

APPENDIX F – Comments Received from Working Group Members

Review Request Email Sent to WG (Sections 1 – 4)

On behalf of the full VDOT team, **Thank You** all for your time and active participation at our second HB1841 Working Group meeting. We were happy to hear your input and feedback on our work to date.

We would also like to especially thank Delegate Keam and Girl Scout Troop 1673 for their efforts to bring this Working Group together to take on this important task.

The VDOT team took away a great deal from your feedback and we have developed the content for the first four sections of the Working Group report for your comments. Attached are four items:

- the VDOT slides from the meeting;
- the compiled pre-meeting survey responses;
- the Working Group meeting summary; and
- Draft Working Group Report – Sections 1-4.

As we mentioned during the meeting, we are requesting your review of the draft Working Group Report. Attached are the first four sections of the report, covering background information related to the HB 1841 topics.

REVIEW REQUESTED: We would like to give all Working Group members an opportunity to review the report content that has been drafted and to provide feedback. This report is from the Working Group and is intended to reflect the diverse thoughts of the Working Group. The authors on the VDOT team have captured a significant amount of input during the two meetings and surveys, and we want to make sure that we have accurately captured your input.

If it is possible for you to submit your comments to the VDOT team using track changes or comment bubbles in the Word document, that would be helpful to the VDOT authors. If that format does not work for you for any reason, please feel free to e-mail your comments. **Please submit your comments by Monday, September 20** so that we can finalize the report and submit for VDOT Executive Leadership review and to the General Assembly by November 1.

The remainder of the report is being finalized, and we will be sending this out by the first of next week, including feedback on several of the outstanding questions posed during the call. We anticipate requesting review comments be returned on those sections by Monday, September 27 on these sections.

As we noted during the discussion, VDOT is committed to this task as well as designing, maintaining, and operating an inclusive and safe transportation system for all users of all abilities. We look forward to working with you to deliver on this commitment.

Review Request Email Sent to WG (Sections 5 – 7)

As we mentioned in last week's e-mail, we are sending out the remainder of the Working Group Report for your review. Attached are the last three sections of the report, covering the responses to the three Working Group topics/questions posed in HB 1841.

REVIEW REQUESTED: We would like to give all Working Group members an opportunity to review the report content that has been drafted and to provide feedback. This report is from the Working Group and is intended to reflect the diverse thoughts of the Working Group. As previously shared, the authors on the VDOT team have captured a significant amount of input during the two meetings and surveys, and we want to make sure that we have accurately captured your input and arrived at meaningful answers to the questions posed in the legislation:

- Should there be a model policy;
- recommendations for a model policy; and
- provide input to the federal MUTCD rulemaking process.

If it is possible for you to submit your comments to the VDOT team using track changes or comment bubbles in the Word document, that would be helpful to the VDOT authors. If that format does not work for you for any reason, please feel free to e-mail your comments. **Please submit your comments by Monday, September 27** (this is one week following the submission timeframe for the first four sections) so that we can finalize the report and submit for VDOT Executive Leadership review and to the General Assembly by November 1. Please let us know if you have any questions.

As we noted during the discussion, VDOT is committed to this task as well as designing, maintaining, and operating an inclusive and safe transportation system for all users of all abilities. We look forward to working with you to deliver on this commitment.

Comments from City of Alexandria

- On page 17 of the report, the report lists existing governing requirements for crosswalks and curb ramps at the various levels of government. While it is not a "shall" document, FHWA has a useful guide for improving pedestrian safety at uncontrolled crossing locations, which they released in 2018 as part of their Safe Transportation for Every Pedestrian (STEP) program. In Alexandria, we rely on this resource constantly to help us determine what crossing treatments are appropriate at different locations. It would be helpful to have this incorporated into the report somehow so it can be considered if/when the model policy is developed.

- We suggest the NACTO Urban Street Design Guide be incorporated as a foundational resource, as many localities, including Alexandria, have based their local design guidance and best practices off of this document where federal or state standards fail to provide sufficient specificity or guidance.

- For Section 4.5, we recommend the document mention of the FHWA official ruling on decorative crosswalks.

- In the recommendations document, we suggest that instead of saying "the needs of pedestrians must be balanced with the needs of vehicle drivers and other road users in crosswalk design", it should say "pedestrian safety must be prioritized in crosswalk design". (p. 12)

- In Section 6.1 Specific Model Policy Elements to Include (starts on pg. 13), the last bullets says "a protocol for citizens to request new crosswalks…". Could additional information be provided about this? For example, would an existing 311 or resident request process be sufficient? Will each jurisdiction be able to determine what is appropriate?

- Also in Section 6.1, as a preventative measure, we suggest that one of the criteria for selecting appropriate locations for crosswalks be latent demand, not current demand. Some agencies rely on existing pedestrian volumes and decline a crosswalk request based on "lack of demand", without acknowledging that many people may not cross there because there is no crosswalk or associated pedestrian safety treatments.

Comments from APA Virginia Chapter

- Under the WG Meeting #1 on June 11, [underlined] I added
    - Other members felt that complete uniformity is not necessary if the design context varies, and this could be based on speeds, volumes, urban vs. rural, roadway width, adjacent land uses, etc.
- Safety should be the top priority when developing a model policy…
    - A checklist for designers was suggested.

Comments from American Council of the Blind, Virginia Chapter

- I have reviewed the two parts of the document and find nothing wrong with what is there. However, I'm concerned about an issue I brought up that effects the application of the Model Crosswalk Policy.
  I mentioned the concern of pedestrians when they are confronted with discontinuous sidewalks. Since crosswalks and sidewalks are inextricably linked, I don't think they can be separated.
  When a pedestrian comes to the end of a sidewalk in the middle of a block, they are confronted with the decision of how to continue toward their destination. Many pedestrians with vision or mobility disabilities will not be able to negotiate the informal paths that previous pedestrians may have forged. They are forced to find alternative paved access. This may involve crossing access roads or streets of various levels of occupancy and velocity.
  In order to minimize these situations and the engineering modifications necessary to make these aberrations safe, I wonder if we should make some recommendation about minimizing the occurence of sidewalks that end mid-block.

Comments from City of Richmond

Comments provided as comment bubbles in Word Document – relevant text and comment shown below.

- Section 1.2: Crosswalks Background
  - Comment: I believe that one needs to define a legal crosswalk (whether marked or unmarked) as defined by the Code of Virginia as well as the Federal definition.

- Subsection: VDOT's Pedestrian Crossings
  - Comment: What about Locally Owned Pedestrian Crossings?

- "Also, 74% of pedestrian injury crashes and 86% of fatal pedestrian crashes occurred at locations without a marked crosswalk."
  - Comment: Was the pedestrian crossing the street in all cases?

- "Crosswalks with additional artistic elements will have significantly higher costs than any of the types described above."
  - Comment: Are you speaking to decorative pavers / brick crosswalks or crosswalk art?

- "Standard CG-12, which sets forth VDOT's detailed design requirements for curb ramps."
  - Comment: This is not adequate for the conditions found in the field.

Comments from Girl Scout Troop 1673

Comments provided as comment bubbles in Word Document – relevant text and comment shown below.

- Section 2.2: VDOT and the Transportation System in the Commonwealth of Virginia – "Parallel lines crosswalk…"
    - Comment: Is this for paint, thermoplastic? Is this crosswalk only or also detectable warning surface tiles? What is the cost difference for other high vis crosswalks? This begs the question of how cities an afford the artistic crosswalks but cannot update crosswalks to make them highly visible

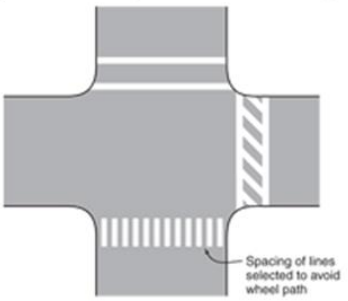
- Section 3.2: Federal Requirements; Subsection *US Code on Traffic Control Devices Standards; bullet b)* – "State or other Federal MUTCD…"
    - Comment: Must this be followed or is it guidance? Written by VDOT?

- Section 3.2: Federal Requirements; Subsection *Manual on Traffic Control Devices (MUTCD)* – "When crosswalk lines are used,…"
    - Comment: We know this is not the case in many places. We know you are researching, but we'd love to know how this is enforced by FHWA. Do they do compliance checks?

- Section 3.2: Federal Requirements; Subsection *Manual on Traffic Control Devices (MUTCD)* – "It is important to note that Official Interpretations do not set new policy,…"
    - Comment: Based on the official interpretation, some leeway has been taken in VA with the artistic crosswalks. We appreciate that the MUTCD allows them if they have white lines, colors are subdued, repeating pattern.

- Section 3.2: Federal Requirements; Subsection *Manual on Traffic Control Devices (MUTCD)* – "zebra marking pattern not one of the allowable types…"
    - Comment: It is confusing that this image is from the MUTCD which shows the zebra pattern on the right. Can you please tell us why that is? (snip taken from attached edits)

Figure 3B-19. Examples of Crosswalk Markings



- Section 3.3: Code of Virginia and Virginia Administrative Code Requirements; Subsection *Localities and Curb Ramp Design* – “Curb ramps be constructed at intersections for use by persons with mobility impairments…”
    - Comment: What type, color? Truncated domes, gravel (which is not useful), yellow, red?

- Section 3.4: VDOT Policies and Practices; Subsection *Highway Safety Improvement Program (HSIP)* – “VDOT has identified safety improvements…”
    - Comment: What were the resulting changes to VDOT policies/recommendations from PSAP and HSIP? Were more crosswalks installed as a result or just a modification of crosswalks? Or other traffic control devices?

- Section 3.4: VDOT Policies and Practices; Subsection *Virginia’s Strategic Highway Safety Plan and 5 Es of Transportation Safety*
    - Comment: Is there a draft SHSP available for review?

- Section 6.1: Recommendations for Model Crosswalk Design and Installation Policy Content; Subsection *Guiding Principles of a Model Policy* – “Complete uniformity in crosswalk design is neither necessary nor desirable,…”
    - Comment: Perhaps an if/then diagram to be shared out to localities/municipalities and what is being done by VDOT

- Section 6.1: Recommendations for Model Crosswalk Design and Installation Policy Content; Subsection *Guiding Principles of a Model Policy* – “Fiscal responsibility…”
    - Comment: We would rather have more crosswalks that are safer than one “high end” crosswalk in a town (keeping maintainability in mind). Is there a high visibility crosswalk that is more cost effective than others (e.g. continental vs. ladder?). Clearly thermoplastic will be more costly, but less expensive than repainting in two years?

- Section 6.1: Recommendations for Model Crosswalk Design and Installation Policy Content; Subsection *Guiding Principles of a Model Policy* – “studies on the effectiveness of crossing treatments,…”
    - Comment: Presently are all new crosswalk proposals studied? Seems like decision making criteria defined below by FHWA or VDOT would eliminate the need for studies, unless the case is truly unique

- Section 6.1: Recommendations for Model Crosswalk Design and Installation Policy Content; Subsection *Specific Model Policy Elements to Include* – “Criteria defining a process for selecting…”
    - Comment: Should these criteria be done at a federal level? Who establishes these criteria and those for high-vis markings and installation and maintenance? VDOT with stakeholder input? Will these criteria be part of the recommendation for the model crosswalk? If not all these

criteria risk being different for each locality/municipality and losing the consistency for which we are aiming.

- Section 6.1: Recommendations for Model Crosswalk Design and Installation Policy Content; Subsection *Specific Model Policy Elements to Include* – “protocol for citizens to request new crosswalks, request maintenance on existing crosswalks…”
    - Comment: How will it be communicated to the public? Perhaps a news segment?

Comments from City of Falls Church

- No additional comments were provided

Comments from Virginia Department for the Blind and Vision Impaired

- No additional comments were provided

APPENDIX G – Literature Review Summary

TECHNICAL ASSISTANCE MEMORANDUM

CROSSWALK DESIGN AND EFFECTIVENESS—A LITERATURE REVIEW

Peter B. Ohlms, AICP
Senior Research Scientist
Virginia Transportation Research Council

July 2021

INTRODUCTION

This literature review summarizes published studies, articles, and reports, along with research in progress, for several topics related to crosswalk design. The core topic is presented first: the effectiveness of high-visibility crosswalk marking styles compared to basic marking styles. Other topics include effects of marked crosswalks versus unmarked crossings, color and contrast of curb ramp detectable warning surfaces, methods to provide wayfinding guidance to pedestrians with no or low vision, crosswalk placement details, and decorative crosswalks. Related topics, including guidance devices not in widespread use and emerging technology solutions, are summarized last, as these are outside the scope of crosswalk design and effectiveness but may be of interest to stakeholders. Most sources were identified through a literature search conducted by the VDOT Research Library (Ernest and O'Leary, 2021).

EFFECTIVENESS OF HIGH-VISIBILITY VERSUS BASIC CROSSWALK MARKINGS

Studies looking at specific marking styles have had mixed results, partly because of the difficulty in isolating the effect of crosswalk marking style from other features—such as signs, signals, and geometric details—at a crossing. Studies have also used various measures of effectiveness, including crosswalk visibility as stated by drivers, traffic speeds, crash outcomes, and driver yielding rates. In general, previous research reviews have concluded that high-visibility markings are more effective than basic markings in several ways (Dill et al., 2021; McGrane and Mitman, 2013).

High-visibility markings have generally been shown to increase the distance from which a driver is able to detect a crosswalk, as compared to the basic marking pattern. The FHWA's *Crosswalk Marking Field Visibility Study* found that participants driving a course in daytime and nighttime conditions detected piano key and bar pair high-visibility crosswalks sooner than basic ones (Fitzpatrick et al., 2010). During the daytime, this translated into 8 seconds of increased awareness when approaching midblock crossings at 30 mph. The study recommended making high-visibility marking styles the default for crossings where vehicles do not have a stop sign or signal.

No studies were found indicating particular advantages of marking colors other than white. After experimenting with yellow-green markings at over 100 school zone crosswalks, Chicago reported no significant change in the percentage of speeding drivers (Chicago Department of Transportation, 2005), leading the FHWA to conclude that yellow-green markings were not superior to white markings (Federal Highway Administration, 2006).

In terms of crash outcomes, the Chicago study also included a limited crash analysis (two years of before data and one year of after data at a subset of the sites) that had mixed results. Two journal articles documented pedestrian crash reductions associated with high-visibility crosswalk markings in other major cities. Chen et al. (2013) examined 20 years of crash data in New York City and found that, although there were decreases in crashes at all sites, there was a statistically significant and larger decrease of 48% attributable to high-visibility crosswalks. However, the article was unclear if the other sites had basic crosswalk markings or were unmarked. Feldman et al. (2010) compared 54 San Francisco school-zone intersections with high-visibility crosswalks to 54 with basic markings. They found a 37% pedestrian crash reduction but noted that they may not have fully accounted for a citywide downward trend in pedestrian crashes. (Also, as is typical for school zones in San Francisco, the crosswalk markings were yellow rather than white.) Because both of these studies examined intersection crossings in major cities, it is not known if their findings are transferable to other contexts. However, Dill et al. (2021) referenced a forthcoming guide in stating two CMFs for high-visibility crosswalks compared to basic markings – 0.52 for urban locations and 0.63 for urban school zones – that align with the crash reductions from these two journal articles.

Zegeer et al. (2005) examined crash outcomes in more contexts—1,000 marked crosswalks and 1,000 matched unmarked comparison sites. The study's major findings addressed marked versus unmarked crossings and are discussed in the next section of this literature review. When modeling crash effects, the study's authors found that marking style was not predictive of crash outcomes overall. The modeling approach considered "crosswalk types with more markings" (i.e., high-visibility styles) as well as crosswalks with basic markings. Although some preliminary models indicated that the high-visibility styles were associated with slightly lower crash rates than basic markings, when the models incorporated regional variables, the association was "quite nonsignificant."

In terms of driver yielding rates, the literature is not entirely clear. Two studies examined driver yielding at unsignalized crosswalks including those with high-visibility markings, but neither study isolated the effect of crosswalk marking type from other features of each crossing. Fitzpatrick et al. (2006) examined 42 sites in 7 states and found driver yielding rates as low as 10% at some sites but as high as 90% at others. Nitzburg and Knoblauch (2001) had two treatment sites with high-visibility markings and an illuminated overhead sign and two control sites with only basic markings in Florida. They found driver yielding rates at the treatment sites to be 30-40% higher during the daytime and 8% higher at night, the latter increase not being statistically significant. In a before-after study at eight sites in Las Vegas, Pulugurtha et al. (2012) did find a statistically significant improvement in driver yielding after installation of high-visibility markings, although it was unclear from their study whether these replaced basic crosswalk markings or unmarked crossings (the study noted that the before condition had "inconspicuous crosswalks" at many of the sites).

An ongoing study in North Carolina seeks to verify driver yielding outcomes at high-visibility crosswalks compared to unmarked or basic marked crosswalks and to determine if that effect is sustained when an area has many high-visibility crosswalks (North Carolina Department of Transportation, n.d.). After delays due to the COVID-19 pandemic, data collection was completed in July 2021, with study completion expected by December (O'Brien, 2021).

No studies were found that quantified the effect of marking style on pedestrians with low vision, but some reported that such pedestrians preferred high-visibility marking styles. For example, the NCHRP guidebook *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities* stated that pedestrians with low vision have expressed a preference for ladder-type markings, with the combination of transverse and longitudinal lines making it easier for them to maintain the proper heading, and that brick-colored crosswalks may be less distinguishable (National Academies of Sciences, Engineering, and Medicine, 2017). Logically, as markings deteriorate over time under vehicular traffic, crosswalk patterns with relatively more marking material are likely to remain visible longer than patterns with less marking material (O'Brien, 2021).

The scope of a national study published in 2017 originally included developing crash modification factors (CMFs) for seven uncontrolled crossing treatments including high-visibility crosswalk marking patterns (Zegeer et al., 2017). However, high-visibility markings were ultimately not one of the four crossing treatments fully evaluated in the study, with the authors noting that more research was needed to determine the markings' safety effects in order to support decision-making regarding cost-effectiveness. Even so, the report recommended that engineers consider using high-visibility markings at crosswalks with high traffic volumes to increase visibility to approaching drivers.

An ongoing study sponsored by the FHWA will produce a guide to selecting crosswalk marking patterns (basic, piano key, ladder, and bar pair) based on safety, cost, and overall effectiveness (National Academies of Sciences, Engineering, and Medicine, 2021). Field work concluded in June 20201, and study completion is expected by December (O'Brien, 2021).

EFFECTS OF MARKED CROSSWALKS VERSUS UNMARKED CROSSINGS

A research review on pedestrian crossings noted that the presence of marked crosswalks was associated with decreased pedestrian crash risk, as were median refuges and sidewalks (Dill et al., 2021). That being said, marked crosswalks *alone* do not necessarily reduce crashes, partly because of interactions with other roadway characteristics (e.g., wider roadways, undivided crossings, and arterials) that can increase risk. Zegeer et al. (2005) analyzed 5 years of pedestrian crash data at 1,000 marked crosswalks and 1,000 matched unmarked comparison sites and found that on many roadways, reducing pedestrian crashes requires improvements beyond simply marking a crosswalk. In other words, deploying marked crosswalks requires sensitivity to context. Compared to crossing locations on similar roads with no crosswalk markings, the study found higher pedestrian crash rates at marked crosswalks on multilane roads with over 12,000 vehicles per day with no raised median or over 15,000 vehicles per day with a raised median.

The authors noted that marked crosswalks were neither "a magic cure for pedestrian safety problems" nor "a negative measure that will necessarily increase pedestrian crashes."

Road user behavior is another measure of effectiveness. At marked crosswalks at 11 intersections in four U.S. cities, Knoblauch et al. (2001) found pedestrians checking for oncoming traffic slightly (but not statistically significantly) more than at unmarked crossings, contradicting an argument that some had made about marked crosswalks giving pedestrians a false sense of security. They also found that drivers reduced their speeds, a surrogate measure of driver awareness. On low-speed two-lane and multilane roads (6 sites, all in California), Mitman et al. (2008) found that drivers were more likely to yield to pedestrians at marked crosswalks than at unmarked crossings.

Appendix H of *NCHRP Report 841* (2017) summarizes and critiques studies conducted before 2001 that had been thought to indicate higher rates of pedestrian crashes at marked crosswalks versus unmarked crossings. It also reviews studies (some of which are included in this literature review) that evaluated pedestrian behavior and motorist behavior. Its summary of the literature on marked versus unmarked crosswalks included the following:

> "[It] is clear that marked crosswalks are generally not associated with any statistically significant difference in pedestrian crash risk (compared to unmarked crosswalk sites) on two-lane roads or on multi-lane roads with fewer than 12,000 vehicles per day. On multi-lane roads with ADT higher than 12,000 vehicles per day, marked crosswalks installed alone, without other substantial safety devices, carry significantly increased crash risk for pedestrians, unless more substantial pedestrian safety treatments are provided…
>
> "Studies of pedestrian and motorist behavior suggest that pedestrian behavior is generally improved by marking crosswalks, and no indication of reckless behavior has been found associated with marked crosswalks. However, most of these behavioral studies were on two- or three-lane roads, where no differences were found in pedestrian crash risk between marked and unmarked crosswalks."

COLOR AND CONTRAST OF CURB RAMP DETECTABLE WARNING SURFACES

Detectable warning surfaces (DWSs) at curb ramps provide a tactile indication of the transition between sidewalk and street for pedestrians who are blind. For pedestrians with low vision, the color of the DWS and/or its contrast between the street and sidewalk can also help identify the ramp and a likely crossing location.

As far back as the early 1990s, there were arguments about whether to use contrast as the requirement or to specify a certain color. Bentzen et al. (1994) tested 10 pairs of DWSs and background surfaces on an indoor transit station platform using 24 participants. The results indicated that yellow was readily detectable even when its contrast with the background surface was relatively low. Jenness and Singer (2006) studied 13 DWS colors at an outdoor unshaded site using 50 participants. The study emphasized the importance of contrast but acknowledged that agencies might desire to specify a small set of standardized DWS colors. Based on the results, the authors suggested that agencies willing to specify two DWS colors should require

yellow on dark surfaces and an orange-red color on lighter surfaces such as concrete. For agencies wanting to apply a single DWS color uniformly, yellow was recommended.

METHODS TO PROVIDE WAYFINDING GUIDANCE TO PEDESTRIANS WITH NO OR LOW VISION

People with low or no vision may encounter difficulties with the wayfinding tasks associated with street crossings. These tasks include locating the crosswalk, aligning to cross the street, initiating the crossing within crosswalk boundaries, and maintaining a heading to remain within the crosswalk for the duration of the crossing. A 2004 joint workshop of the Institute of Transportation Engineers and the U.S. Access Board identified standardization of curb ramp design and associated traffic operations as the most important way to improve wayfinding for travelers with low or no vision (Stollof, 2005). Elements of curb ramp design that can assist with wayfinding include aligning the ramp slope with the direction of the crosswalk and providing returned curbs parallel to the direction of the crosswalk where a landscaped buffer is present; parallel curb ramps (used where sidewalks are narrow and there is no landscaped buffer) can achieve neither of these goals without some type of fencing (National Academies of Sciences, Engineering, and Medicine, 2017).

At signalized intersections, users who are blind must also know whether pushbutton actuation is required, locate the pushbutton if so, and identify when the walk interval begins. Accessible pedestrian signals (APS) are one key way of providing this information on crossing tasks along with supporting wayfinding using audible beaconing and vibrotactile pushbuttons with raised arrow symbols that provide some tactile guidance on the direction of the crossing. APS has been studied extensively, and those studies are not summarized here, because VDOT has already worked with stakeholder groups to enact policies regarding the installation of APS.

As crossings or intersections deviate from the typical signal-controlled intersection of two perpendicular streets, wayfinding tasks become increasingly difficult. Physical treatments beyond APS can assist with wayfinding. The NCHRP guidebook *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities* provides an accessibility assessment framework to help engineers evaluate three performance measures at a proposed site: (1) the crossing sight distance, (2) the estimated level of crossing delay, and (3) the expected level of risk for blind travelers (National Academies of Sciences, Engineering, and Medicine, 2017).

CROSSWALK PLACEMENT DETAILS

Some studies, particularly those related to roundabouts (e.g., Lu et al., 2011), have examined the effects of placing crosswalks in various relationships to the streets they parallel and cross. These placement details can affect crash rates, traffic operations, crossing distances, the directness of pedestrian travel paths, and, for pedestrians with low or no vision, the difficulty of locating a crosswalk and aligning to cross (Jacquemart, 2012).

An ongoing study for the Oregon Department of Transportation is examining the relationship between pedestrian safety and the lateral offset of crosswalks—i.e., whether crosswalks set back from the corner are safer than those closer to the corner (National Academies of Sciences, Engineering, and Medicine, 2020). The agency anticipates using the findings to improve safety by adjusting crosswalk placement when it improves 25,000 non-compliant curb ramps on state roadways. A similar study for the Indiana Department of Transportation is forthcoming (Purdue University, 2021).

DECORATIVE CROSSWALKS

Recently, urbanists, economic development specialists, and some advocates have pushed for decorative and aesthetic enhancements to crosswalks, from three-dimensional effects to rainbow color patterns. Such treatments are often outside current U.S. standards. Their stated purposes range from enhancing pedestrian safety through increased crosswalk visibility to enhancing a business or cultural district. Engineers and other advocates have pushed back, citing concerns about diminished motorist recognition, driver and pedestrian distraction, and difficulties in recognizing these crosswalks, especially for people with low vision. To address these questions, FHWA initiated a study in June 2020 (Federal Highway Administration, 2020). It will focus on the rainbow color pattern and will include effects on pedestrians with low vision. Results are expected in May 2022.

RELATED AND EMERGING PEDESTRIAN CROSSING TOPICS

Several studies covered topics that are outside the scope of crosswalk design and effectiveness: guidance devices and emerging technologies that are not in widespread use in the U.S. Although these topics often present more questions than answers and may describe solutions that are not typically ready for widespread deployment, there may be value in increasing stakeholder awareness of them.

Guidance Devices Not In Widespread Use

Ikeda et al. (2015) proposed the use of DWS-adjacent light-emitting blocks that could be detected underfoot and using residual vision to improve the conspicuity of such locations. Multiple articles by the same authors were identified on light-emitting blocks, none of which appeared to examine their cost-effectiveness, and the devices are not in widespread use.

The truncated domes used in DWSs are a type of tactile walking surface indicator (TWSI) designed to alert pedestrians of a change, such as from sidewalk to street. Another type of TWSI is designed to guide pedestrians directionally, such as locating a crosswalk and aligning to cross, typically using raised parallel bars. These guidance surfaces are not standardized in the U.S., although several U.S. transit agencies have installed them. They are standardized in some other countries such as Japan; several international studies were found that are not summarized here but could provide more technical details.

A relatively recent U.S. study of raised bar guidance surfaces suggested them as a solution specifically for midblock and roundabout crosswalks (Bentzen et al., 2017). In that study, 16 participants with little or no vision failed to locate a crosswalk without such a guidance surface on nearly 20% of first and second attempts and were well aligned to cross on only about half of their trials. With the guidance surface, only 2.4% of approaches resulted in failing to locate the crosswalk, and participants were well aligned to cross on more than three-fourths of trials. Participants also responded positively to questions about the surface and expressed a desire to have such surfaces installed. A later article evaluated the effects of raised bars on travelers with mobility disabilities (Bentzen et al., 2020).

An active study under the Transit Cooperative Research Program will develop research-based guidance for TWSIs, including at intersections and crossings that are difficult to locate (National Academies of Sciences, Engineering, and Medicine, n.d.). As of summer 2021, the portion of the study involving human subjects had been delayed due to the COVID-19 pandemic; preliminary results were expected in 2022 with project completion by spring 2023 (O'Brien, 2021). The study's results could advance standardization of TWSIs, particularly guidance surfaces, in the U.S.

Raised guidance surfaces are not typically used in the crosswalk or roadway itself, where they would likely be subject to damage by vehicles and winter maintenance operations. Barlow et al. (2013) deployed raised guide strips 4 in. wide and 0.25 in. high along the inside edge of one crosswalk line at several large, complex signalized intersections; the guide strip was a product marketed as a temporary rumble strip. The guide strips were roughly as effective as APS beaconing in helping blind travelers maintain a heading during street crossings, suggesting that guide strips could be an option at challenging unsignalized crossings or for travelers with both visual and hearing disabilities. However, the material used was not a permanent one, and there were concerns about durability. The study also noted that some participants mistook "the many layers of thermoplastic tape used for some of the crosswalk lines" for the guide strip, suggesting that some users were able to detect the material difference between pavements and slightly raised thermoplastic crosswalk marking materials. No studies were found indicating how robust this ability tends to be in terms of wayfinding or how the effect varies as thermoplastic markings deteriorate over time. Scott et al. (2011) had tested the same guide strip configuration as Barlow et al. (2013) along with an edge strip configuration that deployed parallel guide strips along the boundaries of the crosswalk—which might approximate the detectability of multiple layers of thermoplastic. Scott et al. (2011) found no wayfinding advantage to this dual edge strip configuration over the single guide strip. In part, this was because participants used a constant-contact cane technique with the single guide strip, becoming aware that they were off course almost immediately if they veered from it, but were told to travel between the dual edge strips without following them—resulting in some participants unknowingly crossing over the edge strips and veering far off course.

Building on the directional guidance provided by the tactile arrows used on APS pushbuttons, Takato et al. (2020) examined elongated versions of these tactile cues that are at hand height, rather than underfoot as with TWSIs. The study found that tactile bars with lengths greater than 500 mm (about 20 inches) were effective in informing study participants of the

direction of the crosswalk, reducing their veering angle during crossings, and increasing participants' confidence.

Emerging Technology Solutions

Apps and proposed technologies that work with smartphones and smart canes have emerged to support wayfinding. For example, FHWA's Pedestrian Technology Test Bed has studied an audio-visual alert given to drivers approaching a midblock crosswalk via dashboard-mounted devices, along with a smartphone app for pedestrians that indicated when a crossing beacon was flashing (Roldan et al., 2020). The Ohio State School for the Blind tested a crosswalk marking paint that would interact with smart canes; its cost was reportedly 20% more than "regular road paint" (Ripken, 2018). Computer vision systems have been explored that could recognize crosswalks for users with no or low vision (e.g., Fusco et al., 2014). Studies of such systems are not summarized in detail in this literature review, because they typically are not in widespread deployment and would not benefit pedestrians who lack the appropriate apps or smart cane devices.

A technology solution that may be less experimental than the above examples is the provision of verbal descriptions of intersections and their crosswalks, curb ramps, and signalization details by way of an intersection database. A test of such a database in Portland, Oregon with 22 blind participants found that it was more helpful with using pushbuttons and initiating and completing crossings than with wayfinding tasks; overall, all participants stated that they found the intersection database helpful (Guth et al., 2019).

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APPENDIX H – Working Group Member Submissions to FHWA/USDOT Docket for Proposed Draft 11th Edition of the MUTCD

Links to FHWA/USDOT Notice of Proposed Amendments Docket Comments from WG Members on the Proposed Draft 11th Edition of the MUTCD

FHWA Rulemaking Docket ID: FHWA-2020-0001

https://www.regulations.gov/docket/FHWA-2020-0001

Working Group Member Submissions to the Docket:

Virginia Department of Transportation:

Comment ID: FHWA-2020-0001-12931

https://www.regulations.gov/comment/FHWA-2020-0001-12931

American Council of the Blind:

Comment ID: FHWA-2020-0001-13309

https://www.regulations.gov/comment/FHWA-2020-0001-13309

Girl Scouts of the Nation's Capital – Troop 1673:

Comment ID: FHWA-2020-0001-5743

https://www.regulations.gov/comment/FHWA-2020-0001-5743

APPENDIX I – References: VDOT and other Agency Policies and Plans

- ADA Transition Plan (April 2019)
- VDOT Accessible Pedestrian Signals Policy (IIM-TE-388)
- VDOT Roles and Responsibilities ADA Compliance, Curb Ramp Assessments, and Curb Ramp Improvements Policy (IIM-TE-376.1)
- VDOT Program for ADA Compliance of Department Right-of-Way Assets (IIM-TE-377/IIM-CR-5)
- Guidelines for the Placement of Curb Ramps Policy (IIM-LD-55.17)
- Pedestrian Crossing Accommodations at Unsignalized Intersections Policy (IIM-TE-384)
- Crosswalk Paver Units/Crosswalk Art Policy (IIM-LD-218.3)
- Federal MUTCD
- Virginia Supplement to the MUTCD
- Federal Docket for Draft 11th Edition of the MUTCD
- Road & Bridge Standard Drawings (includes CG-12 curb ramp and PM-3 crosswalk details)
- UVA Transportation Training Academy
- Virginia Transportation Research Council
- Pedestrian Safety Action Plan
- Virginia Strategic Highway Safety Plan