National Committee on
Uniform Traffic Control Devices

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Item Number: 25B-RW-01

NCUTCD PROPOSAL FOR CHANGES TO THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES

COMMITTEE / TASK FORCE:	Regulatory and Warning Sign Technical Committee
ITEM NUMBER:	25B-RW-01
TOPIC:	Lane Reduction Signing
ORIGIN OF REQUEST:	Lane Reduction Signing and Markings MCTF
AFFECTED SECTIONS OF MUTCD:	2C.08, 2C.47 Figures 2B-16, 2C-11, 2C-13A-E, 2C-16

DEVELOPMENT HISTORY:
Approved by RWSTC: 06/12/2025
Concurrence from Markings TC:.....06/26/2025
Approved by NCUTCD Council: .....

This is a proposed change to the MUTCD that has been developed by a technical committee, joint committee, or joint task force of the NCUTCD. The NCUTCD is distributing this to its sponsoring organizations for review and comment. Sponsor comments will be considered in revising the proposal prior to NCUTCD Council consideration. This proposal does not represent a revision of the MUTCD and does not constitute official MUTCD standards, guidance, options, or support. If approved by the NCUTCD Council, the recommended changes will be submitted to FHWA for consideration for inclusion in a future MUTCD revision. The MUTCD can be revised only through the federal rulemaking process.

SUMMARY:
Termination of a continuing lane or lanes often incurs high workloads on road users. Road users in the terminating lane must change lanes or execute a merge maneuver, often in traffic moving at free-flow speeds. Research conducted through the Traffic Control Devices Pooled Fund Study indicates opportunities to improve the consistency and differentiation of current signing and pavement marking practices, providing clarity with regard to the end state of the non-continuing lane.

DISCUSSION:
Where road users cannot readily determine the end state of a non-continuing lane, increases in workload are likely to incur characteristic patterns of crashes. Prevalence of certain crash types is further exacerbated by horizontal alignment, vertical alignment, large volumes of truck traffic, lane width, and the absence of shoulders.

Differentiated approaches to signing and pavement markings ahead of a lane termination can be used to identify the ultimate state of the non-continuing lane, whether it is a lane drop (a

mandatory turn or exiting lane) or a lane reduction. Depictions of the differences between lane drops and lane reductions for various scenarios are included in Figure 1.

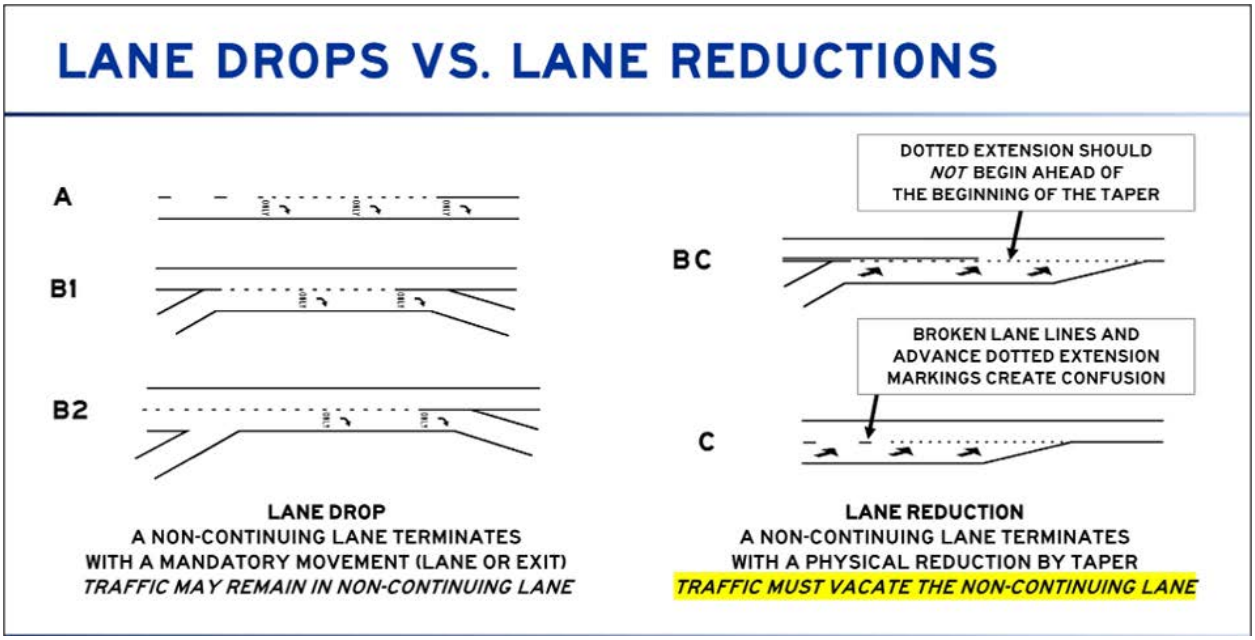


Figure 1. Illustrations comparing lane drops and lane reductions

Road users approaching any lane termination typically exhibit frequent variations in seek distance, additional mirror glances, head turns for conflict checks, and adjustments in speed. Observed workload is higher for right lane terminations due to increased fraction of heavy vehicles in the right lane. Clear identification of the distance to the beginning of the lane reduction taper can help users manage workload and plan ahead to mitigate conflicts.

Existing practices for signing lane reductions (a physical reduction in the number of lanes by means of a taper) continue to vary, despite changes incorporated in the 11th Edition of the MUTCD. While the RIGHT LANE ENDS (W9-1) sign is intended for placement at an upstream location (typically the advance placement distance) some network operators substitute the "Lane Ends" (W4-2) symbol sign at the advance placement distance. Inconsistencies occur when the W4-2 symbol sign is also used closer to the lane reduction taper, often supplementing an upstream sign or alone in locations where warning signs cannot be installed at the distance specified in Table 2C-3, such as ahead of lane reduction tapers on short entrance ramps and on single-direction roadways departing an intersection.

Differentiated signing and markings on the approach to the lane reduction taper can further clarify the location of the beginning of the taper itself, facilitating road user recognition of anticipated workload according to the various segments identified in Figure 2 on the following page. The segment of roadway preceding and including the lane reduction is divided into three segments, illustrated in Figure 2. The characteristics of user workload within each segment vary, with increases in workload beginning in the upstream zone (ahead of the first warning sign, typically placed at the distance specified in Table 2C-3) and diversifying in the approach zone (between the warning sign at the conforming advance placement distance and the beginning of the taper). Depending on conditions, workload is maximized in the transition zone (along the lane reduction taper) and tapers at various rates in the downstream zone.

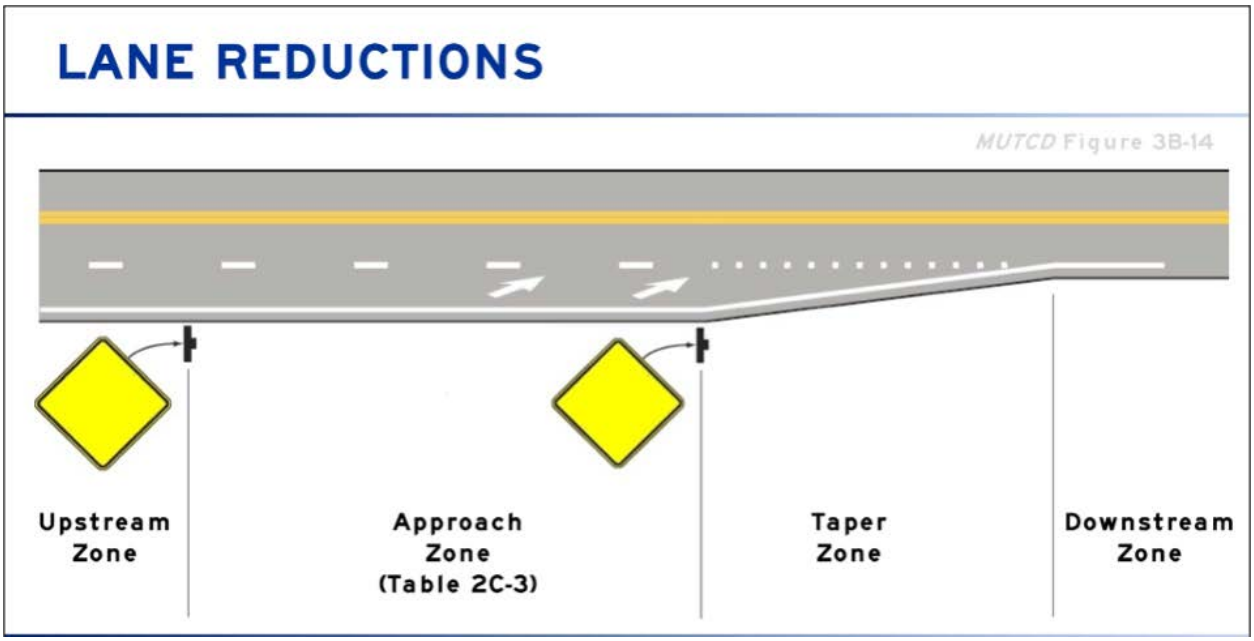


Figure 2. Workload zones approaching a lane reduction taper, where the "Taper Zone" is also referred to as a "transition taper" or "Transition Zone". (This figure displays pavement markings from a previous edition of the *MUTCD*.)

Consistency of information display between locations with similar characteristics can reduce the prevalence of unnecessary or erratic lane changes, unnecessary late merging, and overall workload and stress for road users. When signing and markings are varied according to the distance to lane reduction taper, road users will identify a relationship between sign placement and the *time* available before the vehicle passes the beginning of the lane reduction taper.

Proposed Changes advanced by the Regulatory & Warning Signs TC allow for a variety of existing practices, incurring few changes for agencies that use either sign or a combination of both signs. The proposal also introduces a sign that research indicated performs exceptionally well and is intended solely for use at the beginning of the lane reduction taper. Proposed Changes advanced by the Markings TC will address the results of research related to differentiating between a broken lane line and a dotted lane line to identify the beginning of the lane reduction taper and using a solid line to differentiate between locations where the non-continuing lane is a lane reduction and not a lane drop.

Summary of Related Research Results

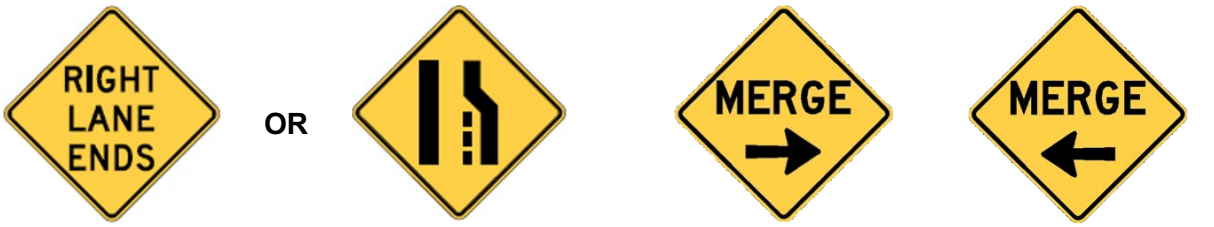
Since 2013, a joint effort between the Regulatory & Warning Signs Technical Committee (RWSTC) and Markings Technical Committee (MTC) has advanced research regarding lane reduction signing and pavement markings. NCUTCD discussions regarding consistency of signing and differentiation of pavement marking types have informed the research cited in the preparation of proposed changes.

This Proposed Change incorporates ongoing and related research results published within the past ten years, including four Traffic Control Devices Pooled Fund Studies, listed below.

- Lane Line Markings in Advance of Lane-Reduction Transitions, February 2016
- Comprehension and Legibility of Selected Symbol Signs Phase IV, December 2017
- Signing, in Combination with Lane Markings, in Advance of Lane Reduction Transitions, February 2019
- Sign Guidance for Late Merge, June 2023

These studies are available at https://pooledfund.org/details/study/565 with download links.

The research cited above produced results related to the performance of a variety of warning signs used by agencies in the United States. Specifically, the "Comprehension and Legibility of Selected Symbol Signs" report provided results associated with the performance of signs most commonly used in the United States, including the RIGHT LANE ENDS (W9-1) word message sign and the Lane Reduction (W4-2) symbol sign, which closely resembles the symbol sign used to warn of lane reductions in Canada. Additionally, the researchers examined the performance of signs commonly used in the vicinity of the beginning of the lane reduction taper, including a sign featuring the legend MERGE with a Type A Arrow pointing in the direction of the merging maneuver. Signs from the research that tested most positively are displayed in Figure 3, with both versions of the MERGE with Type A Arrow signs included for clarity.



W9-1R **W4-2R** LEFT LANE ENDS TAPER BEGINS RIGHT LANE ENDS TAPER BEGINS

Figure 3. Illustrations of the highest-performing existing signing and the Mn/DOT MERGE with Type A Arrow sign.

Among existing signs, the W9-1 RIGHT LANE ENDS sign scored highest for clarity and consistency with the roadway geometry. The RIGHT LANE ENDS sign was ranked highest among more than three-quarters of the participants for conveying the meaning that a physical lane reduction would be occurring downstream and accumulated the lowest number of overall incorrect responses in comprehension and response testing. In current practice, the RIGHT LANE ENDS sign is typically placed at the conforming advance placement distance even as some agencies substitute the W4-2 Lane Reduction symbol sign.

The W4-2 "Lane Reduction" symbol sign, used interchangeably with the RIGHT LANE ENDS sign and occasionally used along the transition zone, incurred some confusion regarding the immediacy of its message. While this sign did score highly for the message "right lane ends", respondents confused the meanings of "right lane ends" and "merge", indicating that its message failed to consistently contrast with the immediacy of a forced merge. The W4-2 symbol sign was frequently mistaken for the message of "lanes narrow", which does not produce the same response, that is, respondents vacating the non-continuing lane. This sign did produce the longest visibility distance, however, likely on account of the graphical display.

The “MERGE with Type Arrow” sign, as illustrated in Figure 3, has been used by the Minnesota Department of Transportation for temporary traffic control applications and in permanent installations since the 1990s. Observed installations from agencies throughout the region exhibit consistency with regard to limiting placement in locations adjacent to the beginning of the taper. Field observations in Minnesota indicate a desirable road user response in both permanent and temporary traffic control applications while the robust simplicity of the consistently-applied message exhibits similar results in “zipper merge” applications.

Agencies using this sign typically provide advance warning signs whenever possible, as this sign is not intended to be used as an advance warning sign. It can, however, be used alone in locations where advance warning signs are not installed. MERGE with Type A Arrow signs featuring a left-facing arrow are intended for placement on the right-hand side of the roadway in locations where the right lane ends. Correspondingly, the sign with the left arrow is intended for placement on the left-hand side of the roadway in locations where the left lane ends.

Respondents in the study stated that this sign means “merge” or “lane ends, merge”, demonstrating the sign’s applicability to the transition zone. Furthermore, researchers concluded that a high fraction of responses indicating solely the message of “merge” indicates a strong likelihood of immediate action by the road user. While dissimilar to the RIGHT LANE ENDS sign in terms of the perceived immediacy of the message, the MERGE with Type A Arrow sign performed highly with regard to a low likelihood of mistaking between right and left, a shortcoming of other tested signs. These results suggest that this sign is not intended as a replacement for the RIGHT LANE ENDS sign and is not interchangeable with the W4-2 Lane Reduction symbol sign.

Allowing for the use of both the W9-1 and W4-2 signs as advance warning signs accommodates most existing practices and aids users in consistently assessing the location of the taper with regard to time, a factor in the calculation of the advance placement distances listed in Table 2C-3. Research indicated that these signs performed well when used in advance of the condition and solely to warn traffic approaching locations where continuing lanes terminate in a lane reduction.

These three recommended signs and the associated pavement markings appear to produce the largest fraction of high-performing responses in both comprehension and road user response in testing. The patterns of those responses indicate the presence of these three logic-based relationships associated with the use of research-recommended traffic control devices.

- Differentiation of action by the road user can be achieved by illustrating a contrast between non-continuing lanes terminated with a mandatory movement (“lane drop”) and lanes terminated by a physical reduction by taper in the number of lanes (“lane reduction)”.
- Differentiation regarding the location of the beginning of the taper can be achieved by using a sequence of unique sign installations associated in various stages of workload that produce responses associated with a desired action and degree of primacy.
- Differentiation in message primacy (*time* to a forced maneuver) can be achieved through the consistency in applying associated specific signs and specific pavement markings in locations most associated with the desired user understanding and response.

Summary of Proposed Changes

This proposal contains recommendations relating solely to signing. The pavement markings depicted in the figures in this proposal are representative of the research results associated with the signing and pavement markings proposed for lane reductions in the cited studies. Figures shown in this proposal will be modified as needed to match the configuration of pavement markings upon approval of the companion MTC item by the NCUTCD Council.

Proposed revisions to signing in Chapter 2C are summarized in this list, which is arranged by the order in which signs would appear in sequence. These changes apply signing in locations where users inferred a related message and meaning, indicating the need to accentuate differentiation of messages among signs placed at various distances.

- Restricting the use of the RIGHT LANE ENDS sign to installation at the specified advance placement distance for a high-judgment maneuver in Table 2C-3
- Renaming the Lane Ends sign to the Lane Reduction Symbol sign and limiting its use as a replacement for the RIGHT (LEFT) LANE ENDS sign, harmonizing the use of this sign with the corresponding and similar symbol sign used in Canada, which is typically used solely as an advance warning sign
- Increasing the Level of Mandate for the use of distance plaques (W16-series) in conjunction with advance warning signs (W9-1 and W4-2) placed further in advance or at an alternative location not consistent with the distance specified in Table 2C-3, to provide increased awareness that the distance to the lane reduction taper is atypical
- Adding a new sign, the W9-X MERGE WITH ARROW sign, intended for placement at or near the beginning of the lane reduction taper, to clearly indicate the location of the taper, particularly in locations where an advance warning sign cannot be provided or where sight distance or traffic characteristics limit the visibility of the beginning of the lane reduction transition
- Adding a new sign, the W-16X BEYOND INTERSECTION plaque, intended for placement beneath W9-1 installed in advance of an intersection preceding a lane reduction occurring on the other side of the intersection
- Prohibiting the use of chevrons for lane reduction tapers and clarifying the use of chevrons for curvilinear geometric features
- Revising all of the depictions in Figure 2C-13 to display changes in the use of warning signs, displaying pavement markings indicated by the results of the cited research

RECOMMENDED MUTCD CHANGES:

The following present the proposed changes to the current MUTCD within the context of the current MUTCD language. Proposed additions to the MUTCD are shown in blue underline and proposed deletions from the MUTCD are shown in ~~red strikethrough~~. Changes previously approved by NCUTCD Council (but not yet adopted by FHWA) are shown in green double underline for additions and ~~green double strikethrough~~ for deletions. In some cases, background comments may be provided with the MUTCD text. These comments are indicated by [bracketed white text in shaded green]. Deletions made by a technical committee, joint committee, or task force after initial distribution to sponsoring organizations are shown in ~~highlighted red strikethrough and sans-serif text~~. Additions made by a technical committee, joint committee, or task force after initial distribution to sponsoring organizations are shown in underline blue and sans-serif text.

PART 2
SIGNS

CHAPTER 2C. WARNING SIGNS AND OBJECT MARKERS

Section 2C.08 Chevron Alignment Sign (W1-8)

Standard:

01 **The use of the Chevron Alignment (W1-8) sign (see Figures 2C-1 and 2C-2) to provide additional emphasis and guidance for a change in horizontal alignment shall be in accordance with the information shown in Table 2C-4.**

Option:

02 Chevron Alignment signs may be used instead of or in addition to standard delineators~~.~~ to emphasize curvilinear changes in roadway alignment.

Standard:

03 **The Chevron Alignment sign shall be a vertical rectangle. No border shall be used on the Chevron Alignment sign.**

04 **If used, Chevron Alignment signs shall be installed on the outside of a turn or curve, in line with and at approximately a right angle to approaching traffic. Chevron Alignment signs shall be installed at a minimum height of 4 feet, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way.**

Guidance:

05 The approximate spacing of Chevron Alignment signs on the turn or curve measured from the point of curvature (PC) should be as shown in Table 2C-5.

06 The Chevron Alignment signs should be visible for a sufficient distance to provide the road user with adequate time to react to the change in alignment.

Option:

07 LEDs may be used to enhance the conspicuity of Chevron Alignment signs (see Section 2A.12).

Standard:

08 **The LEDs used in the Chevron Alignment sign shall consist of yellow LEDs outlining the chevron symbol.**

09 **Chevron Alignment signs shall not be placed on the far side of a T-intersection facing traffic on the stem approach to warn drivers that a through movement is not physically possible, as this is the function of a Two-Direction (or One-Direction) Large Arrow sign.**

10 **Chevron Alignment signs shall not be used to mark obstructions within or adjacent to the roadway, including the beginning of guardrails or barriers, as this is the function of an object marker (see Section 2C.70).**

11 **Chevron Alignment signs directing traffic to the right shall not be used in the central island of a roundabout or a neighborhood traffic circle.**

Standard:

12 **Chevron Alignment signs shall not be used along lane reduction transitions or in conjunction with other linear tapers such as lane width transition tapers or offset transition tapers.**

Section 2C.47 Lane Ends Signs (W4-2 ~~and~~ or W9-1, W9-X, and W16-XP)

Support:

01 The RIGHT (LEFT) LANE ENDS (W9-1) sign and Lane ~~Ends~~ Reduction (W4-2) symbol sign ~~and RIGHT (LEFT) LANE ENDS (W9-1) signs~~ (see Figure 2C-11) are used to provide advance warning of the reduction in the number of traffic lanes in the direction of travel. The W9-X MERGE with arrow sign is used to indicate the beginning of a lane reduction taper.

02 The sequence of the W4-2 ~~and~~ or W9-1 and the W9-X signs is illustrated in Figure 2C-13.

02a The W4-2 sign is not considered interchangeable with the W9-X sign.

Guidance:

03 A RIGHT (LEFT) LANE ENDS (W9-1) ~~The Lane Ends (W4-2) sign~~ should be installed at the advance placement distance in accordance with Table 2C-3.

Option:

04 An additional RIGHT (LEFT) LANE ENDS (W9-1) sign may be installed upstream in advance of the ~~Lane Ends~~ sign posted at the distance specified in Table 2C-3 to provide additional warning that a lane is ending and that a merging maneuver will be required.

04a The Lane Reduction (W4-2) symbol sign may be installed as an alternative to the RIGHT (LEFT) LANE ENDS (W9-1) sign.

Guidance:

05 If an additional upstream or downstream W4-2 or W9-1 sign is installed, a Distance (W16-2P series or W16-3P series) plaque (see Figure 2C-16) should be installed below the W4-2 or W9-1 sign.

06 On one-way streets or on divided highways where the left-hand lane is ending and the width of the median will permit, the W9-1L and/or W4-2L signs should be placed facing approaching traffic on ~~the left-hand side or median~~ both sides of the roadway facing approaching traffic.

06a If a W9-1 (or W4-2) sign cannot be placed at the distance specified in Table 2C-3 and must be placed closer to the beginning of the taper, a Distance (W16-2P series or W16-3P series) plaque should be installed below the warning sign.

Option:

~~07 Where a lane ends a distance beyond the intersection that is less than the advance placement distance indicated in Table 2C-3, the W4-2 sign may be located at the far side of the intersection (see Sheet 4 of Figure 2C-13).~~ [Content relocated to new Paragraph 11c]

07a A single MERGE with arrow (W9-X) sign may be installed as the final sign in the sequence approaching a lane reduction, as near as practical to the beginning of the lane reduction taper.

07b In locations where a W9-1 (or W4-2) sign cannot be installed in advance of the lane reduction, such as along short acceleration lanes, a MERGE with arrow (W9-X) sign may be installed as near as practical to the beginning of the lane reduction taper.

~~*Guidance:*~~

~~*08 When the W4-2 sign is located at the far side of the intersection in accordance with Paragraph 7 of this Section, the W9-1 sign should be placed upstream of the intersection with the appropriate distance plaque.*~~ [Content relocated to new Paragraph 11b]

~~Support:~~

~~09 Section 3B.12 contains information regarding the use of pavement markings in conjunction with a lane reduction.~~ [Content relocated to new Paragraph 11d]

Guidance:

10 Lane ~~Ends~~ Reduction symbol (W4-2) signs should not be installed in advance of the downstream end of an acceleration lane.

Standard:

11 The W4-2 and W9-1 signs shall not be used in dropped lane situations, including EXIT ONLY lanes. In dropped lane situations on conventional roads at intersections, regulatory signs (see Section 2B.28) shall be used to inform road users that a through lane becomes a mandatory turn lane.

11a Installations of the W9-X sign shall be limited to the side of the road nearest the non-continuing lane such that the arrow displayed on the sign points into the roadway.

Option:

11b When the W4-2 sign is located at the far side of the intersection in accordance with Paragraph 11c of this Section, the W9-1 sign should be placed upstream of the intersection with a W16-X BEYOND INTERSECTION plaque or the appropriate distance plaque.

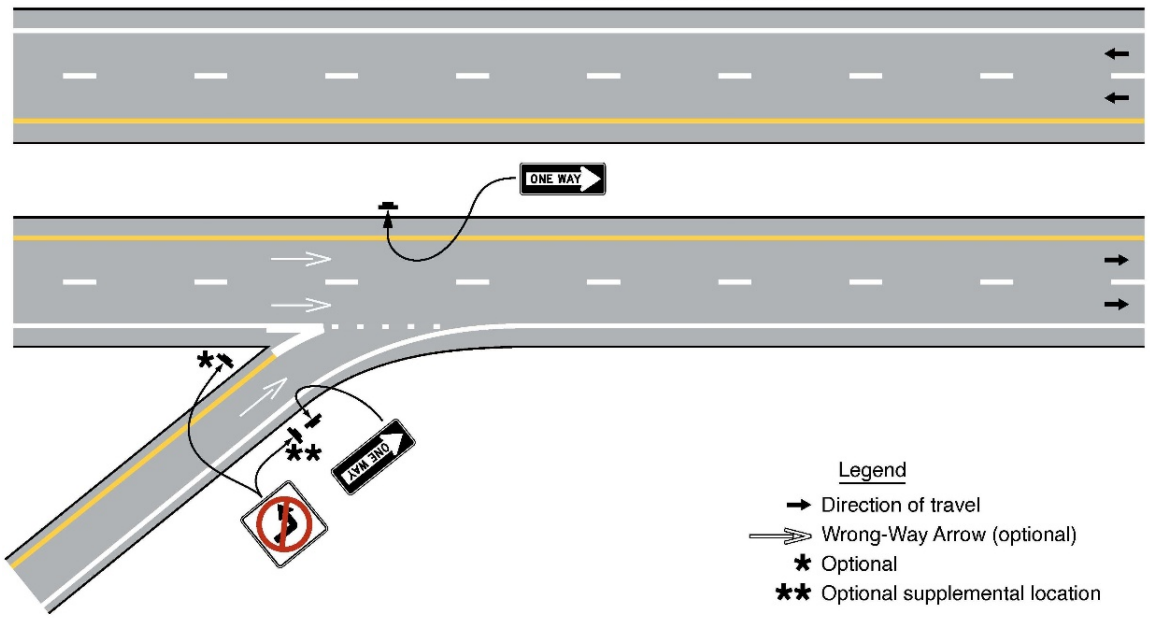
11c Where a lane ends a distance beyond the intersection that is less than the advance placement distance indicated in Table 2C-3, a W4-2 sign may be located at the far side of the intersection with a Distance (W16-2P-series or W16-3P-series) plaque mounted underneath the sign (see Sheet 4 of Figure 2C-13).

Support:

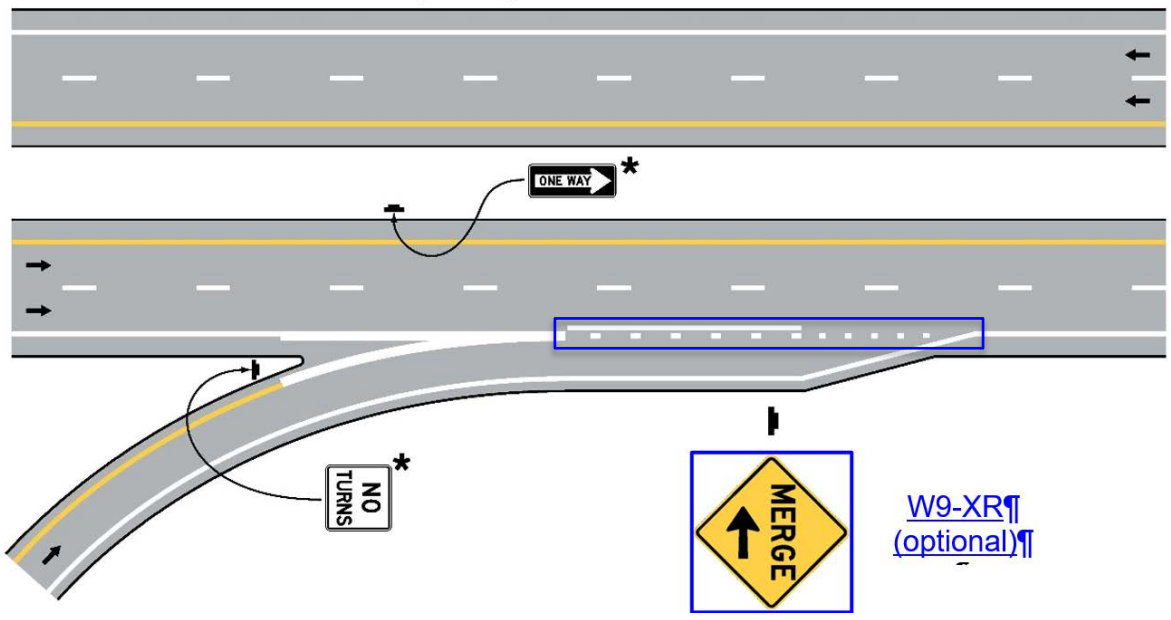
11d Section 3B.12 contains information regarding the use of pavement markings in conjunction with a lane reduction.

Figure 2B-16. Example of Application of Regulatory Signing and Pavement Markings at an Entrance Ramp Terminal

A – Design does not clearly indicate the direction of flow



B – Design clearly indicates the direction of flow



PROPOSED CHANGES TO FIGURE

1. Add Optional W9-X MERGE WITH ARROW sign at beginning of taper.
2. Interim depiction of pavement marking patterns and lane reduction arrows reflect existing content in the MUTCD that is harmonized with research results with the addition of the solid line consistent with the research report. These depictions are subject to change pending Council approval of the MTC proposal addressing this research.

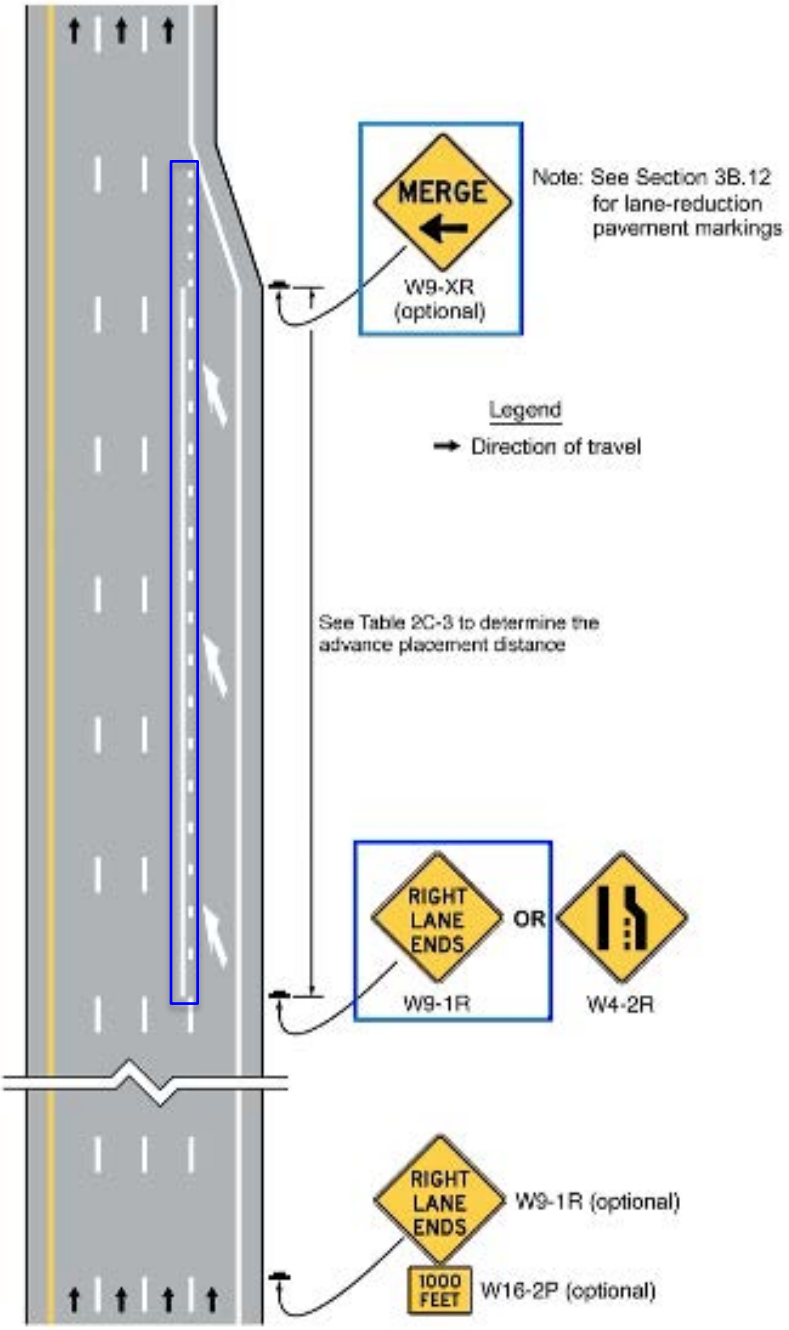
Figure 2C-11. Merging and Passing Signs and Plaques

PROPOSED CHANGES TO FIGURE

1. Added W9-X MERGE with arrow sign, recommending W9-2 designation

ure 2C-13. **Example Sequences for Lane Ends and Lane Merge Signs** (Sheet 1 of 5)

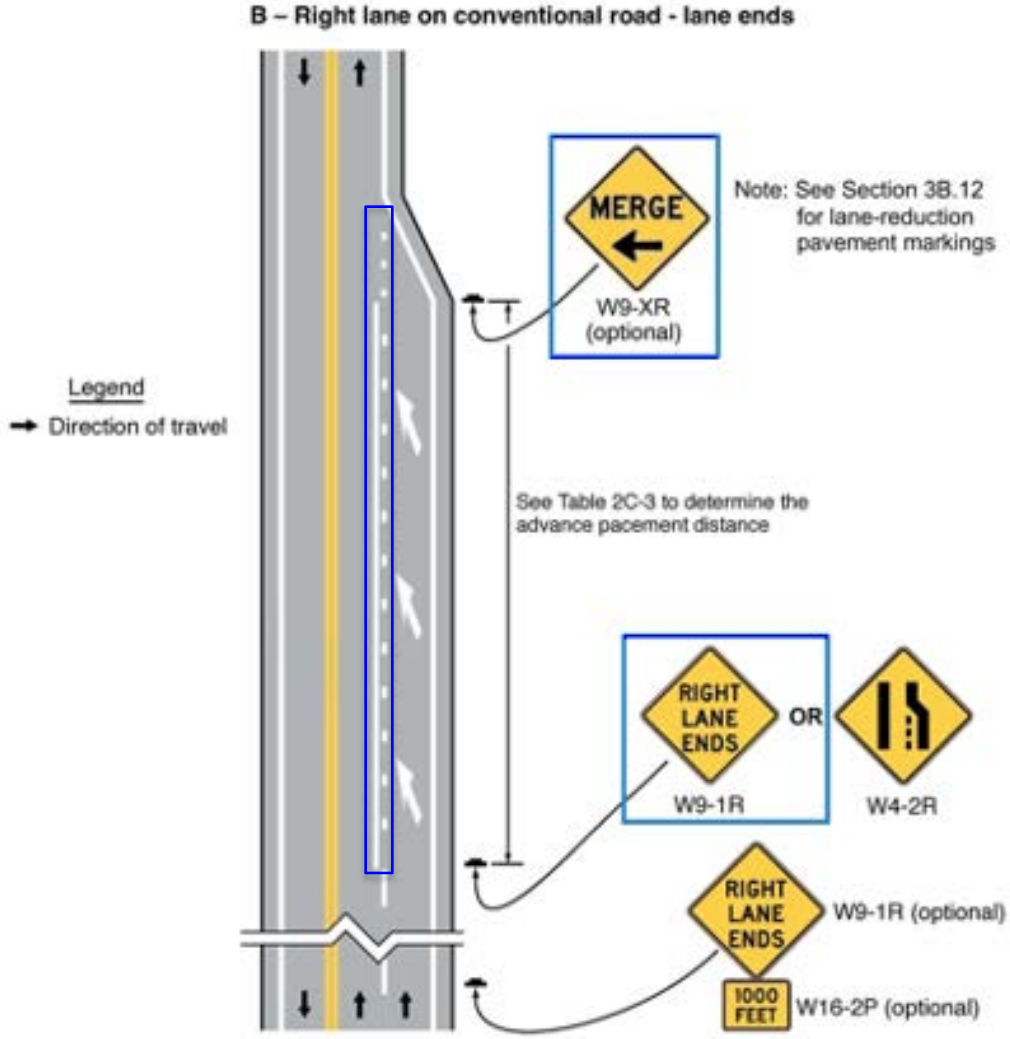
A – Freeway or expressway - lane ends



PROPOSED CHANGES TO FIGURE

1. Added W9-1R sign at conforming advance placement location
2. Added optional W9-XR MERGE with arrow sign at beginning of taper
3. Interim depiction of pavement marking patterns and lane reduction arrows reflect existing content in the MUTCD that is harmonized with research results with the addition of the solid line consistent with the research report. These depictions are subject to change pending Council approval of the MTC proposal addressing this research.

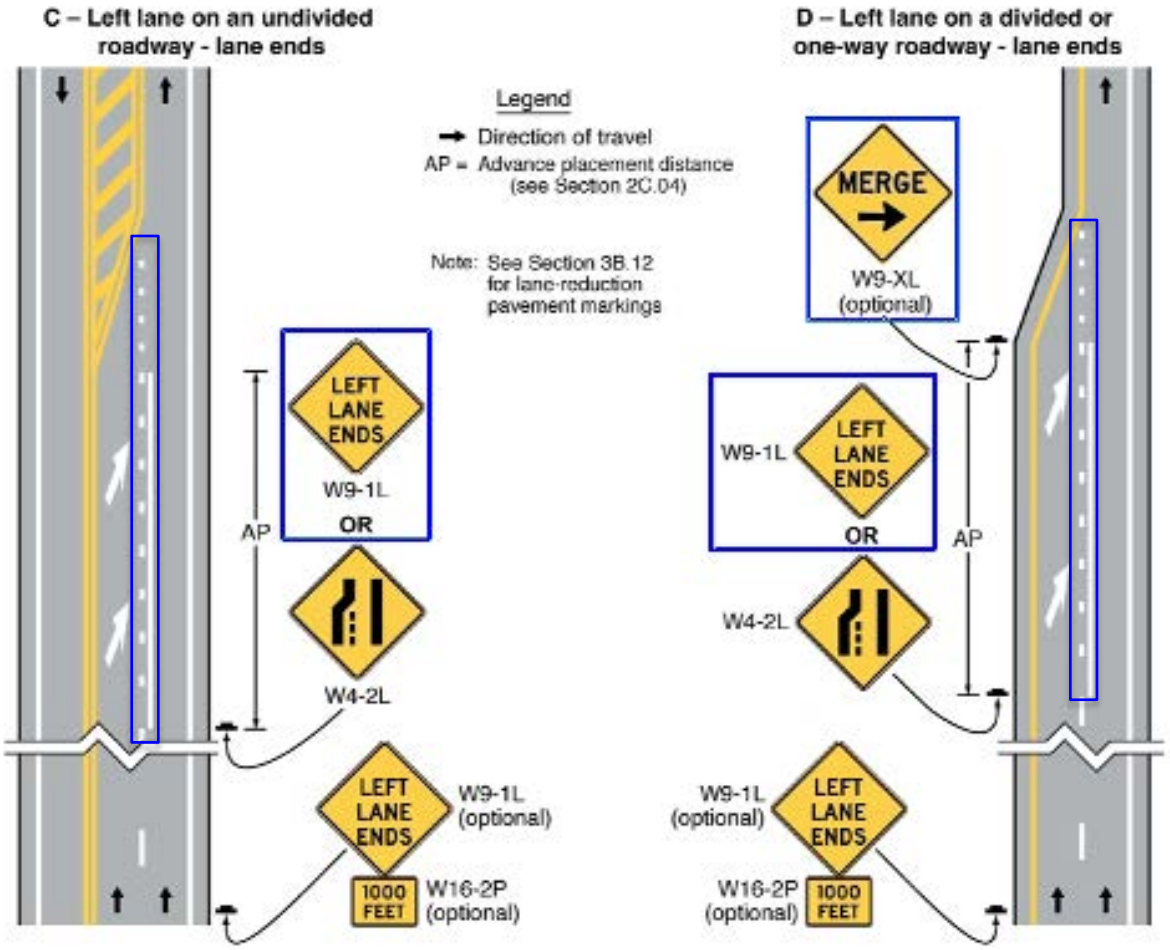
Figure 2C-13. Example Sequences for Lane Ends and Lane Merge Signs (Sheet 2 of 5)



PROPOSED CHANGES TO FIGURE

1. Added W9-1R sign at conforming advance placement location
2. Added optional W9-XR MERGE with arrow sign at beginning of taper
3. Interim depiction of pavement marking patterns and lane reduction arrows reflect existing content in the MUTCD that is harmonized with research results with the addition of the solid line consistent with the research report. These depictions are subject to change pending Council approval of the MTC proposal addressing this research.

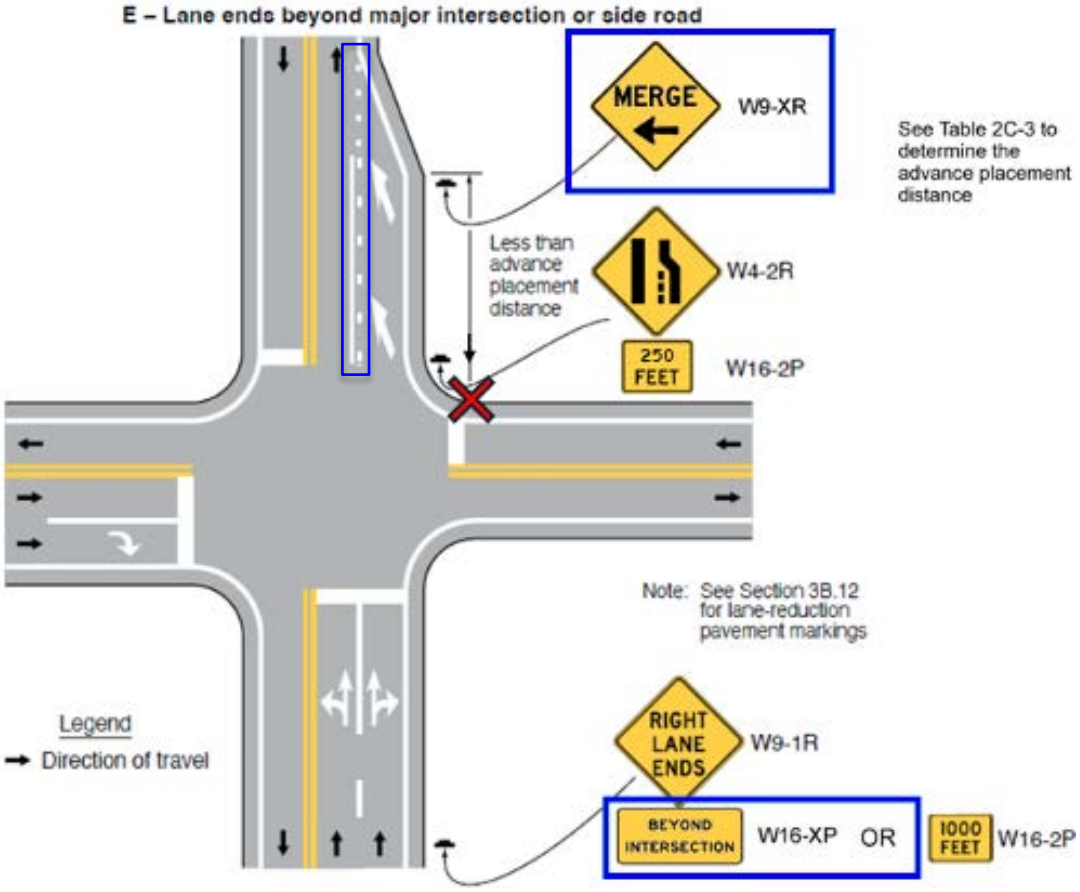
Figure 2C-13. Example Sequences for Lane Ends and Lane Merge Signs (Sheet 3 of 5)



PROPOSED CHANGES TO FIGURE

1. Added W9-1L signs at conforming advance placement locations.
2. Added optional W9-XL MERGE with arrow sign at beginning of taper in Depiction D only.
3. Interim depiction of pavement marking patterns and lane reduction arrows reflect existing content in the MUTCD that is harmonized with research results with the addition of the solid line consistent with the research report. These depictions are subject to change pending Council approval of the MTC proposal addressing this research.

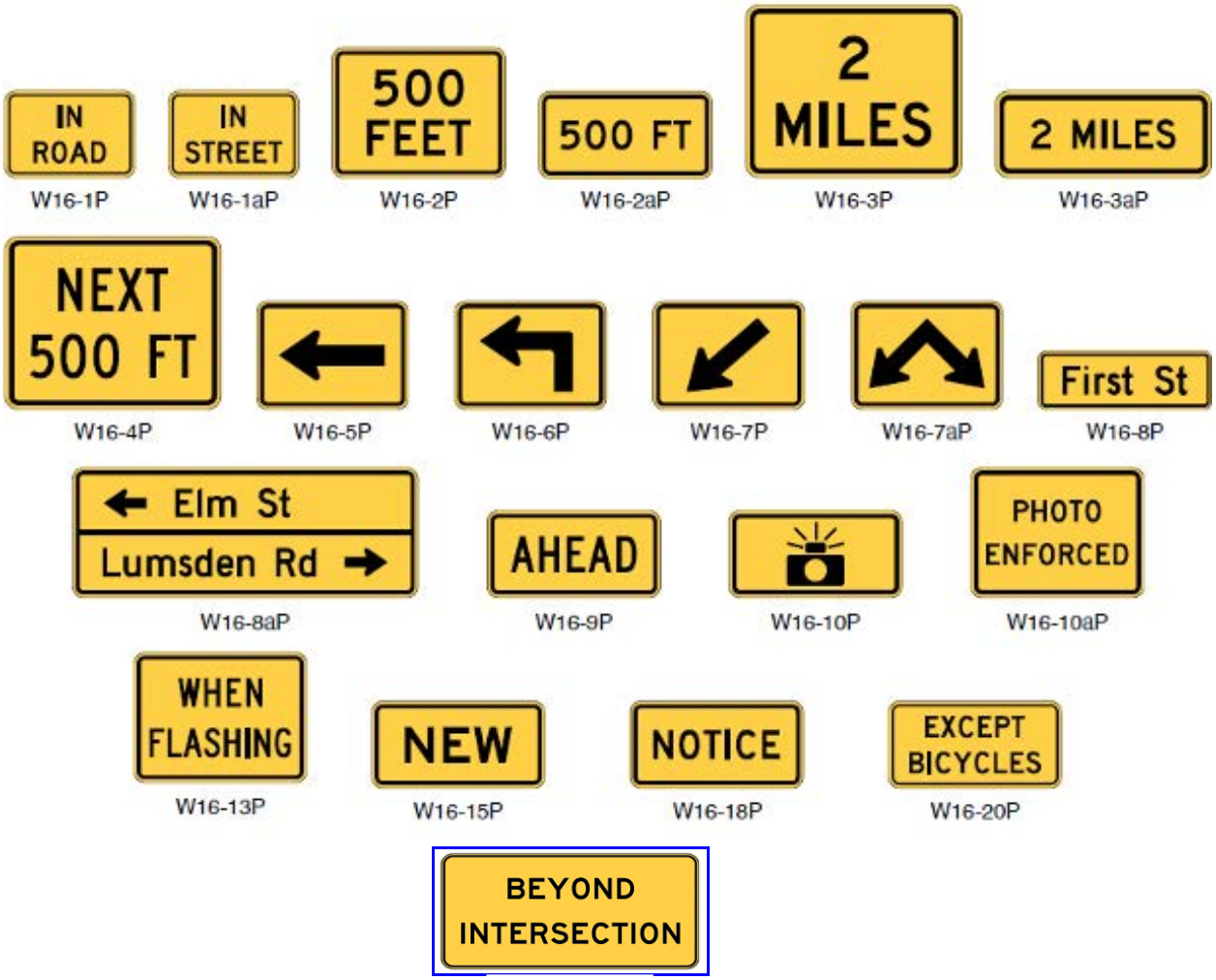
Figure 2C-13. Example Sequences for Lane Ends and Lane Merge Signs (Sheet 4 of 5)



PROPOSED CHANGES TO FIGURE

1. Added recommended W16-XP “BEYOND INTERSECTION” plaque beneath W9-1R sign with alternative of W16-2P distance plaque.
2. Added recommended W16-2P distance plaque beneath W4-2R sign.
3. Added optional W9-XR MERGE with arrow sign at beginning of taper.
4. Corrected dimensioning line between W4-2R sign and beginning of taper to place the upstream arrow adjacent to the location of the warning sign and not the projection of the traveled way
5. Altered the distance shown in the plaque so that it is less than a typical advance placement distance for low-speed roadways, to match the circumstances where this sign would be used
6. Interim depiction of pavement marking patterns and lane reduction arrows reflect existing content in the MUTCD that is harmonized with research results with the addition of the solid line consistent with the research report. These depictions are subject to change pending Council approval of the MTC proposal addressing this research.

Figure 2C-16. Supplemental Warning Plaques



Note: The background color (yellow or fluorescent yellow-green) shall match the color of the warning sign that it supplements.

PROPOSED CHANGES TO FIGURE

1. Added W16-XP “BEYOND INTERSECTION” plaque.