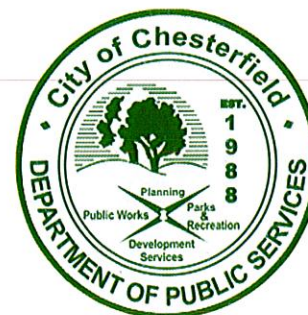


III.F



Memorandum

Department of Planning and Public Works

To: Planning and Public Works Committee

From: Susan Mueller, Principal Engineer *S Mueller*

Date: 10/12/2012

RE: Appalachian Trail Striping

The City has been asked to consider eliminating the centerline and edge line striping on the approved construction plans for the Appalachian Trail construction project. A memo from Mr. Geisel and a PowerPoint presentation are attached hereto for your review and consideration.

Based upon the information provided in these attachments, **Staff requests that the Planning and Public Works Committee consider the materials and provide policy direction for Staff.** Should you need additional information, please advise.

attachments

cc: Mike Geisel, DPS

Memorandum
Department of Public Services



To: Mayor Geiger
Councilmember Grissom
Councilmember Grier
From: Mike Geisel, P.E., PWLF
Date: 10/12/2012
Re: Appalachian Trail

Pursuant to your inquiries relative to the traffic lane striping requirements for Appalachian Trail, I have prepared the following information for your use.

The Appalachian Trail, Phase One project is partially funded through Federal, Surface Transportation Funds. As such, plans, specifications, changes, and all aspects of the project have to be approved through the Missouri Department of Transportation (MoDOT).

After this project was approved for funding, the City solicited proposals from qualified engineering firms and subsequently contracted with CDG (Campbell Design Group) for the preparation of plans and specifications for the project.

As you are also aware, City and Consulting Staff initiated a comprehensive neighborhood participation and awareness effort in conjunction with the design. As a result of these communications, instead of simply removing and replacing the pavement as it previously existed, the City decided to proceed to incorporate specific design elements including intersection bump outs and special road textures in front of Shenandoah Elementary school.

Subsequently, a final set of road plans and specifications were developed by the City's consultant and were submitted to MoDOT for review and approval. These plans specified solid white traffic striping at the outside of the traffic lanes and a double yellow line along the centerline. The traffic striping was part of the signed and sealed plans prepared by the City's consultant. Any proposed change to the approved plans would have to be submitted to MoDOT for consideration. In turn, MoDOT will rely on professional standards, specifications, guidance and experience. **Any changes would have to be subject to approval from the Federal Highways Administration.**

It should be stated clearly that traffic striping is not used for aesthetic purposes. Traffic striping is a traffic control device, as much as are traffic signs, stop bars, cross walks, and speed limits. Each line color, line configuration, and even line width is intended to communicate a specific condition or restrictive action.

Per the City's code, the City Engineer is responsible for determining the appropriate traffic control and is authorized to place the required traffic control devices. It should also be noted that traffic control devices in the City are required to be in conformance with the "manual and specifications approved by the State Highway Commission". The manual used to provide standards and guidance for traffic control is the MUTCD, (MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES).

The original design for Appalachian Trail requires single white lines to mark the outside limits of the travel lane and a double yellow line along the centerline to separate traffic in opposing directions. Primarily, the striping requirement results from the irregular curb line along the traveled way, due to the intersection bump outs. **The traffic striping is necessary in the designer's opinion, to ensure that motorists do not unexpectedly encounter the six inch vertical curb where the pavement narrows at intersections.** It should be clear that the design engineer bears a great deal of responsibility and liability for providing a safe roadway.

When Staff was asked to review the striping requirement, Staff referred to the MUTCD for guidance. The MUTCD is 864 pages long. As such, I've provided select excerpts for convenience. This is not intended to be an exhaustive research discussion on the MUTCD, its applicability or requirements, but simply a reference to illustrate our thought process.

In summary;

For roads exceeding 20' in width and with average daily traffic (ADT) exceeding 6,000 vehicles per day, there is a requirement that centerline striping SHALL be provided. Appalachian Trail does NOT have 6,000 ADT. So the application of the centerline striping is not mandatory under this provision. The MUTCD further states that centerline striping SHOULD be used for roadways exceeding 20' in width and exceeding 3,000 ADT. Appalachian Trail approaches 3,000 ADT.

However, the MUTCD also suggests that centerline striping should be used where an engineering study indicates a need. **In this instance, the engineer has determined that the irregular curb line dictates the need for definition of the centerline by striping.**

When centerline stripes are used, they have to be in one of three configurations:

- a) Two direction passing zone – (single broken yellow line)
- b) One direction passing zone – (single solid yellow line and single broken yellow line)
- c) Two direction no passing zone – (two solid parallel yellow lines)

A single, solid yellow line cannot be used as a centerline stripe (see page 349 of MUTCD)

If you use option a) or b) as described above, you have to define where it is safe to pass and where it is not safe to pass. City Staff would discourage any permissive passing condition along Appalachian Trail.

After review of the design and application of the striping on Appalachian Trail, it is Staff's professional engineering opinion that the striping should be placed as required on the Campbell Design Group plans to provide the utmost safety and properly direct motorists along the irregular street curb line.

Further, it should be equally clear that the City should be consistent in the application of its traffic control devices. A very similar road configuration exists on Stablestone and the same striping was implemented.

It is also relevant to state that this roadway was striped with a double yellow centerline prior to the road construction.

Finally, it is also our belief that the striping affects traffic behavior. The net effect of edge line striping and centerline striping is to create the appearance of a narrower roadway. Empirical data indicate that travel speeds are actually reduced due to the striping.

However, **to be completely clear, while our professional opinion and recommendation is that the striping is required,** it is not a legal mandate. There are clearly liability and safety issues, but the striping configuration is a design decision, not a legal requirement. That being said, eliminating the

striping is not a simple decision. Under these conditions, if the residents were determined to eliminate the striping contrary to our professional opinions, the following process would be necessary:

- 1) The City Council would direct Staff to petition MoDOT for removal of the striping requirement.
- 2) The City would also have to concurrently request the design engineer to remove the striping from the plan set. It is likely that the design engineer would not willingly remove the striping and it is expected that the design engineer would require a release of liability from the City if the striping were to be eliminated.
- 3) MoDOT would act on the City's request. At this juncture, I have no prediction as to what MoDOT's position would be. I would presume that MoDOT would generally support the design engineer's original requirement, but I simply have no confidence in what MoDOT's Response would be.
- 4) Depending on MoDOT's response, the City's contractor would be instructed to stripe\not stripe accordingly.

I hope this memorandum provides you the documentation and supporting information relative to the engineering considerations involved in the road striping. If you have any additional questions or require additional information, please let me know.

attachments

Cc Michael Herring, City Administrator
Brian McGownd, Public Works Director – City Engineer
Susan Mueller, Principal Engineer

City Code

300.130. Authority to install traffic control devices.

The City Traffic Engineer shall place and maintain traffic control signs, signals, and devices when and as required under the traffic ordinances of the City to make effective the provisions of said ordinances, any may place and maintain such additional traffic control devices as he may deem necessary to regulate traffic under the traffic ordinances of the City or under State law or to guide or warn traffic.

300.135. Manual and specifications for traffic control devices.

All traffic control signs, signals and devices shall conform to the manual and specifications approved by the State Highway Commission or resolution adopted by the legislative body of the City. All signs or signals required hereunder for a particular purpose shall go so far as practicable be uniform as to type and location throughout the City. All traffic control devices so erected and not inconsistent with the provisions of this ordinance shall be official traffic control devices.

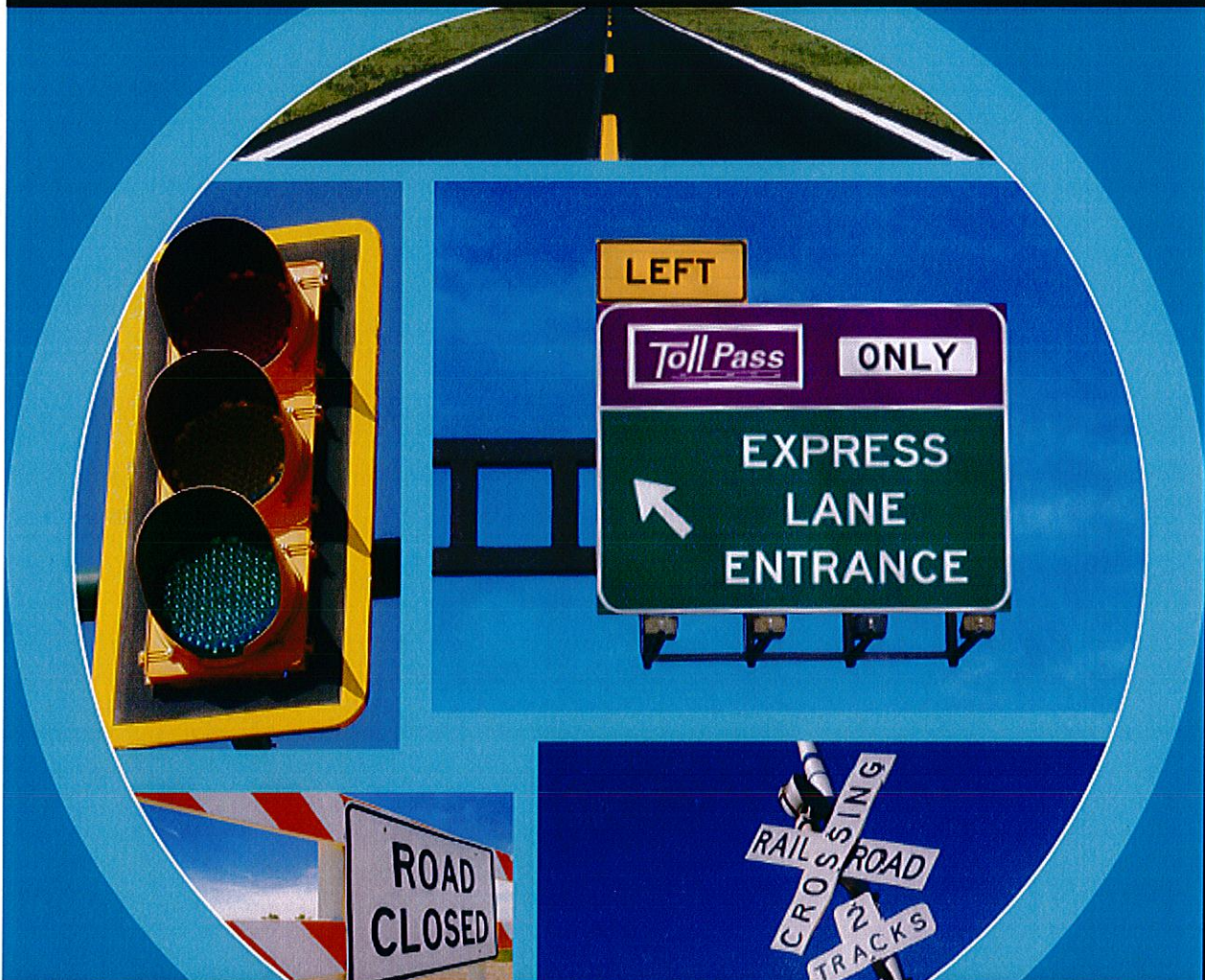
300.200. Traffic lanes.

1. The City Traffic Engineer is hereby authorized to mark traffic lanes upon the roadway of any street or highway where a regular alignment of traffic is necessary.
2. Where such traffic lanes have been marked, it shall be unlawful for the operator of any vehicle to fail or refuse to keep such vehicle within the boundaries of any such lane except when lawfully passing another vehicle or preparatory to making a lawful turning movement.

Manual on Uniform Traffic Control Devices

for Streets and Highways

2009 Edition



U.S. Department of Transportation
Federal Highway Administration





City of Chesterfield

Appalachian Trail



Existing Conditions

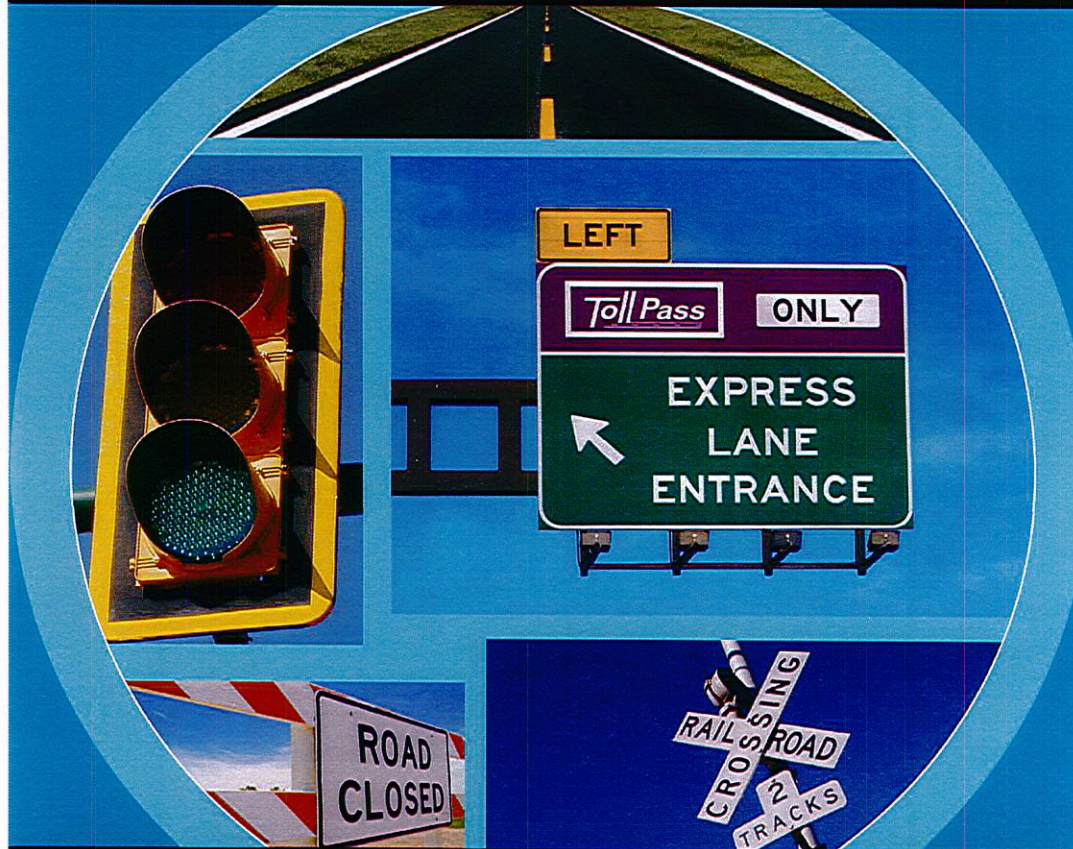


Proposed Improvements

Manual on Uniform Traffic Control Devices

for Streets and Highways

2009 Edition



U.S. Department of Transportation
Federal Highway Administration

Section 3A.06 Functions, Widths, and Patterns of Longitudinal Pavement Markings

Standard:

- 01 **The general functions of longitudinal lines shall be:**
 - A. **A double line indicates maximum or special restrictions,**
 - B. **A solid line discourages or prohibits crossing (depending on the specific application),**
 - C. **A broken line indicates a permissive condition, and**
 - D. **A dotted line provides guidance or warning of a downstream change in lane function.**
- 02 **The widths and patterns of longitudinal lines shall be as follows:**
 - A. **Normal line—4 to 6 inches wide.**
 - B. **Wide line—at least twice the width of a normal line.**
 - C. **Double line—two parallel lines separated by a discernible space.**
 - D. **Broken line—normal line segments separated by gaps.**
 - E. **Dotted line—noticeably shorter line segments separated by shorter gaps than used for a broken line. The width of a dotted line extension shall be at least the same as the width of the line it extends.**

- 10 White chevron crosshatch markings (see Section 3B.24) may be placed in the neutral area of exit ramp and entrance ramp gores for special emphasis as shown in Figures 3B-8 and 3B-10 and Drawing A of Figure 3B-9. The channelizing lines and the optional chevron crosshatch markings at exit ramp and entrance ramp gores may be supplemented with white retroreflective or internally illuminated raised pavement markers (see Sections 3B.11 and 3B.13) for enhanced nighttime visibility.

Section 3B.06 Edge Line Pavement Markings

Standard:

- 01 **If used, edge line pavement markings shall delineate the right or left edges of a roadway.**
- 02 **Except for dotted edge line extensions (see Section 3B.08), edge line markings shall not be continued through intersections or major driveways.**
- 03 **If used on the roadways of divided highways or one-way streets, or on any ramp in the direction of travel, left edge line pavement markings shall consist of a normal solid yellow line to delineate the left-hand edge of a roadway or to indicate driving or passing restrictions left of these markings.**
- 04 **If used, right edge line pavement markings shall consist of a normal solid white line to delineate the right-hand edge of the roadway.**

CHAPTER 3B. PAVEMENT AND CURB MARKINGS

Section 3B.01 Yellow Center Line Pavement Markings and Warrants

Standard:

- 01 **Center line pavement markings, when used, shall be the pavement markings used to delineate the separation of traffic lanes that have opposite directions of travel on a roadway and shall be yellow.**

Option:

- 02 Center line pavement markings may be placed at a location that is not the geometric center of the roadway.
- 03 On roadways without continuous center line pavement markings, short sections may be marked with center line pavement markings to control the position of traffic at specific locations, such as around curves, over hills, on approaches to grade crossings, at grade crossings, and at bridges.

Standard:

- 04 **The center line markings on two-lane, two-way roadways shall be one of the following as shown in Figure 3B-1:**
- A. **Two-direction passing zone markings consisting of a normal broken yellow line where crossing the center line markings for passing with care is permitted for traffic traveling in either direction;**
 - B. **One-direction no-passing zone markings consisting of a double yellow line, one of which is a normal broken yellow line and the other is a normal solid yellow line, where crossing the center line markings for passing with care is permitted for the traffic traveling adjacent to the broken line, but is prohibited for traffic traveling adjacent to the solid line; or**
 - C. **Two-direction no-passing zone markings consisting of two normal solid yellow lines where crossing the center line markings for passing is prohibited for traffic traveling in either direction.**
- 05 **A single solid yellow line shall not be used as a center line marking on a two-way roadway.**
- 06 **The center line markings on undivided two-way roadways with four or more lanes for moving motor vehicle traffic always available shall be the two-direction no-passing zone markings consisting of a solid double yellow line as shown in Figure 3B-2.**

Guidance:

Section 3B.02 No-Passing Zone Pavement Markings and Warrants

Standard:

- 01 No-passing zones shall be marked by either the one direction no-passing zone pavement markings or the two-direction no-passing zone pavement markings described in Section 3B.01 and shown in Figures 3B-1 and 3B-3.
- 02 When center line markings are used, no-passing zone markings shall be used on two-way roadways at lane-reduction transitions (see Section 3B.09) and on approaches to obstructions that must be passed on the right (see Section 3B.10).
- 03 On two-way, two- or three-lane roadways where center line markings are installed, no-passing zones shall be established at vertical and horizontal curves and other locations where an engineering study indicates that passing must be prohibited because of inadequate sight distances or other special conditions.
- 04 On roadways with center line markings, no-passing zone markings shall be used at horizontal or vertical curves where the passing sight distance is less than the minimum shown in Table 3B-1 for the 85th-percentile speed or the posted or statutory speed limit. The passing sight distance on a vertical curve is the distance at which an object 3.5 feet above the pavement surface can be seen from a point 3.5 feet above the pavement (see Figure 3B-4). Similarly, the passing sight distance on a horizontal curve is the distance measured along the center line (or right-hand lane line of a three-lane roadway) between two points 3.5 feet above the pavement on a line tangent to the embankment or other obstruction that cuts off the view on the inside of the curve (see Figure 3B-4).

Support:

- 05 The upstream end of a no-passing zone at point “a” in Figure 3B-4 is that point where the sight distance first becomes less than that specified in Table 3B-1. The downstream end of the no-passing zone at point “b” in Figure 3B-4 is that point at which the sight distance again becomes greater than the minimum specified.
- 06 The values of the minimum passing sight distances that are shown in Table 3B-1 are for operational use in marking no-passing zones and are less than the values that are suggested for geometric design by the AASHTO Policy on Geometric Design of Streets and Highways (see Section 1A.11).

Table 3B-1. Minimum Passing Sight Distances for No-Passing Zone Markings

85th-Percentile or Posted or Statutory Speed Limit	Minimum Passing Sight Distance
25 mph	450 feet
30 mph	500 feet
35 mph	550 feet
40 mph	600 feet
45 mph	700 feet
50 mph	800 feet
55 mph	900 feet
60 mph	1,000 feet
65 mph	1,100 feet
70 mph	1,200 feet

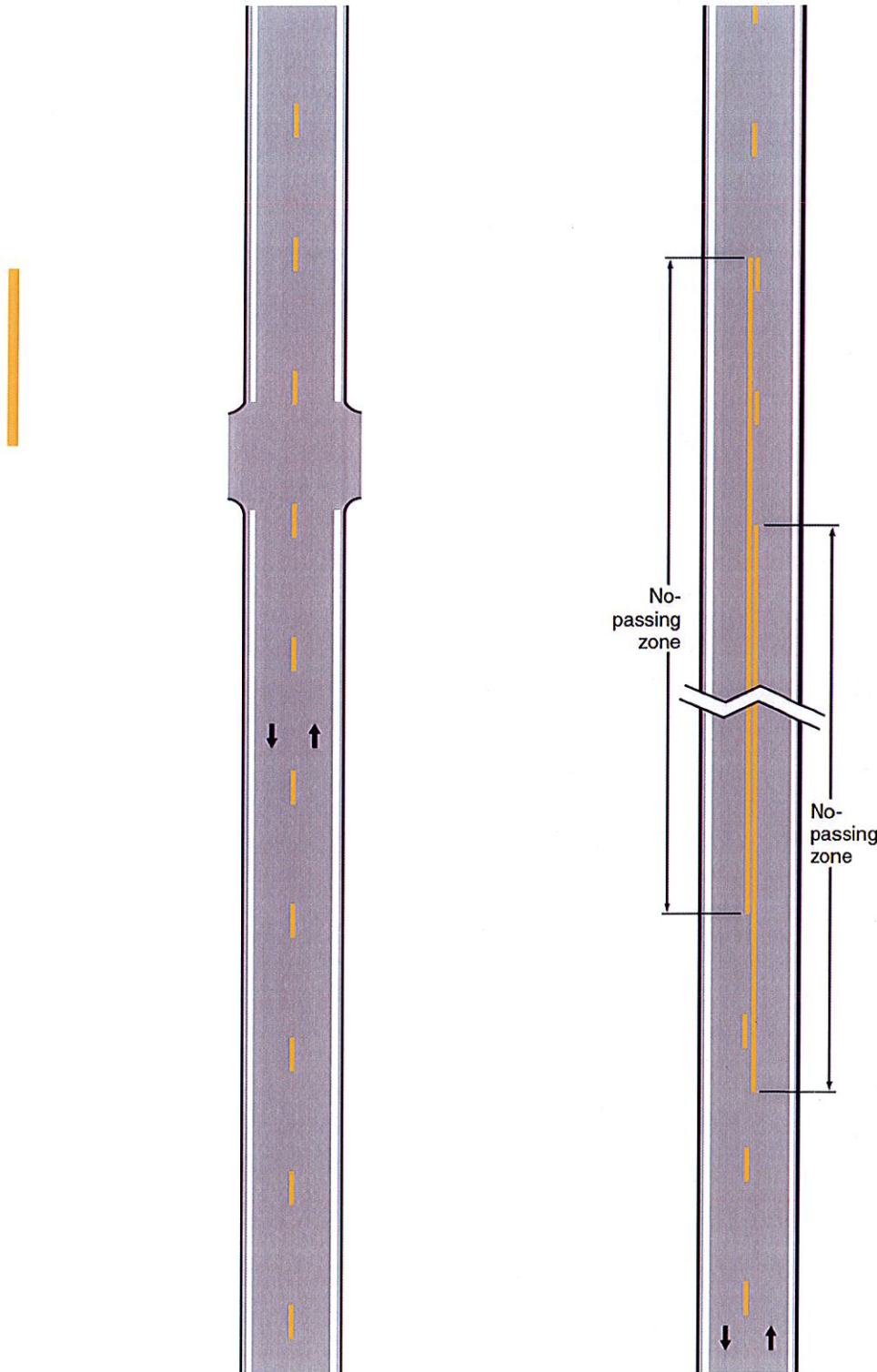
Figure 3B-1. Examples of Two-Lane, Two-Way Marking Applications

A - Typical two-lane, two-way marking with passing permitted in both directions

B - Typical two-lane, two-way marking with no-passing zones

Legend

→ Direction of travel



CHAPTER 3B. PAVEMENT AND CURB MARKINGS

Section 3B.01 Yellow Center Line Pavement Markings and Warrants

Standard:

01 **Center line pavement markings, when used, shall be the pavement markings used to delineate the separation of traffic lanes that have opposite directions of travel on a roadway and shall be yellow.**

Option:

02 **Center line pavement markings may be placed at a location that is not the geometric center of the roadway.**

03 **On roadways without continuous center line pavement markings, short sections may be marked with center line pavement markings to control the position of traffic at specific locations, such as around curves, over hills, or approaches to grade crossings, at grade crossings, and at bridges.**

Standard:

04 **The center line markings on two-lane, two-way roadways shall be one of the following as shown in Figure 3B-1:**

- A. **Two-direction passing zone markings consisting of a normal broken yellow line where crossing the center line markings for passing with care is permitted for traffic traveling in either direction;**
- B. **One-direction no-passing zone markings consisting of a double yellow line, one of which is a normal broken yellow line and the other is a normal solid yellow line, where crossing the center line markings for passing with care is permitted for the traffic traveling adjacent to the broken line, but is prohibited for traffic traveling adjacent to the solid line; or**
- C. **Two-direction no-passing zone markings consisting of two normal solid yellow lines where crossing the center line markings for passing is prohibited for traffic traveling in either direction.**

05 **A single solid yellow line shall not be used as a center line marking on a two-way roadway.**

06 **The center line markings on undivided two-way roadways with four or more lanes for moving motor vehicle traffic always available shall be the two-direction no-passing zone markings consisting of a solid double yellow line as shown in Figure 3B-2.**

Guidance:

07 *On two-way roadways with three through lanes for moving motor vehicle traffic, two lanes should be designated for traffic in one direction by using one- or two-direction no-passing zone markings as shown in Figure 3B-3.*

Support:

08 **Sections 11-301(c) and 11-311(c) of the "Uniform Vehicle Code (UVC)" contain information regarding left turns across center line no-passing zone markings and paved medians, respectively. The UVC can be obtained from the National Committee on Uniform Traffic Laws and Ordinances at the address shown on Page i.**

Standard:

09 **Center line markings shall be placed on all paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater. Center line markings shall also be placed on all paved two-way streets or highways that have three or more lanes for moving motor vehicle traffic.**

Section 3B.06 Edge Line Pavement Markings

Standard:

- 01 **If used, edge line pavement markings shall delineate the right or left edges of a roadway.**
- 02 **Except for dotted edge line extensions (see Section 3B.08), edge line markings shall not be continued through intersections or major driveways.**
- 03 **If used on the roadways of divided highways or one-way streets, or on any ramp in the direction of travel, left edge line pavement markings shall consist of a normal solid yellow line to delineate the left-hand edge of a roadway or to indicate driving or passing restrictions left of these markings.**
- 04 **If used, right edge line pavement markings shall consist of a normal solid white line to delineate the right-hand edge of the roadway.**

Guidance:

- 05 *Edge line markings should not be broken for minor driveways.*

Support:

- 06 *Edge line markings have unique value as visual references to guide road users during adverse weather and visibility conditions.*

Option:

- 07 *Wide solid edge line markings may be used for greater emphasis.*

Section 3B.07 Warrants for Use of Edge Lines

Standard:

- 01 **Edge line markings shall be placed on paved streets or highways with the following characteristics:**
 - A. **Freeways,**
 - B. **Expressways, and**
 - C. **Rural arterials with a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater.**

Guidance:

- 02 *Edge line markings should be placed on paved streets or highways with the following characteristics:*
 - A. *Rural arterials and collectors with a traveled way of 20 feet or more in width and an ADT of 3,000 vehicles per day or greater.*
 - B. *At other paved streets and highways where an engineering study indicates a need for edge line markings.*
- 03 *Edge line markings should not be placed where an engineering study or engineering judgment indicates that providing them is likely to decrease safety.*

Option:

- 04 *Edge line markings may be placed on streets and highways with or without center line markings.*
- 05 *Edge line markings may be excluded, based on engineering judgment, for reasons such as if the traveled way edges are delineated by curbs, parking, or other markings.*
- 06 *If a bicycle lane is marked on the outside portion of the traveled way, the edge line that would mark the outside edge of the bicycle lane may be omitted.*
- 07 *Edge line markings may be used where edge delineation is desirable to minimize unnecessary driving on paved shoulders or on refuge areas that have lesser structural pavement strength than the adjacent roadway.*