

Virginia Work Area Protection Manual

Standards and Guidelines for Temporary Traffic Control

2011 Edition



VIRGINIA WORK AREA PROTECTION MANUAL

STANDARDS AND GUIDELINES

FOR TEMPORARY TRAFFIC CONTROL

VIRGINIA DEPARTMENT OF TRANSPORTATION
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VIRGINIA WORK AREA PROTECTION MANUAL

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VIRGINIA WORK AREA PROTECTION MANUAL

INTRODUCTION

Standard:

- 01 **Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, bikeway, or private road open to public travel (see definition in Section 1A.13 of the Virginia Supplement to the 2009 MUTCD) by authority of a public agency or official having jurisdiction, or, in the case of a private road, by authority of the private owner or private official having jurisdiction.**
- 02 **Part 6 of the “2009 Manual On Uniform Traffic Control Devices (MUTCD)” is reproduced and modified here as a separate publication to meet the special demand for uniform standards for temporary traffic control during construction and maintenance operations on streets and highways in the Commonwealth of Virginia.**
- 03 **The “2009 Manual on Uniform Traffic Control Devices (MUTCD)” is incorporated by reference in 23 Code of Federal Regulations (CFR), Part 655, Subpart F and shall be recognized as the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel (see definition in Section 1A.13 of the Virginia Supplement to the 2009 MUTCD) in accordance with 23 U.S.C. 109(d) and 402(a). The policies and procedures of the Federal Highway Administration (FHWA) to obtain basic uniformity of traffic control devices shall be as described in 23 CFR 655, Subpart F.**
- 04 **In accordance with 23 CFR 655.603(a), for the purposes of applicability of the 2009 MUTCD:**
- A. Toll roads under the jurisdiction of public agencies or authorities or public-private partnerships shall be considered to be public highways;**
 - B. Private roads open to public travel shall be as defined in Section 1A.13 of the 2009 MUTCD; and**
 - C. Parking areas, including the driving aisles within those parking areas, that are either publicly or privately owned shall not be considered to be “open to public travel” for purposes of 2009 MUTCD applicability.**
- 05 **Any traffic control device design or application provision contained in this Manual shall be considered to be in the public domain. Traffic control devices contained in this Manual shall not be protected by a patent, trademark, or copyright, except for the Interstate Shield and any items owned by FHWA.**

Support:

- 06 The need for uniform standards was recognized long ago. The American Association of State Highway Officials (AASHO), now known as the American Association of State Highway and Transportation Officials (AASHTO), published a manual for rural highways in 1927, and the National Conference on Street and Highway Safety (NCSHS) published a manual for urban streets in 1930. In the early years, the necessity for unification of the standards applicable to the different classes of road and street systems was obvious. To meet this need, a joint committee of AASHO and NCSHS developed and published the original edition of this “Manual on Uniform Traffic Control Devices” (MUTCD) in 1935. That committee, now called the National Committee on Uniform Traffic Control Devices (NCUTCD), though changed from time to time in name, organization, and personnel, has been in continuous existence and has contributed to periodic revisions of this Manual. The FHWA has administered the MUTCD since the 1971 edition. The FHWA and its predecessor organizations have participated in the development and publishing of the previous editions. There were nine previous editions of the MUTCD, and several of those editions were revised one or more times. Table I-1 of the 2009 MUTCD traces the evolution of the MUTCD, including the two manuals developed by AASHO and NCSHS.

Standard:

- 07 **The U.S. Secretary of Transportation, under authority granted by the Highway Safety Act of 1966, decreed that traffic control devices on all streets and highways open to public travel in accordance with 23 U.S.C. 109(d) and 402(a) in each State shall be in substantial conformance with the Standards issued or endorsed by the FHWA.**

Support:

- 08 The “Uniform Vehicle Code (UVC)” is one of the publications referenced in the 2009 MUTCD. The UVC contains a model set of motor vehicle codes and traffic laws for use throughout the United States.

Guidance:

- 09 *The States should adopt Section 15-116 of the UVC, which states that, “No person shall install or maintain in any area of private property used by the public any sign, signal, marking, or other device intended to regulate, warn, or guide traffic unless it conforms with the State manual and specifications adopted under Section 15-104.”*

Support:

- 10 The need for standard controls is especially acute during roadway temporary traffic control operations. Abnormal conditions are the rule, and therefore, traffic is particularly dependent on design, placement, and uniformity of traffic control devices to direct and guide it safely and efficiently through what would otherwise be hazardous areas. The constantly shifting and changing nature of work zone activity on or adjacent to the roadway may require frequent readjustments of traffic control devices in order to handle new situations. Thus, the proper and adequate placement of standard highway signs, signals, pavement markings, channelizing devices, and traffic control devices on roadways in work zones is a continuous responsibility of officials having authority and jurisdiction over the particular roadway. This responsibility includes periodic daytime and nighttime inspection of existing devices and conditions throughout the duration of the temporary traffic control operation.
- 11 This Manual is issued to promote a uniform standard of traffic control associated with SPECIAL EVENTS, INCIDENT MANAGEMENT, and WORK AREA PROTECTION along the highways of Virginia. The standards, policies, and objectives contained in this Manual are intended to furnish information and guidance to personnel authorized to do work on the highway right-of-way, and are not intended to establish a legal requirement for installation. Good engineering judgment must be used to arrive at the best traffic controls for a particular worksite, depending on the nature of the activity, location and duration of work, type of roadway, traffic volume and speed, and potential hazard. Thus, while this Manual provides guidelines for design and application of traffic control devices, the Manual is not a substitute for engineering judgment.

Guidance:

- 12 *It should be recognized that it is not feasible to cover every conceivable situation. The objective of this Manual is to illustrate many of the typical worksites and to describe many common conditions encountered. When circumstances occur which are not specifically covered in this Manual, or which require modification of the instructions contained herein, the judgment of the various levels of operating supervisors must be relied upon to meet the basic objectives. When warranted, the appropriate Regional Traffic Engineer should be consulted to select or tailor the proper traffic control devices.*

Support:

- 13 Nothing contained herein is intended to abridge or disclaim the “2009 Manual on Uniform Traffic Control Devices,” but rather to augment and to supplement for the safety of the traveling public.
- 14 The Standard, Guidance, Option, and Support material described in this edition of Part 6 to the 2009 MUTCD provide the transportation professional with the information needed to make appropriate decisions regarding the use of traffic control devices on streets, highways, bikeways, and private roads open to public travel (see definition in Section 1A.13 of the Virginia Supplement to the 2009 MUTCD).
- 15 Throughout this Manual the headings Standard, Guidance, Option, and Support are used to classify the nature of the text that follows. Figures and tables, including the notes contained therein, supplement the text and might constitute a Standard, Guidance, Option, or Support. The user needs to refer to the appropriate text to classify the nature of the figure, table, or note contained therein.

Standard:

- 16 **When used in the 2009 MUTCD, the Virginia Supplement to the 2009 MUTCD, and this Manual, the text headings of Standard, Guidance, Option, and Support shall be as defined below:**
1. **Standard** — a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. All standards statements are labeled, and the text appears in bold type. The verb “shall” is typically used. The verbs “should” and “may” are not used in Standard statements. Standard statements are sometimes modified by Options. Section 1A.09 of the Virginia Supplement to the 2009 MUTCD contains additional guidance related to the application of Standard statements.
 2. **Guidance** — a statement of highly recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. These deviations shall be properly documented when not following guidance

stipulations. All Guidance statements are labeled, and the text appears in italicized type. The verb “should” is typically used. The verbs “shall” and “may” are not used in Guidance statements. Guidance statements are sometimes modified by Options.

- 3. Option — a statement of practice that is a permissive condition and carries no requirement or recommendation. Option statements sometime contain allowable modifications to a Standard or Guidance statement. All Option statements are labeled, and the text appears in underlined type. The verb “may” is typically used. The verbs “shall” and “should” are not used in Option statements.**
- 4. Support — an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. Support statements are labeled, and the text appears in normal un-bolded type. The verbs “shall”, “should”, and “may” are not used in Support statements.**

Support:

- 17 The decision to use a particular device at a particular location is typically made on the basis of an engineering study of the location. Thus, while the 2011 WAPM provides standards for design and application of traffic control devices, this Manual is not a substitute for engineering judgment. It is the intent that the provisions of the 2011 WAPM be standards for traffic control devices installation, but not a legal requirement for installation.

Standard:

- 18 **Whether specified as part of a project’s plan or contract assembly, or performance of a maintenance operation, or performance of utility work within the right of way, the provisions of the 2011 WAPM shall be used for the establishment of temporary traffic control as well as any modification to an approved Traffic Control Plan.**

Support:

- 19 Definitions of an engineering study and engineering judgment are contained in Section 6A.03.
- 20 Throughout this Manual all dimensions and distances are provided in English units. Appendix A2 of the 2009 MUTCD contains tables for converting each of the English unit numerical values that are used in this Manual to the equivalent Metric (International System of Units) values.

Guidance:

- 21 *If Metric units are to be used in laying out distances or determining sizes of devices, such units should be specified on plan drawings and made known to those responsible for designing, installing, or maintaining traffic control devices.*
- 22 *Except when a specific numeral is required or recommended by the text of a Section of this Manual, numerals displayed on the images of devices in the figures that specify quantities such as times, distances, speed limits, and weights should be regarded as examples only. When installing any of these devices, the numerals should be appropriately altered to fit the specific situation.*

Support:

- 23 The following information will be useful when reference is being made to a specific portion of text in this Manual.
- 24 There are nine Parts in the 2009 MUTCD and each Part is comprised of one or more Chapters. This Manual contains Virginia’s version of Part 6 of the 2009 MUTCD and is referred to as the “Virginia Work Area Protection Manual, 2011 Edition.” Each Chapter is comprised of one or more Sections. Parts are given a numerical identification, such as Part 6 – Temporary Traffic Control. Chapters are identified by the Part number and a letter, such as Chapter 6C – Temporary Traffic Control Elements. Sections are identified by the Chapter number and letter followed by a decimal point and a number, such as Section 6C.03 – Components of Temporary Traffic Control Zones.
- 25 Each Section is comprised of one or more paragraphs. The paragraphs are indented and are identified by a number. Paragraphs are counted from the beginning of each Section without regard to the intervening text headings (Standard, Guidance, Option, or Support). Some paragraphs have lettered or numbered items. As an example of how to cite this Manual, the phrase “When used, a downstream taper on a multi-lane roadway should have a length of approximately 50 feet minimum to 100 feet maximum with devices placed at a spacing of approximately 20 feet.” that appears in Section 6C.09 of this Manual would be referenced in writing as “Section 6C.09, P14” and would be verbally referenced as “Paragraph 14 of Section 6C.09.”

Standard:

- 26 **In accordance with 23 CFR 655.603(b)(3), States or other Federal agencies that have their own MUTCDs or Supplements shall revise these MUTCDs or Supplements to be in substantial conformance with changes to the National MUTCD within 2 years of the effective date of the Final Rule for the changes. Substantial conformance of such State or other Federal agency MUTCDs or Supplements shall be as defined in 23 CFR 655.603(b)(1).**
- 27 **After the effective date of a new edition of the MUTCD or a revision thereto, or after the adoption thereof by the State, whichever occurs later, new or reconstructed devices installed shall be in compliance with the new edition or revision.**
- 28 **In cases involving Federal-aid projects for new highway or bikeway construction or reconstruction, the traffic control devices installed (temporary or permanent) shall be in conformance with the most recent edition of the National MUTCD before that highway is opened or re-opened to the public for unrestricted travel [23 CFR 655.603(d)(2) and (d)(3)].**
- 29 **Unless a particular device is no longer serviceable, non-compliant devices on existing highways and bikeways shall be brought into compliance with the current edition of the National MUTCD as part of the systematic upgrading of substandard traffic control devices (and installation of new required traffic control devices) required pursuant to the Highway Safety Program, 23 U.S.C. §402(a). The FHWA has the authority to establish other target compliance dates for implementation of particular changes to the 2009 MUTCD [23 CFR 655.603(d)(1)]. These target compliance dates established by the FHWA shall be as shown in Table I-2.**
- 30 **Except as provided in Paragraph 30, when a non-compliant traffic control device is being replaced or refurbished because it is damaged, missing, or no longer serviceable for any reason, it shall be replaced with a compliant device.**

Option:

- 31 A damaged, missing, or otherwise non-serviceable device that is non-compliant may be replaced in kind if engineering judgment indicates that:
- A. One compliant device in the midst of a series of adjacent non-compliant devices would be confusing to road users; and/or
 - B. The schedule for replacement of the whole series of non-compliant devices will result in achieving timely compliance with Table I-2 of the 2009 MUTCD.

CHAPTER 6A. GENERAL

Section 6A.01 General

Support:

- 01 Whenever the acronym “TTC” is used in this Manual and Part 6 of the 2009 MUTCD, it refers to “temporary traffic control.”

Standard:

- 02 **The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel (see definition in Section 1A.13 of the Virginia Supplement to the 2009 MUTCD), including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.**

Support:

- 03 When the normal function of the roadway, or a private road open to public travel, is suspended, TTC planning provides for continuity of the movement of motor vehicle, bicycle, and pedestrian traffic (including accessible passage); transit operations; and access (and accessibility) to property and utilities.
- 04 The primary function of TTC is to provide for the reasonably safe and effective movement of road users through or around TTC zones while reasonably protecting road users, workers, responders to traffic incidents, and equipment.
- 05 Of equal importance to the public traveling through the TTC zone is the safety of workers performing the many varied tasks within the work space. TTC zones present constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the workers and incident management responders on or near the roadway (see Section 6D.03). At the same time, the TTC zone provides for the efficient completion of whatever activity interrupted the normal use of the roadway.
- 06 Consideration for road user safety, worker and responder safety, and the efficiency of road user flow is an integral element of every TTC zone, from planning through completion. A concurrent objective of the TTC is the efficient construction and maintenance of the highway and the efficient resolution of traffic incidents.
- 07 No one set of TTC devices can satisfy all conditions for a given project or incident. At the same time, defining details that would be adequate to cover all applications is not practical. Instead, this Manual and Part 6 of the 2009 MUTCD displays typical applications that depict common applications of TTC devices. The TTC selected for each situation depends on type of highway, road user conditions, duration of operation, physical constraints, and the nearness of the work space or incident management activity to road users.
- 08 Improved road user performance might be realized through a well-prepared public relations effort that covers the nature of the work, the time and duration of its execution, the anticipated effects upon road users, and possible alternate routes and modes of travel. Such programs have been found to result in a significant reduction in the number of road users traveling through the TTC zone, which reduces the possible number of conflicts.
- 09 Operational improvements might be realized by using intelligent transportation systems (ITS) in work zones. The use in work zones of ITS technology, such as portable camera systems, highway advisory radio, variable speed limits, ramp metering, traveler information, merge guidance, and queue detection information, is aimed at increasing safety for both workers and road users and helping to ensure a more efficient traffic flow. The use in work zones of ITS technologies has been found to be effective in providing traffic monitoring and management, data collection, and traveler information.

Standard:

- 10 **TTC plans and devices shall be the responsibility of the authority of a public body or official having jurisdiction for guiding road users. There shall be adequate statutory authority for the implementation and enforcement of needed road user regulations, parking controls, speed zoning, and the management of traffic incidents. Such statutes shall provide sufficient flexibility in the application of TTC to meet the needs of changing conditions in the TTC zone.**

Support:

- 11 Temporary facilities, including pedestrian routes around worksites, are also covered by the accessibility requirements of the Americans with Disabilities Act of 1990 (ADA) (Public Law 101-336, 104 Stat. 327, July 26, 1990. 42 U.S.C. 12101-12213 (as amended)).

Guidance:

- 12 *The TTC plan should start in the planning phase and continue through the design, construction, and restoration phases. The TTC plans and devices should follow the principles set forth in this Manual and Part 6 of the 2009 MUTCD. The management of traffic incidents should follow the principles set forth in Chapter 6I.*

Option:

- 13 TTC plans may deviate from the typical applications described in Chapter 6H to allow for conditions and requirements of a particular site or jurisdiction.

Support:

- 14 The provisions of this Manual and Part 6 of the 2009 MUTCD apply to both rural and urban areas. A rural highway is normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians. An urban street is typically characterized by relatively low speeds, wide ranges of road user volumes, narrower roadway lanes, frequent intersections and driveways, significant pedestrian activity, and more businesses and houses.
- 15 The determination as to whether a particular facility at a particular time of day can be considered to be a high-volume roadway or can be considered to be a low-volume roadway is made by the public agency or official having jurisdiction.

Section 6A.02 Engineering Study and Engineering Judgment*Support:*

- 01 Definitions of an engineering study and engineering judgment are contained in Section 6A.03.

Standard:

- 02 **The 2009 MUTCD, Virginia Supplement to the 2009 MUTCD, and this Manual describe the application of traffic control devices, but shall not be a legal requirement for their installation.**

Guidance:

- 03 *The decision to use or not use a particular traffic control device at a particular location should be made on the basis of an engineering study and the application of engineering judgment. Thus, while the 2009 MUTCD, the Virginia Supplement to the 2009 MUTCD, and this Manual provide Standards, Guidance, and Options for design and application of traffic control devices, the 2009 MUTCD, the Virginia Supplement to the 2009 MUTCD, and this Manual should not be considered a substitute for engineering study and the application of engineering judgment. Engineering judgment should be exercised in the selection and application of traffic control devices, as well as in the location and design of the roads and streets that the devices complement. Jurisdictions with responsibility for traffic control that do not have professional engineers on their staffs should seek professional engineering assistance from others, such as a professional traffic engineering consultant.*
- 04 *An engineering study should be the basis for a decision to deviate from a Standard (see definition in Section 6A.03 of this Manual).*

Standard:

- 05 **Whether specified as part of a project's plan or contract assembly, or performance of a maintenance operation, or performance of utility work within the right of way, the provisions of the 2011 WAPM shall be used for the establishment of temporary traffic control as well as the modification to an approved Traffic Control Plan.**

Section 6A.03 Definitions of Words and Phrases in This Manual**Standard:**

- 01 **The following select words and phrases have been incorporated from Section 1A.13 of the Virginia Supplement to the 2009 MUTCD along with some additions for convenience in using this Manual. Additional words and phrases and references exist in Section 1A.13 and shall be applicable when such definitions are not within this Manual. When used in this Manual, the following words and phrases shall have the following meanings:**
1. **Advisory Speed**—a recommended speed for all vehicles operating on a section of highway and based on the highway design, operating characteristics, and conditions.

2. **Average Daily Traffic (ADT)**—the average 24 hour volume, being the total volume during a stated period divided by the number of days in that period. Normally, this would be periodic daily traffic volumes over several days, not adjusted for days of the week or seasons of the year.
3. **Centerline Markings**—the yellow pavement marking line(s) that delineates the separation of traffic lanes that have opposite directions of travel on a roadway. These markings need not be at the geometrical center of the pavement.
4. **Changeable Message Signs (CMS)**—signs that are capable of displaying more than one message, changeable manually, by remote control, or by automatic control. A CMS may be mounted on a trailer or vehicle. These signs are referred to as Dynamic Message Signs in the National Intelligent Transportation Systems (ITS) Architecture.
5. **Channelizing Line Marking**—a wide or double solid white line used to form islands where traffic in the same direction of travel is permitted on both sides of the island.
6. **Clear Zone**—the total roadside border area, starting at the edge of the traveled way, that is available for an errant driver to stop or regain control of a vehicle. This area might consist of a shoulder, a recoverable slope, and/or a nonrecoverable, traversable slope with a clear run-out area at its toe.
7. **Conflict Monitor**—a device used to detect and respond to improper or conflicting signal indications and improper operating voltages in a traffic controller assembly.
8. **Crashworthy**—a characteristic of a roadside appurtenance that has been successfully crash tested in accordance with a national standard such as the National Cooperative Highway Research Program Report 350, “Recommended Procedures for the Safety Performance Evaluation of Highway Features” or the 2009 AASHTO “Manual for Assessing Safety Hardware (MASH)” report.
9. **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.
10. **Delineator**—a retroreflective device mounted on the roadway surface or at the side of the roadway in a series to indicate the alignment of the roadway, especially at night or in adverse weather.
11. **Detectable**—having a continuous edge within 6 inch of the surface so that pedestrians who have visual disabilities can sense its presence and receive usable guidance information.
12. **Detour**—the removal of traffic from one roadway or highway to an alternate roadway or highway under the following timeframes:
 - (a) **Short Term Detour**—a signed detour that occupies a location for more than 2 hours within a single work period but not longer than three consecutive days.
 - (b) **Long Term Detour**—a signed detour that occupies a location longer than three consecutive days, or on a periodic basis (less than 24 consecutive hours) longer than three days.
13. **Downstream**—a term that refers to a location that is encountered by traffic subsequent to an upstream location as it flows in an “upstream to downstream” direction. For example, “the downstream end of a lane line separating the turn lane from a through lane on the approach to an intersection” is the end of the lane line that is closest to the intersection.
14. **Edge Line Markings**—white or yellow pavement marking lines that delineate the right or left edge(s) of a traveled way.
15. **Engineering Judgment**—the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, 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. Changes to temporary traffic control as shown in this Manual based on engineering judgment shall be documented.

16. **Engineering Study**—the comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, 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.
17. **Expressway**—a divided highway with partial control of access.
18. **Flashing (Flashing Mode)**—a mode of operation in which a traffic signal indication is turned on and off repetitively.
19. **Flagger**—a certified person who actively controls the flow of vehicular traffic into and/or through a temporary traffic control zone using hand-signaling devices or an Automated Flagger Assistance Device (AFAD).
20. **Guide Sign**—a sign that shows route designations, destinations, directions, distances, services, points of interest, or other geographical, recreational, or cultural information.
21. **Highway**—a general term for denoting a public way for purposes of travel by vehicular travel, including the entire area within the right-of-way.
22. **Interchange**—a system of interconnecting roadways providing for traffic movement between two or more highways that do not intersect at grade.
23. **Lane Line Markings**—white pavement marking lines that delineate the separation of traffic lanes that have the same direction of travel on a roadway.
24. **Limited Access Highway**—a highway especially designed for through traffic, over which abutters have no easement or right of way, air, or access to by reason of the fact that their property abuts upon such highway. This includes freeways, expressways and other partially-controlled access facilities.
25. **Longitudinal Markings**—pavement markings that are generally placed parallel and adjacent to the flow of traffic such as lane lines, centerlines, edge lines, channelizing lines, and others.
26. **Manual for Assessing Safety Hardware (MASH)**—a national standard for crash testing of safety roadside appurtenances required after January 1, 2011.
27. **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.
28. **Object Marker**—a device used to mark obstructions within or adjacent to the roadway.
29. **Parking Lane**—a space reserved for parking of vehicles.
30. **Pedestrian**—a person afoot, in a wheelchair, on skates, or on a skateboard.
31. **Plaque**—a traffic control device intended to communicate specific information to road users through a word, symbol, or arrow legend that is placed immediately adjacent to a sign to supplement the message on the sign. The difference between a plaque and a sign is that a plaque cannot be used alone. The designation for a plaque includes a "P" suffix.
32. **Portable Changeable Message Signs (PCMS)**—a portable trailer-mounted sign that is capable of displaying more than one message, changeable manually, by remote control, or by automatic control.
33. **Portable Traffic Signal**—a temporary traffic control signal that is designed so that it can be easily transported and reused at different locations.
34. **Post-Mounted Sign**—a sign that is placed to the side of the roadway such that no portion of the sign or its support is directly above the roadway or shoulder.
35. **Posted Speed Limit**—a speed limit determined by law or regulation and displayed on Speed Limit signs.
36. **Preemption**—the transfer of normal operation of a traffic control signal to a special control mode of operation.
37. **Private Road Open to Public Travel**—private toll roads and roads (including any adjacent sidewalks that generally run parallel to the road) within shopping centers, airports, sports arenas, and other

similar business and/or recreation facilities that are privately owned, but where the public is allowed to travel without access restrictions. Roads within private gated properties (except for gated toll roads) where access is restricted at all times, parking areas, driving aisles within parking areas, and private grade crossings shall not be included in this definition.

38. **Public Road**—any road, street, toll road, or similar facility under the jurisdiction of and maintained by a public agency and open to public travel.
39. **Raised Pavement Marker**—a device mounted on or in a road surface that has a height generally not exceeding approximately 1 inch above the road surface for a permanent marker, or not exceeding approximately 2 inches above the road surface for a temporary flexible marker, and that is intended to be used as a positioning guide and/or to supplement or substitute for pavement markings.
40. **Regional Traffic Engineer**—a person of responsible charge per the Code of Virginia, or their designee working under their supervision, who is responsible for design and maintenance of temporary traffic control within their jurisdiction.
41. **Regulatory Signs**—a sign that gives notice to road users of traffic laws or regulations.
42. **Retroreflectivity**—a property of a surface that allows a large portion of the light coming from a point source to be returned directly back to a point near its origin.
43. **Right-of-Way [Assignment]**—the permitting of vehicles and/or pedestrians to proceed in a lawful manner in preference to other vehicles or pedestrians by the display of sign or signal indications.
44. **Road User**—a vehicle operator (including cars, trucks, and motorcycles), bicyclist, or pedestrian (including persons with disabilities), within the highway or on a private road open to public travel, including workers in temporary traffic control zones.
45. **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. In the event a highway includes two or more separate roadways, the term roadway as used in this Manual shall refer to any such roadway separately, but not to all such roadways collectively.
46. **Roadway Network**—a geographical arrangement of intersecting roadways.
47. **Roundabout**—a circular intersection with yield control at entry, which permits a vehicle on the circulatory roadway to proceed, and with deflection of the approaching vehicle counter-clockwise around a central island.
48. **Rumble Strip**—a series of intermittent, narrow, transverse areas of rough-textured, slightly raised, or depressed road surface that is installed to alert road users to unusual traffic conditions.
49. **Rural Highway**—a type of roadway normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians.
50. **Safe-Positioned**—the positioning of emergency vehicles at an incident in a manner that attempts to protect both the responders performing their duties and road users traveling through the incident scene, while minimizing, to the extent practical, disruption of the adjacent traffic flow.
51. **Shared Roadway**—a roadway that is officially designated and marked as a bicycle route, but which is open to motor vehicle travel and upon which no bicycle lane is designated.
52. **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 might also be used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers), and other authorized motorized and non-motorized users.
53. **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.
54. **Sign**—any traffic control device that is intended to communicate specific information to road users through a word or symbol legend. Signs do not include traffic control signals, pavement markings, delineators, or channelization devices.

- 55. **Sign Assembly**—a group of signs, located on the same support(s), that supplement one another in conveying information to road users.
- 56. **Sign Illumination**—either internal or external lighting that shows similar color by day or night. Street, highway, or strobe lighting shall not be considered as meeting this definition.
- 57. **Sign Legend**—all word messages, logos, and symbol designs that are intended to convey specific meanings.
- 58. **Sign Panel**—a separate panel or piece of material containing a word or symbol legend that is affixed to the face of a sign.
- 59. **Speed**—speed is defined based on the following classifications:
 - (a) **Advisory Speed**—a recommended speed for all vehicles operating on a section of highway and based on the highway design, operating characteristics, and conditions.
 - (b) **Average Speed**—the summation of the instantaneous or spot-measured speeds at a specific location of vehicles divided by the number of vehicles observed.
 - (c) **Design Speed**—a selected speed used to determine the various geometric design features of a roadway.
 - (d) **85th-Percentile Speed**—The speed at or below which 85 percent of the motorized vehicles travel.
 - (e) **Operating Speed**—a speed at which a typical vehicle or the overall traffic operates. Operating speed may be defined with speed values such as the average, pace, or 85th-percentile speeds.
 - (f) **Statutory Speed**—a speed limit established by legislative action that typically is applicable for highways with specified design, functional, jurisdictional and/or location characteristic and is not necessarily shown on Speed Limit signs.
- 60. **Speed Limit**—the maximum (or minimum) speed applicable to a section of highway as established by law.
- 61. **Speed Zone**—a section of highway with a speed limit that is established by law but which may be different from a legislatively specified statutory speed limit.
- 62. **Stop Line**—a solid white pavement marking line extending across approach lanes to indicate the point at which a stop is intended or required to be made.
- 63. **Temporary Traffic Control Spotter**—a certified flagger who watches and advises co-workers who are installing and removing temporary traffic control devices, traffic counting devices or removing debris from the roadway. A TTC Spotter may stop or slow traffic using a red flag and the correct flagger procedures.
- 64. **Temporary Traffic Control Zone**—an area of a highway where road user conditions are changed because of a work zone or incident by the use of temporary traffic control devices, flaggers, police, or other authorized personnel.
- 65. **Traffic**—pedestrians, bicyclists, ridden or herded animals, vehicles, streetcars, and other conveyances either singularly or together while using any highway for purposes of travel.
- 66. **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.
- 67. **Traffic Control Signal (Traffic Signal)**—any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed.
- 68. **Traffic Spotter**—A certified flagger who alerts and assists motorist through a temporary traffic control zone on low volume (under 500 VDP), low speed (30 MPH or lower) roadways using a red flag, the correct flagging procedures and the minimal sign requirement of a Road Work Ahead sign.
- 69. **Traveled Way**—the portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.
- 70. **Truck-Mounted Attenuator**—Energy-absorbing device attached to the rear of trucks to reduce the severity of rear-end crashes.

71. **Upstream**—a term that refers to a location that is encountered by traffic prior to a downstream location as it flows in an “upstream to downstream” direction. For example, “the upstream end of a lane line separating the turn lane from a through lane on the approach to an intersection” is the end of the line that is furthest from the intersection.
72. **Urban Street**—a type of street normally characterized by relatively low speeds, wide ranges of traffic volumes, narrower lanes, frequent intersections and driveways, significant pedestrian traffic, and more businesses and houses.
73. **Warning Light**—a portable, powered, yellow, lens-directed, enclosed light that is used in a temporary traffic control zone in either a steady burn or a flashing mode.
74. **Warning Sign**—a sign that gives notice to road users of a situation that might not be readily apparent.
75. **Warrant**—a warrant describes threshold conditions to the engineer in evaluating the potential safety and operational benefits of traffic control devices and is based upon average or normal conditions. Warrants are not a substitute for engineering judgment. The fact that a warrant for a particular traffic control device is met is not conclusive justification for the installation of the device.
76. **Worker**—a person on foot whose duties place him or her within the right-of-way of a street, highway, or pathway, such as street, highway, or pathway construction and maintenance forces, survey crews, utility crews, responders to incidents within the street, highway, or pathway right-of-way, and law enforcement personnel when directing traffic, investigating crashes, and handling lane closures, obstructed roadways, and disasters within the right-of-way of a street, highway, or pathway.
77. **Work Zone**—a work zone is an area on or above a highway, roadway, pedestrian facility or shared-use path with construction, maintenance, permit or utility work activities.
78. **Wrong-Way Arrows**—slender, elongated, white pavement marking arrows placed upstream from the ramp terminus to indicate the correct direction of traffic flow. Wrong-way arrows are intended primarily to warn wrong-way road users that they are going in the wrong direction.

Section 6A.04 Meanings of Acronyms and Abbreviations in this Manual

Standard:

- 01 The following acronyms and abbreviations, when used in this Manual, shall have the following meanings:

1. **AADT**—annual average daily traffic
2. **AASHTO**—American Association of State Highway and Transportation Officials
3. **ATSSA**—American Traffic Safety Services Association
4. **ADA**—Americans with Disabilities Act
5. **ADT**—average daily traffic
6. **AFAD**—Automated Flagging Assistance Device
7. **ANSI**—American National Standards Institute
8. **CFR**—Code of Federal Regulations
9. **CMS**—changeable message sign
10. **EPA**—Environmental Protection Agency
11. **FHWA**—Federal Highway Administration
12. **HOT**—high occupancy tolls
13. **HOV**—high-occupancy vehicle
14. **IIM-LD**—Location and Design Division Instructional and Informational Memorandum
15. **ICS**—Incident Command System
16. **ITE**—Institute of Transportation Engineers
17. **ITS**—intelligent transportation systems
18. **LED**—light emitting diode
19. **MASH**—Manual for Assessing Safety Hardware
20. **MPH or mph**—miles per hour
21. **MUTCD**—Manual on Uniform Traffic Control Devices
22. **NCHRP**—National Cooperative Highway Research Program
23. **NIMS**—National Incident Management System

- 24. **PCMS**—portable changeable message sign
- 25. **PRT**—perception-response time
- 26. **RPM**—raised pavement marker
- 27. **SHSM**—Standard Highway Signs and Markings book
- 28. **TCP**—traffic control plan
- 29. **TED**—Traffic Engineering Division Memorandum
- 30. **TIMC**—traffic incident management control
- 31. **TMP**—Transportation Management Plan
- 32. **TOC**—Transportation Operations Center
- 33. **TRB**—Transportation Research Board
- 34. **TRPM**—temporary raised pavement marker
- 35. **TTC**—temporary traffic control
- 36. **U.S.**—United States
- 37. **U.S.C.**—United States Code
- 38. **USDOT**—United States Department of Transportation
- 39. **UVC**—Uniform Vehicle Code
- 40. **VDOT**—Virginia Department of Transportation
- 41. **VSHS**—2011 Virginia Standard Highway Signs book
- 42. **VPH** or **vph**—vehicles per hour
- 43. **VSP**—Virginia State Police
- 44. **WAPM**—Work Area Protection Manual
- 45. **WZTC**—Work Zone Traffic Control

CHAPTER 6B. FUNDAMENTAL PRINCIPLES

Section 6B.01 Fundamental Principles of Temporary Traffic Control

Support:

- 01 Construction, maintenance, utility, and incident zones can all benefit from TTC to compensate for the unexpected or unusual situations faced by road users. When planning for TTC in these zones, it can be assumed that it is appropriate for road users to exercise caution. Even though road users are assumed to be using caution, special care is still needed in applying TTC techniques.
- 02 Special plans preparation and coordination with transit, other highway agencies, law enforcement and other emergency units, utilities, schools, and railroad companies might be needed to reduce unexpected and unusual road user operation situations.
- 03 During TTC activities, commercial vehicles might need to follow a different route from passenger vehicles because of bridge, weight, clearance, or geometric restrictions. Also, vehicles carrying hazardous materials might need to follow a different route from other vehicles. The Hazardous Materials and National Network signs are included in Sections 2B.62 and 2B.63 of the 2009 MUTCD, respectively.
- 04 Experience has shown that following the fundamental principles of this Manual and Part 6 of the 2009 MUTCD will assist road users and help protect workers in the vicinity of TTC zones.

Guidance:

- 05 *Road user and worker safety and accessibility in TTC zones should be an integral and high-priority element of every project from planning through design and construction. Similarly, maintenance and utility work should be planned and conducted with the safety and accessibility of all motorists, bicyclists, pedestrians (including those with disabilities), and workers being considered at all times. If the TTC zone includes a grade crossing, early coordination with the railroad company or light rail transit agency should take place.*

Support:

- 06 Formulating specific plans for TTC at traffic incidents is difficult because of the variety of situations that can arise. Section 6I provides more information on TTC at traffic incidents.

Guidance:

- 07 *The following are the seven fundamental principles of TTC:*
 - 1. *General plans or guidelines should be developed to provide safety for motorists, bicyclists, pedestrians, workers, enforcement/emergency officials, and equipment, with the following factors being considered:*
 - A. *The basic safety principles governing the design of permanent roadways and roadsides should also govern the design of TTC zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and TTC devices as nearly as possible comparable to those for normal highway situations.*
 - B. *A TTC plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by an official who is knowledgeable (for example, trained and/or certified) in proper TTC practices. See the latest version of IIM-LD-241/TE-351 for detailed information on the development of Transportation Management Plans (TMPs) and TTC plans.*
 - 2. *Road user movement should be inhibited as little as practical, based on the following considerations:*
 - A. *TTC at work and incident sites should be designed on the assumption that drivers will only reduce their speeds if they clearly perceive a need to do so (see Section 6C.01 of the 2009 MUTCD).*
 - B. *Frequent and abrupt changes in geometrics such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers, should be avoided.*
 - C. *Attempts should be made to reduce the volume of traffic using the roadway or highway to match the restricted capacity conditions. Road users should be encouraged to use alternative routes that do not include TTC zones. For high-volume roadways and highways, the closure of selected entrance ramps or other access points and the use of signed diversion routes should be evaluated.*
 - D. *Work should be scheduled in a manner that minimizes the need for lane closures or alternate routes, while still getting the work completed quickly and the lanes or roadway open to traffic as soon as possible.*

- E. *If work operations permit, lane closures on high-volume streets and highways should be scheduled during off-peak hours. Night work should be considered if the work can be accomplished with a series of short-term operations.*
 - F. *Bicyclists and pedestrians, including those with disabilities, should be provided with access and reasonably safe passage through the TTC zone.*
 - G. *The need for smooth riding surfaces for motorcyclists should be provided, or advanced warning notification given whenever roadways surfaces are disturbed (see Section 6G.15 and Temporary Traffic Control layouts Figures TTC-57—59 in Chapter 6H).*
 - H. *Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur if significant impacts to roadway operations are anticipated.*
3. *Motorists, bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing TTC zones and incident sites. The following principles should be applied:*
 - A. *Adequate warning, delineation, and channelization should be provided to assist in guiding road users in advance of and through the TTC zone or incident site by using proper pavement marking, signing, or other devices that are effective under varying conditions. Providing information that is in usable formats by pedestrians with visual disabilities should also be considered.*
 - B. *TTC devices inconsistent with intended travel paths through TTC zones should be removed or covered. However, in intermediate-term stationary, short-term, and mobile operations, where visible permanent devices are inconsistent with intended travel paths, devices that highlight or emphasize the appropriate path should be used. Providing traffic control devices that are accessible to and usable by pedestrians with disabilities should be considered.*
 - C. *Flagging procedures, when used, should provide positive guidance to road users traversing the TTC zone.*
 4. *To provide acceptable levels of operations, routine day and night inspections of TTC elements should be performed as follows:*
 - A. *Individuals who are knowledgeable (for example, trained and/or certified in Work Zone Traffic Control) in the principles of proper TTC should be assigned responsibility for safety in TTC zones. The most important duty of these individuals should be to check that all TTC devices of the project are consistent with the TTC plan and this Manual and are effective for motorists, bicyclists, pedestrians, and workers.*
 - B. *As the work progresses, temporary traffic controls and/or working conditions should be modified, if appropriate, in order to provide mobility and positive guidance to the road user and to provide worker safety. The individual responsible for TTC should have the authority to halt work until applicable or remedial safety measures are taken.*
 - C. *TTC zones should be carefully monitored and their conditions documented under varying conditions of road user volumes, light, and weather to check that applicable TTC devices are effective, clearly visible, clean, and in compliance with the TTC plan and this Manual.*
 - D. *When warranted, an engineering study should be made (in cooperation with law enforcement officials) of reported crashes occurring within the TTC zone. Crash records in TTC zones should be monitored to identify the need for changes in the TTC zone, see the latest version of IIM-LD-241/TE-351 for detailed information on reviewing fatal work zone crashes on projects.*

Standard:

- 08 **Temporary traffic control installations shall be reviewed daily to ensure the functionality of the temporary traffic control devices and compliance to this Manual and the traffic control plan. These reviews shall be documented on a weekly basis using the Work Zone Safety Checklist form found in Appendix B of this Manual including as much detailed information as warranted for the type of operation.**

Guidance:

- 09 *A review of temporary traffic control installations should also be performed on a periodic basis during nighttime conditions to ensure the retroreflectivity of the TTC devices meet the acceptable standard as defined in the latest edition of the American Traffic Safety Service Association's (ATSSA) "Quality Standards for Work Zone Traffic Control Devices" publication.*

Standard:

- 10 **A review of the temporary traffic control shall be performed for compliance immediately after a change in traffic patterns. A review shall also be performed after an inclement weather event (thunderstorm, snow, sleet, etc.). Deficiencies in the temporary traffic control shall be corrected and documented as soon as possible.**
- 11 **The review and documentation of the temporary traffic control installation shall be by someone trained and knowledgeable about the fundamental principles of temporary traffic control and related work activities being performed. The individual responsible for temporary traffic control review shall have the authority to halt work until applicable or remedial safety measures are taken.**
- 12 **Changes to the TTC plan shall be documented with what the changes were and the reason for the change.**

Option:

- 13 Other methods of documentation include written notes, project diary entries, photographs, and video recordings.

Guidance:

- 14 *Attention should be given to the maintenance of roadside safety during the life of the TTC zone by applying the following principles:*
- A. To accommodate run-off-the-road incidents, disabled vehicles, or emergency situations, unencumbered roadside recovery areas or clear zones should be provided where practical.*
 - B. Channelization of road users should be accomplished by the use of pavement markings, signing, and crashworthy, detectable channelizing devices.*
 - C. Work equipment, workers' private vehicles, materials, and debris should be stored in such a manner to reduce the probability of being impacted by run-off-the-road vehicles.*

Standard:

- 15 **All temporary traffic control devices shall be removed as soon as practical when they are no longer needed. When work is suspended for periods longer than 30 minutes, advance warning signs (including supports) that are no longer appropriate shall be removed from the roadway (including shoulders). Other inappropriate devices shall be removed from the work area so they are not visible to drivers.**

Option:

- 16 Advance warning signs and their portable supports may be disassembled and stored behind barrier or guardrail.

Guidance:

- 17 *Each person whose actions affect TTC zone safety, from the upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make.*

Standard:

- 18 **Only those individuals who are trained in Work Zone Traffic Control practices and have a basic understanding of the principles (established by applicable standards and guidelines, including those of this Manual) shall supervise the selection, placement, and maintenance of TTC devices used for TTC zones and for incident management.**

Guidance:

- 19 *Good public relations should be maintained by applying the following principles:*
- A. The needs of all road users should be assessed such that appropriate advance notice is given and clearly defined alternative paths are provided.*
 - B. The cooperation of the various news media should be sought in publicizing the existence of and reasons for TTC zones because news releases can assist in keeping the road users well informed.*
 - C. The needs of abutting property owners, residents, and businesses should be assessed and appropriate accommodations made.*
 - D. The needs of emergency service providers (law enforcement, fire, and medical) should be assessed and appropriate coordination and accommodations made.*
 - E. The needs of railroads and transit should be assessed and appropriate coordination and accommodations made.*

F. The needs of operators of commercial vehicles such as buses and large trucks should be assessed and appropriate accommodations made.

Standard:

20 **Before any new detour or temporary route is opened to traffic, all necessary signs shall be in place and the route reviewed.**

CHAPTER 6C. TEMPORARY TRAFFIC CONTROL ELEMENTS

Section 6C.01 Temporary Traffic Control Plans

Support:

- 01 Whenever the acronym “TTC” is used in this Chapter, it refers to “temporary traffic control”.

Standard:

- 02 **The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.**

Support:

- 03 A TTC plan describes TTC measures to be used for facilitating road users through a work zone or an incident area. TTC plans play a vital role in providing continuity of reasonably safe and efficient road user flow when a work zone, incident, or other event temporarily disrupts normal road user flow. Important auxiliary provisions that cannot conveniently be specified on project plans can easily be incorporated into Special Provisions within the TTC plan.
- 04 TTC plans range in scope from being very detailed to simply referencing typical drawings contained in this Manual, standard approved highway agency drawings and manuals, or specific drawings contained in the contract documents. The degree of detail in the TTC plan depends entirely on the nature and complexity of the situation.

Guidance:

- 05 *TTC plans should be prepared by persons knowledgeable (for example, trained and/or certified) about the fundamental principles of TTC and work activities to be performed. The design, selection and placement of TTC devices for a TTC plan should be based on engineering judgment.*
- 06 *Coordination should be made between adjacent or overlapping projects to check that duplicate signing is not used and to check compatibility of traffic control between adjacent or overlapping projects.*
- 07 *Traffic control planning should be completed for all highway construction, utility work, maintenance operations, and incident management including minor maintenance and utility projects prior to occupying the TTC zone. Planning for all road users should be included in the process.*
- 08 *Provisions for effective continuity of accessible circulation paths for pedestrians should be incorporated into the TTC process. Where existing pedestrian routes are blocked or detoured, information should be provided about alternative routes that are usable by pedestrians with disabilities, particularly those who have visual disabilities. Access to temporary bus stops, reasonably safe travel across intersections with accessible pedestrian signals (see Section 4E.09 of the 2009 MUTCD), and other routing issues should be considered where temporary pedestrian routes are channelized. Barriers and channelizing devices that are detectable by people with visual disabilities should be provided.*

Option:

- 09 Provisions may be incorporated into the project bid documents that enable contractors to develop an alternate TTC plan.
- 10 Modifications of TTC plans may be necessary because of changed conditions or a determination of better methods of safely and efficiently handling road users.

Guidance:

- 11 *This alternate or modified plan should have the approval of the responsible highway agency prior to implementation.*
- 12 *Provisions for effective continuity of transit service should be incorporated into the TTC planning process because often public transit buses cannot efficiently be detoured in the same manner as other vehicles (particularly for short-term maintenance projects). Where applicable, the TTC plan should provide for features such as accessible temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, including persons with disabilities, if applicable (see Section 8A.08 of the 2009 MUTCD for additional light rail transit issues to consider for TTC).*
- 13 *Provisions for effective continuity of railroad service and acceptable access to abutting property owners and businesses should also be incorporated into the TTC planning process.*

- 14 *Reduced speed limits should be used only in the specific portion of the TTC zone where conditions or restrictive features are present. However, frequent changes in the speed limit should be avoided. A TTC plan should be designed so that vehicles can reasonably safely travel through the TTC zone with a speed limit reduction of no more than 10 mph.*

Standard:

- 15 **Speeds shall only be reduced within construction/maintenance work zones by the Regional Traffic Engineer upon completion of an engineering and traffic study warranting the reduction. Documentation of the speed reduction change shall be performed and maintained (see Work Zone Speed Analysis form, TE-350).**

Guidance

- 16 *TTC plans should be designed in accordance with the approach speeds prior to construction when possible.*
- 17 *A reduction of more than 10 mph in the speed limit should be used only when required by restrictive features in the TTC zone. Where restrictive features justify a speed reduction of more than 10 mph, additional driver notification should be provided. The speed limit should be stepped down in advance of the location requiring the lowest speed in ten-mile per hour increments, and additional TTC warning devices should be used.*
- 18 *Reduced speed zoning (lowering the regulatory speed limit) should be avoided as much as practical because drivers will reduce their speeds only if they clearly perceive a need to do so.*

Support:

- 19 Research has demonstrated that large reductions in the speed limit, such as a 30 mph reduction, increase speed variance and the potential for crashes. Smaller reductions in the speed limit of up to 10 mph cause smaller changes in speed variance and lessen the potential for increased crashes. A reduction in the regulatory speed limit of only up to 10 mph from the normal speed limit has been shown to be more effective.

Section 6C.02 Temporary Traffic Control Zones

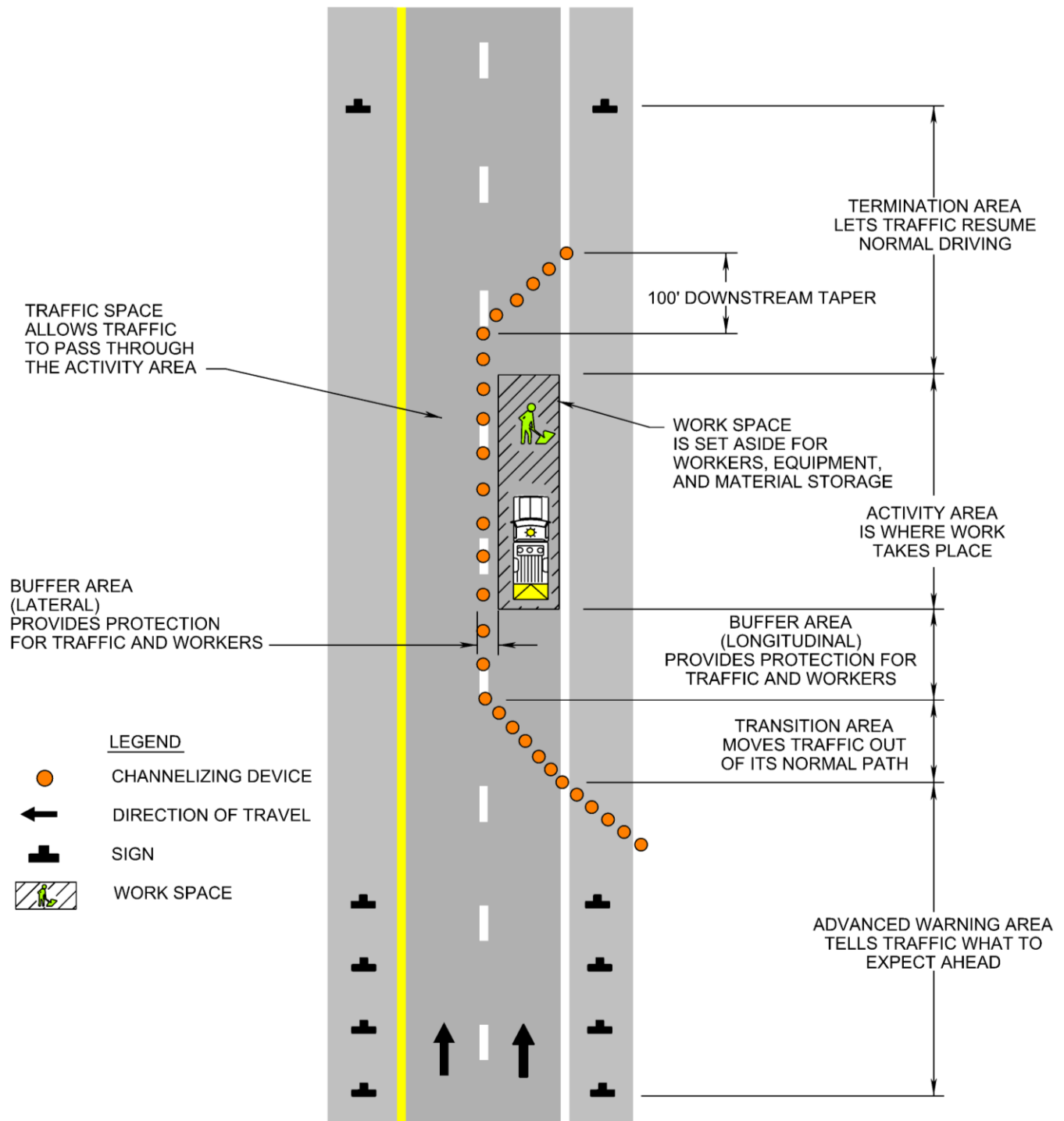
Support:

- 01 A TTC zone is an area of a highway where road user conditions are changed because of a work zone or an incident through the use of TTC devices, uniformed law enforcement officers, or other authorized personnel.
- 02 A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC device.
- 03 An incident zone is an area of a highway where temporary traffic controls are imposed by authorized officials in response to a traffic incident (see Section 6I.01). It extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where road users return to the original lane alignment and are clear of the incident.
- 04 A planned special event often creates the need to establish altered traffic patterns to handle the increased traffic volumes generated by the event. The size of the TTC zone associated with a planned special event can be small, such as closing a street for a festival, or can extend throughout a municipality for larger events. The duration of the TTC zone is determined by the duration of the planned special event and its affect on traffic volumes.

Section 6C.03 Components of Temporary Traffic Control Zones

Support:

- 01 Most TTC zones are divided into five areas: the advance warning area, the transition area, the buffer space area, the activity area, and the termination area. Figure 6C-1 illustrates these five areas. These five areas are described in Sections 6C.04 through 6C.08.

Figure 6C-1, Component Parts of a Temporary Traffic Control Zone

Section 6C.04 Advance Warning Area

Support:

- 01 The advance warning area is the section of highway where road users are informed about the upcoming work zone or incident area.

Option:

- 02 The advance warning area may vary from a single sign or high-intensity rotating, oscillating, or strobe lights on a vehicle to a series of signs in advance of the TTC zone activity area.

Guidance:

- 03 *Sign spacing distance should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less (see Table 6C-1).*

Option:

- 04 Low speed urban streets with speeds of 25 mph or less may reduce the spacing to 100' - 200' between signs. Urban streets with speeds of 30 to 40 mph may use 250' to 350' between signs.
- 05 Advance warning may be eliminated when the activity area is sufficiently removed from the road users' path so that it does not interfere with the normal flow (See Appendix A for clear zone requirements) and approved by the Regional Traffic Engineer.

Table 6C-1, Spacing of Advance Warning Signs

Road Type	Spacing (Feet)
Urban street with 25 mph or less posted speed	100 – 200
Urban street with 30 to 40 mph posted speed	250 – 350
* All Other Roadways with 45 mph or less posted speed	350 – 500
All Other Roadways with greater than 45 mph posted speed	500 – 800
Limited Access highways	1300 – 1500

* Urban streets with greater than 40 mph posted speed limits fall into this category.

Support:

- 06 The need to provide additional reaction time for a condition is one example of justification for increasing the sign spacing. Conversely, decreasing the sign spacing might be justified in order to place a sign immediately downstream of an intersection or major driveway such that traffic turning onto the roadway in the direction of the TTC zone will be warned of the upcoming condition. In addition, in urban conditions, it is generally better to attempt to place all advance warning signs within a one block area versus spreading out over several blocks, provided that motorists have time to recognize and react to the signs.

Section 6C.05 Transition Area

Support:

- 01 The transition area is that section of highway where road users are redirected out of their normal path. Transition areas usually involve strategic use of tapers, which because of their importance are discussed separately in detail.

Standard:

- 02 **When redirection of the road users' normal path is required, they shall be channelized from the normal path to a new path.**

Support:

- 03 In mobile operations, the transition area moves with the work space.
- 04 Because it is impractical in mobile operations to redirect the road user's normal path with stationary channelization, more dominant vehicle-mounted traffic control devices, such as arrow boards, portable changeable message signs, and high-intensity rotating, flashing, oscillating, or strobe lights, may be used instead of channelizing devices to establish a transition area.

Section 6C.06 Buffer Space

Support:

- 01 The buffer space is a lateral and/or longitudinal area that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

Standard:

- 02 **Neither work activity nor storage or placement of equipment, vehicles (including law enforcement), or material shall occur within a buffer space.**

Option:

- 03 Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of road user flow. The activity area may contain one or more lateral or longitudinal buffer spaces.

Guidance:

- 04 *A longitudinal buffer space should be placed in advance of a work space. The longitudinal buffer space may also be used to separate opposing road user flows that use portions of the same traffic lane, as shown in Figure 6C-2.*
- 05 *If a longitudinal buffer space is used, the length should be as shown in Table 6C-2 and is based on the posted speed limit.*

Support:

- 06 Typically, the buffer space is formed as a traffic island and defined by channelizing devices.
- 07 When a shadow vehicle, arrow board, or changeable message sign is placed in a closed lane in advance of a work space, only the area upstream of the vehicle, arrow board, or changeable message sign constitutes the buffer space.

Option:

- 08 The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figure 6C-2, or such areas as excavations or pavement-edge drop-offs. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows.

Table 6C-2, Length of the Longitudinal Buffer Space

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 – 120
25	155 – 165
30	200 – 210
35	250 – 260
40	305 – 320
45	360 – 380
50	425 – 445
55	500 – 520
60	570 – 590
65	645 – 675
70	730 – 760
75	820 – 850

Guidance:

- 09 *The width of a lateral buffer space should be determined by engineering judgment.*
- 10 *Where traffic barrier service is being utilized, consideration should be given to the maximum dynamic deflection for the type of barrier service being used so that the effective buffer space between the barrier and work area is achieved (see Appendix A for barrier dynamic deflection values).*

Option

- 11 When work occurs on a high-volume, highly congested facility, a vehicle storage or staging space may be provided for incident response and emergency vehicles (for example, tow trucks and fire apparatus) so that these vehicles can respond quickly to road user incidents.

Guidance:

- 12 *If used, an incident response and emergency-vehicle storage area should not extend into any portion of the buffer space.*

Section 6C.07 Activity Area

Support:

- 01 The activity area is the section of the highway where the work activity takes place. It is comprised of the work space, and the traffic space.
- 02 The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream. Work spaces are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

Option:

- 03 The work space may be stationary or may move as work progresses.

Guidance:

- 04 *Since there might be several work spaces (some even separated by several miles) within the project limits, each work space should be adequately signed to inform road users and reduce confusion.*
- 05 *The maximum length of the work space should not exceed two miles unless approved by the Regional Traffic Engineer.*

Support:

- 06 The traffic space is the portion of the highway in which road users are routed through the activity area.

Section 6C.08 Termination Area

Standard:

- 01 **The termination area shall be used to return road users to their normal path. The termination area shall extend from the downstream end of the work area to the last TTC device such as END ROAD WORK signs, if posted.**

Option:

- 02 An END ROAD WORK sign, a Speed Limit sign, or other signs may be used to inform road users that they can resume normal operations.
- 03 A longitudinal buffer space may be used between the work space and the beginning of the downstream taper.

Section 6C.09 TapersOption:

- 01 Tapers may be used in both the transition and termination areas. Whenever tapers are to be used in close proximity to an interchange ramp, crossroads, curves, or other influencing factors, the length of the tapers may be adjusted.

Support:

- 02 Tapers are created by using a series of channelizing devices and/or pavement markings to move traffic out of or into the normal path. Types of tapers are shown in Figure 6C-2.

Table 6C-3, Taper Length Criteria for Temporary Traffic Control Zones

Type of Taper	Taper Length (L)
Merging	L= Minimum
Shifting	L Desired, $\frac{1}{2}$ L Minimum
Shoulder	$\frac{1}{3}$ L Minimum
Two-Way Traffic	50 Feet Minimum, 100 Feet Maximum
Downstream	50 Feet Minimum, 100 Feet Maximum
L= Taper Length, W= Width of Offset, S= Posted Speed Limit	

Table 6C-4, Taper Length Chart

Taper Length (L)					
Posted Speed Limit (mph)	Width of Offset (Feet)				Remarks
	9	10	11	12	
≤ 25	95	105	115	125	$L = S^2W/60$
30	135	150	165	180	"
35	185	205	225	245	"
40	240	267	294	320	"
45	405	450	495	540	$L = SW$
50	450	500	550	600	"
55	495	550	605	660	"
60	540	600	660	720	"
65	585	650	715	780	"
70<	630	700	770	840	"
Limited Access highway merging taper length (L) shall be 1000 feet regardless of the posted speed and $SW=L$ is desired for the shifting taper length with $\frac{1}{2}L$ being the minimum.					

- 03 Longer tapers are not necessarily better than shorter tapers (particularly in urban areas with characteristics such as short block lengths or driveways) because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The test concerning adequate lengths of tapers involves observation of driver performance after TTC plans are put into effect.

Guidance:

- 04 *The criteria for determining the taper length (L) are shown in Table 6C-3 and should be the minimum used.*
- 05 *The appropriate taper length (L) should be determined using the Table 6C-4.*
- 06 *The maximum distance in feet between devices in a taper should not exceed 20 feet at posted speeds up to 35 mph, and 40 feet for posted speeds greater than 35 mph.*

Support:

- 07 A merging taper requires the longest distance because drivers are required to merge into common road space.

Guidance:

- 08 *A merging taper should be long enough to enable merging drivers to have adequate advance warning and sufficient length to adjust their speeds and merge into a single lane before the end of the transition.*

Support:

- 09 A shifting taper is used when a lateral shift is needed. When more space is available, a longer than minimum taper distance can be beneficial. Changes in alignment can also be accomplished by using horizontal curves designed for normal highway speeds.

Guidance:

- 10 *A shifting taper should have a length of approximately $\frac{1}{2} L$ (see Tables 6C-3 and 6C-4). Limited Access highway shifting taper should be $SW=L$ with $\frac{1}{2} L$ being the minimum.*

Support:

- 11 A shoulder taper may be beneficial on a high-speed roadway where shoulders are part of the activity area and are closed, or when improved (paved) shoulders or parking lane might be mistaken as a driving lane. In these instances, the same type, but abbreviated, closure procedures used on a normal (travel) portion of the roadway can be used.

Guidance:

- 12 *If used, shoulder tapers should have a length of approximately $\frac{1}{3} L$ (see Tables 6C-3 and 6C-4). If a shoulder or parking lane is used as a travel lane, either through practice or during a TTC activity, a normal merging (L) taper or shifting ($\frac{1}{2} L$) taper should be used.*

Option:

- 13 A downstream taper may be useful in termination areas to provide a visual cue to the driver that access is available back into the original lane or path that was closed.

Guidance:

- 14 *When used, a downstream taper on a multi-lane roadway should have a length of approximately 50 feet minimum to 100 feet maximum with devices placed at a spacing of approximately 20 feet contained within the lane adjacent to the open travel lane (see Figure TTC-18).*

Support:

- 15 The one-lane, two-way taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction.

Guidance:

- 16 *Traffic should be controlled by a flagger or a STOP or YIELD sign. A short taper having a maximum length of 100 feet with channelizing devices at approximately 20-foot spacing should be used to guide traffic into the one-way section. A 50 to 100 foot downstream taper should also be used to guide motorist back to the open travel lane.*

Support:

- 17 An example of a one-lane, two-way traffic taper is shown in Figure 6C-3.

Section 6C.10 Detours and Diversions*Support:*

- 01 A detour is a temporary rerouting of road users onto an existing highway in order to avoid a TTC zone.

Guidance:

- 02 *Detours should be clearly signed over their entire length so that road users can easily use existing highways to return to the original highway.*
- 03 *A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work area.*

Figure 6C-2, Examples of Types of Tapers and Buffer Spaces

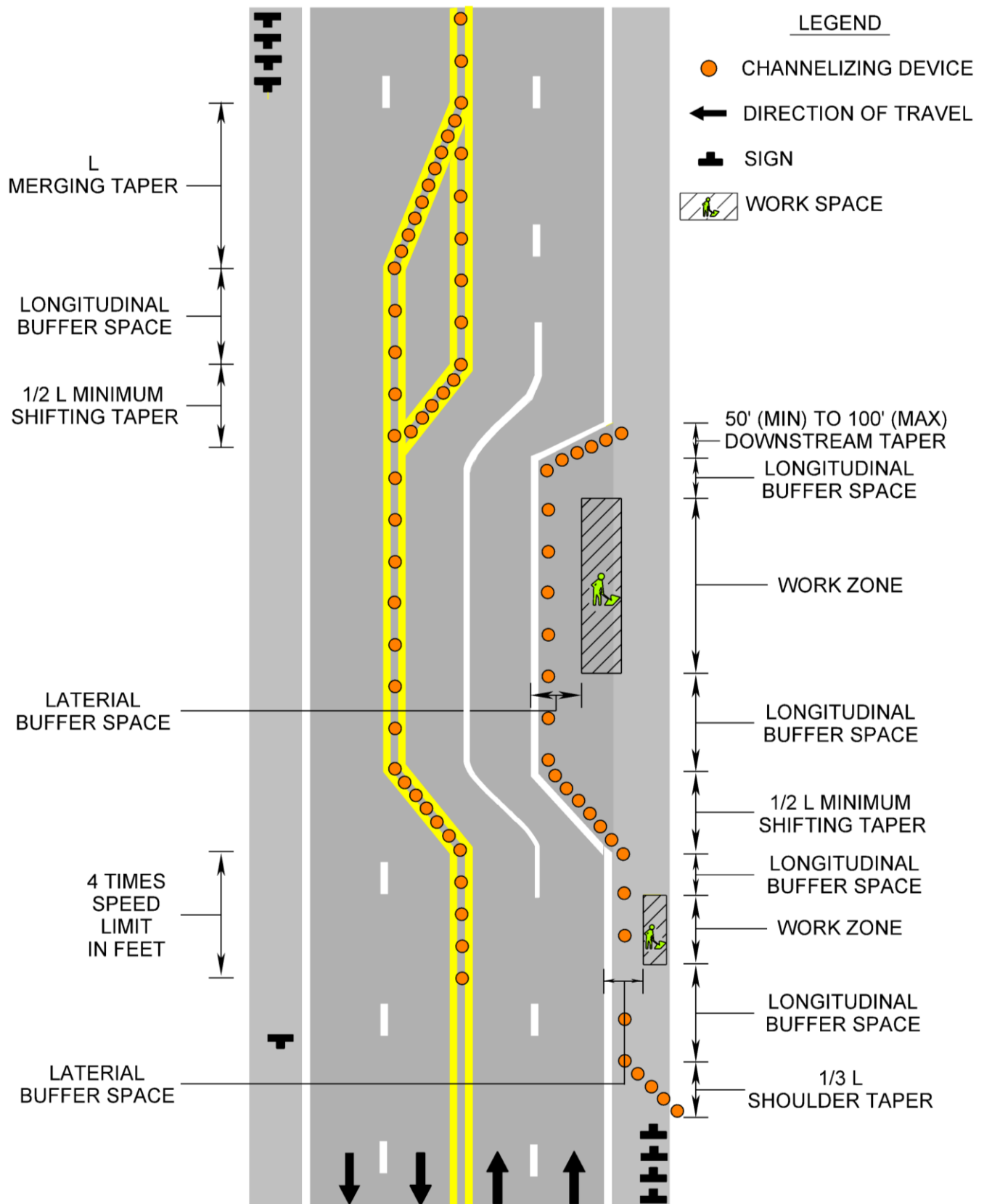
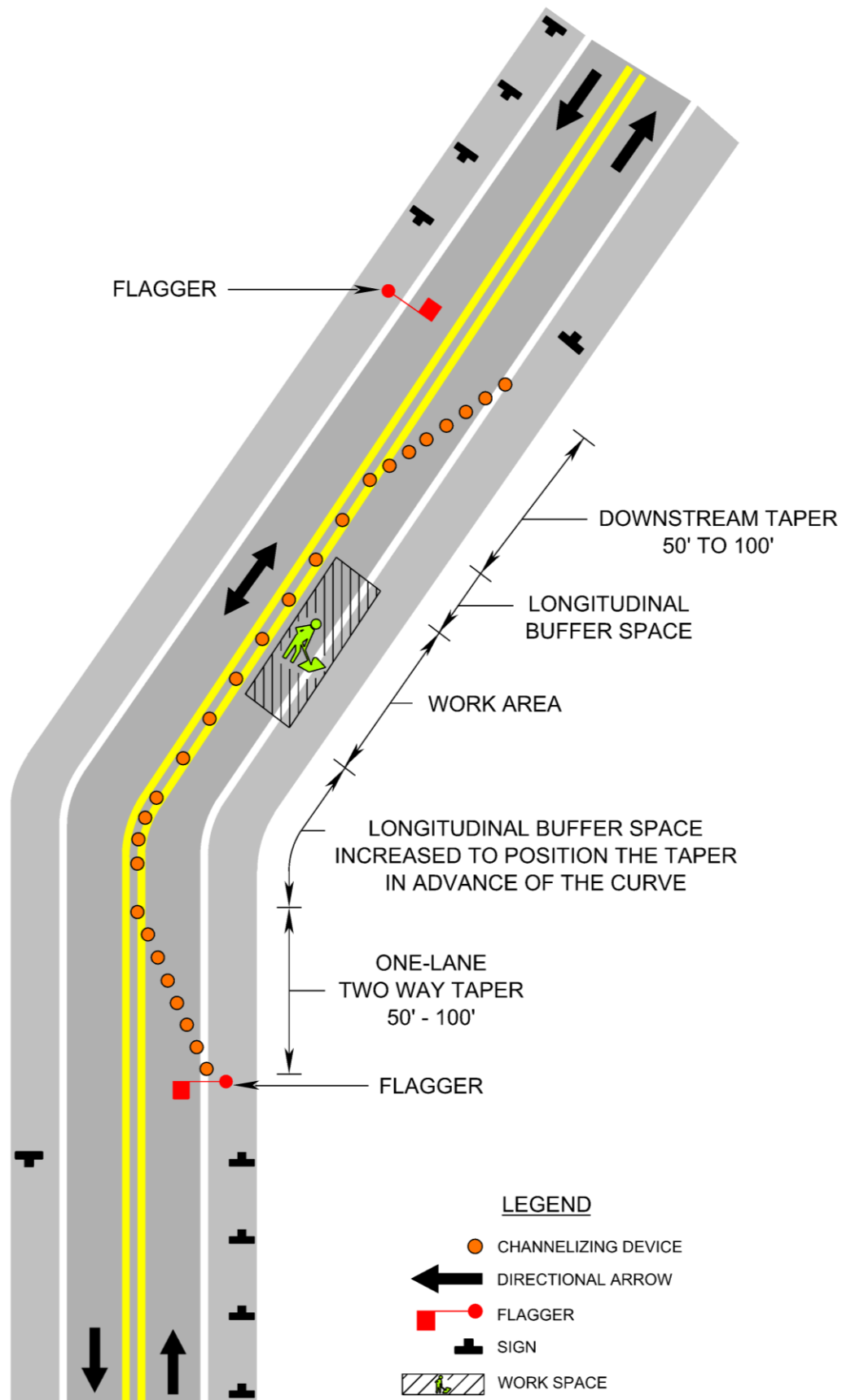


Figure 6C-3, Example of a One-Lane, Two-Way Taper



Section 6C.11 One-Lane, Two-Way Traffic Control**Standard:**

- 01 **When traffic in both directions must use a single lane for a limited distance, movements from each end shall be coordinated.**

Guidance:

- 02 *Provisions should be made for alternate one-way movement through the constricted section via methods such as flagger control, a flag transfer, a pilot car, traffic control signals, or stop or yield control.*
- 03 *Control points at each end should be chosen to permit easy passing of opposing lanes of vehicles.*
- 04 *If traffic on the affected one-lane roadway is not visible from one end to the other, then flagging procedures, a pilot car with a flagger used as described in Sections 6C.14 and 6F.63, or a traffic control signal should be used to control opposing traffic flows.*

Option:

- 05 If the work space on a low-volume (less than 500 vpd) street or road is short and road users from both directions are able to see the traffic approaching from the opposite direction through and beyond the worksite, the movement of traffic through a one-lane, two-way constriction may be self-regulating.
- 06 On roadways 20 foot or less in width, cones for channelization may be eliminated due to limited room for vehicles to pass activities and equipment in the remaining travel lane.

Standard:

- 07 **A one-lane, two-way taper shall be used to close the lane with work activities for conditions described in Paragraph 6.**

Section 6C.12 Flagger Method of One-Lane, Two-Way Traffic ControlOption:

- 01 When a one-lane, two-way TTC zone is short enough to allow a flagger to see from one end of the zone to the other, traffic may be controlled by either a single flagger or by a flagger at each end of the section.

Guidance:

- 02 *When a single flagger is used, the flagger should be stationed on the shoulder opposite the constriction or work space, or in a position where good visibility and traffic control can be maintained at all times. When good visibility and traffic control cannot be maintained by one flagger station, traffic should be controlled by a flagger at each end of the section. One of the flaggers should be designated as the coordinator or lead flagger. Flaggers should be able to communicate with each other orally, electronically, or with manual signals. These manual signals should not be mistaken for flagging signals.*

Section 6C.13 Flag Transfer Method of One-Lane, Two-Way Traffic Control**Support:**

- 01 The driver of the last vehicle proceeding into the one-lane section is given a red flag (or other token) and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that it is reasonably safe to allow traffic to move in the other direction. A variation of this method is to replace the use of a flag with an official pilot car that always follows the last road user vehicle proceeding through the section.

Guidance:

- 02 *The flag transfer method should be employed only where the one-way traffic is confined to a relatively short length of a road, usually not more than 1 mile in length.*

Section 6C.14 Pilot Car Method of One-Lane, Two-Way Traffic ControlOption:

- 01 A pilot car may be used to guide a queue of vehicles through the TTC zone or detour.

Guidance:

- 02 *The operation of the pilot vehicle should be coordinated with flagging operations or other controls at each end of the one-lane section.*

Standard:

- 03 **The PILOT CAR FOLLOW ME (G20-4) sign shall be mounted at a conspicuous location on the rear of the vehicle. The pilot car shall have the name of the contractor or contracting authority prominently displayed.**
- 04 **A flagger shall be stationed on the approach to the activity area to control vehicular traffic until the pilot vehicle is available.**

Section 6C.15 Temporary Traffic Control Signal Method of One-Lane, Two-Way Traffic Control**Option:**

- 01 Traffic control signals may be used to control vehicular traffic movements in one-lane, two-way TTC zones as approved by the Regional Traffic Engineer (see Figure TTC-25, Chapter 4H of the 2009 MUTCD and Standard TS-1 of the Road and Bridge Standards).

Section 6C.16 Stop or Yield Control Method of One-Lane, Two-Way Traffic Control**Option:**

- 01 STOP or YIELD signs may be used to control traffic on low-volume roads at a one-lane, two-way TTC zone when drivers are able to see the other end of the one-lane, two-way operation and have sufficient visibility of approaching vehicles.

Guidance:

- 02 *The use of STOP or YIELD signs for traffic control on low-volume roads at a one-lane, two-way work zone should have written approval from the Regional Traffic Engineer. See warrants for No-Passing Zones at Curves in Chapter 3B of the 2009 MUTCD.*
- 03 *If the STOP or YIELD sign is installed for only one direction, then the STOP or YIELD sign should face road users who are driving on the side of the roadway that is closed for the work activity area.*

CHAPTER 6D. PEDESTRIAN AND WORKER SAFETY

Section 6D.01 Pedestrian Considerations

Support:

- 01 A wide range of pedestrians might be affected by TTC zones, including the young, elderly, and people with disabilities such as hearing, visual, or mobility. These pedestrians need a clearly delineated and usable travel path. Considerations for pedestrians with disabilities are addressed in Section 6D.02.

Standard:

- 02 **The various TTC provisions for pedestrian and worker safety set forth in this Manual and Part 6 of the 2009 MUTCD shall be applied by knowledgeable (for example, trained and/or certified in Advanced Work Zone Traffic Control) persons after appropriate evaluation and engineering judgment.**
- 03 **Advance notification of sidewalk closures shall be provided by the maintaining agency.**
- 04 **If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.**

Option:

- 05 If establishing or maintaining an alternate pedestrian route is not feasible during the project, an alternate means of providing for pedestrians may be used, such as adding free bus service around the project or assigning someone the responsibility to assist pedestrians with disabilities through the project limits.

Support:

- 06 It must be recognized that pedestrians are reluctant to retrace their steps to a prior intersection for a crossing or to add distance or out-of-the-way travel to a destination.

Guidance:

- 07 *The following three items should be considered when planning for pedestrians in TTC zones:*
- A. *Pedestrians should not be led into conflicts with vehicles, equipment, and operations.*
 - B. *Pedestrians should not be led into conflicts with vehicles moving through or around the worksite.*
 - C. *Pedestrians should be provided with a convenient and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or footpath(s).*
- 08 *A pedestrian route should not be severed and/or moved for non-construction activities such as parking for vehicles and equipment.*
- 09 *Consideration should be made to separate pedestrian movements from both worksite activity and vehicular traffic. Unless an acceptable route that does not involve crossing the roadway can be provided, pedestrians should be appropriately directed with advance signing that encourages them to cross to the opposite side of the roadway. In urban and suburban areas with high vehicular traffic volumes, these signs should be placed at intersections (rather than midblock locations) so that pedestrians are not confronted with midblock worksites that will induce them to attempt skirting the worksite or making a midblock crossing.*

Support:

- 10 Figures TTC-35 and TTC-36 show typical TTC device usage and techniques for pedestrian movement through work zones.

Guidance:

- 11 *To accommodate the needs of pedestrians, including those with disabilities, the following considerations should be addressed when temporary pedestrian pathways in TTC zones are designed or modified:*
- A. *Provisions for continuity of accessible paths for pedestrians should be incorporated into the TTC plan.*
 - B. *Access to transit stops should be maintained.*
 - C. *A smooth, continuous hard surface should be provided throughout the entire length of the temporary pedestrian facility. There should be no curbs or abrupt changes in grade or terrain that could cause tripping or be a barrier to wheelchair use. The geometry and alignment of the facility should meet the applicable requirements of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).*

- D. *The width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility. When it is not possible to maintain a minimum width of 48 inches throughout the entire length of the pedestrian pathway, a 60 x 60-inch passing space should be provided at least every 200 feet to allow individuals in wheelchairs to pass.*
- E. *Blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing devices such as audible information devices, accessible pedestrian signals, or barriers and channelizing devices that are detectable to the pedestrians traveling with the aid of a long cane or who have low vision. Where pedestrian traffic is detoured to a TTC signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals should be considered for crossings along an alternate route.*
- F. *When channelization is used to delineate a pedestrian pathway, a continuous detectable edging should be provided throughout the length of the facility such that pedestrians using a long cane can follow it. These detectable edgings should comply with the provisions of Section 6F.71 and Section 6F.82.*
- G. *Signs and other devices mounted lower than 7 feet above the temporary pedestrian pathway should not project more than 4 inches into accessible pedestrian facilities.*

Option:

- 12 Whenever it is feasible, closing off the worksite from pedestrian intrusion may be preferable to channelizing pedestrian traffic along the site with TTC devices.

Guidance:

- 13 *Fencing should not create sight distance restrictions for road users. Fences should not be constructed of materials that would be hazardous if impacted by vehicles. Wooden railing, fencing, and similar systems placed immediately adjacent to motor vehicle traffic should not be used as substitutes for crashworthy temporary traffic barriers.*
- 14 *Ballast for TTC devices should be kept to the minimum amount needed and should be mounted low to prevent penetration of the vehicle windshield.*
- 15 *Movement by work vehicles and equipment across designated pedestrian paths should be minimized and, when necessary, should be controlled by flaggers or TTC. Staging or stopping of work vehicles or equipment along the side of pedestrian paths should be avoided, since it encourages movement of workers, equipment, and materials across the pedestrian path.*
- 16 *Access to the work space by workers and equipment across pedestrian walkways should be minimized because the access often creates unacceptable changes in grade, and rough or muddy terrain, and pedestrians will tend to avoid these areas by attempting non-intersection crossings where no curb ramps are available.*

Option:

- 17 A canopied walkway may be used to protect pedestrians from falling debris, and to provide a covered passage for pedestrians.

Guidance:

- 18 *Covered walkways should be sturdily constructed and adequately lighted for nighttime use.*
- 19 *When pedestrian and vehicle paths are rerouted to a closer proximity to each other, consideration should be given to separating them by a temporary traffic barrier.*
- 20 *If a temporary traffic barrier is used to shield pedestrians, it should be designed to accommodate site conditions.*

Support:

- 21 *Depending on the possible vehicular speed and angle of impact, temporary traffic barriers might deflect upon impact by an errant vehicle. Guidance for locating and designing temporary traffic barriers can be found in Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).*

Standard:

- 22 **Short intermittent segments of temporary traffic barrier shall not be used because they nullify the containment and redirective capabilities of the temporary traffic barrier, increase the potential for serious injury both to vehicle occupants and pedestrians, and encourage the presence of blunt, leading ends. All upstream leading ends that are present shall be appropriately flared or protected with properly installed and**

maintained crashworthy cushions. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly.

- 23 **Normal vertical curbing shall not be used as a substitute for temporary traffic barriers when temporary traffic barriers are needed.**

Option:

- 24 Temporary traffic barriers or longitudinal channelizing devices may be used to discourage pedestrians from unauthorized movements into the work space. They may also be used to inhibit conflicts with vehicular traffic by minimizing the possibility of midblock crossings.

Support:

- 25 A major concern for pedestrians is urban and suburban building construction encroaching onto the contiguous sidewalks, which forces pedestrians off the curb into direct conflict with moving vehicles.

Guidance:

- 26 *If a significant potential exists for vehicle incursions into the pedestrian path, pedestrians should be rerouted or temporary traffic barriers should be installed.*

Support:

- 27 TTC devices, jersey barriers, and wood or chain link fencing with a continuous detectable edging can satisfactorily delineate a pedestrian path.

Guidance:

- 28 *Tape, rope, or plastic chain strung between devices are not detectable, do not comply with the design standards in the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), and should not be used as a control for pedestrian movements.*

- 29 *In general, pedestrian routes should be preserved in urban and commercial suburban areas. Alternative routing should be discouraged.*

Standard:

- 30 **The highway agency or municipality in charge of the TTC zone shall regularly inspect the activity area so that effective pedestrian TTC is maintained.**

Section 6D.02 Accessibility Considerations

Support:

- 01 Additional information on the design and construction of accessible temporary facilities is found in publications listed in the Section 1A.11 of the Virginia Supplement to the 2009 MUTCD (see Publications 12, 38, 39, and 42).

Guidance:

- 02 *The extent of pedestrian needs should be determined through engineering judgment or by the individual responsible for each TTC zone situation. Adequate provisions should be made for pedestrians with disabilities.*

Standard:

- 03 **When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier that is detectable by a person with a visual disability traveling with the aid of a long cane shall be placed across the full width of the closed sidewalk.**

Support:

- 04 Maintaining a detectable, channelized pedestrian route is much more useful to pedestrians who have visual disabilities than closing a walkway and providing audible directions to an alternate route involving additional crossings and a return to the original route. Braille is not useful in conveying such information because it is difficult to find. Audible instructions might be provided, but the extra distance and additional street crossings might add complexity to a trip.

Guidance:

- 05 *Because printed signs and surface delineation are not usable by pedestrians with visual disabilities, blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing audible information devices, accessible pedestrian signals, and barriers and channelizing devices that are detectable to pedestrians traveling with the aid of a long cane or who have low vision.*

Support:

- 06 The most desirable way to provide information to pedestrians with visual disabilities that is equivalent to visual signing for notification of sidewalk closures is a speech message provided by an audible information device. Devices that provide speech messages in response to passive pedestrian actuation are the most desirable. Other devices that continuously emit a message, or that emit a message in response to use of a pushbutton, are also acceptable. Signing information can also be transmitted to personal receivers, but currently such receivers are not likely to be carried or used by pedestrians with visual disabilities in TTC zones. Audible information devices might not be needed if detectable channelizing devices make an alternate route of travel evident to pedestrians with visual disabilities.

Guidance:

- 07 *If a pushbutton is used to provide equivalent TTC information to pedestrians with visual disabilities, the pushbutton should be equipped with a locator tone to notify pedestrians with visual disabilities that a special accommodation is available, and to help them locate the pushbutton.*

Section 6D.03 Worker Safety Considerations*Support:*

- 01 Equally as important as the safety of road users traveling through the TTC zone is the safety of workers. TTC zones present temporary and constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for workers on or near the roadway.
- 02 Installation and removal of TTC devices create a risk to workers on foot, for guidance see Section 6G.25. Maintaining TTC zones with road user flow inhibited as little as possible, and using TTC devices that get the road user's attention and provide positive direction are of particular importance. Likewise, equipment and vehicles moving within the activity area also create a risk to workers on foot. When possible, the separation of moving equipment and construction vehicles from workers on foot provides the operator of these vehicles with a greater separation clearance and improved sight lines to minimize exposure to the hazards of moving vehicles and equipment.

Guidance:

- 03 *The following are the key elements of worker safety and TTC management that should be considered to improve worker safety:*
- A. Training—all workers should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, and placement (see TE-345 for Work Zone Traffic Control Training Requirements).*
 - B. Temporary Traffic Barriers—temporary traffic barriers should be placed along the work space depending on factors such as lateral clearance of workers from adjacent traffic, speed of traffic, duration and type of operations, time of day, and volume of traffic (see Appendix A Guidelines for Use of Barrier/Channelization Devices).*
 - C. Speed Reduction—reducing the speed of vehicular traffic, mainly through regulatory speed zoning, funneling, lane reduction, or the use of uniformed law enforcement officers or flaggers, should be considered.*
 - D. Activity Area—planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the exposure to risk.*
 - E. Worker Safety Planning—a trained person designated by the employer should conduct a basic hazard assessment for the worksite and job classifications required in the activity area. This safety professional should determine whether engineering, administrative, or personal protection measures should be implemented. This plan should be in accordance with the Occupational Safety and Health Act of 1970, as amended, “General Duty Clause” Section 5(a)(1) - Public Law 91-596, 84 Stat. 1590, December 29, 1970, as amended, and with the requirement to assess worker risk exposures for each job site and job*

classification, as per 29 CFR 1926.20 (b)(2) of “Occupational Safety and Health Administration Regulations, General Safety and Health Provisions” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).

Standard:

- 04 **Until July 1, 2012, all workers, including emergency responders, media, towing and recovery personnel, and others within the right-of-way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to work vehicles and construction equipment within the TTC zone shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107–2004 publication entitled “American National Standard for High-Visibility Safety Apparel and Headwear” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure, except as provided in Paragraph 7. A person designated by the employer to be responsible for worker safety shall make the selection of the appropriate class of garment.**
- 05 **Beginning July 1, 2012, all workers, including emergency responders, media, towing and recovery personnel and others within the right-of-way who are either exposed to traffic or to work vehicles and construction equipment within the TTC zone shall wear high-visibility safety apparel that meets Performance Class 3 requirements of the ANSI/ISEA 107–2010 publication entitled “American National Standard for High-Visibility Safety Apparel and Headwear” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), or equivalent revisions, and labeled as meeting the ANSI 107-2010 standard performance for Class 3 risk exposure, except as provided in Paragraph 7.**
- 06 **Beginning July 1, 2012, all workers installing, maintaining and removing TTC devices in nighttime work zones and during emergency situations when traffic control must be installed during low light conditions such as inclement weather (fog, rain, sleet, snow, etc.) shall wear Class E trousers in addition to the standard Performance Class 3 risk requirements of the ANSI/ISEA 107–2010 publication. Nighttime work zones are operations which occur from 30 minutes before sunset until 30 minutes after sunrise.**

Option:

- 07 Emergency and incident responders and law enforcement personnel within the TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled “American National Standard for High-Visibility Public Safety Vests” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), or equivalent revisions, and labeled as ANSI 207-2006, in lieu of ANSI/ISEA 107-2004 apparel.

Standard:

- 08 **When uniformed law enforcement personnel are used to direct traffic, to investigate crashes, or to handle lane closures, obstructed roadways, and disasters, high-visibility safety apparel as described in this Section shall be worn by the law enforcement personnel. Refer to Paragraph 7 of Section 6E.02 for additional guidance.**
- 09 **Except as provided in Paragraph 10, firefighters or other emergency responders working within the right-of-way shall wear high-visibility safety apparel as described in this Section.**

Option:

- 10 Firefighters or other emergency responders working within the right-of-way and engaged in emergency operations that directly expose them to flame, fire, heat, and/or hazardous materials may wear retroreflective turn-out gear that is specified and regulated by other organizations, such as the National Fire Protection Association.
- 11 The following are additional elements of TTC management that may be considered to improve worker safety:
- A. Shadow Vehicle—in the case of mobile and constantly moving operations, such as pothole patching and striping operations, a shadow vehicle, equipped with appropriate lights and warning signs, may be used to protect the workers from impacts by errant vehicles. The shadow vehicle may be equipped with a rear-mounted impact attenuator.
 - B. Road Closure—if alternate routes are available to handle road users, the road may be closed temporarily. This may also facilitate project completion and thus further reduce worker vulnerability.
 - C. Law Enforcement Use—in highly vulnerable work situations, particularly those of relatively short duration, law enforcement units may be stationed to heighten the awareness of passing vehicular traffic and to

improve safety through the TTC zone (See Appendix C Guidelines for use of Virginia State Police in Construction/Maintenance Work Zones).

- D. Lighting—for nighttime work, the TTC zone and approaches may be lighted.
- E. Special Devices—these include rumble strips, changeable message signs, hazard identification beacons, flags, and warning lights. Intrusion warning devices may be used to alert workers to the approach of errant vehicles.

Support:

- 12 Judicious use of the special devices described in Item E in Paragraph 11 might be helpful for certain difficult TTC situations, but misuse or overuse of special devices or techniques might lessen their effectiveness.

CHAPTER 6E. FLAGGER CONTROL

Section 6E.01 Qualifications for Flaggers

Standard:

- 01 A flagger shall be a person who provides TTC.
- 02 The flagger shall be certified in accordance with the VDOT Flagger Certification Program, the American Traffic Safety Services Association Flagger Certification Program or any other VDOT approved flagger program. The flagger shall have his/her certification card with them at all times while performing flagging activities.
- 03 A flagger shall be recertified every two years if the flagger is certified by the VDOT Flagger Certification Program or every three years if the flagger is certified by the ATSSA Flagger Certification Program.
- 04 Flaggers shall be able to communicate to the traveling public in English while performing their job duty as a flagger at the flagger station.
- 05 Since a flagger can be held legally responsible for their actions, the flagger shall be a minimum of 18 years old.

Guidance:

- 06 *Because flaggers are responsible for public safety and make the greatest number of contacts with the public of all highway workers, they should be trained in safe traffic control practices and public contact techniques. Flaggers should be able to satisfactorily demonstrate the following abilities:*
 - A. *Ability to receive and communicate specific instructions clearly, firmly, and courteously;*
 - B. *Ability to move and maneuver quickly in order to avoid danger from errant vehicles;*
 - C. *Ability to control signaling devices (such as paddles and flags) in order to provide clear and positive guidance to drivers approaching a TTC zone in frequently changing situations;*
 - D. *Ability to understand and apply safe traffic control practices, sometimes in stressful or emergency situations; and*
 - E. *Ability to recognize dangerous traffic situations and warn workers in sufficient time to avoid injury.*
- 07 *To assure that a fully alert flagger is present at the flagger station; flaggers should be relieved for a minimum period of fifteen minutes every two hours.*

Section 6E.02 High-Visibility Safety Apparel

Standard:

- 01 The flagger shall remain fully clothed, from neck to feet, when flagging. This includes the wearing of shirts with sleeves (at least short sleeves in length), long pants, steel toe shoes and a hardhat.
- 02 Foot Protection shall comply with either: (1) ASTM F-2412-2005 (or more current ASTM), "Standard Test Methods for Foot Protection," and ASTM F-2413-2005 (or more current ASTM), "Standard Specification for Performance Requirements for Protective Footwear," or the previous standard (2) ANSI Z41-1999, "American National Standard for Personal Protection -- Protective Footwear." Head protection shall comply with ANSI Z89.1-1997 (or more current), "American National Standard for Industrial Head Protection."
- 03 Until July 1, 2012, for daytime and nighttime activity, flaggers shall wear high-visibility safety apparel that meets the Performance Class 2 or Class 3 requirements of the ANSI/ISEA 107-2004 publication entitled "American National Standard for High-Visibility Apparel and Headwear" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD) or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or Class 3 risk exposure. A person designated by the employer to be responsible for worker safety shall make the selection of the appropriate class of garment.
- 04 Beginning July 1, 2012, all flaggers shall wear high-visibility safety apparel that meets Performance Class 3 requirements of the ANSI/ISEA 107-2010 publication entitled "American National Standard for High-Visibility Apparel and Headwear" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD) or equivalent revisions, and labeled as meeting the ANSI 107-2010 standard performance for Class 3 risk exposure.
- 05 Beginning July 1, 2012, for nighttime activities (from 30 minutes before sunset until 30 minutes after sunrise), or other low light conditions such as inclement weather (fog, rain, sleet, snow, etc.) the flagger shall

wear Class E trousers in addition to the standard Performance Class 3 risk requirements of the ANSI/ISEA 107–2010 publication.

06 The high-visibility safety apparel background (outer) material color shall be fluorescent orange-red, fluorescent yellow-green, or a combination of the two as defined in the ANSI standard. The retroreflective material shall be orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of 1,000 feet. The retroreflective safety apparel shall be designed to clearly identify the wearer as a person.

07 When uniformed law enforcement officers are used to direct traffic within a TTC zone, they shall wear high-visibility safety apparel as described in this Section.

Option:

08 In lieu of ANSI/ISEA 107-2010 apparel, law enforcement personnel within the TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled “American National Standard for High-Visibility Public Safety Vests” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD) and labeled as ANSI 207-2006.

Section 6E.03 Hand-Signaling Devices

Standard:

01 The STOP/SLOW paddle shall be the primary and preferred hand-signaling device because the STOP/SLOW paddle gives road users more positive guidance than a red flag or a fluorescent orange/red flag.

02 The STOP/SLOW paddle shall have an octagonal shape on a rigid handle. STOP/SLOW paddles shall be at least 24 inches wide with letters at least 8 inches high. The STOP (R1-1) face shall have white letters and border on a red background. The SLOW (W20-8 (V)) face shall have black letters and a black border on a fluorescent orange background. Reflective sheeting shall be in compliance with Section 247 of the Road and Bridge Specifications.

Guidance:

03 The STOP/SLOW paddle should be fabricated from light semi-rigid material.

Support:

04 The optimum method of displaying a STOP or SLOW message is to place the STOP/SLOW paddle on a rigid staff, with a minimum of 5 feet from the bottom of the sign paddle to the top of the roadway elevation, in order to display a STOP or SLOW message that is stable and high enough to be seen by approaching or stopped traffic.

Option:

05 The STOP/SLOW paddle may be modified to improve conspicuity by incorporating either white or red flashing lights on the STOP face, and either white or yellow flashing lights on the SLOW face. The flashing lights may be arranged in any of the following patterns:

- A. Two white or red lights, one centered vertically above and one centered vertically below the STOP legend; and/or two white or yellow lights, one centered vertically above and one centered vertically below the SLOW legend;
- B. Two white or red lights, one centered horizontally on each side of the STOP legend; and/or two white or yellow lights, one centered horizontally on each side of the SLOW legend;
- C. One white or red light centered below the STOP legend; and/or one white or yellow light centered below the SLOW legend;
- D. A series of eight or more small white or red lights no larger than 1/4 inch in diameter along the outer edge of the paddle, arranged in an octagonal pattern at the eight corners of the border of the STOP face; and/or a series of eight or more small white or yellow lights no larger than 1/4 inch in diameter along the outer edge of the paddle, arranged in a diamond pattern along the border of the SLOW face; or
- E. A series of white lights forming the shapes of the letters in the legend.

06 For surveying and other operations occurring on the shoulder or near the centerline of two-lane roadways, a combination STOP/SLOW paddle and SLOW/SLOW paddle utilizing a double sided SLOW flip panel may be used to prevent unnecessary stopping of vehicles by the flagger.

Standard:

- 07 If flashing lights are used on the STOP face of the paddle, their colors shall be all white or all red. If flashing lights are used on the SLOW face of the paddle, their colors shall be all white or all yellow.
- 08 If more than eight flashing lights are used, the lights shall be arranged such that they clearly convey the octagonal shape of the STOP face of the paddle and/or the diamond shape of the SLOW face of the paddle.
- 09 If flashing lights are used on the STOP/SLOW paddle, the flash rate shall be at least 50, but not more than 60, flashes per minute.
- 10 Flags, when used, shall be red or fluorescent orange/red in color; shall be a minimum of 24 inches square; and shall be securely fastened to a staff that is approximately 36 inches in length.
- 11 Use of flags shall be limited to emergency situations, traffic spotters and TTC spotters.
- 12 When used at nighttime, flags shall be retroreflectorized red.

Guidance:

- 13 *The free edge of a flag should be weighted so the flag will hang vertically, even in heavy winds.*

Standard:

- 14 When a flashlight is used at night it shall be equipped with a steady burn red glow cone or steady burn traffic baton/wand to supplement the STOP/SLOW paddle or flag. The flagger shall hold the flashlight in the left hand, shall hold the paddle or flag in the right hand as shown in Figure 6E-3, and shall use the flashlight in the following manner to control approaching road users:
 - A. To inform road users to stop, the flagger shall hold the flashlight with the left arm extended and pointed down toward the ground, and then shall slowly wave the flashlight in front of the body in a slow arc from left to right such that the arc reaches no farther than 45 degrees from vertical.
 - B. To inform road users to proceed, the flagger shall point the flashlight at the vehicle's bumper, slowly aim the flashlight toward the open lane, then hold the flashlight in that position. The flagger shall not wave the flashlight.
 - C. To alert or slow traffic, the flagger shall point the flashlight toward oncoming traffic and quickly wave the flashlight in a figure eight motion.

Section 6E.04 Automated Flagger Assistance Devices*Support:*

- 01 Automated Flagger Assistance Devices (AFADs) enable a flagger(s) to be positioned out of lane of traffic and are used to control road users through temporary traffic control zones. These devices are designed to be remotely operated either by a single flagger at one end of the TTC zone or at a central location, or by separate flaggers near each device's location.
- 02 There are two types of AFADs:
 - A. An AFAD (see Section 6E.05) that uses a remotely controlled STOP/SLOW sign on either a trailer or a movable cart system to alternately control right-of-way.
 - B. An AFAD (see Section 6E.06) that uses remotely controlled red and yellow lenses and a gate arm to alternately control right-of-way.
- 03 AFADs might be appropriate for short-term and intermediate-term activities (see Section 6G.02). Typical applications include TTC activities such as, but not limited to:
 - A. Bridge maintenance;
 - B. Haul road crossings;
 - C. Guardrail repair; and
 - D. Pavement patching.

Standard:

- 04 AFADs shall only be used when all of the following conditions are met:
 - A. On a two-lane, two-way roadway closed to one lane of traffic;
 - B. Where there is only one lane of approaching traffic in the direction to be controlled;
 - C. Average daily traffic (ADT) count is 12,000 vehicles per day or less or as directed by the Regional Traffic Engineer;

- D. The operator must have an unobstructed view of the Automatic Flagger Assistance Device and approaching traffic in both directions and;**
- E. Approval required by the Regional Traffic Engineer for multiple operators and distances greater than 800 feet.**

05 **When used at night, the AFAD location shall be illuminated in accordance with Section 6E.08.**

Guidance:

06 *AFADs should not be used for long-term stationary work (see Section 6G.02).*

Standard:

07 **Because AFADs are not traffic control signals, they shall not be used as a substitute for or a replacement for a continuously operating temporary traffic control signal as described in Section 6F.93.**

08 **Small, highly portable, movable cart AFAD systems that are positioned manually without the use of a vehicle are treated as a portable sign stand and shall meet the crashworthy performance criteria contained in Section 6F.01.**

Support:

09 A trailer-mounted, towable, AFAD is a NCHRP Report 350 Category IV device.

Guidance:

10 *If used, AFADs should be located in advance of one-lane, two-way tapers and downstream from the point where approaching traffic is to stop in response to the device.*

Standard:

11 **If used, AFADs shall be placed so that all of the signs and other items controlling traffic movement are readily visible to the driver of the initial approaching vehicle with advance warning signs alerting other approaching traffic to be prepared to stop.**

12 **If used, an AFAD shall be operated only by a certified flagger (see Section 6E.01) who has been trained on the operation of the AFAD. The flagger(s) operating the AFAD(s) shall not leave the AFAD(s) unattended at any time while the AFAD(s) is being used.**

13 **The use of AFADs shall conform to one of the following methods:**

- A. An AFAD at each end of the TTC zone (Method 1), or**
- B. An AFAD at one end of the TTC zone and a flagger at the opposite end (Method 2).**

14 **Except as provided in Paragraph 15, two flaggers shall be used when using either Method 1 or Method 2.**

Option:

15 A single flagger may simultaneously operate two AFADs (Method 1) or may operate a single AFAD on one end of the TTC zone while being the flagger at the opposite end of the TTC zone (Method 2) if both of the following conditions are present:

- A. The flagger has an unobstructed view of the AFAD(s), and
- B. The flagger has an unobstructed view of approaching traffic in both directions.

Guidance:

16 *When an AFAD is used, the advance warning signing should include a ROAD WORK AHEAD (W20-1) sign, a ONE LANE ROAD AHEAD (W20-4) sign, and a BE PREPARED TO STOP (W3-4) sign.*

17 *Advance warning signs spacing for the AFAD should be adjusted if traffic queues extend beyond the ONE LANE ROAD AHEAD sign.*

Standard:

18 **When the AFAD is not in use, the signs associated with the AFAD, both at the AFAD location and in advance, shall be removed or covered.**

Section 6E.05 STOP/SLOW Automated Flagger Assistance Devices

Standard:

01 **The STOP/SLOW Automated Flagger Assistance Device (AFAD) (see Section 6E.04) shall include a STOP/SLOW sign that alternately displays the STOP (R1-1) face and the SLOW (W20-8 (V)) face of a STOP/SLOW paddle (see Figure 6E-1).**

- 02 The AFAD's STOP/SLOW sign shall have an octagonal shape, shall be fabricated of rigid material, and shall be mounted with the bottom of the sign a minimum of 6 feet above the pavement on an appropriate support. The size of the STOP/SLOW sign shall be at least 36 x 36 inches with letters at least 12 inches high. The background of the STOP face shall be red with white letters and border. The SLOW face shall be fluorescent orange, diamond shape, with black letters and border. The reflective sheeting for the STOP/SLOW sign shall be in compliance with Section 247 of the Road and Bridge Specifications.
- 03 The AFAD's STOP/SLOW sign shall have a means to positively lock, engage, or otherwise maintain the sign assembly in a stable condition when set in the STOP or SLOW position.
- 04 The AFAD's STOP/SLOW sign shall be supplemented with active conspicuity devices by incorporating either:
- A. White or red flashing lights within the STOP face and white or yellow flashing lights within the SLOW face meeting the provisions contained in Section 6E.03; or
 - B. A LED Stop Beacon (see Section 4L.05 of the 2009 MUTCD) mounted a maximum of 24 inches above the STOP face and a LED Warning Beacon (see Section 4L.03 of the 2009 MUTCD) mounted a maximum of 24 inches above, below, or to the side of the SLOW face. The Stop Beacon shall not be flashed or illuminated when the SLOW face is displayed, and the Warning Beacon shall not be flashed or illuminated when the STOP face is displayed. Except for the mounting locations, the beacons shall comply with the provisions of Chapter 4L of the 2009 MUTCD.

Option:

- 05 Type B warning light(s) (see Section 6F.91) may be used in lieu of the Warning Beacon during the display of the SLOW face of the AFAD's STOP/SLOW sign.

Standard:

- 06 If Type B warning lights are used in lieu of a Warning Beacon, they shall flash continuously when the SLOW face is displayed and shall not be flashed or illuminated when the STOP face is displayed.

Option:

- 07 The faces of the AFAD's STOP/SLOW sign may include louvers to improve the stability of the device in windy or other adverse environmental conditions.

Standard:

- 08 If louvers are used, the louvers shall be designed such that the full sign face is visible to approaching traffic at a distance of 50 feet or greater.

- 09 The STOP/SLOW AFAD shall include a gate arm that descends to a down position across the approach lane of traffic when the STOP face is displayed and then ascends to an upright position when the SLOW face is displayed.

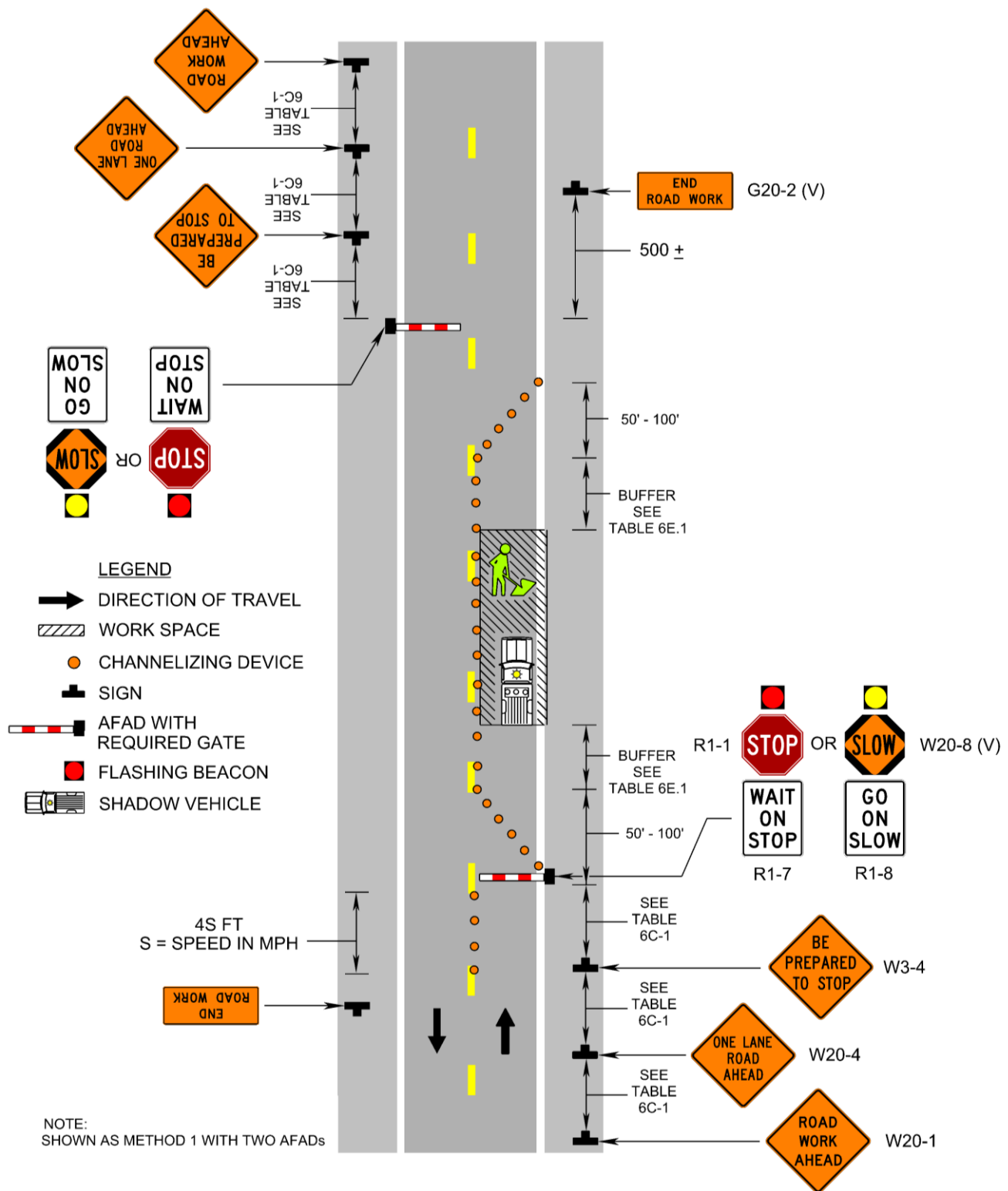
Option:

- 10 In lieu of a stationary STOP/SLOW sign with a separate gate arm, the STOP/SLOW sign may be attached to a mast arm that physically blocks the approach lane of traffic when the STOP face is displayed and then moves to a position that does not block the approach lane when the SLOW face is displayed.

Standard:

- 11 Gate arms shall be fully retroreflectorized on both sides, and shall have vertical alternating fluorescent white and fluorescent red prismatic lens, from left to right, stripes at 16-inch intervals measured horizontally as shown in 2009 MUTCD (see Figure 8C-1). The reflective sheeting shall be in compliance with Section 247 of the Road and Bridge Specifications. When the arm is in the down position blocking the approach lane:
- A. The minimum vertical aspect of the arm and sheeting shall be 4 inches;
 - B. The end of the arm shall reach at least to the center of the lane being controlled but shall not extend beyond the lane being controlled;
 - C. A minimum of 24 inches square red flag or a fluorescent orange/red flag shall be fastened to the end of the gate arm.

Figure 6E-1, Example of the Use of a Stop/Slow Automated Flagger Assistance Device (AFAD)



- 12 A WAIT ON STOP (R1-7) sign and a GO ON SLOW (R1-8) sign (see Figure 6E-1) shall be displayed to road users approaching the AFAD. The signs shall be rectangular in shape and be at least 24 x 30 inches in size with letters at least 6 inches high. The background of the sign face shall be fluorescent white prismatic lens with black letters and border and its reflective sheeting shall be in compliance with Section 247 of the Road and Bridge Specifications
- 13 The signs shall be positioned on the same support structure as the AFAD or immediately adjacent to the AFAD such that they are in the same direct line of view of approaching traffic as the sign face of the AFAD.
- 14 To inform road users to stop, the AFAD shall display the STOP face and the red or white lights, if used, within the STOP face shall flash or the Stop Beacon shall flash. To inform road users to proceed, the AFAD shall display the SLOW face and the yellow or white lights, if used, within the SLOW face shall flash or the Warning Beacon or the Type B warning lights shall flash.
- 15 If STOP/SLOW AFADs are used to control traffic in a one-lane, two-way TTC zone, safeguards shall be incorporated to prevent the flagger(s) from simultaneously displaying the SLOW face at each end of the TTC zone. Additionally, the flagger(s) shall not display the AFAD's SLOW face until all oncoming vehicles have cleared the one-lane portion of the TTC zone.

Section 6E.06 Red/Yellow Lens Automated Flagger Assistance Devices

Standard:

- 01 A Red/Yellow Lens Automated Flagger Assistance Device (AFAD) (see Section 6E.04) shall alternately display a steadily illuminated CIRCULAR RED LED lens and a flashing CIRCULAR YELLOW LED lens to control traffic without the need for a flagger in the immediate vicinity of the AFAD or on the roadway (see Figure 6E-2).
- 02 Red/Yellow Lens AFAD shall have at least one set of CIRCULAR RED and CIRCULAR YELLOW lenses that are 12 inches in diameter. Unless otherwise provided in this Section, the lenses and arrangement, CIRCULAR RED on top and CIRCULAR YELLOW below, shall comply with the bottom of the housing (including brackets) shall be at least 7 feet above the pavement. If the set of lenses is located over any portion of the highway that can be used by motor vehicles, the bottom of the housing (including brackets) shall be at least 15 feet above the pavement.

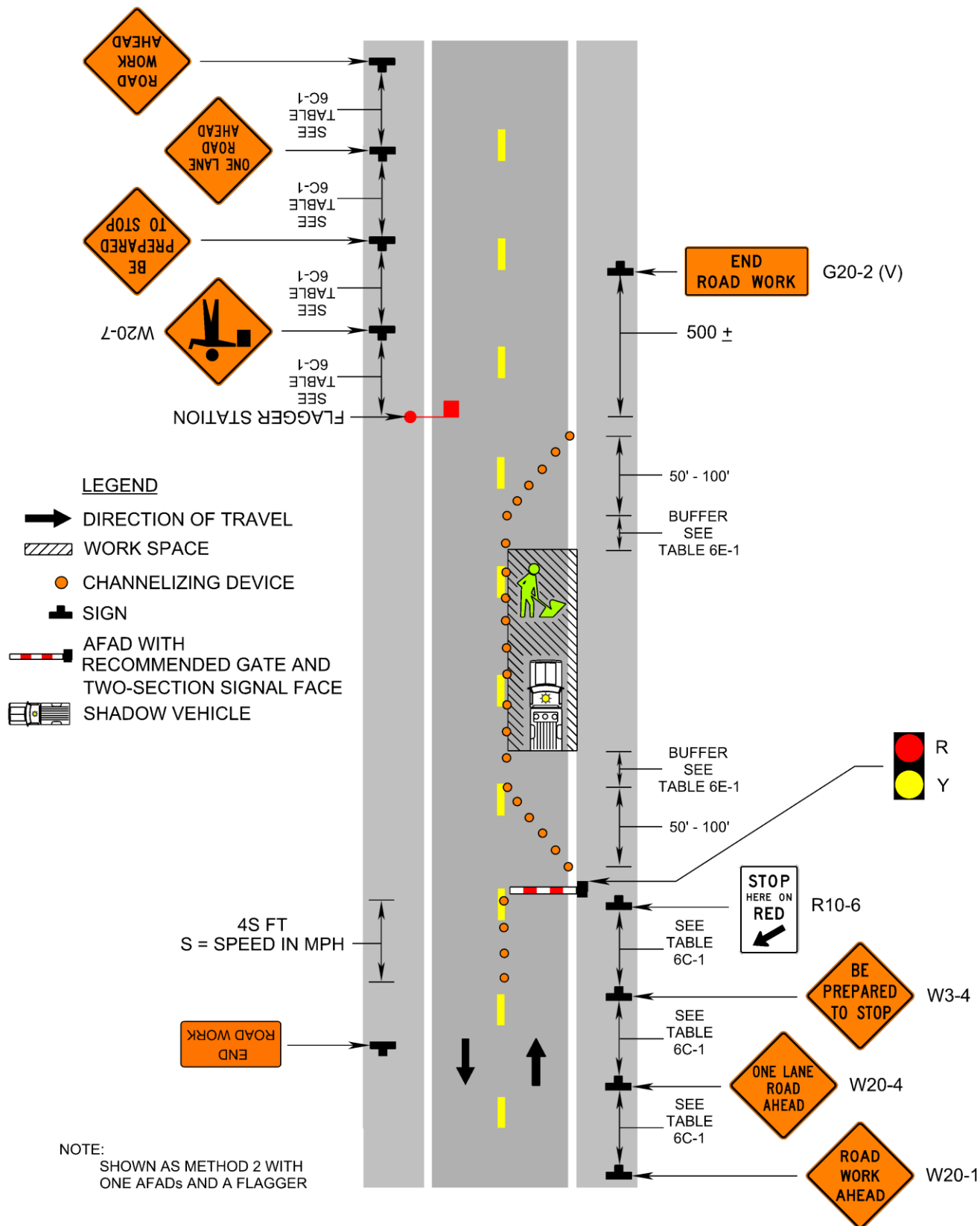
Option:

- 03 Additional sets of CIRCULAR RED and CIRCULAR YELLOW lenses, located over the roadway or on the left-hand side of the approach and operated in unison with the primary set, may be used to improve visibility and/or conspicuity of the AFAD.

Standard:

- 04 A Red/Yellow Lens AFAD shall include a gate arm that descends to a down position across the approach lane of traffic when the steady CIRCULAR RED lens is illuminated and then ascends to an upright position when the flashing CIRCULAR YELLOW lens is illuminated. The gate arm shall be fully retroreflectorized on both sides, and shall have vertical alternating red and white stripes at 16-inch intervals measured horizontally as shown in Figure 8C-1 of the 2009 MUTCD. When the arm is in the down position blocking the approach lane:
 - A. The minimum vertical aspect of the arm and sheeting shall be 4 inches; and
 - B. The end of the arm shall reach at least to the center of the lane being controlled but shall not extend beyond the lane being controlled.
- 05 A STOP HERE ON RED (R10-6 or R10-6a) sign (see Section 2B.53 of the Virginia Supplement to the 2009 MUTCD) shall be installed on the right-hand side of the approach at the point at which drivers are expected to stop when the steady CIRCULAR RED lens is illuminated (see Figure 6E-2). The sign shall be rectangular in shape and each shall be at least 24 x 36 inches in size with letters at least 6 inches high. The background of the sign face shall be fluorescent white prismatic lens with black letters and border and its reflective sheeting shall be in compliance with Section 247 of the Road and Bridge Specifications.

Figure 6E-2, Example of the Red/Yellow Lens Automated Flagger Assistance Device (AFAD)



- 06 To inform road users to stop, the AFAD shall display a steadily illuminated CIRCULAR RED lens and the gate arm shall be in the down position. To inform road users to proceed, the AFAD shall display a flashing CIRCULAR YELLOW lens and the gate arm shall be in the upright position.
- 07 If Red/Yellow Lens AFADs are used to control traffic in a one-lane, two-way TTC zone, safeguards shall be incorporated to prevent the flagger(s) from actuating a simultaneous display of a flashing CIRCULAR YELLOW lens at each end of the TTC zone. Additionally, the flagger shall not actuate the AFAD's display of the flashing CIRCULAR YELLOW lens until all oncoming vehicles have cleared the one-lane portion of the TTC zone.
- 08 A change interval shall be provided as the transition between the display of the flashing CIRCULAR YELLOW indication and the display of the steady CIRCULAR RED indication. During the change interval, the CIRCULAR YELLOW lens shall be steadily illuminated. The gate arm shall remain in the upright position during the display of the steadily illuminated CIRCULAR YELLOW change interval.
- 09 A change interval shall not be provided between the display of the steady CIRCULAR RED indication and the display of the flashing CIRCULAR YELLOW indication.
- Guidance:*
- 10 The steady illuminated CIRCULAR YELLOW change interval should have a duration of at least 5 seconds, unless a different duration, within the range of durations recommended by Section 4D.26 of the 2009 MUTCD, is justified by engineering judgment.
- 11 The AFAD unit should notify the flagger of any unit failure.

Section 6E.07 Flagger Procedures

Support:

- 01 The use of paddles and flags by flaggers is illustrated in Figure 6E-3.

Standard:

- 02 Flaggers shall use a STOP/SLOW paddle, a flag, or an Automated Flagger Assistance Device (AFAD) to control road users approaching a TTC zone. The use of hand movements alone without a paddle, flag, or AFAD to control road users shall be prohibited except for law enforcement personnel or emergency responders at incident scenes as described in Section 6I.01.
- 03 The following methods of signaling with STOP/SLOW paddles shall be used:
- A. To stop road users, the flagger shall face road users and aim the STOP paddle face toward road users in a stationary position with the arm extended horizontally away from the body. The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.
 - B. To direct stopped road users to proceed, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body. The flagger shall motion with the free hand for road users to proceed.
 - C. To alert or slow traffic, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body.

Option:

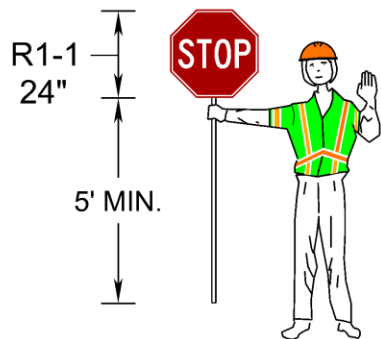
- 04 To further alert or slow traffic, the flagger holding the SLOW paddle face toward road users may motion up and down with the free hand, palm down.

Standard:

- 05 The following methods of signaling with a flag shall be used:
- A. To stop road users, the flagger shall face road users and extend the flag staff horizontally across the road users' lane in a stationary position so that the full area of the flag is visibly hanging below the staff. The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.
 - B. To direct stopped road users to proceed, the flagger shall face road users with the flag and arm lowered from the view of the road users, and shall motion with the free hand for road users to proceed. Flags shall not be used to signal road users to proceed.

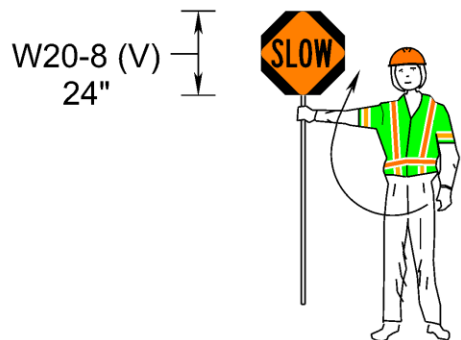
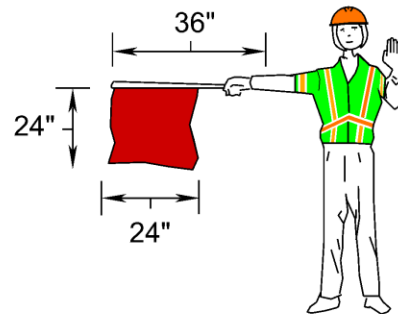
Figure 6E-3, Use of Hand Held Signal Devices

**PREFERRED METHOD
STOP/SLOW PADDLE**



TO STOP TRAFFIC

**EMERGENCY, TRAFFIC SPOTTER &
TEMPORARY TRAFFIC CONTROL SPOTTER
SITUATIONS ONLY
RED OR FLUORESCENT ORANGE/RED FLAG**



TO LET TRAFFIC PROCEED



TO ALERT AND SLOW TRAFFIC

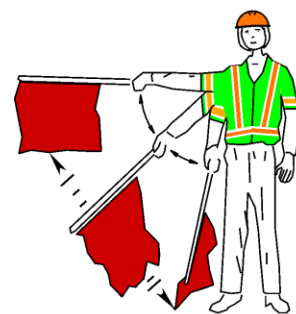


Figure 6E-4, Flagger Requirements (Sheet 1 of 2)

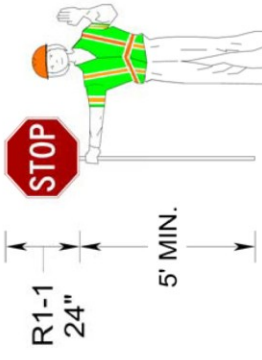
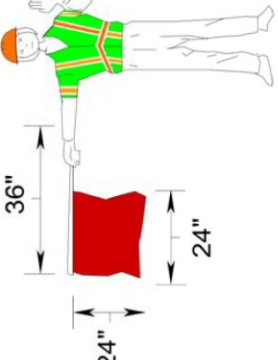
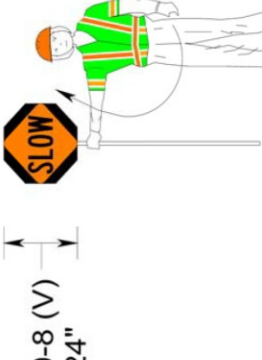
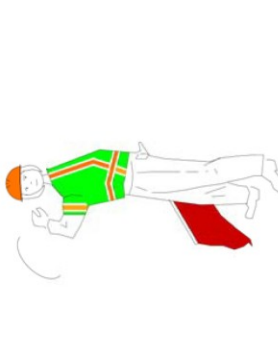
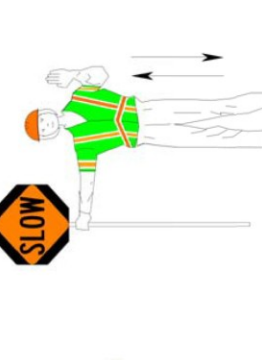
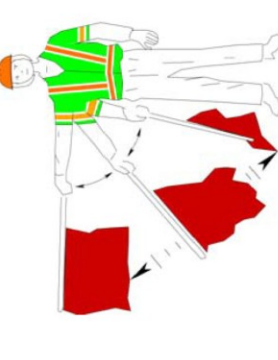
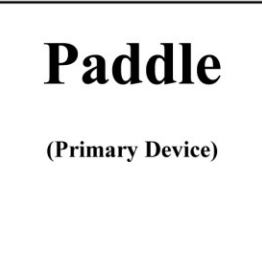

<div>Virginia Department of Transportation</div> <h1>Flagging Requirements</h1>			
<p>Paddle (Primary Devices)</p>  <p>R1-1 24" 24" 5' MIN.</p> <p>W20-8 (V) 24" 24"</p>	<p>Flag (Emergencies, Traffic Spotters and TTC Spotters)</p>  <p>36" 24" 24"</p>	<p>Safeguard Traffic</p> <ol style="list-style-type: none"> 1. A sufficient number of competent, certified, courteous, neat and fully dressed flaggers shall be provided and available at all times when required. 2. The flagger is responsible for safeguarding his fellow workers on the job, warning motorists of dangers ahead, and guiding them safely through a work area. 3. Flaggers shall be available to stop traffic, advise the motorist of any delay, and to keep vehicles in the proper lanes along the work area. 4. Flaggers shall communicate in English specific instructions clearly, firmly and courteously while flagging. 5. Flagger shall be at least 18 years old. <p>Flaggers shall perform their duties in the following manner:</p> <ol style="list-style-type: none"> 1. Ensure all signs are installed prior to performing flagging operations. 2. Be alert and attentive at all times. 3. The flagger shall stand alone, never permitting a group of workers to congregate around the flagger station or allow work vehicles near the flagger station. 4. Always stand while waiting for traffic. 5. Have an avenue of escape if approached by an errant vehicle. 6. Use proper hand signals with the STOP/SLOW paddle. 7. Make eye contact with motorists. 8. Do not leave your post until you are properly relieved. 9. Coordinate with other flaggers. 10. Have your certification card in your possession while performing flagging duties. 	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>
<p>Paddle (Primary Device)</p>  <p>24" 24"</p>	<p>Flag (Emergencies, Traffic Spotters and TTC Spotters)</p>  <p>36" 24" 24"</p>	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>
<p>Paddle (Primary Device)</p>  <p>24" 24"</p>	<p>Flag (Emergencies, Traffic Spotters and TTC Spotters)</p>  <p>36" 24" 24"</p>	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>
<p>Paddle (Primary Device)</p>  <p>24" 24"</p>	<p>Flag (Emergencies, Traffic Spotters and TTC Spotters)</p>  <p>36" 24" 24"</p>	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>	<p>Proper Dressed</p> <ol style="list-style-type: none"> 1. Hard hat. 2. Retroreflective highly-visibility safety apparel meeting ANSI/ISEA 107-2010 Class 3 risk exposure for daytime and nighttime ANSI/ISEA 107-2010 Class 3 risk exposure shall include Type E trousers. 3. Protective footwear must comply with ANSI Z41-1999, ASTM F-2412-2005, ASTM F-2413-2005 (or more current ASTM). 4. Shirt with sleeves and long pants. (Removal of shirt is prohibited). 5. Headphones are prohibited. <p>Note - Nighttime hours are defined as starting 30 minutes before sunset to 30 minutes after sunrise.</p>

Figure 6E-4, Flagger Requirements (Sheet 2 of 2)

Methods of Flagging Traffic

Where to stand

- 1. Flagging stations shall be preceded by proper advance warning signs. Signs shall be removed when the flagger is no longer at their station. At night, flagging stations shall be illuminated with a minimum of horizontal luminance of 5-foot candles (50 lux).
- 2. Stand where you can see and be seen by approaching traffic. Clear sight distance from the graphic flagger sign to the flagger station should be 350' to 500' where the posted speed limit is 45 m.p.h. or 500' to 800' where the posted speed limit is greater than 45 m.p.h. (Less spacing may be necessary in areas where conditions warrant).
- 3. Stand facing traffic either on the edge of the shoulder of the road or near the edge of pavement.
- 4. Flagger stations should be located such that an errant vehicle has additional space to stop without entering the work area. The distance from the flagger station to the work area should be:

Posted Speed (mph)	20	25	30	35	40	45	50	55	60
Minimum SSD	195	240	290	335	385	430	480	530	575

How to stop traffic

- 1. Stand on the shoulder of the roadway facing traffic.
- 2. (a) With a Paddle - Hold the STOP sign paddle in a stationary position. Look directly at the approaching traffic. Raise your free hand with palm exposed to approaching driver and make eye contact with the driver.
(b) With a Flag - Hold the staff in a horizontal position and extend it toward the travel lane being careful not to encroach the travel lane. Look directly at the approaching traffic. Raise your free hand with palm exposed to approaching driver and make eye contact with the driver.
- 3. If time permits, drivers may be informed concerning the reason for the delay. Speaking in English be courteous and brief. For example, "Patching a hole, please drive on the left."

How to release traffic

- 1. Before releasing traffic the flagger will return to the normal flagging location. Keep your paddle on STOP or flag extended until you are safely on the shoulder of the roadway.
- 2. (a) With a Paddle--Stand facing traffic. Hold the SLOW sign paddle in a stationary position with the paddle facing the road user. With your free arm signal the drivers to proceed into the open lane.
(b) With a Flag--Stand parallel to roadway facing the road users. drop the flag to your side and with you free hand motion traffic to proceed to the open lane.
(c) Where traffic is stopped temporarily in one lane, release traffic by turning the paddle a quarter turn so that the word "STOP" faces you and is parallel to the roadway. With your free arm signal the drivers to proceed into the open lane.

How to alert and slow traffic but not stop it

- 1. Stand facing traffic.
- 2. (a) With a Paddle - Hold the SLOW sign paddle in a stationary position with the arm extended horizontally away from the body. For added emphasis, the flagger may raise and lower the free hand with the palm down.
(b) With a Flag - Stand parallel to traffic movement. The flagger should raise the flag from the ground to the shoulder and slowly motion up and down with the free palm down.

Never wave a paddle or flag

- 1. Signals must be clear and direct.
- 2. Use hand signals with devices. Don't make drivers guess what they should do.
- 3. Never wave a paddle or flag to stop traffic or for it to proceed.

- C. To alert or slow traffic, the flagger shall face road users and slowly wave the flag in a sweeping motion of the extended arm from shoulder level to straight down without raising the arm above a horizontal position. The flagger shall keep the free hand down.**

Guidance:

- 06 *The flagger should stand either on the shoulder adjacent to the road user being controlled or in the closed lane prior to stopping road users. A flagger should only stand in the lane being used by moving road users after road users have stopped.*

Standard:

- 07 **Flaggers shall be positioned so they are clearly visible to the first approaching road user at all times and also be visible to other road users. Flaggers shall be stationed sufficiently in advance of the workers to warn them of an errant vehicle.**
- 08 **The flagger shall stand alone, away from other workers, work vehicles, or equipment.**

Option:

- 09 At spot lane closures where adequate sight distance is available for the reasonably safe handling of traffic, the use of one flagger may be sufficient.

Guidance:

- 10 *When a single flagger is used, the flagger should be stationed on the shoulder opposite the spot lane closure work space, or in a position where good visibility and traffic control can be maintained at all times.*

Standard:

- 11 **Only uniformed law enforcement officers are allowed to direct traffic through an operating traffic signal (see Section 46.2-834 of Highway Laws of Virginia). Flaggers do not have the authority and shall not direct vehicles through an operating traffic signal at an intersection.**
- 12 **A flagger shall control only one lane of traffic approaching an intersection as shown in Figure TTC-30.**

Support:

- 13 *Flaggers may use whistles, air horns, or other audible devices to alert and warn workers of the approach of a vehicle which failed to stop at the flagger station when instructed to do so.*

Section 6E.08 Flagger Stations

Standard:

- 01 **Except in emergency situations, flagger stations shall be preceded by an advance warning sign or signs. The Flagger sign shall be removed, covered, or turned away from road users when the flagger operation is suspended for 30 minutes or longer.**
- 02 **Except in emergency situations, flagger stations shall be illuminated at night by an overhead or ground-mounted light source with a minimum of horizontal luminance of 5-foot candles (50 lux). The light source shall be mounted ensuring that it does not prohibit the escape route of the flagger or the light's glare does not prohibit the sight of the traveling public or the flagger.**
- 03 **The intensity of the light source for the flagger station in foot-candle shall be available in written documentation.**

Support:

- 04 *Foot-candle measures the intensity of a light source, while lux measures luminance. Luminance is the amount of light falling on an area or the flagger station. The reference to horizontal luminance means the area of the flagger station is covered at minimum rate of 50 lux over the entire area and not just in spots. To obtain horizontal luminance, the light source is higher than the flagger station and points down on the flagger. The lighting source must not interfere with the flagger or motorist line of sight.*
- 05 *1 foot-candle equals 10.8 lux, so a 5 foot-candle light source will produce more than 50 lux ($5 \times 10.8 = 54$ lux).*

Standard:

- 06 **The requirement for flagger station illumination shall not be considered to be satisfied by street or highway lights or vehicle headlights.**
- 07 **Flagger stations shall be located such that approaching road users will have sufficient distance to stop at an intended stopping point.**

- 08 **Additional flagger stations shall be located on intersecting roadways within the work zone such that approaching road users will have sufficient distance to stop and be controlled by the flagger.**

Guidance:

- 09 *The distances shown in Table 6E-1, which provides information regarding the stopping sight distance as a function of speed, should be used for the location of a flagger station measured from the beginning of the work area. The distances in Table 6E-1 should also be used to provide a clear line of sight to traffic approaching the flagger station. Generally speaking, motorists should be able to see the flagger at the flagger station when they reach the position of the graphic flagger symbol sign. These distances should be increased for downgrades and other geometric conditions that affect stopping distance.*
- 10 *Flagger stations should be located such that an errant vehicle has additional space to stop without entering the work space. The flagger should identify an escape route that can be used to avoid being struck by an errant vehicle.*

Table 6E-1, Buffer Space/ Flagger Distance from Work Area

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 – 120
25	155 – 165
30	200 – 210
35	250 – 260
40	305 – 320
45	360 – 380
50	425 – 445
55	500 – 520
60	570 – 590
65	645 – 675
70	730 – 760

- 11 *A supplemental flagger should be considered in advance of the primary flagger(s) when geometric conditions prevent adequate sight distance to the primary flagger.*

Option:

- 12 Where inadequate shoulders exist, the supplemental flagger may be replaced with a 48" x 48" SLOW (W21-V10) sign.

Section 6E.09 Traffic Spotter

Support:

- 01 A traffic spotter is a certified flagger whose primary function is to alert and assist motorists through temporary traffic control zones on low volume (under 500 VPD), low speed subdivision streets.

Standard:

- 02 **Qualifications, clothing requirements, and hand signaling procedures for traffic spotters shall be the same as for flaggers. The hand signaling devices for traffic spotter shall be a red flag or a fluorescent orange/red flag a minimum of 24 inches square fastened to a staff that is approximately 36 inches in length.**

Guidance:

- 03 *The location of the traffic spotter should be where he is visible and capable of directing traffic from both directions.*

Standard:

- 04 **The ROAD WORK AHEAD (W20-1) sign shall be the minimum sign requirement for traffic spotters.**

Option:

- 05 Additional signing and other traffic control devices may be required depending on the type and visibility of the operation.

Section 6E.10 Temporary Traffic Control Spotter

Support:

- 01 A temporary traffic control (TTC) spotter is a certified flagger whose primary function is to monitor traffic conditions and warn co-workers who are performing tasks such as installing or removing temporary traffic control devices, traffic counters and removing debris from the roadway of oncoming traffic.

Standard:

- 02 **Qualifications, clothing requirements, and hand signaling procedures for TTC spotters shall be the same as for flaggers. The hand signaling device for a TTC spotter shall be a red flag or a fluorescent orange/red flag a minimum of 24 inches square fastened to a staff that is approximately 36 inches in length.**
- 03 **The location of the TTC spotter shall be highly visible to oncoming traffic and the TTC spotter shall stop traffic if necessary when co-workers are installing or removing devices.**

Option:

- 04 TTC spotters may be used for other work operations such as conducting inventory reviews, measuring guardrail, reviewing damaged guardrail, and measuring lane width.

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CHAPTER 6F. TEMPORARY TRAFFIC CONTROL ZONE DEVICES

Section 6F.01 Types of Devices

Guidance:

- 01 *The design and application of TTC devices used in TTC zones should consider the needs of all road users (motorists, bicyclists, and pedestrians), including those with disabilities. The special needs and control of motorcyclists should also be considered through a TTC zone.*

Support:

- 02 FHWA policy requires that all roadside appurtenances such as traffic barriers, barrier terminals and crash cushions, bridge railings, sign and light pole supports, and work zone hardware used on the National Highway System meet the crashworthy performance criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features" and/or the 2009 AASHTO "Manual for Assessing Safety Hardware (MASH)" report. The FHWA website at <http://safety.fhwa.dot.gov/programs/roadsideHardware.htm> identifies all such hardware and includes copies of FHWA acceptance letters for each of them. In the case of proprietary items, links are provided to manufacturers' websites as a source of detailed information on specific devices. The website also contains an "Ask the Experts" section where questions on roadside design issues can be addressed.
- 03 Various Sections of the 2009 MUTCD and 2011 WAPM require certain traffic control devices, their supports, and/or related appurtenances to be crashworthy. Such 2009 MUTCD and 2011 WAPM crashworthiness provisions apply to all streets, highways, and private roads open to public travel. A listing of approved NCHRP Report 350 products used on state maintained roadways is available on VDOT's website at <http://www.virginiadot.org/business/locdes/nchrp350-index.asp>
- 04 Crashworthiness and crash testing information on devices described in 2009 MUTCD Part 6 and the 2011 WAPM are found in AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).
- 05 As defined in Section 6A.02 of this Manual, "crashworthy" is a characteristic of a roadside appurtenance that has been successfully crash tested in accordance with a national standard such as the NCHRP Report 350 and MASH.

Standard:

- 06 **Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide road users, placed on, over, or adjacent to a street, highway, private roads open to public travel (see definition in Section 6A.03) pedestrian facility, or bikeway by authority of a public body or official having jurisdiction.**
- 07 **All traffic control devices used for construction, maintenance, utility, or incident management operations on a street, highway, or private road open to public travel (see definition in Section 6A.03) shall comply with the applicable provisions of this Manual.**

Section 6F.02 General Characteristics of Signs

Support:

- 01 TTC zone signs convey both general and specific messages by means of words, symbols, and/or arrows and have the same three categories as all road user signs: regulatory, warning, and guide.

Standard:

- 02 **Regulatory, warning, guide, and incident management signs used in TTC zones, shall be in compliance with Section 247 of the Road and Bridge Specifications. Reflective sheeting used for all TTC zone signs shall be fluorescent prismatic (high observation angle) lens.**
- 03 **The colors for regulatory signs shall follow the Standards for regulatory signs in Table 2A-5 and Chapter 2B of the 2009 MUTCD. Warning signs in TTC zones shall have a black legend and border on a fluorescent orange background, except for the Grade Crossing Advance Warning (W10-1) sign which shall have a black legend and border on a yellow background, and except for signs that are required or recommended in Parts 2 or 7 of the 2009 MUTCD to have fluorescent yellow-green backgrounds. Colors for guide signs shall follow the Standards in Table 2A-5 and Chapter 2D of the 2009 MUTCD, except for guide signs as otherwise provided in Section 6F.60.**

Support:

- 04 The fluorescent (high observation angle) versions of reflective sign sheeting provide higher conspicuity especially during twilight.

Option:

- 05 Warning and guide signs used for TCC incident management situations (see Chapter 6I) may have a black legend and border on a fluorescent pink background.
- 06 Existing warning and guide signs that are still applicable may remain in place.
- 07 In order to maintain the systematic use of yellow or fluorescent yellow-green backgrounds for pedestrian, bicycle, and school warning signs in a jurisdiction, fluorescent yellow-green background for pedestrian, bicycle, and school warning signs may be used in TTC zones.
- 08 Standard fluorescent orange flags or Type B flashing warning lights may be used in conjunction with signs.

Standard:

- 09 **When standard orange flags or Type B flashing warning lights are used in conjunction with signs, they shall not block the sign face. When flags become faded they shall be removed or replaced.**
- 10 **Except as provided in Section 2A.11 of the 2009 MUTCD, the sizes for TTC signs and plaques shall be as shown in Table 6F-1. Signs found in the Non-Restricted Right-of-Way Roadway column shall be used unless there is a restricted right-of-way or if smaller signs are needed on low volume, low speed residential and urban roadways (under 500 vehicles per day and the posted speed limit is 30 mph or less). Smaller sign sizes are found under the headings of Restricted Right-of-Way Roadway and Residential & Urban < 500 ADT & ≤ 30 MPH columns.**

Guidance:

- 11 *Sign design details are contained in the 2009 MUTCD's "Standard Highway Signs and Marking" (SHSM) book and the Virginia Supplement to the 2009 MUTCD's "Standard Highway Signs" (VSHS) book. These books should be used to fabricate signs.*

Standard:

- 12 **Any proposed or modified Regulatory or Warning signs not in the 2009 MUTCD, the Virginia Supplement to the 2009 MUTCD, or this Manual shall be submitted for review and approval by VDOT's Office of the State Traffic Engineer prior to submission to FHWA.**
- 13 **Deviations from standard sizes as prescribed in these Manuals shall be in 6-inch increments.**

Support

- 14 Section 2A.06 of the Virginia Supplement to the 2009 MUTCD contains additional information regarding the design of signs, including an Option allowing the development of special word message signs if a standard word message or symbol sign is not available to convey the necessary regulatory, warning, or guidance information.

Guidance:

- 15 *Signs used for advance warning should be 48 inch by 48 inch, unless prevented by right-of-way restrictions or approved by the Regional Traffic Engineer.*

Option:

- 16 The dimensions of signs and plaques shown in Table 6F-1 may be increased wherever necessary for greater legibility or emphasis.
- 17 Signs may be made of rigid or flexible material.

Standard:

- 18 **All non-retroreflective signs, including mesh signs, are not allowed and shall not be used due to fading, sunlight shining through, and lack of visibility during hours of darkness.**
- 19 **All signs used day or night, shall be retroreflective with a material that has a smooth, sealed outer surface.**
- 20 **Sign substrates for signs mounted on plastic drums, Type 3 Barricades, and portable sign stands shall be either a flexible retroreflective roll-up material, or a 0.4 inch thick corrugated polypropylene or polyethylene plastic material, or a 0.079 inch thick aluminum/plastic laminate material, shall be in compliance with Section 512 of the Road and Bridge Specifications. The sign substrate shall be the same material that was**

used when the device was tested and found to be in compliance with NCHRP Report 350, Test Level 3 or MASH requirements.

- 21 Rollup signs shall only be used on temporary sign supports and shall not be post-mounted.
- 22 Post-mounted signs shall be made of rigid material (aluminum 0.100-inch thickness) or sign substrates (0.4 inch thick corrugated polypropylene or polyethylene plastic material, or a 0.079 inch thick aluminum/plastic laminate material) and shall be in compliance with Sections 512 and 701 of the Road and Bridge Specifications.

Section 6F.03 Sign Placement

Guidance:

- 01 Signs should be located on the right-hand side of the roadway unless otherwise provided in this Manual.

Standard:

- 02 On roadways having a median wider than 8 feet, right and left sign assemblies shall be required.
- 03 For the purpose of temporary sign installation, the median barrier is considered to be part of the shoulder and its measurement shall be used to determine the total width of the shoulder.

Option:

- 04 Smaller sign sizes may be used in the median when the median width is between 6.5 feet and 8 feet to provide left sign assemblies on a multilane roadway.

Guidance:

- 05 Portable barrier mounted sign stands should be considered for use on median barrier to meet the requirements for double indicating signs.

Support:

- 06 The provisions of this Section regarding mounting height apply unless otherwise provided for a particular sign elsewhere in this Manual.
- 07 Guidelines for height and lateral clearance of temporary ground-mounted signs are shown in Figure 6F-1.

Standard:

- 08 The minimum height of ground-mounted signs, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement, shall be 7 feet (see Figure 6F-1).
- 09 The minimum height of ground-mounted signs, measured vertically from the bottom of the sign to the top of the curb, or in the absence of curb, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of signs installed at the side of the road in business, commercial, or residential areas where parking and/or bicycle or pedestrian movements are likely to occur, or where the view of the sign might be obstructed, shall be 7 feet (see Figure 6F-1).
- 10 The minimum height of ground-mounted signs, measured vertically from the bottom of the sign to the sidewalk, of signs installed above sidewalks shall be 7 feet.
- 11 Ground-mounted sign panels shall be securely fastened to posts or supports and erected plumb and maintained in plumb condition.

Option:

- 12 The height to the bottom of a secondary sign mounted below another sign may be 1 foot less than the height provided in Paragraphs 6 through 10.

Guidance:

- 13 Neither portable nor permanent sign supports should be located on sidewalks, bicycle facilities, or areas designated for pedestrian or bicycle traffic. If the bottom of a secondary sign that is mounted below another sign is mounted lower than 7 feet above a pedestrian sidewalk or pathway (see Section 6D.02) the secondary sign should not project more than 4 inches into the pedestrian facility.

Support:

- 14 In Table 6F-1, standard MUTCD signs are highlighted in either gray or white, while Virginia specific signs are highlighted in orange or pink.

Table 6F-1, Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 1 of 5)

Sign or Plaque	Sign Designation	Section	* Non-Restricted Right-of-Way Roadway	* Restricted Right-of-Way Roadway	* Residential & Urban – < 500 ADT & ≤ 30 MPH
Stop	R1-1	6F.06	48 x 48	36 x 36	36 x 36
Stop (On Stop/Slow Paddle)	R1-1	6E.03	24 x 24	24 x 24	24 x 24
Stop (AFAD)	R1-1	6E.05	36 x 36	36 x 36	36 x 36
Yield	R1-2	6F.06	48 x 48 x 48	36 x 36 x 36*	36 x 36 x 36*
To Oncoming Traffic (Plaque)	R1-2aP	6F.06	48 x 36	36 x 30	36 x 30
Yield Here To Pedestrians	R1-5L, 5R	6F.06	36 x 36	30 x 30	30 x 30
Wait on Stop (AFAD)	R1-7	6E.05	24 x 30	24 x 30	24 x 30
Go on Slow (AFAD)	R1-8	6E.05	24 x 30	24 x 30	24 x 30
Speed Limit	R2-1	6F.14	48 x 60	36 x 48	36 x 48
Fines Higher (Plaque)	R2-6P	6F.14	48 x 36	36 x 24	36 x 24
End Work Zone Speed Limit	R2-12	6F.14	48 x 60	36 x 48	36 x 48
Notice Fines Up To \$500 For Exceeding Speed Limit in Work Zone	R2-V1	6F.13	108 x 54	66 x 42	66 x 42
Movement Prohibition	R3-1,2,3,4,18,27	6F.06	48 x 48	36 x 36	36 x 36
Mandatory Movement (1 lane)	R3-5L, 5R	6F.06	30 x 36	30 x 36	30 x 36
Optional Movement (1 lane)	R3-6L, 6R	6F.06	30 x 36	30 x 36	30 x 36
Mandatory Movement (text)	R3-7L, 7R	6F.06	30 x 30	30 x 30	30 x 30
Advance Intersection Lane Control	R3-8	6F.06	Var. x 30	Var. x 30	Var. x 30
Do Not Pass	R4-1	6F.12	48 x 60	36 x 48	36 x 48
Pass With Care	R4-2	6F.86	48 x 60	36 x 48	36 x 48
Trucks Use Right Lane	R4-5	6F.06	48 x 60	36 x 48	36 x 48
Keep Right	R4-7, 7a, 7b	6F.06	48 x 60	36 x 48	36 x 48
Narrow Keep Right	R4-7c	6F.06	18 x 30	18 x 30	18 x 30
Stay in Lane	R4-9	6F.12	48 x 60	36 x 48	36 x 48
Lane Closed Do Not Pass (Vehicle-Mounted Sign)	R4-V6	6F.34	84 x 36	84 x 36	84 x 36
Keep Left (Right)	R4-V7L, V7R	6F.29	48 x 48	36 x 36	48 x 48
Do Not Enter	R5-1	6F.06	48 x 48	36 x 36	36 x 36
Wrong Way	R5-1a	6F.06	42 x 30	36 x 24	36 x 24
Restricted Width Route	R5-V1	6F.11	108 x 60	66 x 36	42 x 30
One Way	R6-1L, 1R	6F.06	54 x 18	36 x 12	36 x 12
One Way	R6-2R, 2L	6F.06	48 x 60	36 x 48	24 x 30
No Parking (Symbol)	R8-3a	6F.06	48 x 48	36 x 36	24 x 24
Do Not Stop On Tracks	R8-8	TTC-56	48 x 60	36 x 48	36 x 48
Pedestrian Crosswalk	R9-8	6F.15	36 x 18	36 x 18	36 x 18
Sidewalk Closed	R9-9	6F.16	30 x 18	30 x 18	30 x 18
Sidewalk Closed, Use Other Side	R9-10	6F.16	48 x 24	48 x 24	48 x 24
Sidewalk Closed Ahead, Cross Here	R9-11L, 11R	6F.16	48 x 36	48 x 36	48 x 36
Sidewalk Closed, Cross Here	R9-11aL, 11aR	6F.16	48 x 24	48 x 24	48 x 24
Stop Here On Red with Arrow	R10-6	6F.06	24 x 36	24 x 36	24 x 36
Road Closed	R11-2	6F.08	48 x 30	48 x 30	48 x 30
Road Closed - Local Traffic Only	R11-3a,3b,4	6F.09	60 x 30	60 x 30	60 x 30
Ramp Closed	R11-V1	6F.08	48 x 30	48 x 30	48 x 30
Closed - Local Traffic Only	R11-V2	6F.09	60 x 30	60 x 30	60 x 30
Weight Limit	R12-1, 2	6F.10	36 x 48	36 x 48	36 x 48
Weight Limit Symbol	R12-V1	6F.10	48 x 54	36 x 42	36 x 42

Dimensions are shown in inches and shown as width x height

* Sign sizes found in the Non-Restricted Right-of-Way Roadway column shall be used unless geometric condition prohibits their use; otherwise the other columns shall be used (see Section 6F-02 Paragraph 10).

Table 6F-1, Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 2 of 5)

Sign or Plaque	Sign Designation	Section	* Non-Restricted Right-of-Way Roadway	*Restricted Right-of - Way Roadway	*Residential & Urban – < 500 ADT & ≤ 30 MPH
Fender Bender Move Vehicles	R16-4 (V)	6F.17	120 x 60	60 x 48	48 x 36
Turn and Curve Signs	W1-1L, 1R, 2L, 2R, 3L, 3R, 4L, 4R	6F.18	48 x 48	36 x 36	48 x 48
Reverse Curve (2 or more lanes)	W1-4bL, 4bR, 4cL, 4cR	6F.54	48 x 48	36 x 36	48 x 48
One-Direction Large Arrow (Post-Mounted)	W1-6L, 6R	6F.77	60 x 30	48 x 24	48 x 24
One-Direction Large Arrow (On 4' Type 3 Barricade)	W1-6L, 6R	6F.77	48 x 24	48 x 24	48 x 24
One-Direction Large Arrow (On 8' Type 3 Barricade)	W1-6L, 6R	6F.77	60 x 30	60 x 30	60 x 30
Two-Direction Large Arrow (Post-Mounted)	W1-7	6F.77	60 x 30	48 x 24	48 x 24
Two-Direction Large Arrow (On 4' Type 3 Barricade)	W1-7	6F.77	48 x 24	48 x 24	48 x 24
Two-Direction Large Arrow (On 8' Type 3 Barricade)	W1-7	6F.77	60 x 30	60 x 30	60 x 30
Chevron (Post-Mounted)	W1-8L, 8R	6F.18	36 x 48	30 x 36	18 x 24
Chevron (On Channelizing Device)	W1-8L, 8R	6F.18	18 x 24	18 x 24	18 x 24
One-Direction Large Arrow	W1-V1L, V1R	6F.30	96 x 48	96 x 48	96 x 48
Stop Ahead	W3-1	6F.18	48 x 48	36 x 36	48 x 48
Yield Ahead	W3-2	6F.18	48 x 48	36 x 36	48 x 48
Signal Ahead	W3-3	6F.18	48 x 48	36 x 36	48 x 48
Be Prepared to Stop	W3-4	6F.18	48 x 48	36 x 36	48 x 48
Reduced Speed Limit Ahead	W3-5	6F.20	48 x 48	36 x 36	48 x 48
Merging Traffic	W4-1L, 1R, 6L, 6R	6F.18	48 x 48	36 x 36	48 x 48
Lane Ends (Symbol)	W4-2L, 2R	6F.29	48 x 48	36 x 36	48 x 48
Added Lane	W4-3L, 3R	6F.18	48 x 48	36 x 36	48 x 48
No Merge Area (Plaque)	W4-5P	6F.18	24 x 30	18 x 24	24 x 30
Road Narrows	W5-1	6F.18	48 x 48	36 x 36	48 x 48
Narrow Bridge	W5-2	6F.18	48 x 48	36 x 36	48 x 48
One Lane Bridge	W5-3	6F.18	48 x 48	36 x 36	48 x 48
Ramp Narrows	W5-4	6F.33	48 x 48	36 x 36	48 x 48
Lane Width (Plaque)	W5-VP1	6F.33	60 x 18	48 x 18	48 x 18
Divided Highway	W6-1	6F.18	48 x 48	36 x 36	48 x 48
Divided Highway Ends	W6-2	6F.18	48 x 48	36 x 36	48 x 48
Two-Way Traffic	W6-3	6F.39	48 x 48	36 x 36	48 x 48
Two-Way Traffic	W6-4	6F.39	12 x 18	12 x 18	12 x 18
Parallel Road Closed (Plaque)	W6-VP1	6F.39	48 x 36	48 x 36	48 x 36
Hill (Symbol)	W7-1	6F.18	48 x 48	36 x 36	48 x 48
Bump	W8-1	6F.18	48 x 48	36 x 36	48 x 48
Dip	W8-2	6F.18	48 x 48	36 x 36	48 x 48
Pavement Ends	W8-3	6F.18	48 x 48	36 x 36	48 x 48
Soft Shoulder	W8-4	6F.50	48 x 48	36 x 36	48 x 48
Slippery When Wet	W8-5	6F.18	48 x 48	36 x 36	48 x 48
Truck Crossing	W8-6	6F.40	48 x 48	36 x 36	48 x 48
Loose Gravel	W8-7	6F.18	48 x 48	36 x 36	48 x 48
Rough Road	W8-8	6F.41	48 x 48	36 x 36	48 x 48
Low Shoulder	W8-9	6F.50	48 x 48	36 x 36	48 x 48
Uneven Lanes	W8-11	6F.51	48 x 48	36 x 36	48 x 48

Dimensions are shown in inches and shown as width x height

* Sign sizes found in the Non-Restricted Right-of-Way Roadway column shall be used unless geometric condition prohibits their use; otherwise the other columns shall be used (see Section 6F-02 Paragraph 10).

Table 6F-1, Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 3 of 5)

Sign or Plaque	Sign Designation	Section	* Non-Restricted Right-of-Way Roadway	*Restricted Right-of - Way Roadway	*Residential & Urban – < 500 ADT & ≤ 30 MPH
No Center Line	W8-12	6F.53	48 x 48	36 x 36	48 x 48
Fallen Rocks	W8-14	6F.18	48 x 48	36 x 36	48 x 48
Motorcycle (Plaque)	W8-15P	6F.41	30 x 24	24 x 18	30 x 24
Shoulder Drop Off (Plaque)	W8-17P	6F.50	30 x 24	24 x 18	30 x 24
Road May Flood	W8-18	6F.18	48 x 48	36 x 36	48 x 48
No Shoulder	W8-23	6F.18	48 x 48	36 x 36	48 x 48
Steel Plate Ahead	W8-24	6F.52	48 x 48	36 x 36	48 x 48
Shoulder Ends	W8-25	6F.18	48 x 48	36 x 36	48 x 48
Unmarked Pavement Ahead	W8-V4	6F.53	48 x 48	36 x 36	48 x 48
Shoulder Drop Off	W8-V5	6F.50	48 x 48	36 x 36	48 x 48
Lane Ends	W9-1L, 1R	6F.18	48 x 48	36 x 36	48 x 48
Lane Ends Merge Left	W9-2L, 2R	6F.29	48 x 48	36 x 36	48 x 48
Center Lane Closed Ahead	W9-3C, 3L, 3R	6F.28	48 x 48	36 x 36	48 x 48
Grade Crossing Advance Warning (Railroad)	W10-1	TTC-56	36 dia.	36 dia.	36 dia.
Truck (Symbol)	W11-10	6F.40	48 x 48	36 x 36	48 x 48
Construction Entrance	W11-V2	6F.40	48 x 48	36 x 36	48 x 48
Watch for Turning Vehicles	W11-V3	6F.40	48 x 48	36 x 36	48 x 48
Trucks Entering Highway	W11-V4	6F.40	48 x 48	36 x 36	48 x 48
Double Arrow	W12-1	6F.18	48 x 48	36 x 36	48 x 48
Low Clearance	W12-2	6F.18	48 x 48	36 x 36	48 x 48
Advisory Speed (Plaque)	W13-1P	6F.58	30 x 30	24 x 24	30 x 30
On Ramp (Plaque)	W13-4P	6F.31	36 x 36	36 x 36	36 x 36
No Passing Zone (Pennant)	W14-3	6F.18	64 x 64 x 48	48 x 48 x 36	48 x 48 x 36
Arrow (Plaque)	W16-5pL, 5pR	6F.11	24 x 18	24 x 18	24 x 18
Next XX Miles (Plaque)	W16-VP1	6F.59	60 x 18	48 x 12	60 x 18
Every 1 (1/2) (3/4) Mile (Plaque)	W16-VP2	6F.43	60 x 18	48 x 12	60 x 18
XX FEET (Plaque)	W16-VP3	6F.38	60 x 18	48 x 12	60 x 18
Next Exit (Left) (Right) (Plaque)	W16-VP4E, VP4L, VP4R	6F.43	60 x 18	48 x 12	60 x 18
Exit Number (Plaque)	W16-VP5	6F.43	60 x 18	48 x 12	60 x 18
Road Work Ahead	W20-1	6F.21	48 x 48	36 x 36	48 x 48
Detour Ahead	W20-2	6F.23	48 x 48	36 x 36	48 x 48
Road (Street) Closed Ahead	W20-3	6F.24	48 x 48	36 x 36	48 x 48
One Lane Road Ahead	W20-4	6F.25	48 x 48	36 x 36	48 x 48
Lane(s) Closed Ahead	W20-5C, 5L, 5R, 5aL, 5aR	6F.26	48 x 48	36 x 36	48 x 48
Flagger (Symbol)	W20-7	6F.38	48 x 48	36 x 36	48 x 48
Slow (On Stop/Slow Paddle)	W20-8 (V)	6E.03	24 x 24	24 x 24	24 x 24
Slow (AFAD)	W20-8 (V)	6E.05	36 x 36	36 x 36	36 x 36
VEHICLE-MOUNTED SIGNS					
Road Work Ahead – Left (Right) Shoulder Closed	W20-V1L, V1R	6F.34	84 x 36	84 x 36	84 x 36
Road Work Ahead – Center Lane Closed Road Work Ahead – Left (X Left) Lane(s) Closed Road Work Ahead – Right (X Right) Lane(s) Closed	W20-V2C, V2L, V2aL, V2R, V2aR	6F.34	84 x 36	84 x 36	84 x 36
Mowing Ahead – Left (Right) Shoulder Closed	W20-V3L, V3R	6F.34	84 x 36	84 x 36	84 x 36
Mowing Ahead – Left (Right) Lane Closed	W20-V4L, V4R	6F.34	84 x 36	84 x 36	84 x 36

Dimensions are shown in inches and shown as width x height

* Sign sizes found in the Non-Restricted Right-of-Way Roadway column shall be used unless geometric condition prohibits their use; otherwise the other columns shall be used (see Section 6F-02 Paragraph 10).

Table 6F-1, Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 4 of 5)

Sign or Plaque	Sign Designation	Section	* Non-Restricted Right-of-Way Roadway	*Restricted Right-of - Way Roadway	*Residential & Urban – < 500 ADT & ≤ 30 MPH
VEHICLE-MOUNTED SIGNS					
Line Painting Ahead – Center Lane Closed Road Line Painting Ahead – Left (X Left) Lane(s) Closed “ ” – Right (X Right) Lane(s) Closed	W20-V5C, V5L, V5aL, V5R, V5aR	6F.34	84 x 36	84 x 36	84 x 36
Spraying Ahead – Left (Right) Shoulder Closed	W20-V6L, V6R	6F.34	84 x 36	84 x 36	84 x 36
Spraying Ahead – Left (Right) Lane Closed	W20-V7L, V7R	6F.34	84 x 36	84 x 36	84 x 36
Pre-Storm Treatment – Center Lane Closed Pre-Storm Treatment – Left (X Left) Lane(s) Closed “ ” – Right (X Right) Lane(s) Closed	W20-V8C, V8L, V8aL, V8R, V8aR	6F.34	84 x 36	84 x 36	84 x 36
Pre-Storm Treatment	W20-V9	6F.34	48 x 18	48 x 18	48 x 18
Keep Back 100 FT	W20-V10	6F.34	18 x 18	18 x 18	18 x 18
RESUME GROUND-MOUNTED SIGNS UNLESS OTHERWISE NOTED					
Road Closed High Water	W20-V11	6F.24	48 x 48	36 x 36	48 x 48
Ramp Closed Ahead	W20-V12	6F.24	48 x 48	36 x 36	48 x 48
Center (Left) (Right) Turn Lane Closed Ahead	W20-V13C, V13L, V13R	6F.26	48 x 48	36 x 36	48 x 48
Emergency Scene Ahead	W20-V25	6F.27	48 x 48	36 x 36	48 x 48
Slow Moving Vehicle (Vehicle-Mounted Sign)	W21-4	6G.06	36 x 18	36 x 18	36 x 18
Shoulder Work	W21-5	6F.42	48 x 48	36 x 36	48 x 48
Shoulder Closed	W21-5aL, 5aR	6F.42	48 x 48	36 x 36	48 x 48
Shoulder Closed Ahead	W21-5bL, 5bR	6F.42	48 x 48	36 x 36	48 x 48
Utility Work Ahead	W21-7	6F.45	48 x 48	36 x 36	48 x 48
Mowing Ahead	W21-8	6F.22	48 x 48	36 x 36	48 x 48
Watch for Slow Moving Vehicles	W21-V1	6F.22	48 x 48	36 x 36	48 x 48
Road Work Next 2 Miles	W21-V2	6F.21	48 x 48	36 x 36	48 x 48
Mowing Next 2 Miles	W21-V3	6F.22	48 x 48	36 x 36	48 x 48
Line Painting Next 5 Miles	W21-V4	6F.22	48 x 48	36 x 36	48 x 48
Spraying Next 5 Miles	W21-V5	6F.22	48 x 48	36 x 36	48 x 48
Cleanup Crew Working	W21-V6	**2H.08	48 x 48	36 x 36	48 x 48
Litter Pick Up	W21-V7	6F.18	48 x 48	36 x 36	48 x 48
Survey Crew Ahead	W21-V8	6F.44	48 x 48	36 x 36	48 x 48
All Traffic Merge Left (Right)	W21-V9L, V9R	TTC-45	48 x 48	36 x 36	48 x 48
Slow	W21-V10	6F.38	48 x 48	36 x 36	48 x 48
Both Shoulders Closed	W21-V11	6F.42	48 x 48	36 x 36	48 x 48
Both Shoulders Closed Ahead	W21-V12	6F.42	48 x 48	36 x 36	48 x 48
Pull-Off Area	W21-V13	6F.43	48 x 48	36 x 36	48 x 48
Left (Right) Pull-Off Area	W21-V14L, V14R	6F.43	48 x 48	36 x 36	48 x 48
No Pull-Off Area	W21-V15	6F.43	48 x 48	36 x 36	48 x 48
Ramp Work Ahead	W21-V16	6F.31	48 x 48	36 x 36	48 x 48
Signal Work Ahead	W21-V17	6F.32	48 x 48	36 x 36	48 x 48
Blasting Zone Ahead	W22-1	6F.47	48 x 48	36 x 36	48 x 48
Turn Off 2-Way Radio and Cell Phone	W22-2	6F.48	42 x 36	42 x 36	42 x 36
End Blasting Zone	W22-3	6F.49	42 x 36	42 x 36	42 x 36
Slow Traffic Ahead	W23-1	6F.34	48 x 24	48 x 24	48 x 24
New Traffic Pattern Ahead	W23-2	6F.37	48 x 48	36 x 36	48 x 48

Dimensions are shown in inches and shown as width x height

* Sign sizes found in the Non-Restricted Right-of-Way Roadway column shall be used unless geometric condition prohibits their use; otherwise the other columns shall be used (see Section 6F-02 Paragraph 10).

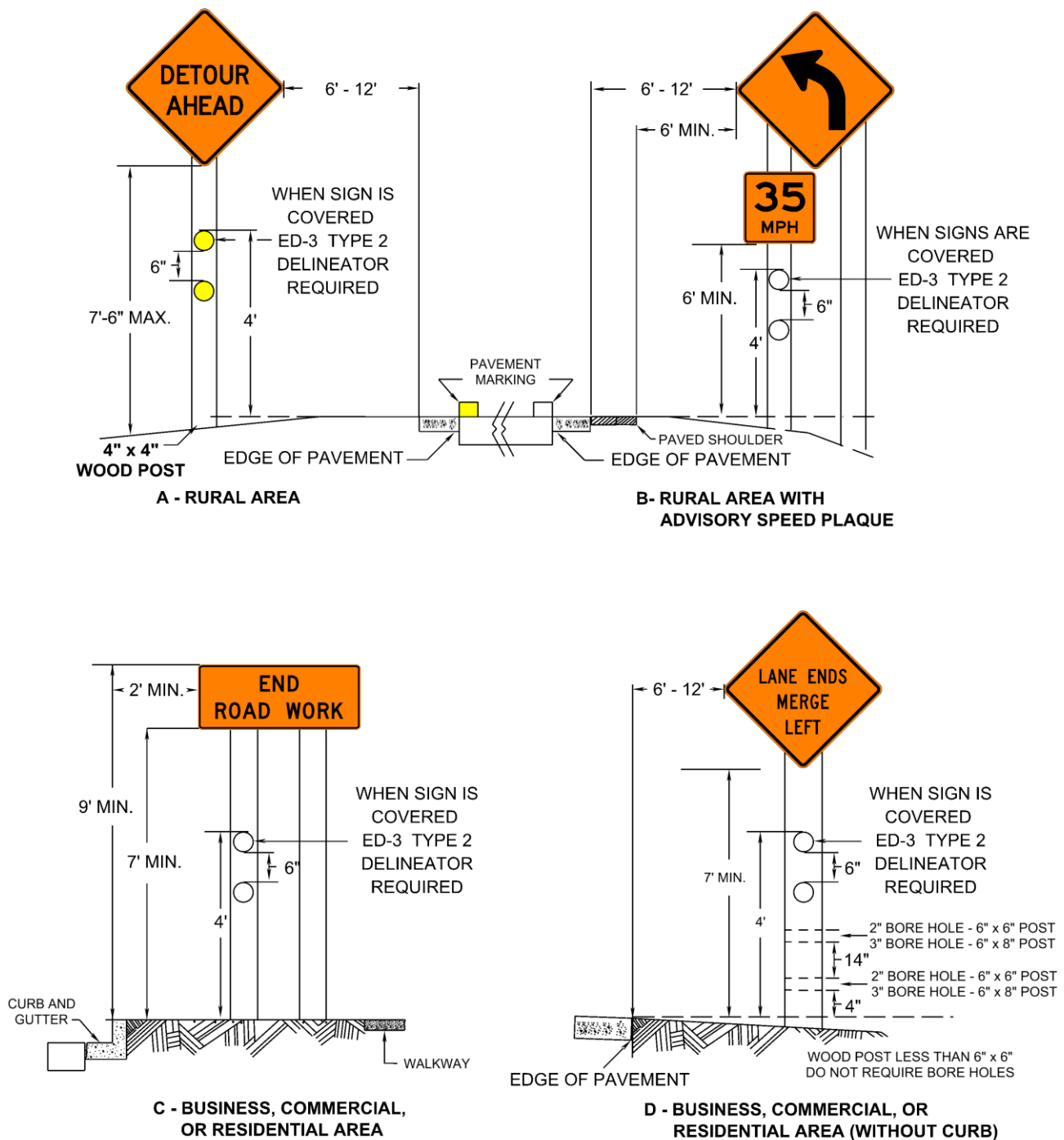
** Sign information is found in the Virginia Supplement to the 2009 MUTCD.

Table 6F-1, Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 5 of 5)

Sign or Plaque	Sign Designation	Section	* Non-Restricted Right-of-Way Roadway	*Restricted Right-of-Way Roadway	*Residential & Urban – < 500 ADT & ≤ 30 MPH
Double Reverse Curve (1 lane)	W24-1L, 1R	6F.55	48 x 48	36 x 36	48 x 48
Double Reverse Curve (2 lanes)	W24-1aL, 1aR	6F.55	48 x 48	36 x 36	48 x 48
Double Reverse Curve (3 lanes)	W24-1bL, 1bR	6F.55	48 x 48	36 x 36	48 x 48
All Lanes	W24-1cP	6F.55	30 x 30	24 x 24	30 x 30
Road Work Next XX Miles	G20-1 (V)	6F.61	60 x 24	48 x 24	48 x 24
End Road Work (Post-Mounted)	G20-2 (V)	6F.62	60 x 24	48 x 24	48 x 24
End Road Work (On Portable Sign Stand)	G20-2 (V)	6F.62	48 x 24	48 x 24	48 x 24
Pilot Car Follow Me (Vehicle-Mounted Sign)	G20-4	6F.63	36 x 18	36 x 18	36 x 18
Work Zone (Plaque)	G20-5aP	6F.11 6F.14	48 x 36	36 x 24	36 x 24
	G20-5aP (V)				
Work Vehicle Do Not Follow (Vehicle-Mounted Sign)	G20-V1	6F.64	48 x 18	48 x 18	48 x 18
End Mowing (Post-Mounted)	G20-V2	6F.62	60 x 24	48 x 24	48 x 24
End Mowing (On Portable Sign Stand)	G20-V2	6F.62	48 x 24	48 x 24	48 x 24
End Survey (Post Mounted)	G20-V3	6F.62	60 x 24	48 x 24	48 x 24
End Survey (On Portable Sign Stand)	G20-V3	6F.62	48 x 24	48 x 24	48 x 24
Caution Frequent Stops (Vehicle-Mounted Sign)	G20-V4a, V4b, V4c	6F.65	Var.	Var.	Var.
XX Miles Ahead (Plaque)	G20-VP1	6F.11	108 x 18	66 x 18	42 x 12
Exit Open	E5-2	6F.35	48 x 36	48 x 36	48 x 36
Exit Closed	E5-2a	6F.35	48 x 36	48 x 36	48 x 36
Exit Only	E5-3	6F.36	48 x 36	48 x 36	48 x 36
Exit	E5-V1L, V1R	6F.36	48 x 48	48 x 48	48 x 48
Pull-Off Area Entrance	E5-V2L, V2R	6F.43	48 x 48	48 x 48	48 x 48
Detour	M4-8	6F.66	30 x 15	24 x 12	24 x 12
End Detour	M4-8a	6F.66	24 x 18	24 x 18	24 x 18
Detour with Horizontal Arrow	M4-9L, 9R,	6F.66	60 x 48	48 x 36	36 x 30
	M4-9L (V), 9R (V)				
Bike/Pedestrian Detour	M4-9aL, 9aR	6F.66	60 x 48	48 x 36	30 x 24
Pedestrian Detour	M4-9bL, 9bR	6F.66	60 x 48	48 x 36	30 x 24
Bike Detour	M4-9cL, 9cR	6F.66	60 x 48	48 x 36	30 x 24
Detour	M4-10	6F.66	48 x 18	48 x 18	48 x 18
Detour – Up Arrow	M4-V1	6F.66	60 x 48	48 x 36	36 x 30
Detour – 45° Arrow	M4-V2L, V2R	6F.66	60 x 48	48 x 36	36 x 30
Detour – Advance Turn 90° Arrow	M4-V3L, V3R	6F.66	60 x 48	48 x 36	36 x 30
Detour – Advance Turn Diagonal Arrow	M4-V4L, V4R	6F.66	60 x 48	48 x 36	36 x 30
Cardinal Direction / Route Shield (Plaque)	M4-V5a, V5b	6F.9 6F.11	66 x 84	36 x 42	48 x 60
TTC Business Entrance (One Line)	M4-V6aL, V6aR	6F.67	Var. x 24	Var. x 24	Var. x 24
TTC Business Entrance (Two Lines)	M4-V6bL, V6bR	6F.67	Var. x 30	Var. x 30	Var. x 30
Street Name (Plaque) (One Line)	M4-VP1a	6F.09	Var. x 18	Var. x 15	Var. x 12
Street Name (Plaque) (Two Lines)	M4-VP1b	6F.66	Var. x 30	Var. x 24	Var. x 18
Incident Management Detour (M4-9L (V), M4-9R (V), M4-V1) sign size shall be 36 x 30					

Dimensions are shown in inches and shown as width x height

* Sign sizes found in the Non-Restricted Right-of-Way Roadway column shall be used unless geometric condition prohibits their use; otherwise the other columns shall be used (see Section 6F-02 Paragraph 10).

Figure 6F-1, Height and Lateral Location of Signs – Typical Post-Mounted Installations

NOTE: FOR POST SIZE & INSTALLATION PROCEDURES SEE EITHER THE PLAN INSERTABLE SHEET OR VIRGINIA ROAD AND BRIDGE STANDARDS STP-1, WSP-1 & ED-3.

Standard:

- 15 **Where it has been determined that the accommodation of pedestrians with disabilities is necessary, signs shall be mounted and placed in accordance with Section 4.4 of the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)”.**
- 16 **Signs mounted on Direction Indicator Barricades, Type 3 Barricades and Type 3 Barricade/sign combinations shall be crashworthy.**

Guidance:

- 17 *Except as provided in Paragraph 17 or Figures TTC-57 through TTC-59, signs mounted on portable sign supports should not be used for a duration of more than 3 consecutive days (72 consecutive hours).*

Option:

- 18 The R9-8 through R9-11a (pedestrian signs) series, R11 (road closed signs) series, W1-6 through W1-8 (arrow and chevron signs) series, M4-10 (detour arrow), E5-V1 (exit sign), or other similar type signs (see Figures 6F-2, 6F-3 and 6F-5) may be used on portable sign supports that do not meet the minimum mounting heights provided in Paragraphs 6 through 8 for longer than 3 days.

Standard:

- 19 **Sign supports shall be crashworthy. Where large signs having an area exceeding 50 square feet are installed on multiple breakaway posts, the clearance from the ground to the bottom of the sign shall be at least 7 feet.**

Guidance:

- 20 *The legs of portable sign supports should be as flush as possible to the ground or roadway surface for stability.*
- 21 *Portable sign supports used for signs found in Paragraph 17, or shown in the typical traffic control figures in Chapter 6H, should be supported with a sand bag weighing approximately 25-pounds on each leg when they are used on long-term projects.*

Standard:

- 22 **The bottom of a sign mounted on a barricade, or other portable support, shall be at least 1 foot above the traveled way.**
- 23 **Portable sign stands shall be self-erecting and support a 20 square-foot sign panel in sustained winds of 50 miles per hour without tipping over, walking, or rotating more than ± 5 degrees about its vertical axis. When used on uneven surfaces, the portable sign stand shall be capable of adjusting to those surfaces to allow the signs to be installed in their normal upright position ± 15 degrees.**
- 24 **Tripod type portable sign stands, regardless of their crashworthiness, shall not be used on any roadway.**

Support:

- 25 *A tripod type sign stand reduces the sign’s retroreflectivity and visibility because it does not allow the sign to be installed perpendicular to the roadway.*

Option:

- 26 Additional weight consisting of a sand bag weighing approximately 25-pounds may be placed on each leg of a sign stand or no more than two cone weights or one drum collar weight positioned on the center of the sign stand and around the mast may be used to comply with the portable sign requirement.
- 27 For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, a portable sign support, or a trailer stationed in advance of the TTC zone or moving along with it.

Support:

- 28 *If alterations are made to specific traffic control device supports that have previously been successfully crash tested in accordance with NCHRP Report 350 or MASH prior to the alteration, the altered supports might not be considered to be crashworthy.*

Section 6F.04 Sign Maintenance**Standard:**

- 01 **All signs shall be reviewed after the initial setup and periodically during every work shift to ensure they are functioning properly and they shall be properly maintained for cleanliness, visibility and correct positioning.**

- 02 When TTC signs are covered to prevent the display of the message, the entire sign shall be covered with silt fence or other materials approved by the Engineer such that no portion of the message side of the sign shall be visible. Tape, such as duct tape, shall not be used on the signs face.
- 03 Plywood shall be used on ground-mounted TTC signs only. Attachment methods used to attach the covering material to the signs shall be of a durable construction that will prevent the unintentional detachment of the material from the sign.
- 04 In addition, the posts where the signs are being covered shall have two ED-3 Type 2 delineators mounting vertically on the post below the signs at a height of 4 feet to the top of the topmost delineator. The bottom delineator shall be mounted 6 inches below the top delineator (see Figure 6F-1).
- 05 At no time shall a TTC sign on a post or portable sign stand be rotated to prevent the display of the message.
- 06 Signs and their portable sign stands shall be removed from the roadway when not in use.

Option:

- 07 Advance warning signs and their portable supports may be disassembled and stored behind barrier or guardrail.
- Standard:**

- 08 Signs that have lost significant legibility shall be promptly replaced in accordance with the American Traffic Safety Service Association's (ATSSA) "Quality Standards for Work Zone Traffic Control Devices" publication.

Support:

- 09 Section 2A.08 of the 2009 MUTCD contains information regarding the retroreflectivity of signs, including the signs that are used in TTC zones.

Section 6F.05 Regulatory Sign Authority

Support:

- 01 Regulatory signs such as those shown in Figure 6F-2 inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.

Standard:

- 02 Regulatory signs shall be authorized by the public agency or official having jurisdiction and shall conform with Chapter 2 of the 2009 MUTCD and its SHSM, or Virginia Supplement to the 2009 MUTCD and its VSHS book.

Section 6F.06 Regulatory Sign Design

Standard:

- 01 TTC regulatory signs shall comply with the Standards for regulatory signs presented in Part 2 of the 2009 MUTCD and its SHSM (see Section 1A.11 of the 2009 MUTCD) or Virginia Supplement to the 2009 MUTCD and its VSHS book.
- 02 Reflective sheeting used on regulatory signs shall be in compliance with Section 247 of the Road and Bridge Specifications.

Support:

- 03 Regulatory signs are generally rectangular with a black legend and border on a white background. Exceptions include the STOP, YIELD, DO NOT ENTER, WRONG WAY, and ONE WAY signs.

Option:

- 04 The ONE WAY sign may be either a horizontal or vertical rectangular sign.

Section 6F.07 Regulatory Sign Applications

Standard:

- 01 If a TTC zone requires regulatory measures different from those existing, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory signs. This change shall be made in compliance with applicable ordinances or statutes of the jurisdiction.

Figure 6F-2, Regulatory Signs and Plaques in Temporary Traffic Control (Sheet 1 of 2)

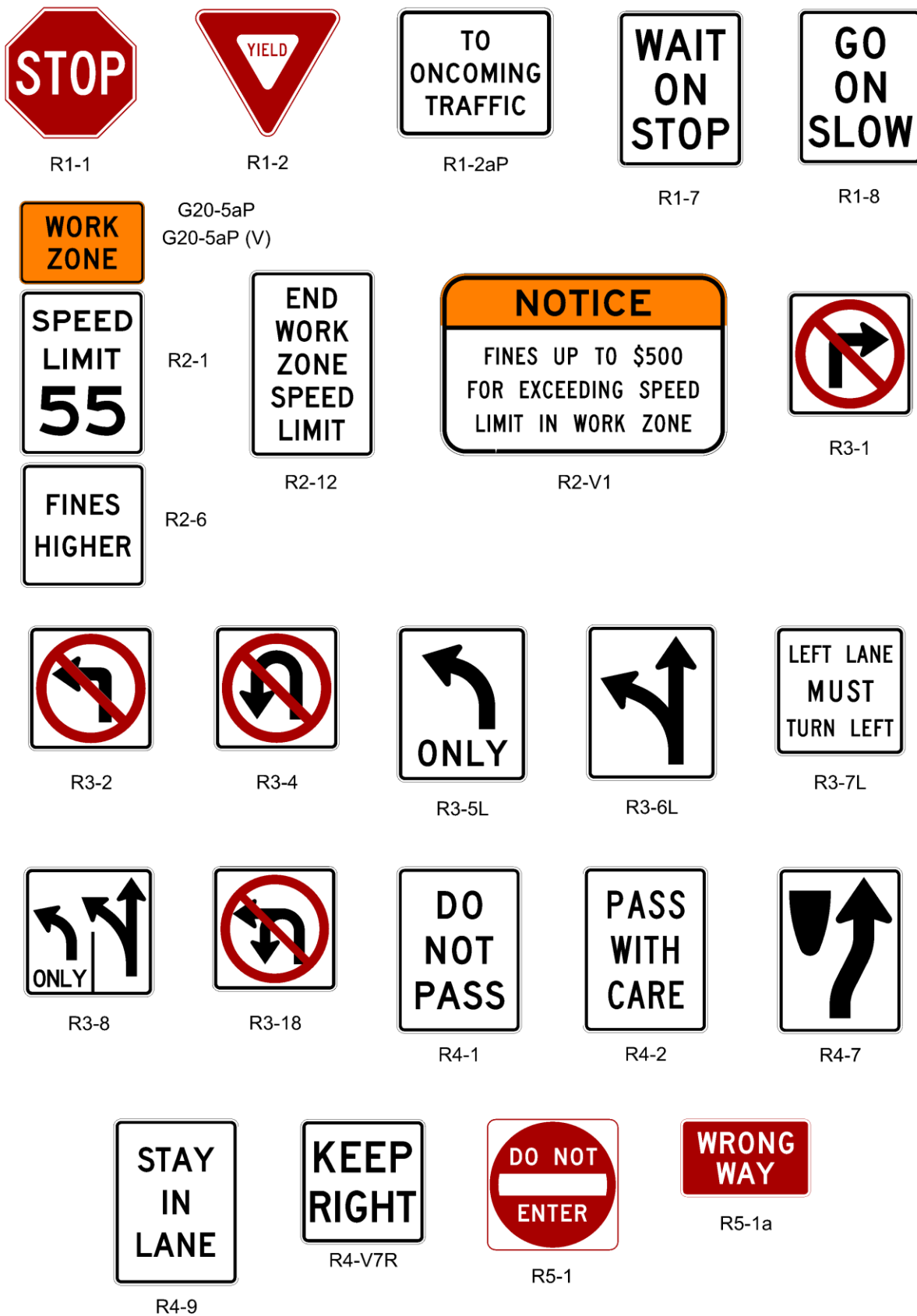
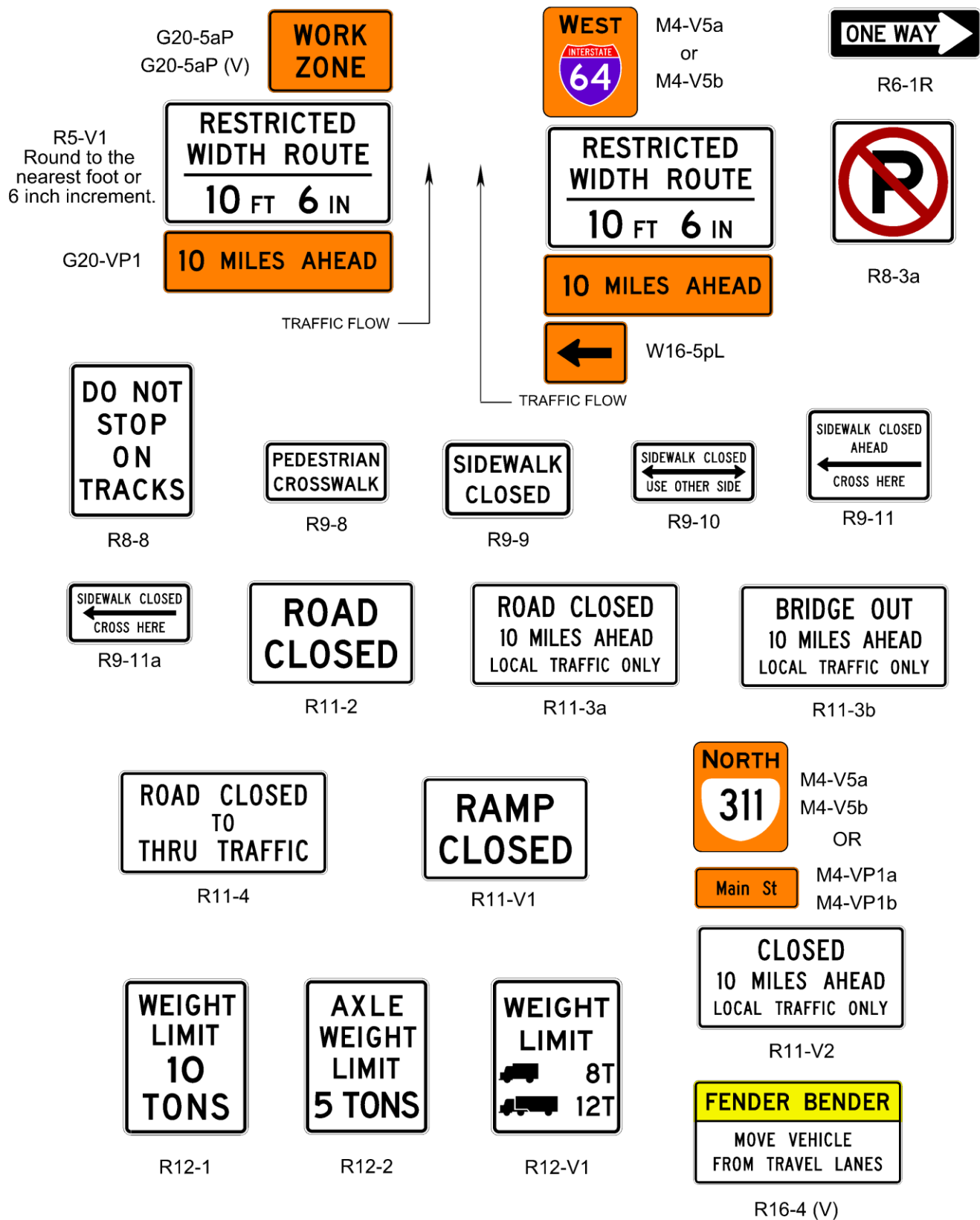


Figure 6F-2, Regulatory Signs and Plaques in Temporary Traffic Control (Sheet 2 of 2)



Section 6F.08 Road (Street) Closed Sign (R11-2) and Ramp Closed Sign (R11-V1)

Guidance:

- 01 *The ROAD (STREET) CLOSED (R11-2) sign (see Figure 6F-2) should be used when the roadway is closed to all road users except contractors' equipment or officially authorized vehicles. The R11-2 sign should be accompanied by appropriate warning and detour signing.*

Option:

- 02 The words BRIDGE OUT (or BRIDGE CLOSED), RAMP CLOSED (R11-V1) may be substituted for ROAD (STREET) CLOSED where applicable.

Guidance:

- 03 *The ROAD (STREET) CLOSED and DETOUR signs on Type 3 Barricades should be located at the corners of intersecting closed roadway or in the traveled way (see Section 6F.76 and Figures TTC-34, TTC-46 to TTC-48).*

Standard:

- 04 **The ROAD (STREET) CLOSED sign shall not be used where road user flow is maintained through the TTC zone with a reduced number of lanes on the existing roadway or where the actual closure is some distance beyond the sign.**
- 05 **The RAMP CLOSED sign shall be installed above a Type 3 Barricade on short-term and long-term projects.**

Option:

- 06 The Type 3 Barricade with RAMP CLOSED sign may be replaced with a shadow vehicle on short-term projects.

Section 6F.09 Local Traffic Only Signs (R11-3a, R11-4, R11-V2)

Guidance:

- 01 *The Local Traffic Only signs (see Figure 6F-2) should be used where road user flow detours to avoid a closure some distance beyond the sign, but where local road users can use the roadway to the point of closure. These signs should be accompanied by appropriate warning and detour signing.*
- 02 *In rural applications, the Local Traffic Only sign should have the legend ROAD CLOSED XX MILES AHEAD LOCAL TRAFFIC ONLY (R11-3a) or CLOSED - LOCAL TRAFFIC ONLY (R11-V2).*

Standard:

- 03 **When the CLOSED - LOCAL TRAFFIC ONLY sign is used, a STREET NAME (M4-VP1a or M4-VP1b) plaque or CARDINAL DIRECTION/ROUTE SHIELD (M4-V5a or M4-V5b) plaque shall be installed above the CLOSED - LOCAL TRAFFIC ONLY sign (see Figure TTC-48).**

Option:

- 04 In urban areas, the legend ROAD (STREET) CLOSED TO THRU TRAFFIC (R11-4) or ROAD CLOSED, LOCAL TRAFFIC ONLY or CLOSED LOCAL TRAFFIC ONLY as described in Paragraph 3 may be used.
- 05 In urban areas, a word message that includes the name of an intersecting street name or well-known destination may be substituted for the words XX MILES AHEAD on the R11-3a sign where applicable.
- 06 The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for the words ROAD (STREET) CLOSED on the R11-3a or R11-4 sign where applicable.

Section 6F.10 Weight Limit Signs (R12-2, R12-5, R12-V1)

Standard:

- 01 **A Weight Limit sign (see Figure 6F-2) which shows the gross weight or axle weight that is permitted on the roadway or bridge, shall be consistent with State or local regulations and shall not be installed without the approval of the authority having jurisdiction over the highway.**
- 02 **Where posting of specific load limits are used, the Weight Limit Symbol (R12-V1) sign shall be used in lieu of the Weight Limit symbol sign (R12-5). The Weight Limit symbol sign (R12-5) from the 2009 MUTCD shall not be used.**
- 03 **Section 2B.59 and Figure 2B-V1 of the Virginia Supplement to the 2009 MUTCD and its VSHS shall be referenced when the Weight Limit Symbol sign is used.**

- 04 **When weight restrictions are imposed because of the activity in a TTC zone, a marked detour shall be provided for vehicles weighing more than the posted limit.**

Section 6F.11 Restricted Width Route Sign (R5-V1)

Support:

- 01 The Virginia Department of Motor Vehicles routinely issues general blanket permits allowing vehicles to exceed the statutory width requirements up to a maximum vehicle and/or load width of 14 feet. These vehicles are allowed to travel on all routes that are not specifically signed limiting the width.
- 02 Construction/maintenance activities might create roadway width restrictions that are less than 14 feet. Therefore, the Department has a need to post signs on these routes notifying permit holders of a width restriction. To accomplish this, we have developed a regulatory sign alerting operators of those vehicles with blanket width permits that the roadway width might be insufficient for their passage. This has been accomplished in an effort to increase safety and to ensure the continual flow of traffic through our work zones.

Standard:

- 03 **Signs shall be installed on roadways where a TTC zone exists with physical barriers on both sides of a single lane and the clear distance between edge lines is less than 14 feet.**
- 04 **A WORK ZONE (G20-5aP, G20-5aP (V)) plaque or CARDINAL DIRECTION/ROUTE SHIELD (M4-V5a or M4-5b) plaque shall be installed above the RESTRICTED WIDTH ROUTE (R5-V1) sign. The CARDINAL DIRECTION/ROUTE SHIELD plaque shall consist of a route shield for guide use (M1-1, M1-4 (Guide), M1-V1b, M1-V1d, M1-V2b and M1-V2d) installed on a fluorescent orange background and the cardinal direction message shall be a black legend (see Figure TTC-25).**
- 05 **A WORK ZONE plaque shall be installed above the RESTRICTED WIDTH ROUTE sign in advance of the location where the clear width is less than 14 feet. The clear width on the RESTRICTED WIDTH ROUTE sign shall be rounded down to the nearest foot or half foot increment. Table 2C-4 of the Virginia Supplement to the 2009 MUTCD shall be used as a guide in determining the advance placement distance of the signs. At all other locations, a CARDINAL DIRECTION/ROUTE SHIELD plaque shall be installed above the RESTRICTED WIDTH ROUTE sign.**

Guidance:

- 06 *Additionally, signs should be installed on the approaches of intersecting routes and alternate routes to the restricted route to alert traffic intending to turn onto the restricted route. Engineering judgment should be used in determining the effective placement of this sign.*
- 07 *When other roadways exist between the last alternate route and the restricted location, which could generate traffic having blanket width permits, consideration should be given to posting additional signs at those intersecting locations.*

Standard:

- 08 **When used the XX MILES AHEAD (G20-VP1) and ARROW (W16-5pl) plaques shall have a black legend and border on a fluorescent orange rectangular background (see Figure TTC-25).**
- 09 **When the RESTRICTED WIDTH ROUTE sign is installed on an intersecting route, an ARROW plaque shall be installed below it to indicate the direction of the restriction.**

Guidance:

- 10 *When an advance RESTRICTED WIDTH ROUTE sign is installed on the restricted route the XX MILES AHEAD plaque should be mounted below the sign.*

Option:

- 11 In addition to the ARROW plaque, the XX MILES AHEAD plaque may be installed on intersecting routes.

Section 6F.12 Do Not Pass Sign (R4-1) and Stay In Lane Sign (R4-9)

Standard:

- 01 **A DO NOT PASS (R4-1) sign shall be used when the centerline has been obliterated or until pavement markings have been installed. The DO NOT PASS sign shall be installed after the NO CENTER LINE (W8-12) sign. Thereafter the DO NOT PASS sign shall be installed every mile if the unmarked area is less than 3 miles or every 2 miles if the unmarked area is longer than 4 miles (see Figure TTC-59).**

- 02 **A STAY IN LANE (R4-9) sign (see Figures 6F-2, TTC-40 and TTC-57) shall be used when motorists are exposed to a lane differential during pavement milling and paving operations.**
- 03 **When used on a portable sign support, the STAY IN LANE sign shall be adjusted daily with the work operation and a sand bag weighing approximately 25-pounds shall be placed on each leg of the sign stand.**

Guidance:

- 04 *A STAY IN LANE sign should be used in multi-lane shift.*

Option:

- 05 A STAY IN LANE sign may be used where a multi-lane shift has been incorporated as part of the TTC on a highway to direct road users around road work that occupies part of the roadway on a multi-lane highway.

Section 6F.13 Notice Fines Up To \$500 For Exceeding Speed Limit In Work Zone Sign (R2-V1)

Support:

- 01 Section §46.2-878.1 of the Code of Virginia, enacted into law on July 1, 2003, establishes a fine for speeding in a work zone at not more than \$500 when workers are present and the work zone is indicated by appropriately placed signs.

Standard:

- 02 **The use of the NOTICE FINES UP TO \$500 FOR EXCEEDING SPEED LIMIT IN WORK ZONE (R2-V1) sign shall be determined by the Regional Traffic Engineer upon the completion of a traffic / engineering study and work zone speed analysis, TE-350. TTC signs for this initiative shall conform to Figure TTC-52.**
- 03 **The first line “NOTICE” shall have a black legend and border on a fluorescent orange rectangular background. The rest of the sign shall have a black legend and border on a white rectangular background (see Figure 6F-2).**

Guidance:

- 04 *In order for this measure to have an optimum impact on safety and be enforceable, it should be coordinated with the local law enforcement community and/or State Police.*
- 05 *Recommended guidelines for selecting work zones for increased fines are as follows:*
- *Projects on Limited Access highways with a work duration of 60 days or more*
 - *Projects on Non-Limited Access highways with a posted or statutory (if not posted) speed limit of 35 mph or greater that will have a work duration of 120 days or more*
 - *Projects (both Limited and Non-Limited access highways) where safety will be increased based on the engineering judgment of the Regional Traffic Engineer*

Section 6F.14 Work Zone Plaque (G20-5aP, G20-5aP (V)), Speed Limit Sign (R2-1), Fines Higher Plaque (R2-6P), and End Work Zone Speed Limit Sign (R2-12)

Standard:

- 01 **When increased fines are imposed for traffic violations within the designated TTC zone a FINES HIGHER assembly consisting of the WORK ZONE (G20-5aP, G20-5aP (V)) plaque shall be used above the SPEED LIMIT (R2-1) sign and the FINES HIGHER (R2-6P) plaque shall be installed below the SPEED LIMIT sign. The FINES HIGHER assembly signs shall be used throughout the TTC zone if additional SPEED LIMIT signs are needed.**
- 02 **An END WORK ZONE SPEED LIMIT (R2-12) sign (see Figure 6F-2) shall be installed at the downstream end of the work zone to provide notice to road users of the termination of the increased fines zone.**
- 03 **The WORK ZONE plaque shall have a black legend and border on a fluorescent orange rectangular background. The SPEED LIMIT and END WORK ZONE SPEED LIMIT signs and FINES HIGHER plaque shall have a black legend and border on a white rectangular background. All supplemental plaques mounted below the Higher Fines signs and plaque shall have a black legend and border on a white rectangular background.**

Option:

- 04 The WORK ZONE plaque along with the SPEED LIMIT sign may be used to emphasize the roadway's posted speed limit when the increased fines are not imposed.

Guidance:

- 05 *The use of the FINES HIGHER assembly should be limited to locations where work is actually underway, or to locations where the roadway, shoulder, or other conditions, require a speed reduction or extra caution on the part of the road user.*
- 06 *Where used, the FINES HIGHER assembly should be located as close to the work area as possible, as shown in Figure TTC-52 as opposed to placement prior to the advance warning signs (ROAD WORK AHEAD, etc.) and just beyond any interchanges, major intersections, or other major traffic generators.*

Support:

- 07 Experience has shown that compliance to reduced speed limit signs is greater if placed as close to the work as possible, as opposed to placement prior to the advance warning signs.
- 08 Section 2B.17 of the 2009 MUTCD contains additional information regarding the use of FINES HIGHER signs.

Section 6F.15 Pedestrian Crosswalk Sign (R9-8)*Option:*

- 01 The PEDESTRIAN CROSSWALK (R9-8) sign (see Figure 6F-2) may be used to indicate where a temporary crosswalk has been established.

Standard:

- 02 **If a temporary crosswalk is established, it shall be accessible to pedestrians with disabilities in accordance with Section 6D.02.**

Section 6F.16 Sidewalk Closed Signs (R9-9, R9-10, R9-11, R9-11a)*Guidance:*

- 01 *SIDEWALK CLOSED signs (see Figure 6F-2) should be used where pedestrian flow is restricted. Bicycle/Pedestrian Detour (M4-9a) signs or Pedestrian Detour (M4-9b) signs should be used where pedestrian flow is rerouted (see Section 6F.66).*
- 02 *The SIDEWALK CLOSED (R9-9) sign should be installed at the beginning of the closed sidewalk, at the intersections preceding the closed sidewalk, and elsewhere along the closed sidewalk as needed.*
- 03 *The SIDEWALK CLOSED, (ARROW) USE OTHER SIDE (R9-10) sign should be installed at the beginning of the restricted sidewalk when a parallel sidewalk exists on the other side of the roadway.*
- 04 *The SIDEWALK CLOSED AHEAD, (ARROW) CROSS HERE (R9-11) sign should be used to indicate to pedestrians that sidewalks beyond the sign are closed and to direct them to open crosswalks, sidewalks, or other travel paths.*
- 05 *The SIDEWALK CLOSED, (ARROW) CROSS HERE (R9-11a) sign should be installed just beyond the point to which pedestrians are being redirected.*

Support:

- 06 These signs are typically mounted on a detectable barricade to encourage compliance and to communicate with pedestrians that the sidewalk is closed. Printed signs are not useful to many pedestrians with visual disabilities. A barrier or barricade detectable by a person with a visual disability is sufficient to indicate that a sidewalk is closed. If the barrier is continuous with detectable channelizing devices for an alternate route, accessible signing might not be necessary. An audible information device is needed when the detectable barricade or barrier for an alternate channelize route is not continuous.

Section 6F.17 Special Regulatory Signs*Option:*

- 01 Special regulatory signs may be used based on engineering judgment consistent with regulatory requirements as per Chapter 2B of the 2009 MUTCD.

Guidance:

- 02 *Special regulatory signs should comply with the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.*

Support:

- 03 An example of a special regulatory sign is the FENDER BENDER MOVE VEHICLES R16-4(V) sign.

Guidance:

- 04 *The FENDER BENDER MOVE VEHICLES R16-4(V) sign should be installed for TMP Category C projects. Care should be taken when locating the sign so that the effectiveness of any work zone signing is not compromised.*
- 05 *An engineering study should determine the use of the FENDER BENDER MOVE VEHICLES sign in highly congested areas with high existing crash rates.*

Option:

- 06 The FENDER BENDER MOVE VEHICLES R16-4(V) sign may be installed for a TMP Category B project.
- 07 Additional FENDER BENDER MOVE VEHICLES signs may be installed on intersecting highways that could be affected by work zone delays as deemed appropriate by the Engineer.

Section 6F.18 Warning Sign Function, Design, and Application**Support:**

- 01 TTC zone warning signs (see Figure 6F-3) notify road users of specific situations or conditions on or adjacent to a roadway that might not otherwise be apparent.

Option:

- 02 Advance warning signs may be used singly or in combination.

Standard:

- 03 **TTC warning signs shall comply with the Standards for warning signs presented in 2009 MUTCD Part 2 and its SHSM (see Section 1A.11 of the 2009 MUTCD or Virginia Supplement to the 2009 MUTCD) and its VSHS. Except as provided in Paragraph 6, TTC warning signs shall be diamond-shaped with a black legend and border on a fluorescent orange background, except for the W10-1 sign which shall have a black legend and border on a yellow background, and except for signs that are in 2009 MUTCD Parts 2 or 7 and the Virginia Supplement to the 2009 MUTCD to have fluorescent yellow-green backgrounds.**
- 04 **Reflective sheeting used on warning signs shall be in compliance with Section 247 of the Road and Bridge Specifications.**
- 05 **Because of their importance, the size of diamond shaped TTC advance warning signs shall be a minimum of 48 x 48 inch.**

Option:

- 06 Where right-of-way constraints prohibit the use of 48 x 48 inch signs, a minimum size of 36 x 36 inch may be used for advance warning signs. Mounting or space considerations may justify a change from the standard diamond shape.
- 07 Where distances are not shown on warning signs as part of the message, a supplemental plaque with the distance legend may be mounted immediately below the sign on the same support.
- 08 Warning signs used for TTC incident management situations may have a black legend and border on a fluorescent prismatic pink (high observation angle) lens background.
- 09 In emergencies, available warning signs having yellow backgrounds may be used if signs with fluorescent orange or fluorescent pink backgrounds are not at hand.

Guidance:

- 10 *Where roadway or road user conditions require greater emphasis, larger than standard size warning signs should be used, with the symbol or legend enlarged approximately in proportion to the outside dimensions.*
- 11 *Where any part of the roadway is obstructed or closed by work activities or incidents, advance warning signs should be installed to alert road users well in advance of these obstructions or restrictions.*
- 12 *Where road users include pedestrians, the provision of supplemental audible information or detectable barriers, longitudinal channelizing devices, or barricades should be considered for people with visual disabilities.*

Support:

- 13 Detectable barriers, longitudinal channelizing devices, or barricades communicate very clearly to pedestrians who have visual disabilities that they can no longer precede in the direction that they are traveling.

Section 6F.19 Position of Advance Warning Signs

Guidance:

- 01 *Where highway conditions permit, warning signs should be placed in advance of the TTC zone at varying distances depending on roadway type, geometric conditions, sight distance and posted speed. Table 6C-1 contains information regarding the spacing of advance warning signs. Where a series of two or more advance warning signs are used, the closest sign to the TTC zone should be placed approximately 100 feet for low-speed urban streets to 1,300 feet or more for Limited Access highways.*
- 02 *Where multiple advance warning signs are needed on the approach to a TTC zone, the ROAD WORK AHEAD (W20-1) sign should be the first advance warning sign encountered by road users.*
- 03 *The word AHEAD should be used in place of a specific distance on advance warning signs in most applications.*

Option:

- 04 As an alternative to the word AHEAD on the advance warning signs, a specific distance may be used.

Support:

- 05 *For urban conditions, it is generally better to attempt to place all advance warning signs within a one block area versus spreading out over several blocks.*
- 06 *Various conditions, such as limited sight distance or obstructions that might require a driver to reduce speed or stop, might require additional advance warning signs.*
- 07 *At TTC zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.*

Option:

- 08 Utility work, maintenance, or minor construction can occur within the TTC zone limits of a major construction project, and additional warning signs may be needed.

Guidance:

- 09 *Utility, maintenance, and minor construction signing and TTC should be coordinated with appropriate authorities so that road users are not confused or misled by the additional TTC devices.*

Section 6F.20 Reduced Speed Limit Ahead Sign (W3-5)

Standard:

- 01 **Speeds shall only be reduced within the TTC zone by the Regional Traffic Engineer upon completion of an engineering and traffic investigation warranting the reduction.**

Guidance:

- 02 *The Reduced Speed Limit Ahead (W3-5) sign (see Figure 6F-3) which serves as a general warning of speed reduction, should be located as close to the work area as possible, as opposed to placement prior to the advance warning signs (ROAD WORK AHEAD, etc.).*

Section 6F.21 Road (Street) Work Ahead Sign (W20-1) and Road Work Next 2 Miles Sign (W21-V2)

Standard:

- 01 **The ROAD WORK AHEAD (W20-1) sign shall be used in place of the Workers (W21-1 and W21-1a) symbol sign. The Worker symbol sign shall not be used.**
- 02 **The ROAD (STREET) WORK (W20-1) sign shall have the legend ROAD (STREET) WORK AHEAD, XX FEET, or XX MILES.**

Guidance:

- 03 *The ROAD (STREET) WORK AHEAD (W20-1) sign (see Figure 6F-3) which serves as a general warning of obstructions or restrictions, should be located in advance of the work space or any detour, on the road where the work is taking place.*
- 04 *Where traffic can enter a TTC zone from a crossroad or a major (high-volume) driveway, an advance warning sign should be used on the crossroad or major driveway.*

Option:

- 05 Other warning signs may be used in place of ROAD WORK AHEAD when appropriate such as RAMP WORK AHEAD (W21-V16), SURVEY CREW AHEAD (W21-V8), etc. based on the type of operation.

Support:

- 06 The maximum length of the work area is two miles unless approved by the Regional Traffic Engineer. Work operations such as paving operations and shoulder grading typically will progress more than two miles during a work shift.

Guidance:

- 07 *The ROAD WORK NEXT 2 MILES sign (W21-V2) should be used instead of the ROAD WORK AHEAD sign (W20-1) if the work area will extend over a greater distance of more than 2 miles during the work shift.*
- 08 *The initial work area should be as short as possible and should not exceed 2 miles. The work area should be extended as work progresses and a secondary ROAD WORK NEXT 2 MILES sign should be installed.*
- 09 *No more than two (2 miles each) ROAD WORK NEXT 2 MILES signs and their supporting advance warning signs should be exposed to motorists at any one time.*

Option:

- 10 The ROAD WORK AHEAD sign or ROAD WORK NEXT 2 MILES sign may be used until December 31, 2012, at which time only the ROAD WORK NEXT 2 MILES sign will be allowed if the work locations occur over a distance of more than 2 miles.

Standard:

- 11 **The distance of the ROAD WORK NEXT 2 MILES sign shall not increase.**

**Section 6F.22 Mowing Ahead Sign (W21-8), Mowing Next 2 Miles Sign (W21-V3),
Watch For Slow Moving Vehicle Sign (W21-V1), Line Painting Next 5 Miles Sign
(W21-V4), and Spraying Next 5 Miles Sign (W21-V5)**

Guidance:

- 01 *The MOWING NEXT 2 MILES (W21-V3) sign (see Figure 6F-3) should be used instead of the MOWING AHEAD (W21-8) sign if the work locations occur over a distance of more than 2 miles.*
- 02 *A WATCH FOR SLOW MOVING VEHICLES (W21-V1) sign (see Figure 6F-3) should be use in conjunction with MOWING NEXT 2 MILES sign, see Figures TTC-9 and TTC-10.*
- 03 *No more than two (2 miles each) MOWING NEXT 2 MILES sign and their supporting advance warning signs should be exposed to motorist at any one time.*

Option:

- 04 Other warning signs may be used in place of MOWING NEXT 2 MILES when appropriate such as LINE PAINTING NEXT 5 MILES (W21-V4) and SPRAYING NEXT 5 MILES (W21-V5) based on the type of operation (see Figure 6F-3).

Standard:

- 05 **The MOWING AHEAD sign shall be used on intersecting roadways entering into a mowing operation.**
- 06 **The distance of the MOWING WORK NEXT 2 MILES sign shall not increase.**
- 07 **The LINE PAINTING and SPRAYING signs shall have the legend LINE PAINTING NEXT 5 MILES, or SPRAYING NEXT 5 MILES. Their distance shall not increase.**

Guidance:

- 08 *No more than two (5 miles each) LINE PAINTING NEXT 5 MILES or SPRAYING NEXT 5 MILES signs and their supporting advance warning signs should be exposed to motorist at any one time.*

Section 6F.23 Detour Ahead Sign (W20-2)

Guidance:

- 01 *The DETOUR AHEAD (W20-2) sign (see Figure 6F-3) should be used in advance of a road user detour over a different roadway or route.*

Standard:

- 02 The **DETOUR** sign shall have the legend **DETOUR AHEAD, XX FEET, or XX MILES**. The **DETOUR** sign in TTC zones shall have a black legend and border on a fluorescent orange background.

Option:

- 03 Detour signs in TTC incident management situations may have a black legend and border on a fluorescent pink background.

Section 6F.24 Road (Street) Closed Ahead Sign (W20-3), Ramp Closed Ahead Sign (W20-V12), and Road Closed High Water Sign (W20-V11)

Guidance:

- 01 The **ROAD (STREET) CLOSED AHEAD (W20-3)** sign (see Figure 6F-3) should be used in advance of the point where a highway is closed to all road users, or to all but local road users.

Standard:

- 02 The **ROAD CLOSED** sign shall have the legend **ROAD (STREET) CLOSED AHEAD, XX FEET, or XX MILES**.

Option:

- 03 Other warning signs may be used in place of ROAD CLOSED AHEAD when appropriate such as, RAMP CLOSED AHEAD (W20-V12).

Guidance:

- 04 The **ROAD CLOSED HIGH WATER (W20-V11)** sign should be used in advance of the point where a roadway is closed to all road users due to high water.

Standard:

- 05 Type 3 Barricades with a **ROAD CLOSED (R11-3)** and Group 2 channelizing devices shall be used to physically close the roadway at the high water location.

Section 6F.25 One Lane Road Ahead Sign (W20-4)

Standard:

- 01 The **ONE LANE ROAD AHEAD (W20-4)** sign (see Figure 6F-3) shall be used only in advance of that point where motor vehicle traffic in both directions must use a common single lane (see Section 6C.11).
- 02 It shall have the legend **ONE LANE ROAD AHEAD, XX FEET, or XX MILES**.

Section 6F.26 Lane(s) Closed Signs (W20-5, W20-5a) and Turn Lane(s) Closed Signs (W20-V13)

Standard:

- 01 The **Lane(s) Closed** sign (see Figure 6F-3) shall be used in advance of that point where one or more through lanes of a multi-lane roadway are closed.
- 02 For a single lane closure, the **Lane Closed (W20-5)** sign (see Figure 6F-3) shall have the legend **RIGHT (LEFT) (CENTER) LANE CLOSED, AHEAD, XX FEET, or XX MILES**. Where two adjacent lanes are closed, the **W20-5a** sign (see Figure 6F-3) shall have the legend **2 RIGHT (LEFT) LANES CLOSED AHEAD, XX FEET, or XX MILES**.

Option:

- 03 Other warning signs may be used in place of RIGHT (LEFT) CENTER LANE CLOSED (W20-5, W20-5a) when appropriate such as, CENTER (LEFT) (RIGHT) TURN LANE CLOSED AHEAD (W20-V13).



W20-5 W20-5a
(2004 SHS)

Optional until Dec. 31, 2012



W9-3 or W20-5 W20-5a
(SHSM)

Optional now but required after Dec. 31, 2012

- 04 The W20-5 signs or W9-3, W9-3L and W9-3R signs may be used until December 31, 2012, at which time only the W9-3 and the W20-5 (SHSM) signs will be allowed.
- 05 The W20-5a RIGHT (LEFT) TWO LANES CLOSED AHEAD, XX FEET, or XX MILES legend or 2 RIGHT (LEFT) LANES CLOSED AHEAD, XX FEET, or XX MILES legend may be used until December 31, 2012, at which time only the 2 RIGHT (LEFT) LANES CLOSED AHEAD, XX FEET, or XX MILES legend will be allowed.
- 06 A base sign, such as the CENTER LANE CLOSED AHEAD sign may be modified with a RIGHT or LEFT overlay panel shown in the 2011 VSHS book.

Section 6F.27 Emergency Scene Ahead Sign (W20-V25)

Support:

- 01 Temporary traffic control for incident management can be found in Chapter 6I.
- Guidance:*
- 02 *The EMERGENCY SCENE AHEAD (W20-V25) sign should be the first advance warning sign encountered by road users in a traffic incident management control (TIMC) zone.*

Standard:

- 03 The EMERGENCY SCENE AHEAD sign used for TIMC zone shall have a black legend and border on a fluorescent pink background.

Option:

- 04 Additional TTC and advance warning signs may be needed in a TIMC zone.

Section 6F.28 Center (Left/Right) Lane Closed Ahead Sign (W9-3)

Standard:

- 01 The CENTER (LEFT/RIGHT) LANE CLOSED AHEAD (W9-3) sign (see Figure 6F-3) shall be used in advance of that point where one or more through lanes of a multi-lane roadway are closed.

Option:

- 02 The CENTER LANE CLOSED AHEAD (W9-3) sign or CENTER (LEFT/RIGHT) LANES CLOSED AHEAD (W20-5a) sign may be used until December 31, 2012, at which time only the CENTER (LEFT/RIGHT) LANE CLOSED AHEAD (W9-3) sign will be allowed.



W20-5a

Optional until Dec. 31, 2012



W9-3

Optional now but required after Dec. 31, 2012

- 03 A base sign, such as the CENTER LANE CLOSED AHEAD sign may be modified with a RIGHT or LEFT overlay panel shown in the 2011 VSHS book.

Section 6F.29 Lane Ends Merge Left/ Right (W9-2), Keep Left/Right (R4-V7), and Lane Ends Signs (W4-2)

Standard:

- 01 The LANE ENDS MERGE LEFT/RIGHT (W9-2) sign shall be used in advance of the Lane Ends (W4-2) sign(s) to warn motorist to merge from the lane which will occupy the work area. The LANE ENDS MERGE sign shall be placed on the shoulder in which the travel lane is closed. The KEEP LEFT/RIGHT (R4-V7) sign shall be used to indicate the open travel lane and shall be placed on the opposite shoulder across from the LANE ENDS MERGE sign (see Figure TTC-16).
- 02 The KEEP LEFT/RIGHT sign shall only be used as a TTC sign and shall not be used in permanent installations.
- 03 The Lane Ends symbol sign with skip lines displayed (see Figure 6F-3) shall be used to warn drivers of the reduction in the number of lanes for moving motor vehicle traffic in the direction of travel on a multi-lane roadway.

Figure 6F-3, Warning Signs and Plaques in Temporary Traffic Control (Sheet 1 of 4)



W1-1R



W1-2R



W1-3R



W1-4R



W1-4bR



W1-4cR



W1-6R



W1-7



W1-8L



W1-V1R



W3-1



W3-2



W3-3



W3-4



W3-5



W4-1R



W4-2R



W4-3R



W4-5R



W4-5P



W4-6R



W5-1



W5-2



W5-3



W5-4



W5-VP1
Round up to nearest
foot or six inch increment.



W6-1



W6-2

Figure 6F-3, Warning Signs and Plaques in Temporary Traffic Control (Sheet 2 of 4)



W6-3



W6-4



W6-VP1



W7-1



W8-1



W8-2



W8-3



W8-4



W8-5



W8-6



W8-7



W8-8



W8-9



W8-11



W8-12



W8-14



W8-15p



W8-18



W8-23



W8-24



W8-25



W8-V4



W8-V5



W9-1R



W9-2R



W9-3

Figure 6F-3, Warning Signs and Plaques in Temporary Traffic Control (Sheet 3 of 4)



W11-10



W11-V2



W11-V3



W11-V4



W12-1



W12-2



W13-1P



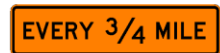
W13-4P



W14-3



W16-VP1



W16-VP2



W16-VP3



W16-VP4E



W16-VP4R



W16-VP5



W20-1



W20-2



W20-3



W20-4



W20-5R



W20-5aR



W20-7



W20-8 (V)



W20-V11



W20-V12



W20-V13R



W20-V25

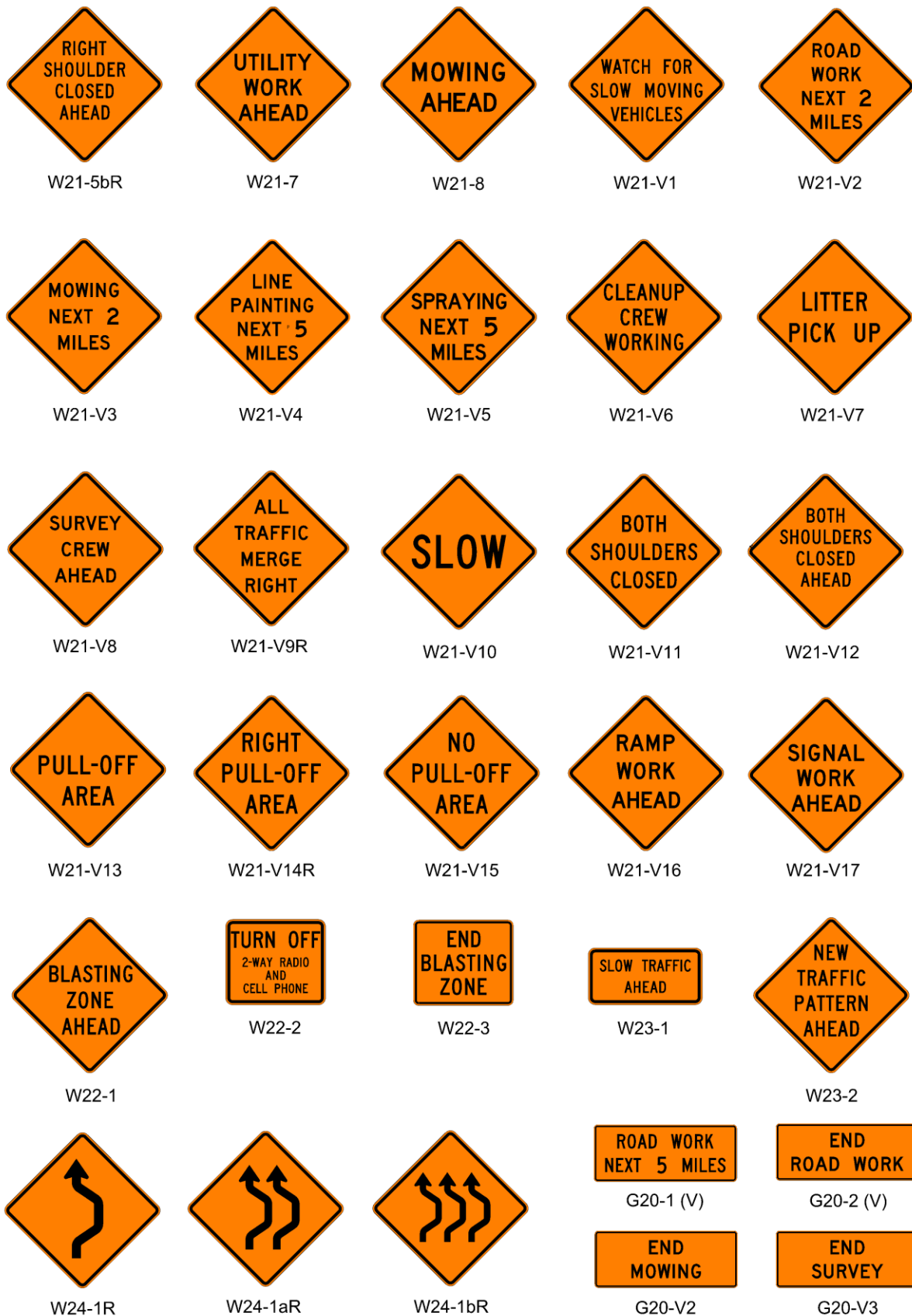


W21-5



W21-5aR

Figure 6F-3, Warning Signs and Plaques in Temporary Traffic Control (Sheet 4 of 4)



Option:

- 04 A base sign, such as the LANES ENDS MERGE RIGHT and the KEEP RIGHT sign may be modified with a LEFT overlay panel shown in the 2011 VSHS book.

Section 6F.30 One-Direction Large Arrow Sign (W1-V1)Support:

- 01 Due to the familiarity of the location and knowledge of the existing lane drop condition by motorist on Non-Limited Access primary and secondary routes an electronic arrow board can be replaced with a One-Directional Large Arrow (W1-V1) sign on long term projects (greater than two weeks).

Standard:

- 02 The size of the One-Direction Large Arrow sign shall be 96" x 48" and it shall have a black arrow and border on a fluorescent orange background.
- 03 The One-Direction Large Arrow sign can only be used on long-term Non-Limited Access Primary and Secondary Routes projects and it shall be approved by the Regional Traffic Engineer before implementation. The One-Directional Large Arrow sign shall not replace an Electronic Arrow Board on a Limited Access highway.
- 04 The Electronic Arrow Board must be in operation for a minimum of two weeks to allow motorist to become accustomed to the new traffic pattern prior to being replaced with the One-Directional Large Arrow sign.
- 05 The mounting height of the One-Direction Large Arrow sign shall be the same as the Electronic Arrow Board, a minimum of seven (7) feet from the bottom of the sign to the roadway elevation.

Option:

- 06 During the two week period when the Electronic Arrow Board is in use, the One-Direction Large Arrow sign may be fastened under the flashing arrow board for greater recognition when the devices are switched.

Section 6F.31 On Ramp Plaque (W13-4P) and Ramp Work Ahead Sign (W21-V16)Guidance:

- 01 *When long-term stationary work is being done on a ramp, but the ramp remains open, the ON RAMP (W13-4P) plaque (see Figure 6F-3) should be used to supplement the advance ROAD WORK AHEAD sign.*

Option:

- 02 A RAMP WORK AHEAD (W21-V16) sign may be used in place of the ROAD WORK AHEAD sign and the ON RAMP plaque.

Section 6F.32 Signal Work Ahead Sign (W21-V17)Guidance:

- 01 *The SIGNAL WORK AHEAD (W21-V17) sign should be used while performing work on a signal.*

Option:

- 02 The ROAD WORK AHEAD sign may be used in place of the SIGNAL WORK AHEAD sign when signal work is on the shoulder of the roadway.

Section 6F.33 Ramp Narrows Sign (W5-4) and Lane Width Plaque (W5-VP1)Guidance:

- 01 *The RAMP NARROWS (W5-4) sign (see Figure 6F-3) should be used in advance of the point where work on a ramp reduces the normal width of the ramp along a part or the entire ramp.*

Standard:

- 02 For long-term stationary work, when the distance between the edge line and the channelizing devices is less than 14 feet, a LANE WIDTH plaque (W5-VP1) displaying the width from the edge line to the channelizing devices in feet and inches shall be mounted below the RAMP NARROWS sign. The clear width on the LANE WIDTH plaque shall be rounded down to the nearest foot or half foot increment (see Figure TTC-38).

Guidance:

- 03 *A traffic engineering study should determine if there is a need for a wide load detour and additional TTC.*

Section 6F.34 Shadow Vehicle and Work Vehicle-Mounted Signs*Guidance:*

- 01 *On two-lane mobile operations, a LANE CLOSED DO NOT PASS (R4-V6) sign should be used on the back of the shadow vehicle.*

Standard:

- 02 **The LANE CLOSED DO NOT PASS sign shall be rectangular-shaped with a black legend and border. The LANE CLOSED portion of the sign shall have a fluorescent orange background and the DO NOT PASS section shall have a white background. See the 2011 VSHS book for fabrication requirements.**
- 03 **The ROAD WORK AHEAD – X LANE CLOSED (W20-V1 and W20-V2 series) sign shall be used on back of the shadow vehicles performing mobile operations on all roadways.**
- 04 **Alternate vehicle-mounted sign messages are ROAD WORK AHEAD – LEFT SHOULDER CLOSED (W20-V1L), ROAD WORK AHEAD – RIGHT SHOULDER CLOSED (W20-V1R), ROAD WORK AHEAD – CENTER LANE CLOSED (W20-V2C), ROAD WORK AHEAD – LEFT LANE CLOSED (W20-V2L), ROAD WORK AHEAD – X LEFT LANE(S) CLOSED (W20-V2aL), ROAD WORK AHEAD – RIGHT LANE CLOSED (W20-V2R) and ROAD WORK AHEAD – X RIGHT LANE(S) CLOSED (W20-V2aR).**
- 05 **Where two adjacent lanes are closed, the ROAD WORK AHEAD – 2 LEFT LANES CLOSED (W20-V2aL) or ROAD WORK AHEAD – 2 RIGHT LANES CLOSED (W20-V2aR) shall be used.**

Option:

- 06 Other warning sign legends may be used in place of the ROAD WORK AHEAD sign when appropriate such as MOWING AHEAD (W20-V3 and W20-V4 series), LINE PAINTING AHEAD (W20-V5 series), and SPRAYING AHEAD (W20-V6 and W20-V7 series) based on the type of operation.
- 07 A base sign, such as ROAD WORK AHEAD LEFT SHOULDER CLOSED sign may be modified with such as MOWING AHEAD or RIGHT overlay panel shown in the 2011 VSHS book.

Standard:

- 08 **When applying sprayed-on pre-storm treatment material, a PRE-STORM TREATMENT (W20-V8 series) sign shall be used on the back of the shadow vehicle with a TMA. A PRE-STORM TREATMENT (W20-V9) sign shall be used on the back of the application (work) vehicle and on a shadow vehicle without a TMA.**
- 09 **The KEEP BACK 100 FT (W20-V10) sign shall be used on the application (work) vehicle such as a pre-storm treatment vehicle or a salt spreader.**

Option:

- 10 The PRE-STORM TREATMENT sign may be eliminated on the application (work) vehicle when there is no physical way to attach the sign to the back of the application (work) vehicle.
- 11 The SLOW TRAFFIC AHEAD (W23-1) sign (see Figure 6F-4) may be used on a shadow vehicle, usually mounted on the rear of the most upstream shadow vehicle, along with other appropriate signs for mobile operations to warn of slow moving work vehicle. A ROAD WORK AHEAD (W20-1) sign may all so be used with the SLOW TRAFFIC AHEAD sign.
- 12 A truck-mounted Changeable Message Sign capable of display three separate lines of text, simulation of flashing arrow and four corner caution mode may be used in place of the ROAD WORK AHEAD – X LANE CLOSED (W20-V1 to W20-V8 series) sign (see Section 6F.68).

Section 6F.35 Exit Open and Exit Closed Signs (E5-2, E5-2a)*Guidance:*

- 01 *An EXIT OPEN (E5-2) or EXIT CLOSED (E5-2a) sign (see Figure 6F-5) should be used to supplement other warning signs where work is being conducted in the vicinity of an exit ramp and where the exit maneuver for vehicular traffic using the ramp is different from the normal condition.*
- 02 *When an exit ramp is closed, an EXIT CLOSED sign panel should be placed diagonally across the interchange/intersection guide signs.*

Standard:

- 03 The EXIT OPEN and EXIT CLOSED sign shall have a black legend and border on a fluorescent orange background.

Section 6F.36 Exit Only Sign (E5-3) and Exit Sign (E5-V1)**Standard:**

- 01 A temporary EXIT (E5-V1) sign (see Figure 6F-5) shall be located in the temporary gore. For better visibility, it shall be mounted a minimum of 7 feet from the pavement surface to the bottom of the sign (see Figure TTC-37).

Option:

- 02 The temporary EXIT sign placed in the temporary gore may be either black on fluorescent orange or white on green.
- 03 An EXIT ONLY (E5-3) sign (see Figure 6F-5) may be used to supplement other warning signs where work is being conducted in the vicinity of an exit ramp and where the exit maneuver for vehicular traffic using the ramp is different from the normal condition.

Section 6F.37 New Traffic Pattern Ahead Sign (W23-2)**Guidance:**

- 01 *A NEW TRAFFIC PATTERN AHEAD (W23-2) sign (see Figure 6F-3) should be used on the approach to an intersection or along a section of roadway to provide advance warning of a change in traffic patterns, such as revised lane usage, roadway geometry, or signal phasing.*
- 02 *To retain its effectiveness, the NEW TRAFFIC PATTERN AHEAD sign should be displayed for up to 2 weeks, and then it should be covered or removed until it is needed again.*

Section 6F.38 Flagger Signs (W20-7a, W20-7), XX Feet Plaque (W16-VP3), and Slow Sign (W21-V10)**Standard:**

- 01 The FLAGGER (W20-7a) sign word message shall not be used.
- 02 The Flagger (W20-7) symbol sign shall be removed or covered from road users when the flagging operation is suspended for 30 minutes or longer.
- 03 On non-stationary flagger operations a Flagger symbol sign shall stay within ½ mile of each flagger.

Guidance:

- 04 *The Flagger (W20-7) symbol sign (see Figure 6F-3) should be used in advance of any point where a flagger is stationed to control road users.*
- 05 *Additional Flagger symbol signs should be placed at ½ mile intervals and either erected by the approaching flagger, or taken down as the operation proceeds past this point.*

Option:

- 06 On long-term projects, a Distance (W16-VP3) plaque may be displayed on a supplemental plaque below the Flagger sign. The sign may be used with appropriate legends or in conjunction with other warning signs, such as the BE PREPARED TO STOP (W3-4) sign (see Figure 6F-3).
- 07 The Distance (W16-2) plaque may be used until December 31, 2012, at which time only the Distance (W16-VP3) plaque will be allowed.



W16-2

Optional until Dec. 31, 2012



W16-VP3 for 36" sign - 48 x 12

W16-VP3 for 48" sign - 60 x 18

Optional now but required after Dec. 31, 2012

- 08 A SLOW (W21-V10) sign may be added to the TTC zone for flagger operation when geometrics conditions prohibit the use of a supplemental flagger. The project's Engineer may allow the SLOW sign to be used in other TTC zones.

Guidance:

- 09 *Where conditions warrant the use of a supplemental flagger but roadway geometrics prohibit the use of a supplemental flagger, a SLOW sign should be placed in the advance warning area.*

Section 6F.39 Two-Way Traffic Signs (W6-3, W6-4) and Parallel Road Closed Plaque (W6-VP1)*Guidance:*

- 01 *When one roadway of a normally divided highway is closed, with two-way vehicular traffic maintained on the other roadway, the Two-Way Traffic (W6-3) sign (see Figure 6F-3) should be used at the beginning of the two-way vehicular traffic section and at intervals to remind road users of opposing vehicular traffic.*
- 02 *The PARALLEL ROAD CLOSED (W6-VP1) plaque should be installed with and below the Two-Way Traffic sign.*

Option:

- 03 When a temporary traffic barrier is used to separate opposing vehicular traffic, the Two-Way Traffic and the PARALLEL ROAD CLOSED signs may be eliminated.
- 04 A crashworthy TWO-WAY TRAFFIC (W6-4) sign may be used on channelizing devices to separate two-way traffic in an urban area.

Section 6F.40 Motorized Traffic Signs - Truck Crossing Symbol (W11-10), Truck Crossing Sign (W8-6), Watch for Turning Vehicles Sign (W11-V3) Trucks Entering Highway Sign (W11-V4), and Construction Entrance Sign (W11-V2)Option:

- 01 Motorized Traffic (W8-6, W11-10, W11-V2, and W11-V4) signs may be used to alert road users to locations where unexpected travel on the roadway or entries into or departures from the roadway by construction vehicles might occur.

Guidance:

- 02 *Truck Crossing (W11-10) symbol sign (see Figure 6F-3) should be used where a construction vehicle crossing of the roadway has been established.*

Option:

- 03 The TRUCK CROSSING (W8-6) word message sign may be used as an alternate to the Truck Crossing (W11-10) symbol sign.
- 04 The TRUCKS ENTERING HIGHWAY (W11-V4) sign may be used on projects where multiple construction vehicles enter the roadway from different locations throughout the project.

Standard:

- 05 **TRUCKS ENTERING HIGHWAY sign shall be used to warn of logging trucks entering roadways (see Figure TTC-63).**

Option:

- 06 The LOG TRUCKS ENTERING HIGHWAY sign may be used in lieu of the TRUCKS ENTERING HIGHWAY sign until December 31, 2012.

Guidance:

- 07 *CONSTRUCTION ENTRANCE (W11-V2) sign should be used to help delivery drivers to identify established construction and delivery entrances on large scale projects.*

Option:

- 08 A CONSTRUCTION ENTRANCE sign number may be modified with another number overlay panel found in the 2011 VSHS book.

Guidance:

- 09 *The WATCH FOR TURNING VEHICLES (W11-V3) sign should be used in advance of intersections or driveways with a high daily turning movement.*

Standard:

- 10 **The WATCH FOR TURNING VEHICLES sign shall not be used on a controlled approach.**

Support:

- 11 These locations might be relatively confined or might occur randomly over a segment of roadway.

Section 6F.41 Rough Road Sign (W8-8) and Motorcycle Plaque (W8-15P)

Guidance:

- 01 *The ROUGH ROAD (W8-8) sign (see Figure 6F-3) should be used to warn of a rough roadway surface and pavement milled surfaces.*

Option:

- 02 A MOTORCYCLE (W8-15P) plaque (see Figure 6F-3) may be mounted below a ROUGH ROAD (W8-8) sign when the sign is mounted on a post.

Section 6F.42 Shoulder Work Signs (W21-5, W21-5a, W21-5b, W21-V11, W21-V12)

Support:

- 01 Shoulder Work signs (see Figure 6F-3) warn of maintenance, reconstruction, or utility operations on the highway shoulder where the roadway is unobstructed.

Standard:

- 02 **The Shoulder Work signs shall have the legend SHOULDER WORK (W21-5), RIGHT (LEFT) SHOULDER CLOSED (W21-5a), RIGHT (LEFT) SHOULDER CLOSED AHEAD, XX FT or XX MILES (W21-5b), BOTH SHOULDERS CLOSED (W21-V11), or BOTH SHOULDERS CLOSED AHEAD (W21-V12).**

Option:

- 03 The Shoulder Work sign may be used in advance of the point on a Non-Limited Access highway where there is shoulder work. It may be used singly or in combination with a ROAD WORK NEXT 2 MILES (W21-V2) or ROAD WORK AHEAD sign.

Guidance:

- 04 *On Limited Access highways, the RIGHT (LEFT) SHOULDER CLOSED AHEAD or BOTH SHOULDERS CLOSED AHEAD (W21-V12) sign followed by RIGHT (LEFT) SHOULDER CLOSED (W21-5a) or BOTH SHOULDERS CLOSED (W21-V11) sign should be used in advance of the point where the shoulder work occurs and should be preceded by a ROAD WORK AHEAD sign. When the shoulder is closed with barrier, a NEXT XX MILE(S) (W16-VP1) or XX FT (W16-VP3) plaque should be used under the RIGHT (LEFT) SHOULDER CLOSED or BOTH SHOULDERS CLOSED signs.*

Option:

- 05 NEXT XX MILE(S) (W16-VP1) or XX FT (W16-VP3) plaque may be added under the RIGHT (LEFT) SHOULDER CLOSED (W21-5a) or BOTH SHOULDERS CLOSED (W21-V11) sign when signs are post-mounted.

- 06 A base sign, such as RIGHT SHOULDER CLOSED AHEAD sign may be modified with a LEFT overlay panel as shown in the 2011 VSHS book.

Section 6F.43 Pull-Off Area Signs (W21-V13, W21-V14, W21-V15, E5-V2) and Supplemental Plaques (W16-VP1, W16-VP2, W16-VP3, W16-VP4, W16-VP5)

Support:

- 01 Pull-off signage is necessary when one or both shoulders are closed with temporary traffic barrier to warn motorist if there are opportunities for disabled vehicles to pull off the roadway (see Figures 6F-3 and 6F-5).

Guidance:

- 02 *A NO PULL-OFF AREA (W21-V15) sign with NEXT XX MILES (W16-VP1) plaque (see Figure 6F-3) should be installed after the shoulder closure sign to warn motorist there are no opportunities for disabled vehicles to pull off the roadway throughout the work area.*

- 03 *Where multiple pull-off areas are provided for disabled vehicles, a LEFT (RIGHT) PULL-OFF AREA (W21-V14L/R) sign with EVERY X MILE (W16-VP2) plaque should be installed after the shoulder closure sign(s). The legend of the plaque should be EVERY ½ MILE, EVERY ¼ MILE, or EVERY 1 MILE (see Figure 6F-3 and Figure TTC-8).*

- 04 *A LEFT/RIGHT PULL-OFF AREA sign along with a XX FEET (W16-VP3) plaque should be installed in advance of every disabled vehicle pull off area. A Pull-Off Area Entrance (E5-V2) sign (see Figure 6F-5) should identify the beginning of every disabled vehicle pull-off area.*
- 05 *Where an interchange will provide a pull-off for disabled vehicles, a PULL-OFF AREA (W21-V13) sign with an Exit Number (W16-VP5) plaque should be installed adjacent to the Interchange Advance Guide sign. If multiple Interchange Advance Guide signs are used then the PULL-OFF AREA sign and the Exit Number plaque should be install between the two Interchange Advance Guide signs. A Pull-Off Area Entrance sign should be installed on the shoulder adjacent to the Interchange Exit Directional sign.*
- 06 *Where interchange numbers are not provided the PULL-OFF AREA sign with a NEXT EXIT (W16-VP4E) plaque should be installed on the shoulder adjacent to the Interchange Advance Guide sign.*

Option:

- 07 A base sign, such as RIGHT PULL-OFF AREA sign may be modified with a LEFT overlay panel shown in the 2011 VSHS book.
- 08 The legends NEXT LEFT (W16-VP4L) or NEXT RIGHT (W16-VP4R) may be substituted for NEXT EXIT plaque.

Section 6F.44 Survey Crew Ahead Sign (W21-V8)

Guidance:

- 01 *The SURVEY CREW AHEAD (W21-V8) sign should be used in place of the SURVEY CREW (W21-6) sign.*
- 02 *The SURVEY CREW AHEAD sign (see Figure 6F-3) should be used to warn of surveying crews working in or adjacent to the roadway.*

Option:

- 03 The SURVEY CREW (W21-6) sign or SURVEY CREW AHEAD (W21-V8) sign may be used until December 31, 2012, at which time only the SURVEY CREW AHEAD (W21-V8) sign will be allowed.



W21-6

Optional until Dec. 31, 2012



W21-V8

Optional now but required after Dec. 31, 2012

Section 6F.45 Utility Work Ahead Sign (W21-7)

Option:

- 01 The UTILITY WORK AHEAD (W21-7) sign (see Figure 6F-3) may be used as an alternate to the ROAD (STREET) WORK (W20-1) sign for utility operations on or adjacent to a highway.
- 02 The words XX FEET or XX MILES may be substituted word ahead on the UTILITY WORK AHEAD sign.

Support:

- 03 Typical examples of where the UTILITY WORK sign is used appear in Temporary Traffic Control (TTC) Figures TTC-1, TTC-3, TTC-4, TTC-5, TTC-15, TTC-16, TTC-17, TTC-18, TTC-19, TTC-35 and TTC-36.

Section 6F.46 Signs for Blasting Areas

Support:

- 01 Radio-Frequency (RF) energy can cause the premature firing of electric detonators (blasting caps) used in TTC zones.

Standard:

- 02 Road users shall be warned to turn off mobile radio transmitters and cellular telephones where blasting operations occur. A sequence of signs shall be prominently displayed to direct operators of mobile radio equipment, including cellular telephones, to turn off transmitters in a blasting area. These signs shall be covered or removed when there are no explosives in the area or the area is otherwise secured.

Section 6F.47 Blasting Zone Ahead Sign (W22-1)**Standard:**

- 01 The BLASTING ZONE AHEAD (W22-1) sign (see Figure 6F-3) shall be used in advance of any TTC zone where explosives are being used. The TURN OFF 2-WAY RADIO AND CELL PHONE and END BLASTING ZONE signs shall be used in sequence with this sign (see Figure TTC-2).

Section 6F.48 Turn Off 2-Way Radio And Cell Phone Sign (W22-2)**Standard:**

- 01 The TURN OFF 2-WAY RADIO AND CELL PHONE (W22-2) sign (see Figure 6F-3) shall follow the BLASTING ZONE AHEAD sign and shall be placed at least 1,000 feet before the beginning of the blasting zone (see Figure TTC-2).

Section 6F.49 End Blasting Zone Sign (W22-3)**Standard:**

- 01 The END BLASTING ZONE (W22-3) sign (see Figure 6F-3) shall be placed a minimum of 1,000 feet past the blasting zone (see Figure TTC-2).

Option:

- 02 The END BLASTING ZONE sign may be placed either with or preceding the END ROAD WORK sign.

**Section 6F.50 Soft Shoulder Sign (W8-4), Low Shoulder Sign (W8-9),
Shoulder Drop Off Sign (W8-V5), and Shoulder Drop Off Plaque (W8-17P)****Option:**

- 01 The SOFT SHOULDER (W8-4) sign (see Figure 6F-3) may be used to warn of a soft shoulder condition.
- 02 The LOW SHOULDER (W8-9) sign (see Figure 6F-3) may be used to warn of a shoulder condition where there is an elevation difference of 2 inches or less between the shoulder and the travel lane.

Standard:

- 03 If used, the LOW SHOULDER sign shall be repeated at 1 mile intervals if the condition extends over a distance in excess of 1 mile.
- 04 The SHOULDER DROP OFF (W8-V5) sign (see Figure 6F-3) shall be used when an unprotected shoulder drop-off, adjacent to the travel lane, exceeds 2 inches in depth for a continuous length along the roadway, based on engineering judgment. Where the condition extends over a distance in excess of 1 mile, the sign shall be repeated at 1 mile intervals.

Option:

- 05 The Shoulder Drop Off (W8-17) symbol sign or SHOULDER DROP OFF (W8-V5) word message sign may be used until December 31, 2012, at which time only the SHOULDER DROP OFF (W8-V5) word message sign will be allowed.



W8-17 (2009 MUTCD)
Optional until Dec. 31, 2012



W8-V5
Optional now but required after Dec. 31, 2012

Standard:

- 06 The SHOULDER DROP OFF (W8-17P) supplemental plaque (see Figure 6F-4 in the 2009 MUTCD) shall be mounted under the Shoulder Drop Off (W8-17) symbol sign when post-mounted.

Section 6F.51 Uneven Lanes Sign (W8-11)**Standard:**

- 01 The UNEVEN LANES (W8-11) sign (see Figure 6F-3) shall be used during operations that create a difference in elevation between adjacent lanes that are open to travel.

- 02 When used on a portable sign support, the UNEVEN LANES sign shall be adjusted daily with the work operation and a sand bag weighing approximately 25-pounds shall be placed on each leg of the sign stand.

Section 6F.52 Steel Plate Ahead Sign (W8-24)

Standard:

- 01 The STEEL PLATE AHEAD (W8-24) sign (see Figure 6F-3) shall be used to warn road users whenever a steel plate(s) is being used to protect the surface of the roadway open to travel.
- 02 When used on a portable sign support, the STEEL PLATE AHEAD sign shall be adjusted daily with the work operation and a sand bag weighing approximately 25-pounds shall be placed on each leg of the sign stand.
- 03 Conspicuity pavement markings shall be applied to steel plate(s) when used (see Section 6G.15).

Support:

- 04 The steel plate could make the road surface uneven and could create slippery conditions during wet weather; therefore, conspicuity pavement markings are required when steel plates are used.

Option:

- 05 Additional warning signs may be necessary for the conditions present. A ride through of the worksite should be performed to check for bumps and rough road conditions.

Section 6F.53 No Center Line Sign (W8-12) and Unmarked Pavement Ahead Sign (W8-V4)

Standard:

- 01 The NO CENTER LINE (W8-12) sign (see Figure 6F-3) shall be used when the work obliterates the double yellow or yellow skip line center line(s) pavement markings. This sign should be placed at the beginning of the TTC zone and repeated at 2-mile intervals in long TTC zones.
- 02 The UNMARKED PAVEMENT AHEAD (W8-V4) sign shall be erected in advance of resurfaced roadway sections 500 feet or more in length where the skip lines or the skip and edge lines have been removed until pavement marking is applied.

Support:

- 03 Section 6F.86 contains information regarding temporary markings.

Option:

- 04 The NO CENTER STRIPE (W8-12) sign or NO CENTER LINE (W8-12) sign message may be used until December 31, 2012, at which time only the NO CENTER LINE sign will be allowed.



W8-12 (2003 MUTCD)
Optional until Dec. 31, 2012



W8-12 (2009 MUTCD)
Optional now but required after Dec. 31, 2012

Section 6F.54 Reverse Curve Signs (W1-4 Series)

Guidance:

- 01 *In order to give road users advance notice of a lane shift, a Reverse Curve (W1-4, W1-4b, or W1-4c) sign (see Figure 6F-3) should be used when a lane (or lanes) is being shifted to the left or right. If the design speed of the curves is 30 mph or less, a Reverse Turn (W1-3) sign should be used.*

Standard:

- 02 If a Reverse Curve (or Turn) sign is used, the direction of the reverse curve (or turn) shall be appropriately illustrated. Except as provided in Paragraph 3, the number of lanes illustrated on the sign shall be the same as the number of through lanes available to road users.

Option:

- 03 Where two or more lanes are being shifted, a W1-4 (or W1-3) sign with an ALL LANES (W24-1cP) plaque (see Figure 6F-3) may be used instead of a sign that illustrates the number of lanes.
- 04 Where more than three lanes are being shifted, the Reverse Curve (or Turn) sign may be rectangular.

Section 6F.55 Double Reverse Curve Signs (W24-1 Series)Option:

- 01 The Double Reverse Curve (W24-1, W24-1a, or W24-1b) sign (see Figure 6F-3) may be used where the tangent distance between two reverse curves is less than 600 feet, thus making it difficult for a second Reverse Curve (W1-4 series) sign to be placed between the curves. If the design speed of the curves is 30 mph or less, Double Reverse Turn signs should be used.

Standard:

- 02 **If a Double Reverse Curve (or Turn) sign is used, the direction of the double reverse curve (or turn) shall be appropriately illustrated. Except as provided in Paragraph 3, the number of lanes illustrated on the sign shall be the same as the number of through lanes available to road users.**

Option:

- 03 Where two or more lanes are being shifted, a W24-1 (or Double Reverse Turn sign showing one lane) sign with an ALL LANES (W24-1cP) plaque (see Figure 6F-3) may be used instead of a sign that illustrates the number of lanes.
- 04 Where more than three lanes are being shifted, the Double Reverse Curve (or Turn) sign may be rectangular.

Section 6F.56 Other Warning SignsOption:

- 01 Advance warning signs may be used by themselves or with other advance warning signs.
- 02 Besides the warning signs specifically related to TTC zones, several other warning signs in Part 2 of the 2009 MUTCD may apply in TTC zones.

Standard:

- 03 **Except as provided in Section 6F.02, other warning signs that are used in TTC zones shall have black legends and borders on a fluorescent orange background.**

Section 6F.57 Special Warning SignsOption:

- 01 Special warning signs may be used based on engineering judgment.

Guidance:

- 02 *Special warning signs should comply with the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.*

Section 6F.58 Advisory Speed Plaque (W13-1P)Option:

- 01 In combination with a warning sign, an Advisory Speed (W13-1P) plaque (see Figure 6F-3) may be used to indicate a recommended speed through the TTC zone.

Standard:

- 02 **An engineering study by the Regional Traffic Engineer or official having jurisdiction shall establish the advisory speed (see Section 2C.08 of the Virginia Supplement to the 2009 MUTCD). Except in emergencies, an Advisory Speed plaque shall not be mounted until the engineering study determines the recommended speed.**
- 03 **The Advisory Speed plaque shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used with fluorescent orange TTC zone signs, this plaque shall have a black legend and border on a fluorescent orange background.**
- 04 **The Advisory Speed plaque shall be at least 30 x 30 inches in size when used with a sign that is 48 x 48 inches or larger or at least 24 x 24 inches in size when used with a sign that is 36 x 36 inches.**

Option:

- 05 The 24 x 24 inches Advisory Speed plaque may be used with the 48 x 48 inches or larger signs until December 31, 2012, at which time only the 30 x 30 inches sign will be allowed.



W13-1 24" x 24"
Optional on 36" x 36" or 48" x 48" signs
until Dec. 31, 2012



W13-1 24" x 24" on 36" x 36" signs
W13-1 30" x 30" on 48" x 48" signs
Optional now but required after Dec. 31, 2012

Section 6F.59 Supplementary Distance Plaque (W16-VP1)Option:

- 01 In combination with a warning sign, a Supplementary Distance (W16-VP1) plaque (see Figure 6F-3) with the legend NEXT XX MILES may be used to indicate the length of highway over which a work activity is being conducted, or over which a condition exists in the TTC zone.
- 02 In long TTC zones, Supplementary Distance plaques with the legend NEXT XX MILES may be placed in combination with warning signs at regular intervals within the zone to indicate the remaining length of highway over which the TTC work activity or condition exists.

Standard:

- 03 **The Supplementary Distance plaque with the legend NEXT XX MILES shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used with fluorescent orange TTC zone signs, this plaque shall have a black legend and border on a fluorescent orange background.**
- 04 **The sign shall be 60 x 18 inches in size when used with a sign that is 48 x 48 inches or least 48 x 12 inches in size when used with a sign that is 36 x 36 inches.**

Option:

- 05 The W7-3p plaque or W16-VP1 plaque may be used until December 31, 2012, at which time only the W16-VP1 plaque will be allowed.



W7-3p for 36" or 48" sign - 24" x 18"
Optional until Dec. 31, 2012



W16-VP1 for 36" sign - 48 x 12
W16-VP1 for 48" sign - 60 x 18
Optional now but required after Dec. 31, 2012

Guidance:

- 06 *When used in TTC zones, the Supplementary Distance plaque with the legend NEXT XX MILES should be placed below the initial warning sign designating that, within the approaching zone, a temporary work activity or condition exists.*

Section 6F.60 Guide SignsSupport:

- 01 Guide signs along highways provide road users with information to help them along their way through the TTC zone. The design of guide signs is presented in Part 2 of the 2009 MUTCD.

Guidance:

- 02 *The following guide signs should be used in TTC zones as needed:*
- A. *Standard route markings, where temporary route changes are necessary,*
 - B. *Directional signs and street name signs, and*
 - C. *Special guide signs relating to the condition or work being done.*

Standard:

- 03 **If additional temporary guide signs are used in TTC zones, they shall have a black legend and border on a fluorescent orange background.**

Option:

- 04 Guide signs used in TTC incident management situations may have a black legend and border on a fluorescent pink background.
- 05 When directional signs and street name signs are used in conjunction with detour routing, these signs may have a black legend and border on a fluorescent orange background.
- 06 When permanent directional signs or permanent street name signs are used in conjunction with detour signing, they may have a white legend on a green background.

Section 6F.61 Road Work Next XX Miles Sign (G20-1 (V))**Guidance:**

- 01 *The ROAD WORK NEXT XX MILES (G20-1 (V)) sign (see Figure 6F-3) should be installed in advance of TTC zones that are more than 2 miles in length.*

Standard:

- 02 **The ROAD WORK NEXT XX MILES sign shall be 60 x 24 inches in size on Non-Restricted Right-of-Way Roadways and 48 x 24 inches in size on Restricted Right-of-Way Roadways and Residential & Urban < 500 ADT and ≤ 30 MPH.**
- 03 **The distance displayed on the ROAD WORK NEXT XX MILES sign shall be rounded up to the nearest whole mile.**

Option:

- 04 The ROAD WORK NEXT XX MILES sign may be mounted on a Type 3 Barricade. The sign may also be used for TTC zones of shorter length.

Section 6F.62 End Road Work Sign (G20-2 (V)), End Mowing Sign (G20-V2), and End Survey Sign(G20-V3)**Standard:**

- 01 **The END ROAD WORK (G20-2 (V)) sign shall be used in place of the 2009 MUTCD's END ROAD WORK (G20-2) sign.**
- 02 **Alternatives to the END ROAD WORK sign shall be END MOWING (G20-V2) and END SURVEY(G20-V3) signs.**

Guidance:

- 03 *The END ROAD WORK, END MOWING or END SURVEY signs should be placed 500 feet downstream end of the termination area as determined by engineering judgment.*

Option:

- 04 The END ROAD WORK sign may be installed on the back of a warning sign facing the opposite direction of road users or on the back of a Type 3 Barricade.

Section 6F.63 Pilot Car Follow Me Sign (G20-4) - (Vehicle-Mounted)**Standard:**

- 01 **The PILOT CAR FOLLOW ME (G20-4) vehicle-mounted sign (see Figure 6F-4) shall be mounted in a conspicuous position on the rear of a vehicle used for guiding one-way vehicular traffic through or around a TTC zone (see Section 6C.13). A flagger shall be stationed on the approach to the activity area and on intersecting routes within the work area to stop vehicular traffic until the pilot vehicle is available.**

Section 6F.64 Work Vehicle Do Not Follow Sign (G20-V1) - (Vehicle-Mounted)**Standard:**

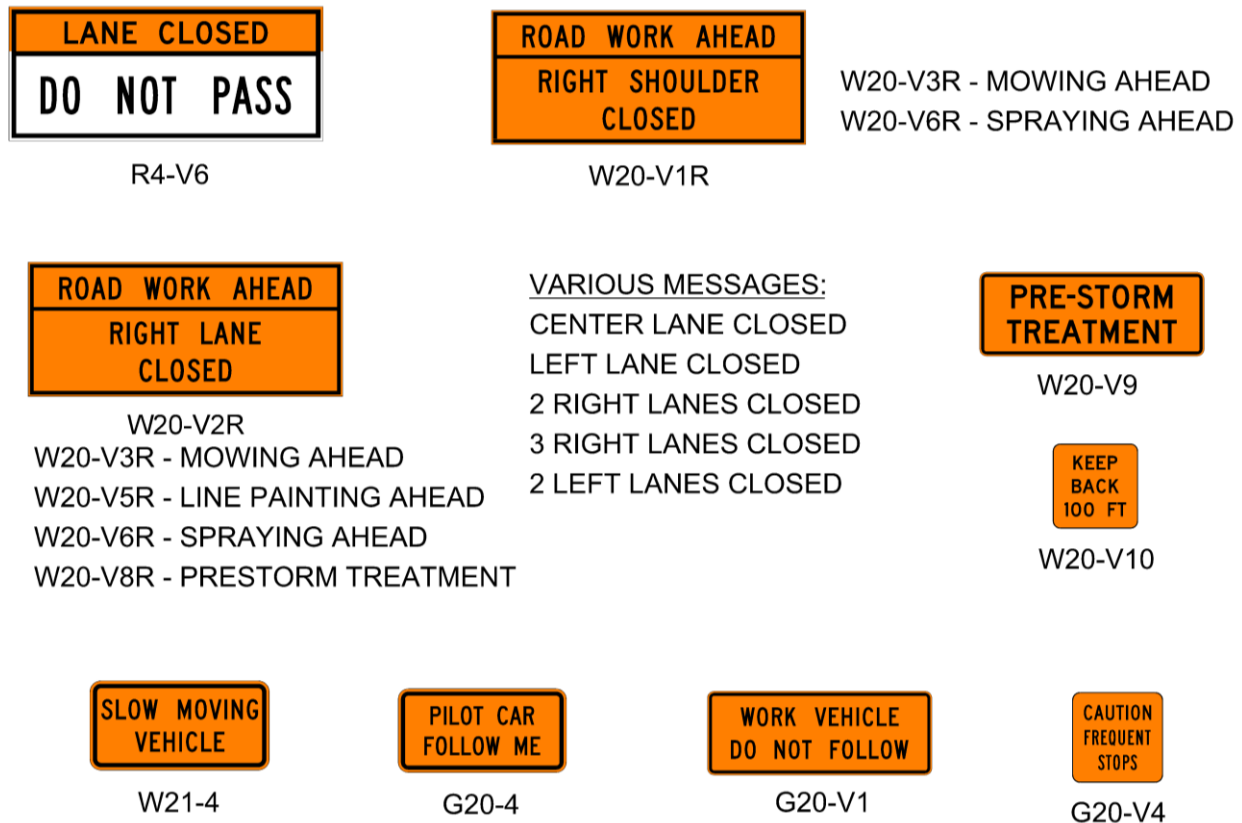
- 01 **The WORK VEHICLE DO NOT FOLLOW (G20-V1) vehicle-mounted sign (see Figure 6F-4) shall be mounted in a conspicuous position on the rear of a vehicle hauling/delivering material to the work space.**

Section 6F.65 Caution Frequent Stops Sign (G20-V4) - (Vehicle-Mounted)

Guidance:

- 01 The CAUTION FREQUENT STOPS (G20-V4) vehicle-mounted sign (see Figure 6F-4) should be mounted in a conspicuous position on the rear of a mobile work vehicle that stops frequently but moves quickly from one location to another along the roadway performing work operations such as debris removal, inventory and spot field reviews.

Figure 6F-4, Vehicle-Mounted Signs for Temporary Traffic Control



Section 6F.66 Detour Signs (M4-8, M4-8a, M4-V1, M4-V2, M4-V3, M4-V4, M4-9, M4-9 (V), M4-9a, M4-9b, M4-9c, and M4-10)

Standard:

- 01 Each detour shall be adequately marked with standard temporary route signs and destination signs.
- 02 Short-term detours on Limited Access highways shall be marked with a DETOUR (M4-V1, M4-V2, M4-V3, M4-V4, M4-9 (V) or M4-9) sign (see Figures 6F-5 and TTC-46).
- 03 Long-term detours on Limited Access highways shall be marked with a DETOUR (M4-8) sign above a Route Shield assembly, Route sign, Cardinal Direction auxiliary signs, and Advance Turn/Direction Arrow auxiliary signs (see Figure TTC-47 and Section 2D of the 2009 MUTCD). Route Sign assemblies shall be mounted in accordance with the general specifications for signs (see Figure 6F-1) with the lowest sign in the assembly at the height prescribed for a single sign. See Figures TTC-34 and TTC-48 for detours on other roadways.

Guidance:

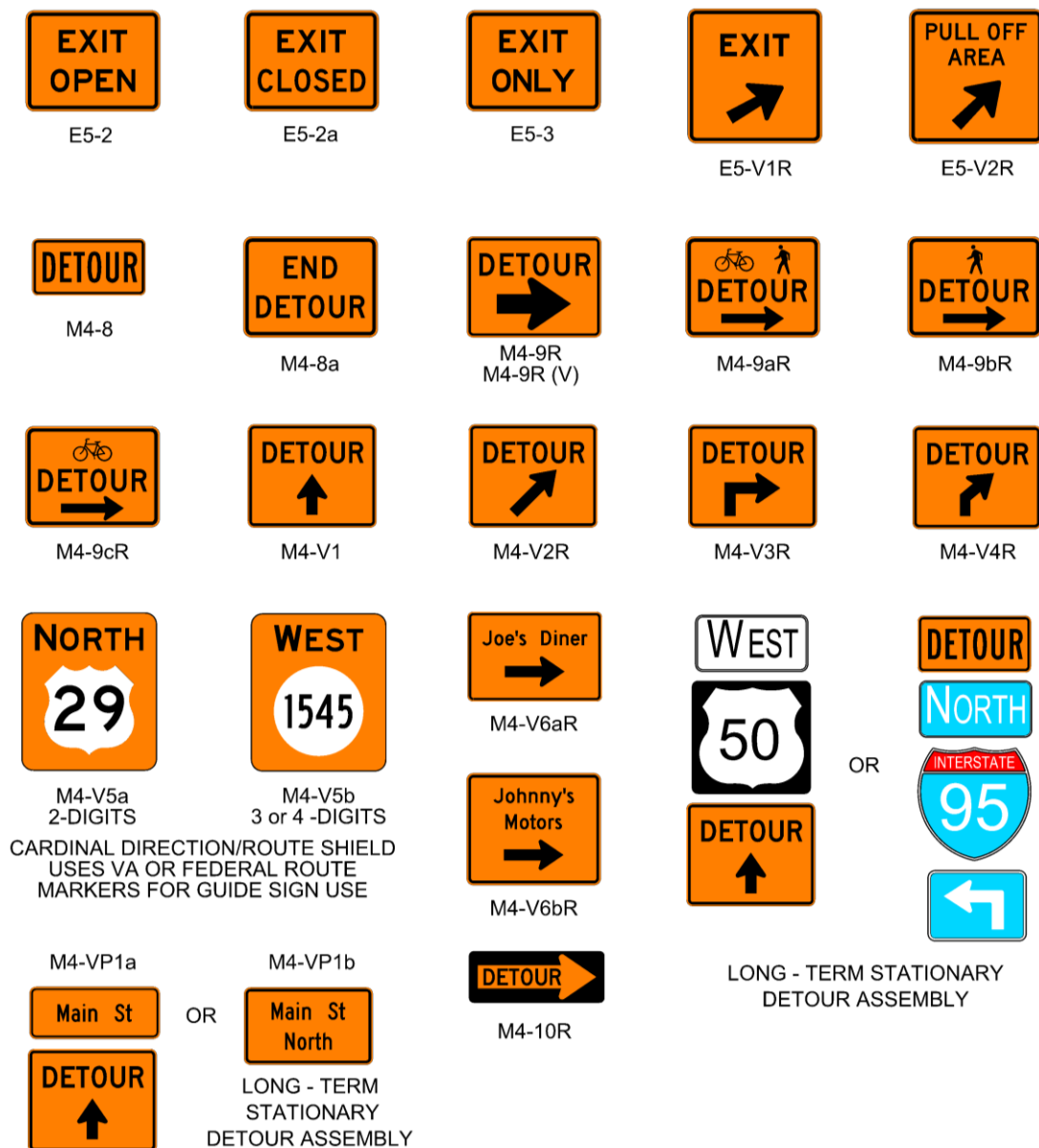
- 04 On roadways with a posted speed limit below 35, an Advance Route Turn assembly or an Advance Turn Detour sign should be installed not less than 200 feet in advance of the turn. On all other roadways, an Advance Route Turn assembly or an Advance Turn Detour sign assembly should be installed not less than 300 feet in advance of the turn.

Option:

- 05 Detour signs in TTC incident management situations may have a black legend and border on a fluorescent pink background.
- 06 The DETOUR (M4-8) sign (see Figure 6F-5) may be mounted at the top of a route sign assembly to mark a temporary route that detours from a highway, bypasses a section closed by a TTC zone, and rejoins the highway beyond the TTC zone.
- 07 The STREET NAME (M4-VP1a or M4-VP2a) plaque may be use above the M4-9 and M4-V1 series.

Guidance:

- 08 *The Detour Arrow (M4-10) sign should normally be mounted just below the ROAD CLOSED (R11-2) sign. The Detour Arrow sign should include a horizontal arrow pointed to the right or left as required.*
- 09 *The DETOUR (M4-9 or M4-9 (V), M4-V1, M4-V2, M4-V3, M4-V4) sign (see Figure 6F-5) should be used for unnumbered highways, for emergency situations, for periods of short durations, or where, over relatively short distances, road users are guided along the detour and back to the desired highway without route signs.*

Figure 6F-5, Exit, Pull Off Area, Exit Open, and Detour Signs for Temporary Traffic Control

Option

- 10 The DETOUR (M4-V1, M4-V2, M4-V3, M4-V4, M4-9 or M4-9 (V)) sign may be used in place of the Advance Turn/Direction Arrow auxiliary signs on Route Shield assembly.

Guidance:

- 11 *Where a Route Shield assembly is not used, a Street Name sign should be placed above, or the street name should be incorporated into, a DETOUR (M4-V1, M4-V2, M4-V3, M4-V4, M4-9 or M4-9 (V)) sign to indicate the name of the street being detoured.*
- 12 *The END DETOUR (M4-8a) sign (see Figure 6F-5) should be used to indicate that the detour has ended.*
- 13 *When the END DETOUR sign is used on a numbered highway, the sign should be mounted above a route sign after the downstream end of the detour.*
- 14 *The Pedestrian/Bicycle Detour (M4-9a) sign (see Figure 6F-5) should be used where a pedestrian/bicycle detour route has been established because of the closing of a pedestrian/bicycle facility to through traffic.*

Standard:

- 15 **If used, the Pedestrian/Bicycle Detour sign shall have an arrow pointing in the appropriate direction.**

Option:

- 16 The arrow on a Pedestrian/Bicycle Detour sign may be on the sign face or on a supplemental plaque.
- 17 The Pedestrian Detour (M4-9b) sign or Bicycle Detour (M4-9c) sign (see Figure 6F-5) may be used where a pedestrian or bicycle detour route (not both) has been established because of the closing of the pedestrian or bicycle facility to through traffic

Section 6F.67 Business Entrance Signs (M4-V6a, M4-V6b)Option:

- 01 The Business Entrance (M4-V6a and M4-V6b) signs may be used in urban areas where the original entrance will be relocated for more than 3 months during construction.

Standard:

- 02 **The Business Entrance sign shall be used to identify the business entrance and shall not contain the business logo.**
- 03 **If the Business Entrance sign is attached to a Group 2 channelizing device, it shall be crashworthy.**

Section 6F.68 Portable Changeable Message SignsSupport:

- 01 Portable changeable message signs (PCMS) are TTC devices installed for temporary use with the flexibility to display a variety of messages. In most cases, the PCMS follow the same provisions for design and application as those given for changeable message signs (CMS) in Chapter 2L of the 2009 MUTCD. The information in this Section describes situations where the provisions for the PCMS differ from those given in Chapter 2L of the 2009 MUTCD.
- 02 The PCMS is used most frequently on high-density urban freeways, but have applications on all types of highways where highway alignment, road user routing problems, or other pertinent conditions require advance warning and information.
- 03 The PCMS has a wide variety of applications in TTC zones including: roadway, lane, or ramp closures; incident management; width restriction information; speed control or reductions; advisories on work scheduling; road user management and diversion; warning of adverse conditions or special events; and other operational control.
- 04 The primary purpose of the PCMS in TTC zones is to advise the road user of unexpected situations. The PCMS is particularly useful as it is capable of:
- A. Conveying complex messages,
 - B. Displaying real time information about conditions ahead, and
 - C. Providing information to assist road users in making decisions prior to the point where actions must be taken.

- 05 Some typical applications include the following:
- A. Where the speed of vehicular traffic is expected to drop substantially;
 - B. Where significant queuing and delays are expected;
 - C. Where adverse environmental conditions are present;
 - D. Where there are changes in alignment or surface conditions;
 - E. Where advance notice of ramp, lane, or roadway closures is needed;
 - F. Where crash or incident management is needed; and/or
 - G. Where changes in the road user pattern occur.

Guidance:

- 06 *The components of a PCMS should include: a message sign, control systems, a power source, and mounting and transporting equipment. The front face of the sign should be covered with a protective material.*

Standard:

- 07 **The PCMS shall comply with the applicable design and application principles established in Chapter 2A of the 2009 MUTCD. The PCMS shall display only traffic operational, regulatory, warning, and guidance information, and shall not be used for advertising messages (see Appendix D, Portable Changeable Message Sign (PCMS) Displays).**

Support:

- 08 Section 2L.02 of the 2009 MUTCD contains information regarding overly simplistic or vague messages that is also applicable to the PCMS.

Standard:

- 09 **The PCMS legend shall be yellow or orange on a black background.**

Support:

- 10 Section 2L.04 of the 2009 MUTCD contains information regarding the luminance, luminance contrast, and contrast orientation that is also applicable to the PCMS.

Guidance:

- 11 *The PCMS should be visible from 1/2 mile under both day and night conditions.*

Support:

- 12 Section 2B.13 of the Virginia Supplement to the 2009 MUTCD contains information regarding the design of the PCMS that is used to display speed limits that change based on operational conditions, or are used to display the speed at which approaching drivers are traveling.

Guidance:

- 13 *The PCMS should be limited to three lines of eight characters per line or should consist of a full matrix display.*
- 14 *Except as provided in Paragraph 15, the letter height used for the PCMS messages should be a minimum of 18 inches.*

Option:

- 15 For the CMS mounted on service patrol trucks or other incident response vehicles, a letter height as short as 10 inches may be used. Shorter letter sizes may also be used on a PCMS used on low speed (30 mph or less) facilities provided that the message is legible from at least 650 feet.

- 16 The PCMS may vary in size.

Guidance:

- 17 *Messages on a PCMS should consist of no more than two phases (two screen displays), and a phase should consist of no more than three lines of text. Each phase should be capable of being understood by itself, regardless of the order in which it is read. Messages should be centered within each line of legend. If more than one PCMS is simultaneously legible to road users, then only one of the signs should display a sequential message at any given time.*

Support:

- 18 Road users have difficulties in reading messages displayed in more than two phases (two screen displays) on a typical three-line PCMS.

Standard:

- 19 **Techniques of message display such as animation, rapid flashing, dissolving, exploding, scrolling, traveling horizontally or vertically across the face of the sign, or other dynamic elements shall not be used.**
- 20 **PCMS messages shall comply with Appendix D and be approved by the project's Engineer.**

Guidance:

- 21 *When a message is divided into two phases, the display time for each phase should be at least 2 seconds, and the sum of the display times for both of the phases should be a maximum of 8 seconds.*
- 22 *All messages should be designed with consideration given to the principles provided in this Section and also taking into account the following:*
- A. *The message should be as brief as possible and should contain three thoughts (with each thought preferably shown on its own line) that convey:*
 - 1. *The problem or situation that the road user will encounter ahead,*
 - 2. *The location of or distance to the problem or situation, and*
 - 3. *The recommended driver action.*
 - B. *If more than two phases are needed to display a message, additional portable changeable message signs should be used. When multiple PCMS's are needed, they should be placed on the same side of the roadway and they should be separated from each other by a distance of at least 1,000 feet on roadways with posted speed of 45 mph or greater and by a distance of at least 500 feet on roadways with posted speed less than 45 mph.*

Standard:

- 23 **When the word messages shown in Tables 1A-1 or 1A-2 of the 2009 MUTCD need to be abbreviated on a PCMS, the provisions described in Section 1A.15 shall be followed.**
- 24 **In order to maintain legibility, PCMS shall automatically adjust their brightness under varying light conditions.**
- 25 **The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable.**
- 26 **The PCMS shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs.**
- 27 **The mounting of the PCMS on a trailer, a large truck, or a service patrol truck shall be such that the bottom of the message sign shall be a minimum of 7 feet above the roadway in urban areas and 5 feet above the roadway in rural areas when it is in the operating mode.**
- 28 **A PCMS shall be used as a supplement to and not as a substitute for conventional signs and pavement markings.**
- 29 **When two portable changeable message signs dual indicate a message (one on the right side and left side of the roadway) they shall be spaced a minimum of 1000 feet apart.**

Guidance:

- 30 *When a PCMS is used for route diversion, it should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.*
- 31 *The PCMS should be sited and aligned to provide maximum legibility and to allow time for road users to respond appropriately to the PCMS message.*
- 32 *The PCMS should be placed off the shoulder of the roadway and behind a traffic barrier, if practical. Where a traffic barrier is not available to shield the PCMS, it should be placed off the shoulder and outside of the clear zone.*

Standard:

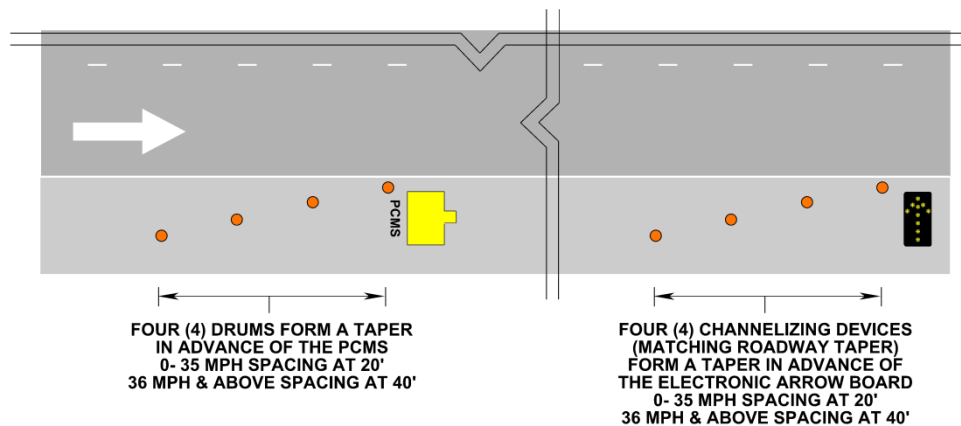
- 33 **If a PCMS has to be placed on the shoulder of the roadway or within the clear zone, it shall be delineated (see Figure 6F-6) with a minimum of four (4) drums placed on the shoulder in advance of the PCMS in a taper with spacing as shown in Table 6F-2. If the PCMS is placed in the median within the clear zone of**

both travel directions, a minimum of four (4) drums shall be placed in a taper in advance of both travel directions with spacing as shown in Table 6F-2.

Guidance:

- 34 When portable changeable message signs are used in TTC zones, they should display only TTC messages.
- 35 When a PCMS is not being used to display TTC messages, it should be relocated such that it is outside of the clear zone or shielded behind a traffic barrier and turned away from traffic. If relocation or shielding is not practical, they should be delineated with retroreflective TTC devices as described in Paragraph 33.

Figure 6F-6, Channelizing Devices for PCMS and Arrow Board



Standard:

- 36 A PCMS trailer shall be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the towed trailer as seen by oncoming road users, where the trailer's signal and brake lights are located.

Section 6F.69 Arrow Boards

Standard:

- 01 An arrow board shall be a sign with a matrix of elements capable of either flashing or sequential displays. This sign shall provide additional warning and directional information to assist in merging and controlling road users through or around a TTC zone.
- 02 An arrow board in the arrow or chevron mode shall be used to advise approaching traffic of a lane closure along major multi-lane roadways in situations involving heavy traffic volumes, high speeds, and/or limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.
- 03 An arrow board shall be used in combination with appropriate signs, channelizing devices, or other TTC devices. A trailer mounted arrow board shall be disconnected from the tow-vehicle when used in stationary operations and the vehicle removed from the transition area.

Guidance:

- 04 An arrow board should be placed on the shoulder of the roadway or, if practical, farther from the traveled lane. It should be delineated (see Figure 6-F6) with a minimum of four (4) channelizing devices (matching those used on the roadway taper) in advance of the arrow board forming a taper with spacing as shown in Table 6F-2. When an arrow board is not being used, it should be removed; if not removed, it should be shielded; or if the previous two options are not feasible, it should be delineated with a minimum of four (4) retroreflective Group 2 channelizing devices.

Standard:

- 05 Arrow boards shall meet the minimum size, legibility distance, number of elements, and other specifications shown in Figure 6F-7.

Support:

- 06 Type A arrow boards are appropriate for use on low-speed (30 mph or less) urban streets. Type B arrow boards are appropriate for intermediate-speed (31 to 44 mph) facilities. Type C arrow boards are intended to be used on

high-speed (45 mph or greater), high-volume motor vehicle traffic control projects. Type D arrow boards are intended for use on low-speed (30 mph or less) urban streets on authorized vehicles.

Standard:

- 07 **Type A, B, and C arrow boards shall have solid rectangular appearances. A Type D arrow board shall conform to the shape of the arrow.**
- 08 **All arrow boards shall be finished in non-reflective black. The arrow board shall be mounted on a vehicle, a trailer, or other suitable support.**
- 09 **An arrow board trailer shall be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the towed trailer as seen by oncoming road users, where the trailer's signal and brake lights are located.**

Guidance:

- 10 *The minimum mounting height, measured vertically from the bottom of the board to the roadway below it or to the elevation of the near edge of the roadway, of an arrow board should be 7 feet, except on vehicle-mounted arrow boards, which should be as high as practical.*
- 11 *A vehicle-mounted arrow board should be provided with remote controls.*

Standard:

- 12 **Arrow board elements shall be capable of at least a 50 percent dimming from full brilliance. The dimmed mode shall be used for nighttime operation of arrow boards.**

Guidance:

- 13 *Full brilliance should be used for daytime operation of arrow boards.*

Standard:

- 14 **The arrow board shall have suitable elements capable of the various operating modes. The color presented by the elements shall be yellow.**

Guidance:

- 15 *If an arrow board consisting of a bulb matrix is used, the elements should be recess-mounted or equipped with an upper hood of not less than 180 degrees.*

Standard:

- 16 **The minimum element on-time shall be 50 percent for the flashing mode, with equal intervals of 25 percent for each sequential phase. The flashing rate shall be not less than 25 or more than 40 flashes per minute.**
- 17 **An arrow board shall have the following three mode selections:
 - A. A Flashing Arrow or Sequential Chevron mode;
 - B. A flashing Double Arrow mode; and
 - C. A flashing Caution mode.**
- 18 **An arrow board in the arrow or chevron mode shall be used only for stationary or moving lane closures on multi-lane roadways.**
- 19 **For shoulder work, blocking the shoulder, for roadside work near the shoulder, or for temporarily closing one lane on a two-lane, two-way roadway, an arrow board shall be used only in the four-corner caution mode.**

Guidance:

- 20 *For a stationary lane closure, the arrow board should be located on the shoulder at the beginning of the merging taper.*
- 21 *Where the shoulder is narrow, the arrow board should be located in the closed lane as close to the beginning of the merging taper as possible, but completely within the channelizing devices.*

Standard:

- 22 **For consistency and to reduce confusion, only one arrow board shall be used for each travel lanes closed. When arrow boards are used to close multiple lanes, a separate arrow board shall be used for each closed lane.**

Guidance:

- 23 When arrow boards are used to close multiple lanes, if the first arrow board is placed on the shoulder, the second arrow board should be placed in the first closed lane at the beginning of the second merging taper (see Figure TTC-18). When the first arrow board is placed in the first closed lane, the second arrow board should be placed in the second closed lane at the downstream end of the second merging taper.
- 24 For mobile operations where a lane is closed, the arrow board should be located to provide adequate separation from the work operation to allow for appropriate reaction by approaching drivers.





Standard:

- 25 A vehicle displaying an arrow board shall be equipped with amber high-intensity rotating, oscillating, or strobe lights, however, the lights shall not interfere with the visibility and recognition of the arrow board.
- 26 Arrow boards shall only be used to indicate a lane closure. Arrow boards shall not be used to indicate a lane shift.
- 27 An arrow display shall not be used on a two-lane, two-way roadway for temporary one-lane operation.

Option:

- 28 A changeable message sign may be used to simulate an arrow board display on vehicle-mounted signs in moving/mobile operations, followed by a word message describing the operation.

Figure 6F-7, Advance Warning Arrow Board Display Specifications

Operating Mode	Display (Type C Board Illustrated)
The following modes shall be provided:	(Right arrow shown; left is similar)
1. At least one of the two following modes shall be provided: Flashing Arrow	 Move/Merge Right
Sequential Chevron	 Move/Merge Right
2. Flashing Double Arrow	 Move/Merge Right or Left
3. Flashing Caution	 Flashing Caution

Board Type	Minimum Size (Inches)	Minimum Legibility Distance (miles)	Minimum Number of Elements
A	48 x 24	1/2	12
B	60 x 30	3/4	13
C	96 x 48	1	15
D	(DOUBLE ARROW SHAPE)	1/2	12

Standard:

Arrow board shall be maintained in a manner in which all of the appropriate number of lamps for the selected mode are operating properly.

***Immediate corrective action shall be take when there is more than one lamp out in the stem.

***Immediate corrective action shall be take when there are any lamps out in the arrow head(s).

Standard:

- 29 **Arrow boards shall be maintained in a manner in which all of the appropriate numbers of lamps for selected mode are operating properly. Corrective action shall be taken when there is more than one lamp out in the stem (prior to returning to the next work shift). Immediate (within 30 minutes of notification) corrective action shall be taken when there are any lamps out in the arrow head(s).**

Section 6F.70 High-Level Warning Devices (Flag Trees)Option:

- 01 A high-level warning device (flag tree) may supplement other TTC devices in TTC zones.

Support:

- 02 A high-level warning device, most commonly used in high-density road user situations to warn road users of short-term operations, is designed to be seen over the top of typical passenger cars and/or parked vehicles. A typical high-level warning device is shown in Figure 6H-1.

Standard:

- 03 **A high-level warning device shall consist of a minimum of two flags with or without a Type B high-intensity flashing warning light. The distance from the roadway to the bottom of the lens of the light and to the lowest point of the flag material shall be not less than 8 feet. The flag shall be 16 inches square or larger and shall be orange or fluorescent red-orange in color.**

Option:

- 04 An appropriate warning sign may be mounted below the flags.

Section 6F.71 Channelizing Devices**Standard:**

- 01 **Designs of various channelizing devices shall be as shown in Figure 6F-9. All channelizing devices shall be crashworthy.**

Support:

- 02 The function of channelizing devices is to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and longitudinal channelizing devices.
- 03 Channelizing devices provide for smooth and gradual vehicular traffic flow from one lane to another, onto a bypass or detour, or into a narrower traveled way. They are also used to channelize vehicular traffic away from the work space, pavement drop-offs, pedestrian or shared-use paths, or opposing directions of vehicular traffic.

Standard:

- 04 **Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision.**
- 05 **Where channelizing devices are used to channelize pedestrians, there shall be continuous detectable bottom and top surfaces to be detectable to users of long canes. The bottom of the bottom surface shall be no higher than 2 inches above the ground. The top of the top surface shall be no lower than 32 inches above the ground.**

Option:

- 06 A gap not exceeding 2 inches between the bottom rail and the ground surface may be used to facilitate drainage.

Guidance:

- 07 *Where multiple channelizing devices are aligned to form a continuous pedestrian channelizer, connection points should be smooth to optimize long-cane and hand trailing.*
- 08 *The spacing between cones, tubular markers, vertical panels, and drums, should be as shown in Table 6F-2. The spacing of channelizing devices in tangent sections of the TTC zone is normally twice the distance for devices used in the taper and around curves of 6 degrees and greater (or radius of 950 feet or less).*
- 09 *When channelizing devices have the potential of leading vehicular traffic out of the intended vehicular traffic space as shown in Figure TTC-42, the channelizing devices should be extended a distance in feet of four times the speed limit in mph beyond the downstream end of the transition area.*

Option:

- 10 Warning lights (see Section 6F.91) may be added to channelizing devices in areas with frequent fog, snow, or severe roadway curvature, or where visual distractions are present.

Standard:

- 11 **Warning lights shall flash when placed on channelizing devices used alone or in a cluster to warn of a condition. Except for the sequential flashing warning lights discussed in Paragraphs 12 and 13, warning lights placed on channelizing devices used in a series to channelize road users shall be steady-burn.**

Option:

- 12 A series of sequential flashing warning lights may be placed on channelizing devices that form a merging taper in order to increase driver detection and recognition of the merging taper.

Standard:

- 13 **When used, the successive flashing of the sequential warning lights shall occur from the upstream end of the merging taper to the downstream end of the merging taper in order to identify the desired vehicle path. Each warning light in the sequence shall be flashed at a rate of not less than 55 nor more than 75 times per minute.**
- 14 **Warning lights or other devices placed on channelizing devices shall meet crashworthiness requirements and have approval for use on that type of channelizing device. Barrier retroreflective panels shall not be installed on Group 1 or 2 channelizing devices.**
- 15 **The retroreflective material used on channelizing devices shall have a smooth, sealed outer surface that will display a similar color day or night. In addition to conforming to the requirements stated herein, channelizing devices, including retroreflective material, shall be in compliance with Section 247 of the Road and Bridge Specifications.**

Option:

- 16 The name and telephone number of the highway agency, contractor, or supplier may be displayed on the non-retroreflective surface of all types of channelizing devices.

Standard:

- 17 **The letters and numbers of the name and telephone number shall be non-retroreflective and not over 2 inches in height.**

Guidance:

- 18 *Particular attention should be given to maintaining the channelizing devices to keep them clean, visible, and properly positioned at all times.*

Standard:

- 19 **Devices that are damaged or have lost a significant amount of their retroreflectivity and effectiveness shall be replaced. Replacement and correction of ineffective channelizing devices shall be accomplished in accordance with the latest edition of the American Traffic Safety Service Association's (ATSSA) "Quality Standards for Work Zone Traffic Control Devices" publication.**

Section 6F.72 Cones**Standard:**

- 01 **Cones (see Figure 6F-9) shall be predominantly orange and shall be made of a material that can be struck without causing damage to the impacting vehicle. The minimum height of cones for use on all roadways shall be 36 inch.**
- 02 **For nighttime use, cones shall be retroreflectorized or equipped with lighting devices for maximum visibility. Retroreflectorization of cones that are 36 inches in height shall be provided by a 6-inch wide white and located 3 to 4 inches from the top of the cone and an additional 4-inch wide white band located approximately 2 inches below the 6-inch band.**
- 03 **Retroreflectorization of cones that are more than 36 inches in height shall be provided by horizontal, circumferential, alternating orange and white retroreflective stripes that are 4 to 6 inches wide. Each cone shall have a minimum of two orange and two white stripes with the top stripe being orange. Any non-retroreflective spaces between the orange and white stripes shall not exceed 3 inches in width.**

Option:

- 04 When workers are present to maintain them, traffic cones may be used to channelize road users, divide opposing vehicular traffic lanes, divide lanes when two or more lanes are kept open in the same direction, and delineate short duration maintenance and utility work.

Guidance:

- 05 *Steps should be taken to minimize the possibility of cones being blown over or displaced by wind or moving vehicular traffic.*

Standard:

- 06 **When workers are not present on the jobsite to maintain the cones, Group 2 channelizing devices shall be used for channelization.**

Option:

- 07 Cones may be doubled up to increase their weight.

Support:

- 08 Some cones are constructed with bases that can be filled with ballast. Others have specially weighted bases, or weight such as sandbag rings that can be dropped over the cones and onto the base to provide added stability.

Guidance:

- 09 *Ballast should be kept to the minimum amount needed.*

Section 6F.73 Tubular Markers**Standard:**

- 01 **Tubular markers (see Figure 6F-9) shall be predominantly orange and shall not be less than 36 inches high and 2 inches wide facing road users. They shall be made of a material that can be struck without causing damage to the impacting vehicle.**
- 02 **Tubular markers shall be retroreflectorized and shall be in compliance with Section 247 of the Road and Bridge Specifications. Retroreflectorization of tubular markers that have a height of less than 42 inches shall be provided by two 3-inch wide white bands placed a maximum of 2 inches from the top with a maximum of 6 inches between the bands. Retroreflectorization of tubular markers that have a height of 42 inches or more shall be provided by four 4- to 6-inch wide alternating orange and white stripes with the top stripe being orange.**

Guidance:

- 03 *Tubular markers have less visible area than other devices and should be used only where space restrictions do not allow for the use of other more visible devices.*
- 04 *Tubular markers should be stabilized by affixing them to the pavement, by using weighted bases, or weights such as sandbag rings that can be dropped over the tubular markers and onto the base to provide added stability unless the condition stated in Paragraph 7 exists. Ballast should be kept to the minimum amount needed.*

Table 6F-2, Spacing of Channelizing Devices

Work Zone Location	Posted Speed Limit (mph)	Spacing of Devices (Feet)
In Tapers and Curves	35 mph or less	20
Parallel to the Travel way	35 mph or less	40
Spot Construction Access *	35 mph or less	80
In Tapers and Curves	Greater than 35 mph	40
Parallel to the Travel way	Greater than 35 mph	80
Spot Construction Access *	Greater than 35 mph	120
*For easier access by construction vehicles into the work area, spacing of devices may be increased to this distance, but shall not exceed one access per 0.25 mile unless approved by the engineer and documented.		

Option:

- 05 Tubular markers may be used effectively to divide opposing lanes of road users, divide vehicular traffic lanes when two or more lanes of moving vehicular traffic are kept open in the same direction, and to delineate the edge of a pavement drop off where space limitations do not allow the use of larger devices.

Standard:

- 06 **A tubular marker shall be attached to the pavement to display the minimum 2-inch width to the approaching road users.**
- 07 **When workers are not present on the jobsite to maintain the tubular markers, the tubular markers shall be affixed to the pavement.**

Section 6F.74 Vertical Panels**Standard:**

- 01 **Vertical panels (see Figure 6F-9) shall have retroreflective striped material 12 inches in width and at least 24 inches in height. They shall have alternating diagonal fluorescent orange and fluorescent white retroreflective stripes sloping downward at an angle of 45 degrees in the direction vehicular traffic is to pass.**
- 02 **Where the height of the retroreflective material on the vertical panel is 36 inches or more, a stripe width of 6 inches shall be used.**

Option:

- 03 Where the height of the retroreflective material on the vertical panel is less than 36 inches, a stripe width of 4 inches may be used.
- 04 Where space is limited, vertical panels may be used to channelize vehicular traffic, divide opposing lanes, or replace barricades when approved by the Regional Traffic Engineer.

Section 6F.75 Drums**Standard:**

- 01 **Drums (see Figure 6F-9) used for road user warning or channelization shall be constructed of lightweight, deformable materials. They shall be a minimum of 36 inches in height and have at least an 18-inch minimum width regardless of orientation. Metal drums shall not be used. The markings on drums shall be horizontal, circumferential, alternating orange and white retroreflective stripes 6 inches wide. Each drum shall have a minimum of two orange and two white stripes with the top stripe being orange and shall be in compliance with Section 247 of the Road and Bridge Specifications.**
- 02 **Any non-retroreflectorized spaces between the horizontal orange and white stripes shall not exceed 3 inches wide. Drums shall have closed tops that will not allow collection of construction debris or other debris.**

Support:

- 03 **Drums are highly visible, have good target value, give the appearance of being formidable obstacles and, therefore, command the respect of road users. They are portable enough to be shifted from place to place within a TTC zone in order to accommodate changing conditions, but are generally used in situations where they will remain in place for a prolonged period of time.**

Option:

- 04 Although drums are most commonly used to channelize or delineate road user flow, they may also be used alone or in groups to mark specific locations.

Guidance:

- 05 *Drums should not be weighted with sand, water, or any material to the extent that would make them hazardous to road users or workers when struck. Drums used in regions susceptible to freezing should have drain holes in the bottom so that water will not accumulate and freeze causing a hazard if struck by a road user.*

Standard:

- 06 **Ballast shall not be placed on the top of a drum. Drums shall be adequately ballasted to prevent movement by passing vehicles. Weighted collars shall lay flat on the ground or roadway around the bottom of drums, and shall be the approved type and size for that particular device.**

Guidance:

- 07 Drums that use weighted collars for ballast should use a minimum of 2 drum collars when placed within 12 feet of active travel lanes on Limited Access highways to ensure stability.

Standard:

- 08 Drums shall be used in all unmanned work zone locations, in all merging and shifting tapers on Limited Access highways during nighttime operations, and in tapers providing delineation of PCMS's. On long-term stationary TTC zones, drums shall be used in tapers providing delineation of the Arrow Board.

Section 6F.76 Type 3 Barricades*Support:*

- 01 A barricade is a portable or fixed device having three rails with appropriate markings and is used to control road users by closing or restricting all or a portion of the right-of-way.
- 02 Type 3 Barricades are shown in Figures 6F-8 and 6F-9.

Standard:

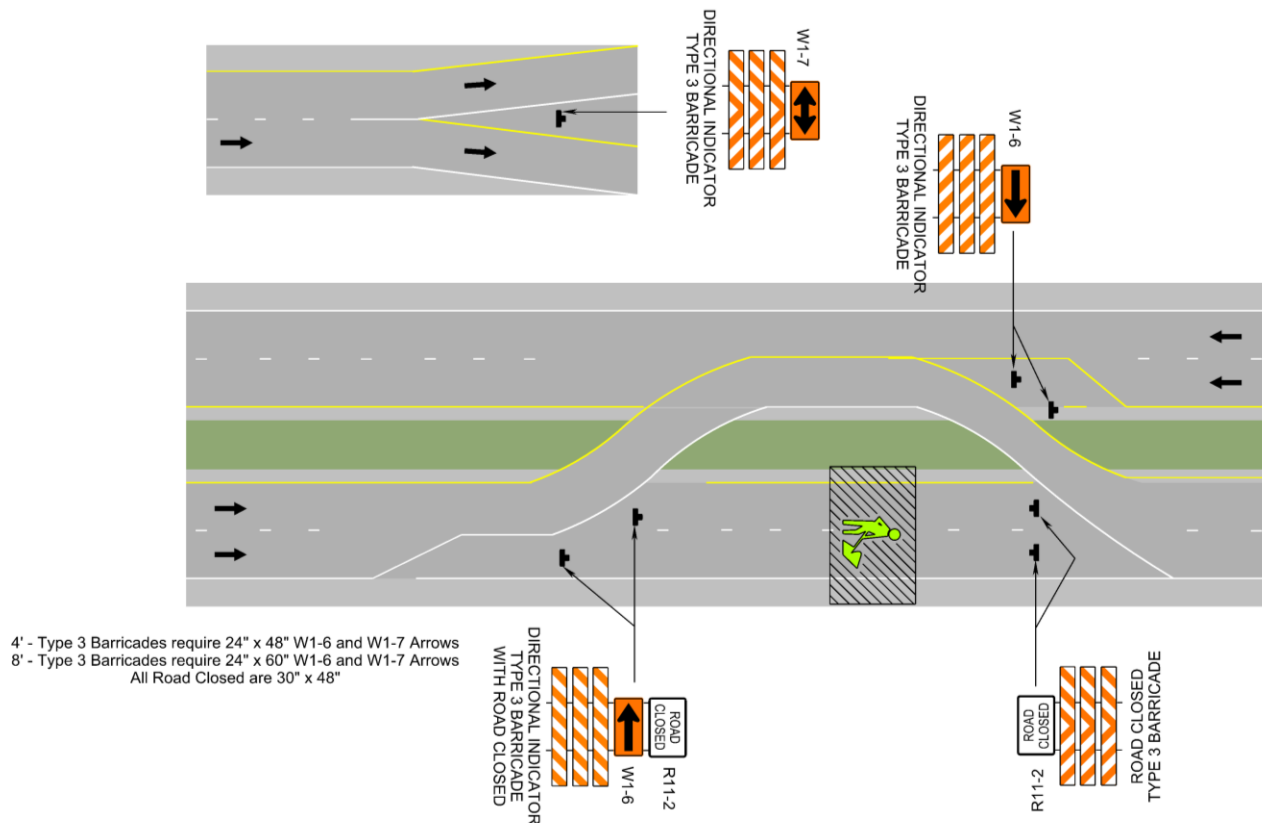
- 03 Stripes on Type 3 Barricade rails shall be alternating fluorescent orange and fluorescent white sloping downward at an angle of 45 degrees in the direction road users are to pass. Barricade stripes shall be 6 inches wide.
- 04 The minimum length for Type 3 Barricades shall be 48 inches. Each barricade rail shall be 12 inches wide. Barricades used on Limited Access highways shall have a minimum of 270 square inches of retroreflective area facing road users.

Guidance:

- 05 Where Type 3 Barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which road users must turn (see Figures 6F-8 and 6F-9).
- 06 Where both right and left turns are provided, the barricade stripes should slope downward in both directions from the center of the barricade or barricades (see Figures 6F-8 and 6F-9).

Figure 6F-8, Type 3 Barricade Placement Guidelines

See Figures TTC-43 and TTC-44 for installation details



- 07 *Where no turns are intended, the stripes should be positioned to slope downward toward the center of the barricade or barricades (see Figures 6F-8 and 6F- 9).*
- 08 *Barricade rails should be supported in a manner that will allow them to be seen by the road user, and in a manner that provides a stable support that is not easily blown over or displaced.*
- 09 *The width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility. When it is not possible to maintain a minimum width of 60 inches throughout the entire length of the pedestrian pathway, a 60 x 60-inch passing space should be provided at least every 200 feet to allow individuals in wheelchairs to pass.*
- 10 *Type 3 Barricade rail supports should not project into pedestrian circulation routes more than 4 inches from the support between 27 and 80 inches from the surface as described in Section 4.4.1 of the “Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).*

Standard:

- 11 **Type 3 Barricades shall be crashworthy as they are located adjacent to vehicular traffic flow and are subject to impact by errant vehicles.**

Guidance:

- 12 *On Limited Access highways or in other situations where Type 3 Barricades may be susceptible to overturning in the wind, ballasting should be used.*

Option:

- 13 Sandbags (one 50-pound bag) may be placed on each leg of the frame of Type 3 Barricades as flat to the ground as possible to provide the required ballast.

Standard:

- 14 **Ballast shall not be placed on top of any striped rail. Type 3 Barricades shall not be ballasted by objects such as rocks or chunks of concrete. Ballast shall not extend into the accessible passage width of 60 inches.**

Guidance:

- 15 *Type 3 Barricades should be used to close or partially close a road.*

Option:

- 16 Type 3 Barricades used at a road closure may be placed completely across a roadway or from curb to curb. Type 3 Barricades may be used alone or in groups to close or partially close a road.

Standard:

- 17 **Where provision is made for access of authorized equipment and vehicles, the responsibility for ensuring the placement of Type 3 Barricades shall be assigned to a person who will provide proper closure at the end of each work day.**

Support:

- 18 *When a highway is legally closed but access must still be allowed for local road users, barricades usually are not extended completely across the roadway.*

Standard:

- 19 **A sign shall be installed with the appropriate legend concerning permissible use by local road users (see Section 6F.09). Adequate visibility of the barricades from both directions shall be provided.**

Guidance:

- 20 *Signs mounted on Type 3 Barricades should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails.*

Option:

- 21 Crashworthy signs may be mounted on or above a Type 3 Barricade.

Section 6F.77 Direction Indicator Barricades

Standard:

- 01 The Direction Indicator Barricade (see Figure 6F-9) shall consist of a One-Direction Large Arrow (W1-6) sign mounted above a diagonal striped, horizontally aligned, retroreflective rail. Their stripes shall direct traffic the same as Type 3 Barricades (see Figures 6F-8 and 6F-9).
- 02 The One-Direction Large Arrow (W1-6) sign shall be black on a fluorescent orange background. The stripes on the bottom rail shall be alternating fluorescent orange and fluorescent white sheeting sloping downward at an angle of 45 degrees in the direction road users are to pass. The stripes shall be 4 inches wide. The One-Direction Large Arrow (W1-6) sign shall be 24 x 12 inches. The bottom rail shall have a length of 24 inches and a height of 12 inches.
- 03 The Direction Indicator Barricade, including any associated ballast or lights, shall be crashworthy.

Option:

- 04 The Direction Indicator Barricade may be used in tapers, transitions, and other areas where specific directional guidance to drivers is necessary and may be used in place of drums in tapers on Limited Access highways.

Guidance:

- 05 *If used, Direction Indicator Barricades should be used in series to direct the driver through the transition and into the intended travel lane.*
- 06 *The bottom of a sign mounted on a barricade, or other portable support, shall be at least 1 foot above the traveled way.*

Section 6F.78 Temporary Traffic Barriers as Channelizing Devices

Support:

- 01 Temporary traffic barriers are not TTC devices in themselves; however, when placed in a position identical to a line of channelizing devices and marked and/or equipped with appropriate channelization features to provide guidance and warning both day and night, they serve as TTC devices.

Standard:

- 02 Temporary traffic barriers serving as TTC devices shall comply with requirements for such devices as set forth throughout this Manual and Part 6 of the 2009 MUTCD.
- 03 Temporary traffic barriers (see Section 6F.94) shall not be used solely to channelize road users, but also to protect the work space. If used to channelize vehicular traffic, the temporary traffic barrier shall be supplemented with delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility.
- 04 Temporary traffic barriers by themselves shall not be used for a merging taper.

Guidance:

- 05 *Group 2 channelizing devices, pavement markers and pavement markings should be used for a merging taper in advance of the traffic barrier (see Figure TTC-20). Temporary traffic barriers should not be used for a constricted/restricted TTC zone.*
- 06 *When used for channelization, temporary traffic barriers should be of a light color for increased visibility.*

Section 6F.79 Longitudinal Channelizing Devices

Support:

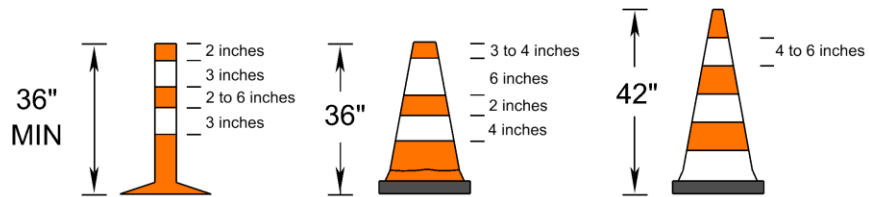
- 01 Longitudinal channelizing devices (see Figure 6F-9) are lightweight, deformable devices that are highly visible, have good target value, and can be connected together or used singly as Type 3 Barricades.

Standard:

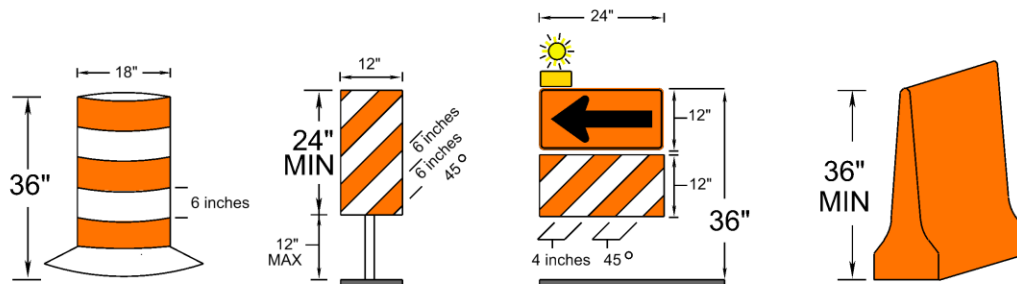
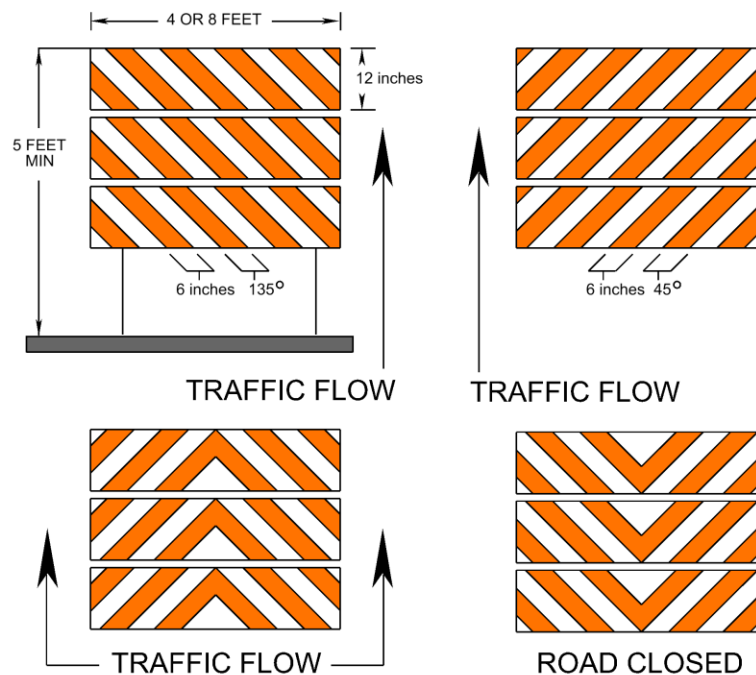
- 02 If used singly as Type 3 Barricades, longitudinal channelizing devices shall comply with the general size, color, stripe pattern, retroreflectivity, and placement characteristics established for the devices described in this Chapter.
- 03 If used to channelize vehicular traffic at night, longitudinal channelizing devices shall be interlocked and supplemented with retroreflective material or delineation for improved nighttime visibility.

Figure 6F-9, Channelizing Devices

GROUP 1
TUBULAR MARKER & CONE



GROUP 2
DRUM, VERTICAL PANEL,
DIRECTIONAL INDICATOR BARRICADE &
LONGITUDINAL CHANNELIZING DEVICE

**TYPE 3 BARRICADES**

THE SIDES OF BARRICADES FACING TRAFFIC SHALL BE 6 INCH ORANGE & WHITE
FLUORESCENT PRISMATIC (HIGH OBSERVATION ANGLE)
LENS STRIPES REQUIRED

Option:

- 04 Longitudinal channelizing devices may be used instead of a line of cones, drums, or barricades.
- 05 Longitudinal channelizing devices may be hollow and filled with water as ballast.
- 06 Longitudinal channelizing devices may be used for pedestrian traffic control.

Standard:

- 07 **If used for pedestrian traffic control, longitudinal channelizing devices shall be interlocked to delineate or channelize flow. The interlocking devices shall not have gaps that allow pedestrians to stray from the channelizing path.**

Guidance:

- 08 *Longitudinal channelizing devices have not met the crashworthy requirements for temporary traffic barriers and should not be used to shield obstacles or provide positive protection for pedestrians or workers.*

Section 6F.80 Temporary Lane SeparatorsOption:

- 01 Temporary lane separators may be used to channelize road users, to divide opposing vehicular traffic lanes, to divide lanes when two or more lanes are open in the same direction, and to provide continuous pedestrian channelization.

Standard:

- 02 **Temporary lane separators shall be crashworthy. Temporary lane separators shall have a maximum height of 4 inches and a maximum width of 1 foot, and shall have sloping sides in order to facilitate crossover by emergency vehicles.**

Option:

- 03 Temporary lane separators may be supplemented with any of the approved channelizing devices contained in this Chapter, such as tubular markers, vertical panels, and opposing traffic lane dividers.

Standard:

- 04 **If appropriate channelizing devices are used to supplement a temporary lane separator, the channelizing devices shall be retroreflectorized to provide nighttime visibility. If channelizing devices are not used, the temporary lane separator shall contain retroreflectorization to enhance its visibility.**

Guidance:

- 05 *A temporary lane separator should be stabilized by affixing it to the pavement in a manner suitable to its design, while allowing the unit to be shifted from place to place within the TTC zone in order to accommodate changing conditions.*

Standard:

- 06 **At pedestrian crossing locations, temporary lane separators shall have an opening or be shortened to provide a pathway that is at least 60 inches wide for crossing pedestrians.**

Section 6F.81 Other Channelizing Devices**Standard:**

- 01 **Channelizing devices other than those described in this Chapter shall require approval from the State Traffic Engineer of the Virginia Department of Transportation based on an engineering study prior to their use.**

Guidance:

- 02 *Other channelizing devices should comply with the general size, color, stripe pattern, retroreflection, and placement characteristics established for the devices described in this Chapter.*

Section 6F.82 Detectable Edging for Pedestrians**Support:**

- 01 Individual channelizing devices, tape or rope used to connect individual devices, other discontinuous barriers and devices, and pavement markings are not detectable by persons with visual disabilities and are incapable of providing detectable path guidance on temporary or realigned sidewalks or other pedestrian facilities.

Guidance:

- 02 *When it is determined that a facility should be accessible to and detectable by pedestrians with visual disabilities, a continuously detectable edging should be provided throughout the length of the facility such that it can be followed by pedestrians using long canes for guidance. This edging should protrude at least 6 inches above the surface of the sidewalk or pathway, with the bottom of the edging a maximum of 2.5 inches above the surface. This edging should be continuous throughout the length of the facility except for gaps at locations where pedestrians or vehicles will be turning or crossing. This edging should consist of a prefabricated or formed-in-place curbing or other continuous device that is placed along the edge of the sidewalk or walkway. This edging should be firmly attached to the ground or to other devices. Adjacent sections of this edging should be interconnected such that the edging is not displaced by pedestrian or vehicular traffic or work operations, and such that it does not constitute a hazard to pedestrians, workers, or other road users.*

Support:

- 03 Examples of detectable edging for pedestrians include:
- A. Prefabricated lightweight sections of plastic, metal, or other suitable materials that are interconnected and fixed in place to form a continuous edge.
 - B. Prefabricated lightweight sections of plastic, metal, or other suitable materials that are interconnected, fixed in place, and placed at ground level to provide a continuous connection between channelizing devices located at intervals along the edge of the sidewalk or walkway.
 - C. Sections of lumber interconnected and fixed in place to form a continuous edge.
 - D. Formed-in-place asphalt or concrete curb.
 - E. Prefabricated concrete curb sections that are interconnected and fixed in place to form a continuous edge.
 - F. Continuous temporary traffic barrier or longitudinal channelizing barricades placed along the edge of the sidewalk or walkway that provides a pedestrian edging at ground level.
 - G. Chain link or other fencing equipped with a continuous bottom rail.

Guidance:

- 04 *Detectable pedestrian edging should be orange, white, or yellow and should match the color of the adjacent channelizing devices or traffic control devices, if any are present.*

Section 6F.83 Temporary Raised Islands**Standard:**

- 01 **Temporary raised islands shall be used only in combination with pavement striping and other suitable channelizing devices. Type A pavement markings, matching the temporary pavement marking, shall be applied to the temporary raised island.**
- 02 **Temporary raised islands shall not be used on Limited Access highways.**

Option:

- 03 A temporary raised island may be used to separate vehicular traffic flows in two-lane, two-way operations on roadways having a vehicular traffic volume range of up to 15,000 average daily traffic (ADT).
- 04 Temporary raised islands also may be used in other than two-lane, two-way operations where physical separation of vehicular traffic from the TTC zone is not required.

Guidance:

- 05 *Temporary raised islands should have the basic dimensions of 4 inches high by at least 15 inches wide and have rounded or chamfered corners.*
- 06 *The temporary raised islands should not be designed in such a manner that they would cause a motorist to lose control of the vehicle if the vehicle inadvertently strikes the temporary raised island. If struck, pieces of the island should not be dislodged to the extent that they could penetrate the occupant compartment or involve other vehicles.*

Standard:

- 07 **Flex post delineators and temporary pavement markers shall be affixed on top of the temporary raised island. The temporary pavement marker shall match the color of the Type A pavement marking of the temporary raised island. The flex post delineator shall be spaced every 80 feet, with a temporary pavement marker spaced in-between each flex post delineator. See L&D special design drawing for Temporary Asphalt Median for details.**

- 08 Flex post delineators (see Figure 6F-9) Tubular Markers, shall be predominantly orange and shall not be less than 36 inches high and 2 inches wide facing road users. They shall be made of a material that can be struck without causing damage to the impacting vehicle.
- 09 Flex post delineators shall be retroreflectorized and shall be in compliance with Section 247 of the Road and Bridge Specifications. Retroreflectorization of flex post delineators that have a height of less than 42 inches shall be provided by two 3-inch wide white bands placed a maximum of 2 inches from the top with a maximum of 6 inches between the bands. Retroreflectorization of tubular markers that have a height of 42 inches or more shall be provided by four 4- to 6-inch wide alternating orange and white stripes with the top stripe being orange.
- 10 At pedestrian crossing locations, temporary raised islands shall have an opening or be shortened to provide at least a 60-inch wide pathway for the crossing pedestrian.

Section 6F.84 Opposing Traffic Lane Divider and Sign (W6-4)

Support:

- 01 Opposing traffic lane dividers are delineation devices used as center lane dividers to separate opposing vehicular traffic on a two-lane, two-way operation.

Standard:

- 02 Opposing traffic lane dividers shall not be placed across pedestrian crossings.
- 03 The Opposing Traffic Lane Divider (W6-4) sign (see Figure 6F-4 of the 2009 MUTCD) shall be an upright, retroreflective fluorescent orange-colored sign placed on a flexible support and sized at least 12 inches wide by 24 inches high.

Section 6F.85 Pavement Markings

Standard:

- 01 The provisions of this Section shall be considered applicable to long-term stationary TTC zones.

Support:

- 02 Pavement markings are installed or existing markings are maintained or enhanced in TTC zones to provide road users with a clearly defined path for travel through the TTC zone in day, night, and twilight periods under both wet and dry pavement conditions.

Guidance:

- 03 *The work should be planned and staged to provide for the placement and removal of the pavement markings in a way that minimizes the disruption to traffic flow approaching and through the TTC zone during the placement and removal process.*

Standard:

- 04 Existing pavement markings shall be maintained in all long-term and intermediate-term stationary (see Section 6G.02, TTC zones in accordance with Chapters 3A and 3B of the 2009 MUTCD) except as otherwise provided for temporary pavement markings in Section 6F.78. Pavement markings shall match the alignment of the markings in place at both ends of the TTC zone. Pavement markings shall be placed along the entire length of any paved surface detour or temporary roadway prior to the detour or roadway being opened to road users.
- 05 For long-term stationary operations, pavement markings in the temporary traveled way that are no longer applicable shall be 100 percent removed or obliterated as soon as practical. Pavement marking obliteration shall remove the non-applicable pavement marking material, and the obliteration method shall minimize pavement scarring. Painting over existing pavement markings with black paint or spraying with asphalt shall not be accepted as a substitute for removal or obliteration.
- 06 Pavement scarring of the roadway in excess of 1/8 inch depth shall be repaired to prevent deterioration of the pavement surface and to provide a smooth surface for motorcyclists.

Option:

- 07 Removable, non-reflective, preformed tape that is approximately the same color as the pavement surface may be used where markings need to be covered temporarily.

Section 6F.86 Temporary Markings

Support:

- 01 Temporary markings are those pavement markings or devices that are placed within TTC zones to provide road users with a clearly defined path of travel through the TTC zone when the permanent markings are either removed or obliterated during the work activities. Temporary markings are typically needed during the reconstruction of a road while it is open to traffic, such as overlays or surface treatments or where lanes are temporarily shifted on pavement that is to remain in place.

Guidance:

- 02 *Unless justified based on engineering judgment, temporary pavement markings should not remain in place for more than 14 days after the application of the pavement surface treatment or the construction of the final pavement surface on new roadways or over existing pavements.*
- 03 *The temporary use of edge lines, channelizing lines, lane-reduction transitions, gore markings, and other longitudinal markings, and the various non-longitudinal markings (such as stop lines, railroad crossings, crosswalks, words, symbols, or arrows) should be in accordance with the Virginia Department of Transportation's policy.*

Standard:

- 04 **Warning signs, channelizing devices and delineation shall be used to indicate required road user paths in TTC zones where it is not possible to provide a clear path by pavement markings.**

Option:

- 05 Temporary delineation may be provided by the use of temporary pavement markers (TPMs) for up to ten consecutive days, see VDOT special provision for application details.

Standard:

- 06 **Except as otherwise provided in this Section, all temporary pavement markings for no-passing zones shall comply with the requirements of Chapters 3A and 3B of the 2009 MUTCD. All temporary broken-line pavement markings shall use the same cycle length as permanent markings and shall have line segments that are at least 2 feet long.**
- 07 **All pavement markings and devices used to delineate road user paths shall be reviewed during daytime and nighttime periods.**

Option:

- 08 Half-cycle lengths with a minimum of 2-foot stripes may be used on roadways with severe curvature (see Section 3A.06 of the 2009 MUTCD) for broken line center lines in passing zones and for lane lines.
- 09 For temporary situations of 3 days or less, for a two- or three-lane road, no-passing zones may be identified by using DO NOT PASS (R4-1), PASS WITH CARE (R4-2), and NO PASSING ZONE (W14-3) signs (see Sections 2B.28, 2B.29, and 2C.45 of the 2009 MUTCD) rather than pavement markings. Also, DO NOT PASS, PASS WITH CARE, and NO PASSING ZONE signs may be used instead of pavement markings on roads with low volumes for longer periods in accordance with the Virginia Department of Transportation's policy.

Guidance:

- 10 *If used, the DO NOT PASS, PASS WITH CARE, and NO PASSING ZONE signs should be placed in accordance with Sections 2B.28, 2B.29, and 2C.45 of the 2009 MUTCD.*
- 11 *If used, the NO CENTER LINE (W8-12) sign should be placed in accordance with Section 6F.53.*

Standard:

- 12 **Pavement dotting used for laying out temporary or permanent pavement marking alignment shall not be used as a substitute for temporary pavement markings or temporary pavement markers.**

Section 6F.87 Temporary Raised Pavement Markers

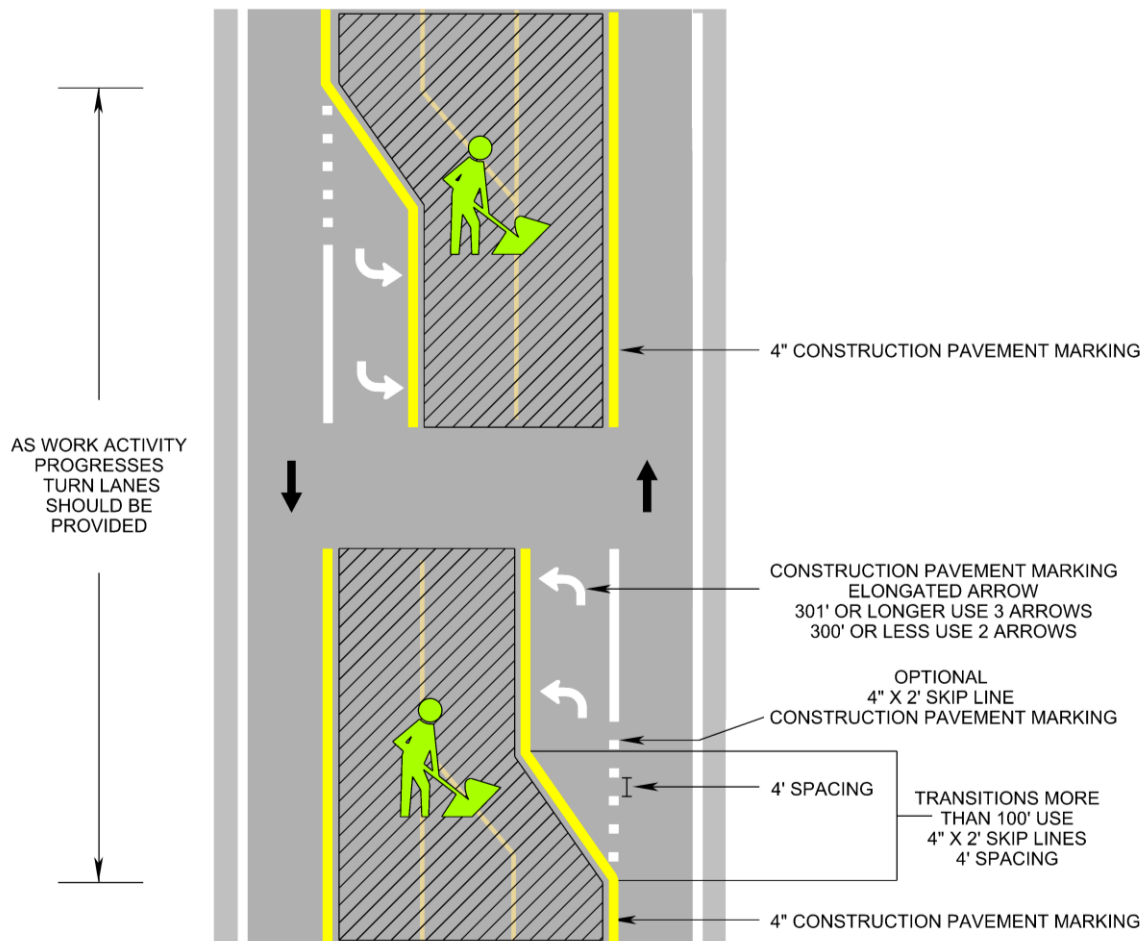
Option:

- 01 Retroreflective or internally illuminated raised pavement markers, or non-retroreflective raised pavement markers supplemented by retroreflective or internally illuminated markers, may be substituted for markings of other types in TTC zones.

Standard:

- 02 If used, the color and pattern of the raised pavement markers shall simulate the color and pattern of the markings for which they substitute.
- 03 Temporary pavement markers shall be installed with construction pavement markings (except non-

Figure 6F-10, Construction Pavement Marking for Tapers and Turn Lanes



NOTE: FOR PAVEMENT MARKING DETAILS SEE ROAD AND BRIDGE STANDARDS PM-3 TO PM-6

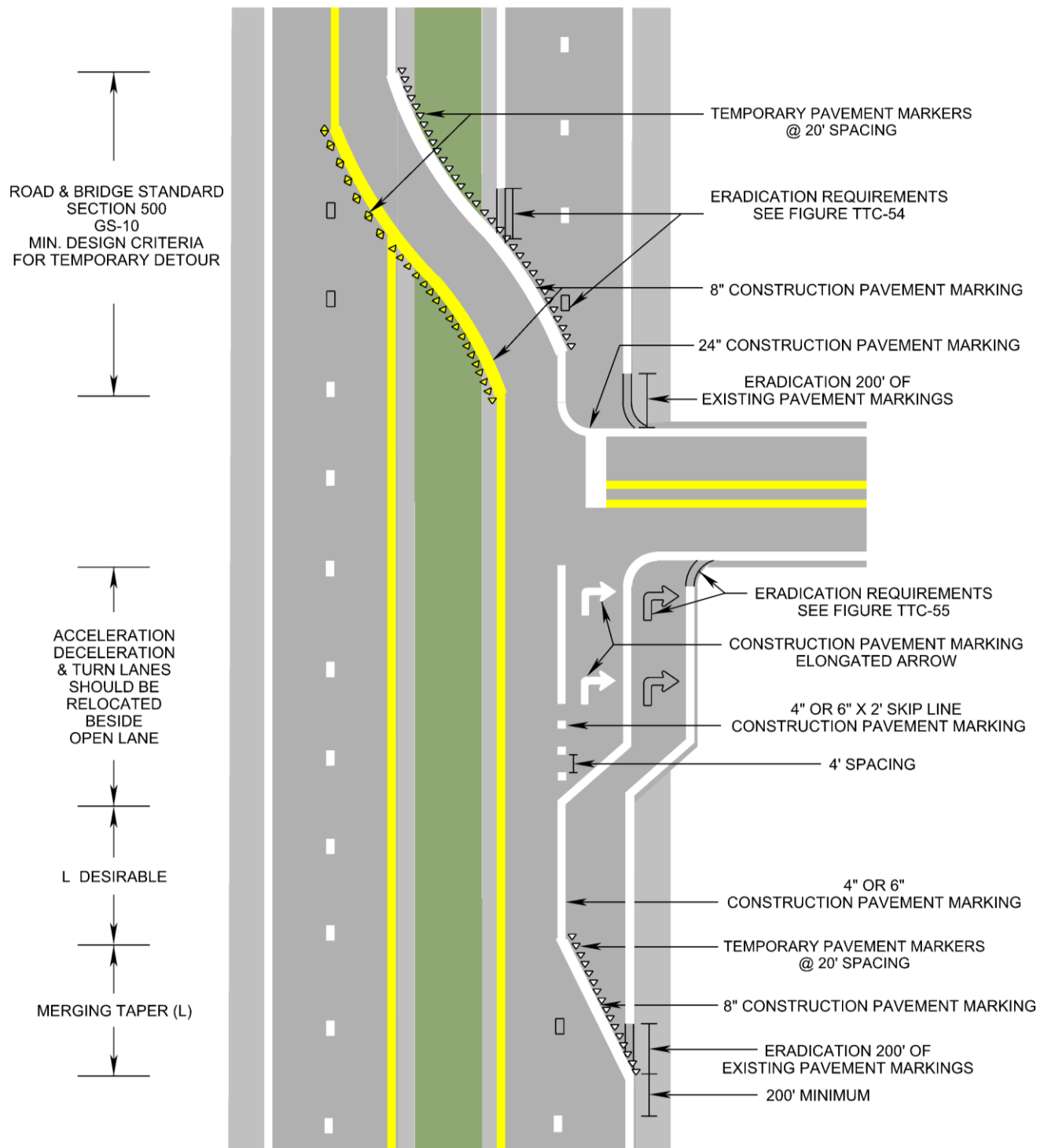
retroreflective removable markings) in transition (lane drop) or lane shift areas of work zones which will encroach upon the traveled way for a period of more than three days and in other areas as required by the Engineer. Temporary pavement markers shall be installed on twenty-foot centers in lane shift and transition areas. When temporary pavement markers are used in other areas, they shall be installed on forty-foot centers unless otherwise required by the Engineer.

- 04 If temporary raised pavement markers are used to substitute for broken line segments, a group of at least three retroreflective markers shall be equally spaced at no greater than $N/8$ (see Section 3B.14 of the Virginia Supplement to the 2009 MUTCD). The value of N for a broken or dotted line shall equal the length of one line segment plus one gap.
- 05 If temporary raised pavement markers are used to substitute for solid lines, the markers shall be equally spaced at no greater than $N/4$, with retroreflective or internally illuminated units at a spacing no greater than $N/2$. The value of N referenced for solid lines shall equal the N for the broken or dotted lines that might be adjacent to or might extend the solid lines (see Section 3B.11 of the Virginia Supplement to the 2009 MUTCD).

Option:

- 06 Temporary raised pavement markers may be used to substitute for broken line segments by using at least two retroreflective markers placed at each end of a segment of 2 to 5 feet in length, using the same cycle length as permanent markings.

Figure 6F-11, Temporary Pavement Marking and Temporary Pavement Markers for Tapers and Acceleration, Deceleration, and Turn Lanes



NOTE: FOR ELONGATED ARROW AND SKIP LINE DETAILS SEE ROAD AND BRIDGE STANDARDS PM-3 TO PM-6

Guidance:

- 07 *Temporary raised pavement markers used on 2- to 5-foot segments to substitute for broken line segments should not be in place for more than 14 days unless justified by engineering judgment.*
- 08 *Raised pavement markers should be considered for use along surfaced detours or temporary roadways, and other changed or new travel-lane alignments.*

Option:

- 09 Retroreflective or internally illuminated raised pavement markers, or non-retroreflective raised pavement markers supplemented by retroreflective or internally illuminated markers, may also be used in TTC zones to supplement markings as prescribed in Chapters 3A and 3B of the 2009 MUTCD.

Support:

- 10 See typical traffic control layout Figure TTC-60 for additional guidelines for installation of temporary raised markers.

Section 6F.88 Delineators**Standard:**

- 01 **When used, delineators shall combine with or supplement other TTC devices. They shall be mounted on crashworthy supports so that the reflecting unit is approximately 4 feet above the near roadway edge. The standard color for delineators used along both sides of two-way streets and highways and the right hand side of one-way roadways shall be white. Delineators used along the left-hand side of one-way roadways shall be yellow.**

Guidance:

- 02 *Spacing along roadway curves should be as set forth in Section 3F.04 of the 2009 MUTCD and should be such that several delineators are constantly visible to the driver.*

Option:

- 03 Delineators may be used in TTC zones to indicate the alignment of the roadway and to outline the required vehicle path through the TTC zone.

Section 6F.89 Lighting Devices*Guidance:*

- 01 *Lighting devices should be provided in TTC zones based on engineering judgment.*
- 02 *When used to supplement channelization, the maximum spacing for warning lights should be identical to the channelizing device spacing requirements.*

Option:

- 03 Lighting devices may be used to supplement retroreflectorized signs, barriers, and channelizing devices. During normal daytime maintenance operations, the functions of flashing warning beacons may be provided by amber colored high-intensity rotating, flashing, oscillating, or strobe lights on a construction/maintenance vehicle.

Standard:

- 04 **Although vehicle hazard warning lights are permitted to be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights, they shall not be used instead of high-intensity rotating, flashing, oscillating, or strobe lights.**

Section 6F.90 Floodlights*Support:*

- 01 Utility, maintenance, or construction activities on highways are frequently conducted during nighttime periods when vehicular traffic volumes are lower. Large construction projects are sometimes operated on a double-shift basis requiring night work (see Section 6G.26).

Guidance:

- 02 *When nighttime work is being performed, floodlights should be used to illuminate the work area, equipment crossings, and other areas.*

Standard:

- 03 **Except in emergency situations, flagger stations shall be illuminated at night with a light source producing at least a minimum of 5 foot candles (50 lux).**
- 04 **Floodlighting shall not produce a disabling glare condition for approaching road users, flaggers, or workers.**
- 05 **The adequacy of the floodlight placement and elimination of potential glare shall be determined by driving through and observing the floodlighted area from each direction on all approaching roadways after the initial floodlight setup, at night, and periodically during each shift.**

Guidance:

- 06 *If glare from standard types of floodlight equipment cannot be eliminated, then consideration should be made for the use of non-glare lighting devices such as non-glare air-filled lighting devices.*

Support:

- 07 Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of 5 foot candles (50 lux) can be adequate for general activities. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 20 foot candles.

Section 6F.91 Warning Lights*Support:*

- 01 Type A, Type B, Type C, and Type D 360-degree warning lights are portable, powered, yellow, lens-directed, enclosed lights.

Standard:

- 02 **Warning lights shall be in accordance with the current ITE “Purchase Specification for Flashing and Steady-Burn Warning Lights” (see section 1A.11 of the Virginia Supplement to the 2009 MUTCD).**
- 03 **When warning lights are used, they shall be mounted on signs or channelizing devices in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield.**

Guidance:

- 04 *The maximum spacing for warning lights should be identical to the channelizing device spacing requirements.*

Support:

- 05 The light weight and portability of warning lights are advantages that make these devices useful as supplements to the retroreflectorization on signs and channelizing devices. The flashing lights are effective in attracting road users' attention.

Option:

- 06 Warning lights may be used in either a steady-burn or flashing mode.

Standard:

- 07 **Except for the sequential flashing warning lights that are described in Paragraphs 8 and 9, flashing warning lights shall not be used for delineation, as a series of flashers fails to identify the desired vehicle path.**

Option:

- 08 A series of sequential flashing warning lights may be placed on channelizing devices that form a merging taper in order to increase driver detection and recognition of the merging taper.

Standard:

- 09 **If a series of sequential flashing warning lights is used, the successive flashing of the lights shall occur from the upstream end of the merging taper to the downstream end of the merging taper in order to identify the desired vehicle path. Each flashing warning light in the sequence shall be flashed at a rate of not less than 55 or more than 75 times per minute.**
- 10 **Type A Low-Intensity Flashing warning lights, Type C Steady-Burn warning lights, and Type D 360-degree Steady-Burn warning lights shall be maintained so as to be capable of being visible on a clear night from a distance of 3,000 feet. Type B High-Intensity Flashing warning lights shall be maintained so as to be capable of being visible on a sunny day when viewed without the sun directly on or behind the device from a distance of 1,000 feet.**

11 Warning lights shall have a minimum mounting height of 30 inches to the bottom of the lens.

Support:

- 12 Type A Low-Intensity Flashing warning lights are used to warn road users during nighttime hours that they are approaching or proceeding in a potentially hazardous area.

Option:

- 13 Type A warning lights may be mounted on channelizing devices.

Support:

- 14 Type B High-Intensity Flashing warning lights are used to warn road users during both daylight and nighttime hours that they are approaching a potentially hazardous area.

Option:

- 15 Type B warning lights are designed to operate 24 hours per day and may be mounted on post-mounted advance warning signs, on independent supports, or concrete barrier.

- 16 Type C Steady-Burn warning lights and Type D 360-degree Steady-Burn warning lights may be used during nighttime hours to delineate the edge of the traveled way.

Guidance:

- 17 *When used to delineate a curve, Type C and Type D 360-degree warning lights should only be used on devices on the outside of the curve, and not on the inside of the curve.*

Section 6F.92 Vehicle Warning Lights

Guidance:

- 01 *Amber warning lights on vehicles should be mounted as to be viewed 360 degrees on vehicles without arrow boards, and 180 degrees on vehicles with arrow boards.*

Standard:

- 02 **Vehicle warning lights shall be a high intensity amber rotating, flashing, oscillating or strobe light or combinations of and meet the following conditions:**

1. Rotating amber lights shall consist of a minimum of two halogen sealed beams enclosed within a dome which displays an amber color when illuminated. Sealed beams shall be at least 60,000 Candlepower and shall have a flash rate of 80 to 100 flashes per minute. Rotating amber lights shall be visible under either day and night conditions a minimum of 1/2 mile on Limited Access highways, or a minimum of 1500 feet on all other roadways. Rotating amber lights shall be mounted as to be viewed 360 degrees; double lights may be used to achieve 360 degree viewing.
2. Oscillating amber lights shall consist of a minimum 35 watt halogen bulb with an oscillating parabolic reflector or LED Module which produces an up and down and side to side motion. Oscillating lights shall display amber color when illuminated or be contained within an amber colored sealed lens. Oscillating amber lights shall be visible under both day and night conditions a minimum of 1/2 mile on Limited Access highways, or a minimum of 1500 feet on all other roadways. Oscillating amber lights shall be mounted as to be viewed 360 degrees; or may be used in combinations with amber rotating and/or strobe lights.
3. High intensity amber strobe lights or amber flashing lights shall consist of a double flash unit and display amber color when illuminated or be contained within an amber colored sealed lens. Flash rate shall be 80±10 flashes per minute. Strobe or flashing lights shall be visible under either day and night conditions a minimum of 1/2 mile on Limited Access highways, or a minimum of 1500 feet on all other roadways. Strobe lights shall be mounted as to be viewed 360 degrees; double lights may be used to achieve 360 degree viewing.

- 03 **Warning lights shall be used on all vehicles performing moving and mobile operations.**

- 04 **The use of high-intensity white rotating, flashing, oscillating, or strobe lights is reserved for emergency vehicles in the Commonwealth and shall not be used on construction/maintenance vehicles**

Option:

- 05 If the work operation vehicle in a moving/mobile operation is a motorized piece of equipment, such as a motor grader, grad-all, etc., warning lights may be optional.

Guidance:

- 06 *During night operations, work vehicles entering and exiting the work area should be equipped with and have operating at least one high intensity amber rotating, flashing, oscillating, or strobe light visible from 360 degrees.*
- 07 *Unless perceived as a hazard, parked work operation vehicles or equipment in a stationary lane closure should not have their vehicle warning lights in operation which could be a distraction to motorist.*

Section 6F.93 Temporary Traffic Control Signals**Standard:**

- 01 **Temporary traffic control signals (see Section 4D.32 of the 2009 MUTCD) used to control road user movements through TTC zones and in other TTC situations shall comply with the applicable provisions of Part 4 of the 2009 MUTCD.**

Support:

- 02 Temporary traffic control signals are typically used in TTC zones such as temporary haul road crossings; temporary one-way operations along a one-lane, two-way highway; temporary one-way operations on bridges, reversible lanes, and intersections.

Standard:

- 03 **A temporary traffic control signal that is used to control traffic through a one-lane, two-way section of roadway shall comply with the provisions of Section 4H.02 of the 2009 MUTCD. The signal requires an all-red interval of sufficient duration for road users to clear the portion of the TTC zone controlled by the traffic control signals. Safeguards shall be incorporated to avoid the possibility of conflicting signal indications at each end of the TTC zone. All equipment shall be in compliance with Section 238 of the Road and Bridge Specifications and in excellent working condition.**

Guidance:

- 04 *Where pedestrian traffic is detoured to a temporary traffic control signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals (see Section 4E.09 of the Virginia Supplement to the 2009 MUTCD) are needed for crossing along an alternate route.*
- 05 *When temporary traffic control signals are used, conflict monitors typical of traditional traffic control signal operations should be used.*

Option:

- 06 Temporary traffic control signals may be portable or temporarily mounted on fixed supports.

Standard:

- 07 **The Regional Traffic Engineer shall determine which traffic control signal will be used - portable or temporarily mounted on fixed supports.**
- 08 **The supports for temporary traffic control signals shall not encroach into the minimum required width of a “pedestrian access route” of 48 inch or an “alternate circulation path” of 36 inch.**

Guidance:

- 09 *Temporary traffic control signals should only be used in situations where temporary traffic control signals are preferable to other means of traffic control, such as changing the work staging or work zone size to eliminate one-way vehicular traffic movements, using flaggers to control one-way or crossing movements, using STOP or YIELD signs, and using warning devices alone.*

Support:

- 10 Factors related to the design and application of temporary traffic control signals include the following:
 - A. Safety and road user needs;
 - B. Work staging and operations;
 - C. The feasibility of using other TTC strategies (for example, flaggers, providing space for two lanes, or detouring road users, including bicyclists and pedestrians);
 - D. Sight distance restrictions;
 - E. Human factors considerations (for example, lack of driver familiarity with temporary traffic control signals);
 - F. Road-user volumes including roadway and intersection capacity;
 - G. Affected side streets and driveways;

- H. Vehicle speeds;
 - I. The placement of other TTC devices;
 - J. Parking;
 - K. Turning restrictions;
 - L. Pedestrians;
 - M. The nature of adjacent land uses (such as residential or commercial);
 - N. Legal authority;
 - O. Signal phasing and timing requirements;
 - P. Full-time or part-time operation;
 - Q. Actuated, fixed-time, or manual operation;
 - R. Power failures or other emergencies;
 - S. Inspection and maintenance needs;
 - T. Need for detailed placement, timing, and operation records; and
 - U. Operation by contractors or by others.
- 11 Although temporary traffic control signals can be mounted on trailers or lightweight portable supports, fixed supports offer superior resistance to displacement or damage by severe weather, vehicle impact, and vandalism.

Guidance:

- 12 *Other TTC devices should be used to supplement temporary traffic control signals, including warning and regulatory signs, pavement markings, and channelizing devices.*
- 13 *The design and placement of temporary traffic control signals should include interconnection to other traffic control signals along the subject roadway.*
- 14 *Temporary traffic control signals not in use should be covered or removed.*
- 15 *If a temporary traffic control signal is located within 1/2 mile of an adjacent traffic control signal, consideration should be given to interconnected operation.*

Standard:

- 16 **Temporary traffic control signals shall not be located within 200 feet of a grade crossing unless the temporary traffic control signal is provided with preemption in accordance with Section 4D.27 of the 2009 MUTCD, or unless a uniformed officer or flagger is provided at the crossing to prevent vehicles from stopping within the crossing.**
- 17 **Temporary traffic control signals exposed to traffic shall have a minimum of four (4) Group 2 channelizing devices placed in a taper on the shoulder in advance of the signal for delineation.**

Section 6F.94 Temporary Traffic Barriers

Support:

- 01 Temporary traffic barriers, including shifting portable or movable barriers, are devices designed to help prevent penetration by vehicles while minimizing injuries to vehicle occupants, and to protect workers, bicyclists, and pedestrians.
- 02 The four primary functions of temporary traffic barriers are:
- A. To keep vehicular traffic from entering work areas, such as excavations or material storage sites;
 - B. To separate workers, bicyclists, and pedestrians from motor vehicle traffic;
 - C. To separate opposing directions of vehicular traffic; and
 - D. To separate vehicular traffic, bicyclists, and pedestrians from the work area such as false work for bridges and other exposed objects.

Option:

- 03 Temporary traffic barriers, including shifting portable or movable barrier installations to accommodate varying directional traffic demands, may be used to separate two-way vehicular traffic.

Guidance:

- 04 *Because the protective requirements of a TTC situation have priority in determining the need for temporary traffic barriers, their use should be based on an engineering study. When serving the additional function of channelizing vehicular traffic (see Section 6F.78) temporary traffic barriers should be a light color for increased visibility.*

Standard:

- 05 **Temporary traffic barriers shall be supplemented with standard delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility if they are used to channelize vehicular traffic. The delineation color shall match the applicable pavement marking color.**
- 06 **Temporary traffic barriers, including their end treatments, shall be crashworthy. In order to mitigate the effect of striking the upstream end of a temporary traffic barrier, the end shall be installed in accordance with VDOT's Road Design Manual and AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD) by flaring until the end is outside the acceptable clear zone or by providing crashworthy end treatments.**
- 07 **Barrier panels 8 inches in width and 12 inches in height shall be installed on top of the barrier. Panels shall be installed on 40 foot centers in transition or taper sections and on 80 foot centers in the tangent sections. A Type B flashing light shall be installed on the run-on end of the barrier and at the breakpoint where the transition or taper ends and the barrier becomes parallel to the roadway. Barrier panels shall have a fluorescent orange retroreflective surface in the direction of oncoming traffic.**
- 08 **The effect of striking the ends of barriers shall be mitigated by the use of impact attenuators or by flaring the ends of barriers away from the traveled way. Following in the order of preference are the methods to be used in mitigating the effect of striking the ends of barriers:**
 - 1. **Where guardrail exists, the guardrail shall be attached to the barrier with the appropriate fixed object attachment.**
 - 2. **Where cut slope exists, bury the barrier into the cut slope and provide for drainage as needed.**
 - 3. **Extend end of barrier until it is beyond the established Clear Zone (see Appendix A for clear zone values).**
 - 4. **When barrier end is inside the desired Clear Zone, attenuator service Type I or Type II (Sand barrels) shall be used. Refer to Location and Design Division's Special Design Drawings. Contact Location and Design Division's Standards/Special Design Section for type and quantity needed for each location.**

Support:

- 09 Movable barriers are a linear system of connected barrier segments capable of being rapidly repositioned laterally using a transfer vehicle that travels along the barrier. The transfer is accomplished in a manner that does not interfere with vehicular traffic in adjacent lanes. Movable barriers enable short-term closures to be installed and removed on long-term projects. Providing a barrier-protected work space for short-term closures and providing unbalanced flow to accommodate changes in the direction of peak-period traffic flows are two of the advantages of using movable barriers. Applications of movable include the following:
 - A. Closing an additional lane during work periods while maintaining the advantage of having the travel way separated from the work space by a barrier;
 - B. Closing an additional lane during off-peak periods to provide extra space for work activities without adversely impacting vehicular traffic flow; and
 - C. Creating a temporary reversible lane, thus providing unbalanced capacity favoring the major direction of vehicular traffic flow.
- 10 Figure 6H-45 of the 2009 MUTCD shows a temporary reversible lane using movable barriers. The notable feature of the movable barrier is that in both Phase A and Phase B, the lanes used by opposing traffic are separated by a barrier.
- 11 Figure 6H-34 of the 2009 MUTCD shows an exterior lane closure using a temporary traffic barrier. Notes 7 through 9 address the option of using a movable barrier. By using a movable barrier, the barrier can be positioned to close the lane during the off-peak periods and can be relocated to open the lane during peak periods to accommodate peak traffic flows. With one pass of the transfer vehicle, the barrier can be moved out of the lane and onto the shoulder. Furthermore, if so desired, with a second pass of the transfer vehicle, the barrier could be moved to the roadside beyond the shoulder.
- 12 More specific information on the use of temporary traffic barriers is contained in Chapters 8 and 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).

Section 6F.95 Crash Cushions

Support:

- 01 Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles, either by smoothly decelerating the vehicle to a stop when hit head-on, or by redirecting the errant vehicle. The two types of crash cushions that are used in TTC zones are stationary crash cushions and truck-mounted attenuators. Crash cushions in TTC zones help protect the drivers from the exposed ends of barriers, fixed objects, shadow vehicles, and other obstacles. Specific information on the use of crash cushions can be found in AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).

Standard:

- 02 **Crash cushions shall be crashworthy. They shall also be designed for each application to stop or redirect errant vehicles under prescribed conditions. Crash cushions shall be periodically inspected to verify that they have not been hit or damaged. Damaged crash cushions shall be promptly repaired or replaced to maintain their crashworthiness.**

Support:

- 03 Stationary crash cushions are used in the same manner as permanent highway installations to protect drivers from the exposed ends of barriers, fixed objects, and other obstacles.

Standard:

- 04 **Stationary crash cushions shall be designed for the specific application intended.**
- 05 **Truck-mounted attenuators (TMA) shall be energy-absorbing devices attached to the rear of shadow trailers or trucks and listed on VDOT's approved device list. If used, the shadow vehicle with the attenuator shall be located in advance of the work area, workers, or equipment to reduce the severity of rear-end crashes from errant vehicles.**
- 06 **A TMA shall not be used more than 3 consecutive days to protect a fixed object.**
- 07 **The rear panel of the TMA cushion shall have alternate 6 to 8-inch wide orange and black chevron (inverted v) stripes. Stripes shall be sloped at a 45 degree angle downward in both directions from the upper center of the rear panel. Fluorescent orange stripes shall be in compliance with Section 247 of the Road and Bridge Specifications**
- 08 **The TMA shall be used in accordance with the manufacturer's specifications including the weight of the support truck. Documentation of the manufacturer's support truck weight recommendation shall be made available when requested, along with a copy of a weigh ticket for the truck. The weigh ticket shall contain adequate information to associate the ticket with the applicable truck.**

Option:

- 09 Additional weight may be added to the support vehicle to achieve the range recommended by the manufacturer of the truck-mounted attenuator provided the total weight is within the Gross Vehicle Weight Recommendation of the support vehicle and is installed such that no movement will occur during impacts.

Support:

- 10 Trucks or trailers are often used as shadow vehicles to protect workers or work equipment from errant vehicles. These shadow vehicles are normally equipped with flashing arrows, changeable message signs, and/or high-intensity rotating, oscillating, or strobe lights located properly in advance of the workers and/or equipment that they are protecting. However, these shadow vehicles might themselves cause injuries to occupants of the errant vehicles if they are not equipped with truck-mounted attenuators.

Standard:

- 11 **Shadow trucks with TMA's shall be used:**
- A. When closing a lane on a four or more lane roadway with a posted speed of 45 mph or greater;**
 - B. On shoulders, ramps and loops of interstate and Limited Access highways;**
 - C. When a mobile operation occupies all or part of the travel lane on a multi-lane roadway with a posted speed of 45 mph or greater;**
 - D. Other locations where the Regional Traffic Engineer feels such protection is warranted.**
- 12 **When the installation and removal of temporary traffic control devices is performed as a mobile operation meeting the conditions listed in Paragraph 11, a TMA shall be used on the shadow vehicle.**

- 13 **All TMA units shall conform to the requirements of NCHRP Report 350, Test Level 3 or MASH.**
- 14 **The shadow vehicle with a TMA shall be positioned a sufficient distance (80-120 feet) in advance of the workers or equipment being protected to allow for appropriate vehicle roll-ahead, but not so far that errant vehicles will travel around the vehicle and strike the protected workers and/or equipment.**
- 15 **When all work crews, equipment, or hazards have been sufficiently removed from the lane closure, the shadow truck shall be removed.**

Guidance:

- 16 *Shadow trucks should be used when installing and removing a lane closure in a roadway. In mobile operations, the shadow truck with a truck-mounted attenuator should be 1000 feet ± in advance of the work vehicle.*
- 17 *For additional operations located further downstream from the taper, a shadow vehicle without a truck-mounted attenuator should be used for protection of work crews, placed a sufficient distance (80-120 feet) in advance of the crews.*

Option:

- 18 Shadow trucks with TMA's may be eliminated when their use would destroy or damage uncured asphalt.

Support:

- 19 Asphalt pavement resurfacing operations are typically those instances where shadow trucks with TMA's would destroy or damage uncured asphalt. Other operations being accomplished under the same project would still require the use of TMA's if their use would not destroy or damage the uncured asphalt. Examples of those operations include shoulder work where the adjacent lane is required to be closed, pavement marking application closures (except pavement marking tape being inlaid into the new asphalt surface), and other similar type operations.

Standard:

- 20 **During operation as a shadow vehicle with a TMA, the truck shall not be used as a work operations vehicle. Channelizing devices or signs shall not be stored or installed from the shadow vehicle with a TMA. All material and/or equipment on the shadow vehicle TMA shall be properly secured to prevent spillage if struck by an errant vehicle.**

Option:

- 21 Additional vehicles in an operation may have a TMA device on it as long as it is not in use as a shadow vehicle providing protection as described in Paragraph 16 and as shown in the typical traffic control layouts in Chapter 6H.

Guidance:

- 22 *The attenuator should be in the full down-and-locked position when in use as a protection vehicle. For stationary operations, the truck-mounted attenuator should be placed in accordance with the manufacturer's recommendations.*

Standard:

- 23 **The TMA shall be visually inspected daily prior to use and shall be in accordance with and used by the manufacturer's specifications.**

Support:

- 24 Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD) contains additional information regarding the use of shadow vehicles.

Section 6F.96 Rumble Strips

Support:

- 01 Transverse rumble strips consist of intermittent, narrow, transverse areas of rough-textured or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to unusual vehicular traffic conditions. Through noise and vibration they attract the driver's attention to such features as unexpected changes in alignment and to conditions requiring a stop.
- 02 Longitudinal rumble strips consist of a series of rough-textured or slightly raised or depressed road surfaces located along the shoulder to alert road users that they are leaving the travel lanes.

Standard:

- 03 **If it is desirable to use a color other than the color of the pavement for a longitudinal rumble strip, the color of the rumble strip shall be the same color as the longitudinal line the rumble strip supplements.**
- 04 **If the color of a transverse rumble strip used within a travel lane is not the color of the pavement, the color of the rumble strip shall be white, black, or orange.**

Option:

- 05 Intervals between transverse rumble strips may be reduced as the distance to the approached conditions is diminished in order to convey an impression that a closure speed is too fast and/or that an action is imminent. A sign warning drivers of the onset of rumble strips may be placed in advance of any transverse rumble strip installation.

Guidance:

- 06 *Transverse rumble strips should be placed transverse to vehicular traffic movement. They should not adversely affect overall pavement skid resistance under wet or dry conditions.*
- 07 *In urban areas, even though a closer spacing might be warranted, transverse rumble strips should be designed in a manner that does not promote unnecessary braking or erratic steering maneuvers by road users.*
- 08 *Transverse rumble strips should not be placed on sharp horizontal or vertical curves.*
- 09 *Rumble strips should not be placed through pedestrian crossings or on bicycle routes.*
- 10 *Transverse rumble strips should not be placed on roadways used by bicyclists unless a minimum clear path of 4 feet is provided at each edge of the roadway or on each paved shoulder as described in AASHTO's "Guide to the Development of Bicycle Facilities" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).*
- 11 *Longitudinal rumble strips should not be placed on the shoulder of a roadway that is used by bicyclists unless a minimum clear path of 4 feet is also provided on the shoulder.*

Section 6F.97 Screens**Support:**

- 01 Screens are used to block the road users' view of activities that can be distracting. Screens might improve safety and motor vehicle traffic flow where volumes approach the roadway capacity because they discourage gawking and reduce headlight glare from oncoming motor vehicle traffic.

Guidance:

- 02 *Screens should not be mounted where they could adversely restrict road user visibility and sight distance and adversely affect the reasonably safe operation of vehicles.*
- 03 *The use of screens mounted on the top of temporary traffic barriers should be considered in crossover applications whenever multi-lane traffic is reduced to two-way motor vehicle traffic to reduce headlight glare from oncoming traffic and improve mobility through the crossover.*

Option:

- 04 Screens may be mounted on the top of temporary traffic barriers that separate two-way motor vehicle traffic.

Guidance:

- 05 *Design of screens should be in accordance with Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD).*

CHAPTER 6G. TYPE OF TEMPORARY TRAFFIC CONTROL ZONE ACTIVITIES

Section 6G.01 Typical Applications

Support:

- 01 Each TTC zone is different. Many variables, such as location of work, highway type, geometrics, vertical and horizontal alignment, intersections, interchanges, road user volumes, road vehicle mix (buses, trucks, cars and motorcycles), and road user speeds affect the needs of each zone. The goal of TTC in work zones is safety with minimum disruption to road users. The key factor in promoting TTC zone safety is proper judgment.
- 02 Typical figures of TTC zones are organized according to duration, location, type of work, and highway type. Table 6H-1 is an index of these Typical Traffic Control figures. These typical applications include the use of various TTC methods, but do not include a layout for every conceivable work situation. Additional figures can also be found in Chapter 6H of the 2009 MUTCD.
- 03 Well-designed TTC plans for planned special events will likely be developed from a combination of treatments from several of the typical traffic control figures.

Guidance:

- 04 *For any planned special event that will have an impact on the traffic on any street or highway, a TTC plan should be developed in conjunction with and be approved by the agency or agencies that have jurisdiction over the affected roadways.*
- 05 *Typical applications should be altered, when necessary, to fit the conditions of a particular TTC zone.*

Option:

- 06 Other devices may be added to supplement the devices shown in the typical traffic control figures, while others may be deleted. The sign spacings and taper lengths may be increased to provide additional time or space for driver response.

Support:

- 07 Decisions regarding the selection of the most appropriate typical traffic control figure to use as a guide for a specific TTC zone require an understanding of each situation. Although there are many ways of categorizing TTC zone applications, the four factors mentioned earlier (work duration, work location, work type, and highway type) are used to characterize the typical traffic control figures illustrated in Chapter 6H.

Section 6G.02 Work Duration

Support:

- 01 Work duration is a major factor in determining the number and types of devices used in TTC zones. The duration of a TTC zone is defined relative to the length of time a work operation occupies a spot location.

Standard:

- 02 **The five categories of work duration and their time at a location shall be:**
 - A. Long-term stationary is work that occupies a location more than 3 days.**
 - B. Intermediate-term stationary is work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.**
 - C. Short-term stationary is daytime work that occupies a location for more than 1 hour within a single daylight period.**
 - D. Short duration is work that occupies a location up to 1 hour.**
 - E. Mobile is work that moves intermittently or continuously.**

Support:

- 03 At long-term stationary TTC zones, there is ample time to install and realize benefits from the full range of TTC procedures and devices that are available for use. Generally, larger channelizing devices, temporary roadways, and temporary traffic barriers are used.

Standard:

- 04 **Since long-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in long-term stationary TTC zones. In addition, Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned cones.**

Guidance:

- 05 *Inappropriate markings in long-term stationary TTC zones should be removed and replaced with temporary markings.*

Support:

- 06 In intermediate-term stationary TTC zones, it might not be feasible or practical to use procedures or devices that would be desirable for long-term stationary TTC zones, such as altered pavement markings, temporary traffic barriers, and temporary roadways. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time.

Standard:

- 07 **Since intermediate-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in intermediate-term stationary TTC zones. In addition, Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned cones.**

Support:

- 08 Most maintenance and utility operations are short-term stationary work.
- 09 As compared to stationary operations, mobile and short-duration operations are activities that might involve different treatments. Devices having greater mobility might be necessary such as signs mounted on trucks. Devices that are larger, more imposing, or more visible can be used effectively and economically. The mobility of the TTC zone is important.

Guidance:

- 10 *Safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location.*

Option:

- 11 Appropriately colored or marked vehicles with amber high-intensity rotating, flashing, oscillating, or strobe lights may be used in place of signs and channelizing devices for short-duration or mobile operations. These vehicles may be augmented with signs or arrow boards.

Support:

- 12 During short-duration work, it often takes longer to set up and remove the TTC zone than to perform the work. Workers face hazards in setting up and taking down the TTC zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed.

Option:

- 13 Considering these factors, simplified control procedures may be warranted for short-duration work. A reduction in the number of devices may be offset by the use of other more dominant devices such as high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.

Support:

- 14 Mobile operations often involve frequent short stops of 15 minutes or less for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations.

Standard:

- 15 **Warning signs and high-intensity amber rotating, flashing, oscillating, or strobe lights shall be used on the vehicles that are participating in the mobile work.**

Option:

- 16 Flags and/or channelizing devices may additionally be used, but shall be continuously repositioned to keep them near the mobile work area.

- 17 Flaggers may be used for mobile operations that often involve frequent short stops.

Support:

- 18 Mobile operations also include work activities where workers and equipment move along the road without stopping, usually at slow speeds. The advance warning area moves with the work area.

Guidance:

- 19 *When mobile operations are being performed, a shadow vehicle equipped with an arrow board or a sign should follow the work vehicle, especially when vehicular traffic speeds or volumes are high. Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.*
- 20 *Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.*

Standard:

- 21 **Mobile operations shall have appropriate devices on the equipment (that is, high-intensity amber rotating, flashing, oscillating, or strobe lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.**
- 22 **If there are mobile operations on a high-speed travel lane of a multi-lane divided highway, arrow boards shall be used. Additionally, if posted speeds are 45 mph or greater, a Truck-Mounted Attenuator (TMA) shall be used on the shadow vehicle(s).**
- 23 **Mobile operations that move at speeds greater than 20 mph, such as pavement marking operations, shall have appropriate devices on the equipment (that is, high-intensity amber rotating, oscillating, or strobe lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.**

Option:

- 24 For mobile operations that move at speeds of less than 5 mph, mobile signs or stationary signing that is periodically retrieved and repositioned in the advance warning area may be used.
- 25 At higher speeds, vehicles may be used as components of the TTC zones for mobile operations. Appropriately colored and marked vehicles with signs, flags, high-intensity amber rotating, flashing, oscillating, or strobe lights, truck-mounted attenuators, and arrow boards or portable changeable message signs may follow a train of moving work vehicles.
- 26 For some continuously moving operations, such as street sweeping and snow removal, a single work vehicle with appropriate warning devices on the vehicle may be used to provide warning to approaching road users.

Support:

- 27 Figure TTC-11 displays traffic control for a single lane moving/mobile operation on a Limited Access highway, while Figure TTC-13 displays traffic control for a single lane moving/mobile operation on a multi-lane, Non-Limited Access highway. Figure TTC-12 displays traffic control for a moving/mobile operation for multiple lane closure on a Limited Access highway.

Option:

- 28 Figures TTC-11 and TTC-12 may be used for Non-Limited Access highways by adjusting the spacing between shadow vehicles to between 500 to 800 feet between vehicles, while spacing between shadow vehicle prior to the work vehicle stays the same. If TTC-12 is used, the spacing between Shadow Vehicle 1 and 2 may be adjusted to 0.5 mile.

Standard:

- 29 **When used in moving/mobile operations, law enforcement vehicles shall be placed as shown in Figures TTC-11 and TTC-12 to minimize their exposure to traffic. Law enforcement vehicles shall not be placed into an open travel lane for planned work operations without the protection of a shadow vehicle.**

Support:

- 30 Figure TTC 14.0 displays traffic control for a moving/mobile operation on a Two-Lane roadway.

Guidance:

- 31 *Where practical and when needed, the work and shadow vehicles should pull over periodically in a moving/mobile operation on a Two-Lane roadway to allow motor vehicle traffic to pass.*
- 32 *Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance from the work vehicle and proceed at the same speed. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
- 33 *A truck-mounted attenuator should be used on the shadow vehicle in Two-Lane moving/mobile operations.*

Section 6G.03 Location of Work

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The choice of TTC needed for a TTC zone depends upon where the work is located. As a general rule, the closer the work is to road users (including bicyclists and pedestrians), the greater the number of TTC devices that are needed. Procedures are described later in this Chapter for establishing TTC zones in the following locations:
 - A. Outside the shoulder,
 - B. On the shoulder with no encroachment,
 - C. On the shoulder with minor encroachment,
 - D. Within the median, and
 - E. Within the traveled way.

Standard:

- 03 **When the work space is within the traveled way, except for short-duration and mobile operations, advance warning signs shall provide a general warning message (ROAD WORK AHEAD), advise that work is taking place (RIGHT or LEFT LANE CLOSED AHEAD) and direct and supply information about highway conditions (KEEP RIGHT or LEFT, and LANE ENDS MERGE RIGHT or LEFT). TTC devices shall indicate how vehicular traffic can move through the TTC zone.**

Section 6G.04 Modifications To Fulfill Special Needs

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The typical applications in Chapter 6H illustrate commonly encountered situations in which TTC devices are employed. Roadway characteristics to consider in selecting the appropriate temporary traffic control figure also include travel speeds and traffic volumes. The definition of a high speed roadway is prevailing speeds of 45 mph and greater, and low speed roadway of speeds of less than 45 mph. High volume roadways have an average daily traffic (ADT) of 500 or more vehicles per day, while low volume roadways have less than 500 vehicles per day.

Option:

- 03 Other devices may be added to supplement the devices provided in the typical applications, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

Guidance:

- 04 *When conditions are more complex, typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6B of the 2009 MUTCD and by incorporating appropriate devices and practices from the following list:*
 - A. *Additional devices:*
 - 1. *Signs*
 - 2. *Arrow boards*
 - 3. *More channelizing devices at closer spacing (see Section 6F.82) for information regarding detectable edging for pedestrians*
 - 4. *Temporary raised pavement markers*
 - 5. *High-level warning devices*
 - 6. *Portable changeable message signs*
 - 7. *Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals)*
 - 8. *Temporary traffic barriers*
 - 9. *Crash cushions*
 - 10. *Screens*
 - 11. *Rumble strips*
 - 12. *More delineation*

B. Upgrading of devices:

1. *A full complement of standard pavement markings*
2. *Brighter and/or wider pavement markings*
3. *Larger and/or brighter signs*
4. *Channelizing devices with greater conspicuity*
5. *Temporary traffic barriers in place of channelizing devices*

*C. Improved geometrics at detours or crossovers, giving particular attention to the provisions set forth in Chapter 6B**D. Increased distances:*

1. *Longer advance warning area*
2. *Longer tapers*

E. Lighting:

1. *Temporary roadway lighting*
2. *Steady-burn lights used with channelizing devices*
3. *Flashing lights for isolated hazards*
4. *Illuminated signs*
5. *Floodlights*

*F. Pedestrian routes and temporary facilities**G. Bicycle diversions and temporary facilities*

- 05 *Where pedestrian or bicycle usage is high, typical traffic control figures should also be modified by giving particular attention to the provisions set forth in Chapter 6D, Section 6F.82, and other Sections of this Manual and Part 6 of the 2009 MUTCD related to accessibility and detectability provisions in TTC zones.*

Section 6G.05 Work Affecting Pedestrian and Bicycle Facilities**Support:**

- 01 *It is not uncommon, particularly in urban areas, that road work and the associated TTC will affect existing pedestrian or bicycle facilities. It is essential that the needs of all road users, including pedestrians with disabilities, are considered in TTC zones.*
- 02 *In addition to specific provisions identified in Sections 6G.06 through 6G.15, there are a number of provisions that might be applicable for all of the types of activities identified in this Chapter.*

Guidance:

- 03 *Where pedestrian or bicycle usage is high, the typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6D, this Chapter, Section 6F.82, and in other Sections of this Manual and the 2009 MUTCD Sections of Part 6 related to accessibility and detectability provisions in TTC zones.*
- 04 *Pedestrians should be separated from the worksite by appropriate devices that maintain the accessibility and detectability for pedestrians with disabilities.*
- 05 *Bicyclists and pedestrians should not be exposed to unprotected excavations, open utility access, overhanging equipment, or other such conditions.*
- 06 *Except for short duration and mobile operations, when a highway shoulder is occupied, a RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) sign should be placed in advance of the activity area. When work is performed on a paved shoulder 8 feet or more in width, channelizing devices should be placed on a taper having a length that conforms to the requirements of a shoulder taper. Signs should be placed such that they do not narrow any existing pedestrian passages to less than 48 inches.*
- 07 *Pedestrian detours should be avoided since pedestrians rarely observe them and the cost of providing accessibility and detectability might outweigh the cost of maintaining a continuous route. Whenever possible, work should be done in a manner that does not create a need to detour pedestrians from existing routes or crossings.*

Standard:

- 08 **Where pedestrian routes are closed, alternate pedestrian routes shall be provided (see TTC Figure 36).**
- 09 **When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.**

Section 6G.06 Work Outside of the Shoulder

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 When work is being performed off the roadway (beyond the shoulders, but within the right-of-way), little or no TTC might be needed. TTC generally is not needed where work is confined to an area 30 feet or more from the edge of the traveled way and out of the clear zone (see Appendix A for clear zone values). However, TTC is appropriate where distracting situations exist, such as vehicles parked on the shoulder, vehicles accessing the worksite via the highway, and equipment traveling on or crossing the roadway to perform the work operations (for example, mowing). For work beyond the shoulder, see Figures TTC-1 and TTC-2.

Guidance:

- 03 *Where the situations described in Paragraph 1 exist, a single warning sign, such as ROAD WORK AHEAD (W20-1), should be used. If the equipment travels on the roadway, the equipment should be equipped with appropriate flags, high-intensity amber rotating, flashing, oscillating, or strobe lights, and/or a SLOW MOVING VEHICLE (W21-4) sign and symbol, see Figures TTC-9 and TTC-10 for slow moving symbol.*

Option:

- 04 If work vehicles are on the shoulder, a RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) signs may be used. For mowing operations, the sign MOWING NEXT 2 MILES (W21-V3) may be used.
- 05 Where the activity is spread out over a distance of more than 2 miles, the RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD sign may be repeated every 1 mile.
- 06 A supplementary plaque with the message NEXT XX MILES (W16-VP1) may be used.

Guidance:

- 07 *A general warning sign like ROAD WORK AHEAD should be used if workers and equipment must occasionally move onto the shoulder.*

Section 6G.07 Work on the Shoulder with No Encroachment

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The provisions of this Section apply to short-term (daytime work that occupies a location for more than 1 hour, but less than 12 hours) through long-term stationary (more than 3 days) operations.

Standard:

- 03 **When paved shoulders having a width of 8 feet or more are closed, at least one advance warning sign shall be used. In addition, channelizing devices shall be used to close the shoulder in advance to delineate the beginning of the work space and direct motor vehicle traffic to remain within the traveled way.**

Guidance:

- 04 *When paved shoulders having a width of 8 feet or more are closed on Limited Access highways and expressways, road users should be warned about potential disabled vehicles that cannot get off the traveled way. An initial general warning sign, such as ROAD WORK AHEAD (W20-1), should be used, followed by a RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) sign. Where the downstream end of the shoulder closure extends beyond the distance that can be perceived by road users, a supplementary plaque bearing the message XX FEET (W16-VP3) or NEXT XX MILES (W16-VP1) should be placed below the RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) signs. On multi-lane, divided highways, signs advising of shoulder work or the condition of the shoulder should be placed on both sides of the roadway to give adequate warning to all road users.*
- 05 *When an improved shoulder is closed on a high-speed roadway, it should be treated as a closure of a portion of the road system because road users expect to be able to use it in emergencies. Road users should be given ample advance warning that shoulders are closed for use as refuge areas throughout a specified length of the approaching TTC zone. The sign(s) should read RIGHT (LEFT) SHOULDER CLOSED AHEAD or BOTH SHOULDERS CLOSED AHEAD sign with supplementary distances plaques indicated. The work space on the*

shoulder should be closed off by a taper or channelizing devices with a length of $1/3 L$ using the formulas in Table 6C-4.

Standard:

06 **When the shoulder is not occupied but work has adversely affected its condition, the LOW SHOULDER (W8-9) or SOFT SHOULDER (W8-4) sign shall be used, as appropriate.**

07 **Where the condition extends over a distance in excess of 1 mile, the sign shall be repeated at 1-mile intervals.**

Option:

08 In addition, a supplementary plaque bearing the message NEXT XX MILES (W16-VP1) may be used. Temporary traffic barriers may be needed to inhibit encroachment of errant vehicles into the work space and to protect workers (see Appendix A for this determination).

Standard:

09 **A shadow vehicle shall be used whenever a person is required to operate equipment mounted on or in the work vehicle such as buckets, augers, post drivers, etc. For operations on the shoulder with duration greater than 60 minutes where workers are present, a shadow vehicle shall be used. A truck-mounted attenuator (TMA) shall be used on the shadow vehicle on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.**

10 **When used for shoulder work, arrow boards shall operate only in the caution mode.**

Guidance:

11 *A minimum of 4 channelizing devices matching the kind used in the roadway taper on the shoulder should be used to delineate the arrow board (see Section 6F.69 and Figure 6F-6).*

Support:

12 A typical application for stationary work operations on shoulders is shown in Figure TTC-4. Short duration or mobile work on shoulders is shown in Figure TTC-3. Long duration shoulder closure with barrier is shown in Figure TTC-6.

Section 6G.08 Work on the Shoulder with Minor Encroachment

Support:

01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Guidance:

02 *When work takes up part of a lane, vehicular traffic volumes, vehicle mix (buses, trucks, cars, motorcycles, and bicycles), speed, and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment permits a remaining lane width of 11 feet, the lane should be closed.*

03 *Truck off-tracking should be considered when determining whether the minimum lane width of 11 feet is adequate.*

Option:

04 A lane width of 10 feet may be used for short-term stationary work on low-volume (less than 500 vpd), low-speed (below 45 mph) roadways when vehicular traffic does not include longer and wider heavy commercial vehicles.

05 A lane width of 10 feet may be used for work activities located on entrance and exit ramps of Limited Access highways.

06 A lane width of 10 feet may be used for intermediate-term stationary operations such as milling/paving operations where the restriction is limited to the areas where the work activities are occurring by moving the channelizing devices out as work progresses and then back once the work activity has past.

07 For long-term stationary operations such as construction projects, a travel lane width of no less than 10 feet may be allowed only when a traffic engineering study, as defined in paragraph 08, is made and documented by the Regional Traffic Engineer or authority with jurisdiction over the roadway.

Standard:

- 08 **A traffic engineering study shall consider as a minimum, traffic volumes, vehicle mix, speed, capacity, and type of operation. This assessment must demonstrate that if not allowed, traffic delays and back-ups will create unacceptable safety factors and/or road network failure.**

Support:

- 09 Figure TTC-5 illustrates a method for handling vehicular traffic where the stationary or short duration work space encroaches slightly into the traveled way.
- 10 Figure TTC-10 illustrates the method of handling vehicular traffic where non-licensed vehicle operations encroach into the Travelway of a Limited Access highway.

Standard:

- 11 **Due to occasional travel by over width vehicles, work zones which reduce the one way travel path of roadways or ramps to widths less than 14'-0" wide measured from edgeline to edgeline shall be signed with a ROAD NARROWS (W5-1) or RAMP NARROWS (W5-4) sign and a supplemental plaque mounted below stating the actual width of the roadway or ramp rounded down to the nearest foot or half foot increment, see Figure TTC-38.**

Guidance:

- 12 *The ROAD NARROWS or RAMP NARROWS sign assembly should be placed approximately 1000 feet in advance of the restricted location, as well as in advance of the last alternate route prior to the lane width restriction.*

Section 6G.09 Work Within the Median**Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Guidance:

- 02 *If work in the median of a divided highway is within 15 feet from the edge of the traveled way for either direction of travel, or within the clear zone as determined by Appendix A, TTC should be used through the use of advance warning signs and channelizing devices in both travel directions.*
- 03 *Trailer-mounted TTC devices placed in the median should be delineated with four Group 2 channelizing devices placed in a taper in both travel directions when it falls within the clear zone of each travel direction.*

Section 6G.10 Work Within the Traveled Way of a Two-Lane Highway**Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 Techniques for controlling vehicular traffic under one-lane, two-way conditions are described in Sections 6C.11, 6E.07, and 6E.08.

Option:

- 03 Flaggers may be used as shown in Figure TTC-23.
- 04 STOP/YIELD sign control may be used on roads with low traffic volumes (less than 500 VPD) as noted in Figure TTC-25. Conditions are based on an engineering study and approval of the Regional Traffic Engineer. Figure 6H-11 of the 2009 MUTCD may also be referenced.
- 05 A temporary traffic control signal may be used as shown in Figure TTC-25.

Section 6G.11 Work Within the Traveled Way of an Urban Street**Support:**

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 In urban TTC zones, decisions are needed on how to control vehicular traffic, such as how many lanes are required, whether any turns need to be prohibited at intersections, and how to maintain access to business, industrial, and residential areas.

- 03 Pedestrian traffic needs separate attention. Chapter 6D contains information regarding pedestrian movements near TTC zones.
- 04 For urban conditions, it is generally better to attempt to place all advance warning signs within a one block area versus spreading out over several blocks, however, motorists must have time to recognize and react to each warning sign.
- 05 Various conditions, such as limited sight distance or obstructions that might require a driver to reduce speed or stop, might require additional advance warning signs.
- 06 At TTC zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.

Standard:

- 07 **If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.**
- 08 **If the TTC zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided (see Part 9 of the 2009 MUTCD).**
- 09 **Where transit stops are affected or relocated because of work activity, both pedestrian and vehicular access to the affected or relocated transit stops shall be provided.**

Guidance:

- 10 *If a designated bicycle route is closed because of the work being done, a signed alternate route should be provided. Bicyclists should not be directed onto the path used by pedestrians.*
- 11 *Worksites within the intersection should be protected against inadvertent pedestrian incursion by providing detectable channelizing devices.*

Support:

- 12 Utility work takes place both within and outside the roadway to construct and maintain services such as power, gas, light, water, or telecommunications. Operations often involve intersections, since that is where many of the network junctions occur. The work force is usually small, only a few vehicles are involved, and the number and types of TTC devices placed in the TTC zone is usually minimal.

Standard:

- 13 **All TTC devices shall be retroreflective or illuminated if utility work is performed during nighttime hours (from 30 minutes prior to sunset through 30 minutes after sunrise).**

Guidance:

- 14 *As discussed under short-duration projects, however, the reduced number of devices in utility work zones should be offset by the use of high-visibility devices, such as high-intensity amber rotating, oscillating, or strobe lights on work vehicles or high-level warning devices.*

Option:

- 15 It may be advantageous to place advance warning signage equally spaced within one travel block as opposed to the placement of one sign per block over a three to four block area.

Support:

- 16 Figures TTC-1, TTC-4, TTC-5, TTC-16, TTC-17, TTC-23, TTC-26, TTC-27, TTC-28, and TTC-29 are examples of typical applications for utility operations. Other typical applications might apply as well.

Section 6G.12 Work Within the Traveled Way of a Multi-Lane, Non-Access Controlled Highway

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 Work on multi-lane (two or more lanes of moving motor vehicle traffic in one direction) highways is divided into right-lane closures, left-lane closures, interior-lane closures, multiple-lane closures, and closures on five-lane roadways.

Standard:

- 03 **When a lane is closed on a multi-lane road for other than a mobile operation, a transition area containing a merging taper and an arrow board shall be used.**

Guidance:

- 04 *When justified by an engineering study (see Appendix A, Guidelines for the Use of Barrier/Channelizing Devices in Work Zones) temporary traffic barriers (see Section 6F.78) should be used to prevent incursions of errant vehicles into hazardous areas or work space.*

Standard:

- 05 **When temporary traffic barriers are placed immediately adjacent to the traveled way, they shall be equipped with appropriate channelizing devices, delineation, and/or other TTC devices. For lane closures, the merging taper shall use channelizing devices and the temporary traffic barrier shall be placed beyond the transition area.**

Support:

- 06 Figure TTC-20 illustrates a lane closure in which temporary traffic barriers are used.

Option:

- 07 When the right lane is closed, TTC similar to that shown in Figure TTC-16 may be used for undivided or divided four-lane roads.

Guidance:

- 08 *If morning and evening peak hour vehicular traffic volumes in the two directions are uneven and the greater volume is on the side where the work is being done in the right-hand lane, consideration should be given to closing the inside lane for opposing vehicular traffic and making the lane available to the side with heavier vehicular traffic, as shown in Figure 6H-31 in the 2009 MUTCD.*
- 09 *Conflicting pavement markings should be removed for long-term projects. For short-term and intermediate-term projects where this is not practical, the channelizing devices in the area where the pavement markings conflict should be placed at a maximum spacing of $\frac{1}{2}$ the normal spacing based on the posted speed limit. Temporary markings should be installed where needed.*
- 10 *If the larger vehicular traffic volume changes to the opposite direction at a different time of the day, the TTC should be changed to allow two lanes for opposing vehicular traffic by moving the devices from the opposing lane to the center line. When it is necessary to create a temporary center line that is not consistent with the pavement markings, channelizing devices should be used and closely spaced.*
- 11 *When closing a left lane on a multi-lane undivided road, as vehicular traffic flow permits, the two interior lanes should be closed, as shown in Figure TTC-42, to provide drivers and workers additional lateral clearance and to provide access to the work space.*

Standard:

- 12 **When only the left lane is closed on undivided roads, channelizing devices shall be placed along the center line as well as along the adjacent lane.**

Guidance:

- 13 *When an interior lane is closed, an adjacent lane should also be considered for closure to provide additional space for vehicles and materials and to facilitate the movement of equipment within the work space.*
- 14 *When multiple lanes in one direction are closed, a capacity analysis should be made to determine the number of lanes needed to accommodate motor vehicle traffic needs. Vehicular traffic should be moved over one lane at a time. As shown in Figure TTC-18, the tapers should be separated by a distance of $2L$, with L being determined by the formulas in Tables 6C-3 and 6C-4.*

Option:

- 15 If operating speeds are 40 mph or less and the space approaching the work area does not permit moving traffic over one lane at a time, a single continuous taper may be used.

Standard:

- 16 **When a directional roadway is closed, inapplicable WRONG WAY signs and markings, and other existing traffic control devices at intersections within the temporary two-lane, two-way operations section shall be covered, removed, or obliterated.**

Option:

- 17 When half the road is closed on an undivided highway, both directions of vehicular traffic may be accommodated as shown in Figure TTC-41. When both interior lanes are closed, temporary traffic controls may be used as provided in Figure TTC-42. When a roadway must be closed on a divided highway, a median crossover may be used (see Section 6G.20 and Figure TTC-44).

Support:

- 18 TTC for lane closures on five-lane roads is similar to other multi-lane undivided roads. Figure TTC-41 can be adapted for use on five-lane roads. Figure TTC-12 can be used on a five-lane road for short duration and mobile operations.

Standard:

- 19 **When work is being performed over a roadway open to traffic (on bridges, overhead signs, traffic signals, etc.) the traveled lanes(s) or shoulder that the work operation is over shall be closed, unless it is physically impossible materials, equipment or personnel could fall into the open lane or shoulder.**

Support:

- 20 There are hazards involved when working over open travel lanes, especially in a bucket truck: The chance of dropping something onto traffic, the chance of a tractor-trailer or over height load striking the bottom of the bucket and ejecting the workers, and the chance the operation is a distraction to passing motorist. Therefore, this practice is not allowed.

Option:

- 21 A mobile closure may be an acceptable method of TTC depending on traffic volumes and location of the overhead work.

Standard:

- 22 **When the center lane of a multi-lane roadway must be closed for work activities, an additional adjoining lane on one side shall be closed such that through traffic is not split around the work area (see Figure TTC-18).**
- 23 **If the center lane closure must encroach on the remaining lanes, a minimum 11 foot travel lane(s) shall be maintained.**
- 24 **A center lane shall not be closed when work is only being performed in an adjacent lane unless the lane closure encroaches into the center lane resulting in a travel lane width of less than 11 feet.**

Section 6G.13 Detours and Diversions

Support:

- 01 Detour signs are used to direct road users onto another roadway. At diversions, road users are directed onto a temporary roadway or alignment placed within or adjacent to the right-of-way. Typical applications for detouring road users are shown in Figures TTC-46, TTC-47 and TTC-48. Figure TTC-43 illustrates the controls around an area where a section of roadway has been closed and a diversion has been constructed. Channelizing devices and pavement markings are used to indicate the transition to the temporary roadway.

Option:

- 02 Detours may be established either daily or nightly for performing work activities such as surface rehabilitation work and then removed during peak travel periods, or may be established for long periods of time such as bridge removal and repair projects.

Support:

- 03 A Short Term Detour occupies a location for more than 2 hours within a single work period but not longer than three consecutive days and uses M4-9, M4-9 (V) and M4-V sign series to direct traffic along an alternate route.
- 04 A Long Term Detour occupies a location longer than three consecutive days, or on a periodic basis (less than 24 consecutive hours) longer than three days and uses a DETOUR (M4-8) sign above a route shield assembly (route marker, cardinal direction auxiliary sign and advance turn/direction arrow auxiliary signs) or the cardinal direction, route marker over the M4-9, M4-9 (V) and M4-V sign series to direct traffic along an alternate route (see Section 6F.66 Detour Signs and Figures TTC-46 and TTC-47).

Standard:

- 05 **Detours and diversions shall be reviewed and approved by the Regional Traffic Engineer or authority with jurisdiction over the roadway prior to implementation.**

Guidance:

- 06 *When a detour is long, Detour signs (see Section 6F.66) should be installed to remind and reassure road users periodically that they are still successfully following the detour.*
- 07 *When an entire roadway is closed, as illustrated in Figure TTC-48, a detour should be provided and road users should be warned in advance of the closure, which in this example is a closure 10 miles from the intersection. If local road users are allowed to use the roadway up to the closure, the ROAD CLOSED - LOCAL TRAFFIC ONLY (R11-3a) sign should be used. The portion of the road open to local road users should have adequate signing, marking, and delineation.*
- 08 *Detours should be signed so that road users will be able to traverse the entire detour route and back to the original roadway as shown in Figures TTC-46 and TTC-47.*

Section 6G.14 Work Within the Traveled Way at an Intersection*Support:*

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.
- 02 The typical applications for intersections are classified according to the location of the work space with respect to the intersection area (as defined by the extension of the curb or edge lines). The three classifications are near side, far side, and in-the-intersection. Work spaces often extend into more than one portion of the intersection. For example, work in one quadrant often creates a near-side work space on one street and a far-side work space on the cross street. In such instances, an appropriate TTC plan is obtained by combining features shown in two or more of the intersection and pedestrian typical applications.
- 03 TTC zones in the vicinity of intersections might block movements and interfere with normal road user flows. Such conflicts frequently occur at more complex signalized intersections having such features as traffic signal heads over particular lanes, lanes allocated to specific movements, multiple signal phases, signal detectors for actuated control, and accessible pedestrian signals and detectors.

Guidance:

- 04 *The effect of the work upon signal operation should be considered, and temporary corrective actions should be taken, if necessary, such as revising signal phasing and/or timing to provide adequate capacity, maintaining or adjusting signal detectors, and relocating signal heads to provide adequate visibility as described in Part 4 of the 2009 MUTCD.*
- 05 *The design and construction of any new signal or modification to an existing signal should include keeping the existing signal in operation while the construction or modification work is being performed.*

Standard:

- 06 **When work will occur near an intersection where operational, capacity, or pedestrian accessibility problems are anticipated, the appropriate VDOT Regional Operations Manager or the agency having jurisdiction shall be contacted.**

Guidance:

- 07 *For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical applications depict urban intersections on arterial streets.*
- 08 *Pedestrian crossings near TTC sites should be separated from the worksite by appropriate barriers that maintain the accessibility and detectability for pedestrians with disabilities.*

Support:

- 09 Near-side work spaces, as depicted in Figure TTC-26, are simply handled as a midblock lane closure. A problem that might occur with near-side lane closure is a reduction in capacity, which during certain hours of operation could result in congestion and backups.

Option:

- 10 When near-side work spaces are used, an exclusive turn lane may be used for through vehicular traffic.

- 11 Where space is restricted in advance of near-side work spaces, as with short block spacings, two warning signs may be used in the advance warning area, and a third action-type warning or a regulatory sign (such as Keep Left) may be placed within the transition area.

Support:

- 12 Far-side work spaces, as depicted in Figure TTC-27, involve additional treatment because road users typically enter the activity area by straight-through and left- or right-turning movements.

Guidance:

- 13 *When a lane through an intersection must be closed on the far side, it should also be closed on the near-side approach to preclude merging movements within the intersection. In addition, if multiple turn lanes feed into the far side closure, one lane of the dual turn lane should be closed.*

Option:

- 14 If there are a significant number of vehicles turning from a near-side lane that is closed on the far side, the near-side lane may be converted to an exclusive turn lane.

Support:

- 15 Figure TTC-28 provides guidance on applicable procedures for work performed within the intersection.

Option:

- 16 If the work is within the intersection, any of the following strategies may be used:

- A. A small work space so that road users can move around it, as shown in Figure TTC-28;
- B. Uniformed law enforcement officers to direct road users;
- C. Certified flaggers to direct road users, as shown in Figure TTC-30;
- D. Work in stages so the work space is kept to a minimum; and
- E. Road closures or upstream diversions to reduce road user volumes.

Guidance:

- 17 *Depending on road user conditions, a uniformed law enforcement officer(s) and/or a certified flagger(s) should be used to control road users.*

Standard:

- 18 **Certified flaggers shall not direct vehicles through a red signal or stop vehicles at a green signal at an intersection since they are not authorized to do so (see Section 46.2-834 of Highway Laws of Virginia).**

Section 6G.15 Steel Plate Conspicuity and Warning

Support:

- 01 Steel plates are occasionally used in areas where an excavation is made in the roadway for repairs or utility work, providing temporary protection to motorists and pedestrians and continued movement of traffic. This situation provides a challenge to motorcyclists when they traverse a steel plate unexpectedly in the roadway.

Standard:

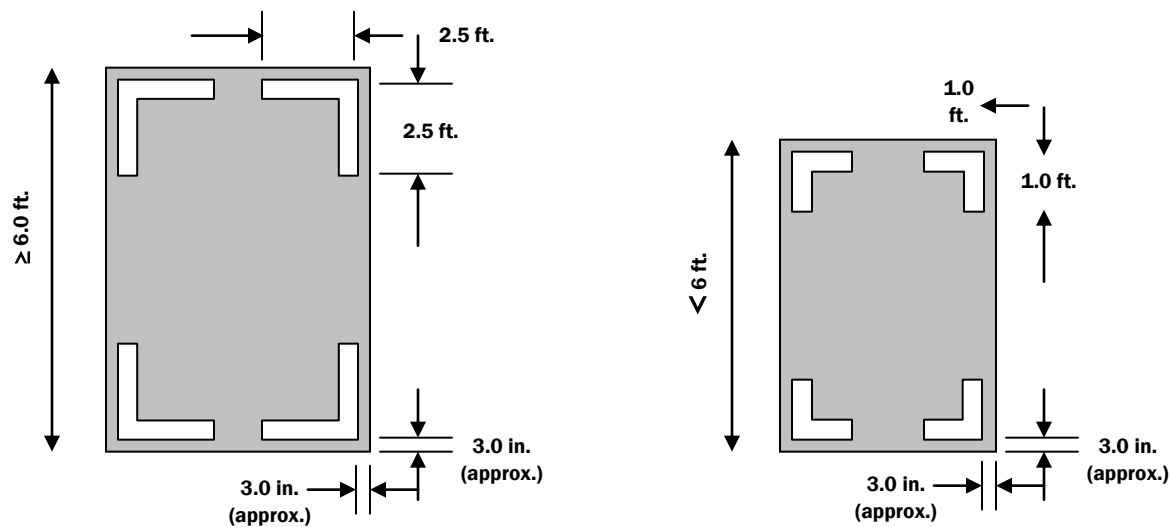
- 02 **Steel plates installed in connection with temporary repairs on roadways open to traffic shall be marked with durable, highly reflective white Type B, Class VI pavement marking tape, no less than 4 inches in width, and shall be recommended for turning movements by the manufacturer. Pavement marking shall be in compliance with Sections 246 and 704 of the Road and Bridge Specifications.**

- 03 **Placement of the reflective white pavement marking shall be as shown in Figure 6G-1. The markings shall be maintained throughout the use of the plate in a condition that provides sufficient retroreflectivity to distinguish the corners of the steel plate. Replacement of the markings shall be based on a visual assessment performed periodically at night by a moving inspection vehicle. Any leg of the marking that has lost fifty percent or more of its conspicuity shall be replaced.**

- 04 **A STEEL PLATE AHEAD (W8-24) sign shall be placed in advance of the temporary steel plate to warn approaching motorists of the changed roadway condition (see Section 6F.52).**

Option:

- 05 Additional warning signs may be needed due to the complexity of the work location and other field conditions.

Figure 6G-1, Steel Plate Conspicuity Markings

LEFT: Steel plates with any side greater than or equal to 6 feet in length
 RIGHT: Steel plates with all sides less than 6 feet in length

Section 6G.16 Work Within the Traveled Way at a Roundabout

Support:

- 01 Each roundabout is unique and the traffic control must be developed to meet the specific conditions of the location and the work operation. A detour could possibly better serve traffic movement and must be considered as an alternative to flagger controlled operations. The typical traffic control shown in Figures TTC-31 through TTC-33 can also be applied to traffic circles.

Standard:

- 02 **Flaggers shall control only one travel lane. For multi-lane roundabouts, one of the two approaching lanes shall be closed in advance of the roundabout as shown in Figures TTC-32 and TTC-33.**

Guidance:

- 03 *Consideration should be given in the use of law enforcement instead of certified flaggers.*
- 04 *When designing the traffic control and installing the TTC devices for work activities at roundabouts, accommodations for the turning radius of tractor trailer vehicles or other large vehicles should be considered and the work zone designed accordingly.*

Option

- 05 Periodic adjustments to the channelizing devices may be allowed in an active work zone to accommodate the turning movements of tractor trailer vehicles or other large vehicles through the temporary traffic control zone.

Section 6G.17 Work Within the Traveled Way of a Limited Access Highway

Support:

- 01 Problems of TTC might occur under the special conditions encountered where vehicular traffic must be moved through or around TTC zones on high-speed, high-volume roadways. Although the general principles outlined in the previous Sections of this Manual are applicable to all types of highways, high-speed, access-controlled highways need special attention in order to accommodate vehicular traffic while also protecting road users and workers. The road user volumes, road vehicle mix (buses, trucks, cars, and motorcycles), and speed of vehicles on these facilities require that careful TTC procedures be implemented, for example, to induce critical merging maneuvers well in advance of work spaces and in a manner that creates minimum turbulence and delay in the vehicular traffic stream. These situations often require more conspicuous devices than specified for normal rural highway or urban street use. However, the same important basic considerations of uniformity and standardization of general principles apply for all roadways.

- 02 Work under high-speed, high-volume vehicular traffic on a controlled access highway is complicated by the roadway design and operational features. The presence of a median that establishes separate roadways for directional vehicular traffic flow might prohibit the closing of one of the roadways or the diverting of vehicular traffic to the other roadway. Lack of access to and from adjacent roadways prohibits rerouting of vehicular traffic away from the work space in many cases. Other conditions exist where work must be limited to night hours, thereby necessitating increased use of warning lights, illumination of work spaces, and advance warning systems.
- 03 TTC for a typical lane closure on a divided highway is shown in Figure TTC-16 for short-term and intermediate-term stationary operations and Figure TTC-20 for long-term stationary operations. Temporary traffic control for mobile operations on Limited Access highways is shown in Figures TTC-11 and TTC-12. A typical application for shifting vehicular traffic lanes around a work space is shown in Figure TTC-40. TTC for multiple lane closure on a roadway is shown in Figure TTC-18 and for an interior lane closure on a roadway is shown in Figure 6H-38 in Chapter 6H of the 2009 MUTCD.

Guidance:

- 04 *The method for closing an interior lane when the open lanes have the capacity to carry vehicular traffic should be as shown in Figure TTC-17. When the capacity of the other lanes is needed, the method shown in Figure 6H-38 in Chapter 6H of the 2009 MUTCD should be used.*

Standard:

- 05 **When work is being performed over a roadway open to traffic (on bridges, overhead signs, traffic signals, etc.) the traveled lanes(s) or shoulder that the work operation is over shall be closed, unless it is physically improbable materials, equipment or personnel could fall into the open lane or shoulder.**

Support:

- 06 There are hazards involved when working over open travel lanes, especially in a bucket truck: The chance of dropping something onto traffic, the chance of a tractor-trailer or over height load striking the bottom of the bucket and ejecting the workers, and the chance the operation is a distraction to passing motorist. Therefore, this practice is not allowed.

Option:

- 07 A mobile closure may be an acceptable method of TTC depending on traffic volumes and location of the overhead work.

Section 6G.18 Pull-Off Areas in Limited Access Highway and Expressway Work Zones

Guidance:

- 01 *Work zone pull-off areas should be considered in work zones along Limited Access highways where one or both shoulders are closed due to construction.*

Option:

- 02 Pull-off areas may serve one or more of the three primary functions:
- Vehicle Refuge – Motorist who experience mechanical problems, flat tires, medical emergencies, distractions from children or passengers, etc. may not be able to travel completely through the work zone before their situation becomes a safety hazard. Appropriately designed pull-off areas can increase the likelihood of a driver reaching a safe area without potential involvement in an incident.
 - Law Enforcement – Law enforcement near the upstream end of a work zone can have a significant effect toward promoting safer driver behavior. However, the effect may be diminished if aggressive drivers perceive that the law enforcement officer will not engage in pursuit. By providing pull-off areas, law enforcement officers can pursue aggressive drivers and have a safe area within the work zone in which to issue citations.
 - Crash clearing and/or investigation – When crashes occur within the work zone, vehicles need to be cleared to the shoulder quickly in order to minimize the amount of upstream traffic congestion. Pull-off areas can provide locations where a greater proportion of motorists may feel comfortable moving their vehicles after a minor incident. Additionally, a pull-off area may provide emergency response vehicles with adequate space to aid victims after a crash without taking up an additional traffic lane.

Guidance:

- 03 *Pull-off areas should be considered where any of the following conditions exist:*
1. *Both the left and right shoulders will be closed simultaneously for a distance greater than 0.5 mile for long duration operations.*
 2. *Speeding is expected to be or has been shown to be a problem and law enforcement is scheduled for the project.*
 3. *The duration of construction will be significant (at least 30 days) where the shoulder would be unavailable for motorist.*
 4. *High crash locations have been identified within or near the work zone limits.*
 5. *Projects have been identified as Category C or "significant projects," by the Department's TMP policy.*
 6. *Traffic volumes are such that, during peak hours, a blockage of a through lane by a disabled vehicle due to the lack of a pull-off area would create an unacceptable level of congestion.*
 7. *Alternate places of refuge do not exist nearby.*
- 04 *The spacing of pull-off areas should be as follows:*
- *For projects with activity areas greater than 1.0 mile but less than 2.0 miles in length, one every 0.5 to 0.75 mile.*
 - *For projects with activity areas greater than 2.0 miles in length, one every mile.*
- 05 *As illustrated in Typical Traffic Control Figure TTC-8, pull-off areas should be a minimum of 1320 feet long. The width of pull-off areas should be at least 12-15 feet.*
- 06 *To minimize conflicts with adjacent construction work, pull-off areas should be avoided on grades steeper than 2% if possible. Where level areas are not available in locations that meet all other criteria, the length of the pull-off should be increase by 200 feet.*
- 07 *Pull-off areas should not be located where adequate sight distance for acceleration and deceleration maneuvers would not exist, such as in proximity to horizontal or vertical crest curves. The location of temporary traffic barrier and construction activities occurring on the inside of horizontal curves just behind that barrier should be considered when determining whether motorists will have adequate sight distance through a horizontal curve.*
- 08 *Where pull-off areas are intended to enhance the role of law enforcement, coordination with law enforcement personnel should begin early in the project implementation schedule.*
- 09 *For shoulder closures greater than 0.5 mile in length, advance warning signs should be placed as follows after the ROAD WORK AHEAD sign:*
1. *A NEXT XX MILES (W16-VP1) supplemental plaque should be provided with the first RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b) or BOTH SHOULDERS CLOSED AHEAD (W21-V12) sign in the sequence.*
 2. *The third sign in the sequence should be either:*
 - *A NO PULL-OFF AREA (W21-V15) warning sign with NEXT XX MILES (W16-VP1) supplemental plate, if there are no pull-off areas throughout the work area, or*
 - *A LEFT (RIGHT) PULL-OFF AREA (W21-V14) warning sign with EVERY X MILE (W16-VP2) supplemental plaque, if pull-off areas are provided. Additional options for the supplemental sign plaque that could be considered for these locations include a XX FEET (W16-VP3), NEXT EXIT (LEFT/RIGHT) (W16-VP4) or EXIT NUMBER (W16-V5) plaque. The plaque message should be appropriate for the geometric conditions and design speed of the roadway (for example "500 FT" or "1000 FT"), "NEXT EXIT," "NEXT LEFT" or "NEXT RIGHT," "EXIT 148 or EXIT 118 C."*
 3. *A LEFT (RIGHT) PULL-OFF AREA (W21-V14) warning sign with a 1000 feet (W16-VP3) supplemental plaque should be placed in advance of each pull-off area.*
 4. *A Pull-Off Area Entrance (E5-V2) sign should be placed immediately prior to the pull-off area to give information to help a driver navigate to it safely.*
 5. *Consideration should be given to whether there is adequate guide signing already in place for nearby interchanges to facilities that would provide adequate places for refuge. For instance, a pull-off area may not be needed within 0.5 mile of a freeway interchange exit if the exit is clearly signed and PULL-OFF AREA (W21-V13) sign with a NEXT EXIT plaque is provided.*

Section 6G.19 Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway

Support:

- 01 Two-lane, two-way operation on one roadway of a normally divided highway is a typical procedure that requires special consideration in the planning, design, and work phases, because unique operational problems (for example, increasing the risk of head-on crashes) can arise with the two-lane, two-way operation.

Standard:

- 02 **When two-lane, two-way traffic control must be maintained on one roadway of a normally divided highway, opposing vehicular traffic shall be separated with either temporary traffic barriers (concrete safety-shape or approved alternate), channelizing devices, or a temporary raised island throughout the length of the two-way operation. The use of markings and complementary signing, by themselves, shall not be used.**

Support:

- 03 Figure TTC-23 shows the procedure for two-lane, two-way operation. Treatments for entrance and exit ramps within the two-way roadway segment of this type of work are shown in Figures 6H-40 and 6H-41 of the 2009 MUTCD.

Guidance:

- 04 *Modifications to any of these layouts must first be reviewed, documented and approved by the Regional Traffic Engineer prior to their use.*

Section 6G.20 Crossovers

Guidance:

- 01 *The following are considered good guiding principles for the design of crossovers:*
- A. Tapers for lane drops should be separated from the crossovers, as shown in Figure TTC-44.*
 - B. Crossovers should be designed for speeds no lower than 10 mph below the posted speed, the off-peak 85th-percentile speed prior to the work starting, or the anticipated operating speed of the roadway, unless unusual site conditions require that a lower design speed be used.*
 - C. A good array of channelizing devices, delineators, and full-length, properly placed pavement markings and pavement markers should be used to provide drivers with a clearly defined travel path.*
 - D. The design of the crossover should accommodate all vehicular traffic, including motorcycles, trucks, and buses.*
 - E. The use of screens mounted on the top of temporary traffic barriers should be considered in crossover applications whenever multi-lane traffic is reduced to two-way motor vehicle traffic to reduce headlight glare from oncoming traffic and improve mobility through the crossover (see Section 6F.97).*

Support:

- 02 Temporary traffic barriers and the excessive use of TTC devices cannot compensate for poor geometric and roadway cross-section design of crossovers.

Section 6G.21 Interchanges

Guidance:

- 01 *Access to interchange ramps on limited-access highways should be maintained even if the work space is in the lane adjacent to the ramps. Access to exit ramps should be clearly marked and delineated with channelizing devices. For long-term projects, conflicting pavement markings should be removed and new ones placed. Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur before ramp closings.*

Option:

- 02 If access is not possible, ramps may be closed by using signs and Type 3 Barricades. As the work space changes, the access area may be changed, as shown in Figure TTC-37. A TTC zone in the exit ramp may be handled as shown in Figure TTC-38.
- 03 When a work space interferes with an entrance ramp, a lane may need to be closed on the highway (see Figure TTC-39). A TTC zone in the entrance ramp may require shifting ramp vehicular traffic (see Figure TTC-39).

Section 6G.22 Movable Barriers

Support:

- 01 Figure 6H-45 of the 2009 MUTCD shows a temporary reversible lane using movable barriers.

Option:

- 02 If the work activity in Figure TTC-20 permits, a movable barrier may be used and relocated to the shoulder during nonwork periods or peak-period vehicular traffic conditions.

Standard:

- 03 **Modifications to Figure 6H-45 of the 2009 MUTCD shall be reviewed and approved by the Regional Traffic Engineer prior to its use and documented.**

Section 6G.23 Work in the Vicinity of a Railroad Grade Crossing

Standard:

- 01 **When railroad grade crossings exist either within or in the vicinity of a TTC zone, lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or a certified flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.**

Support:

- 02 Figure TTC-56 shows work in the vicinity of a grade crossing.
- 03 Section 8A.08 of the 2009 MUTCD contains additional information regarding temporary traffic control zones in the vicinity of grade crossings.

Guidance:

- 04 *Early coordination with the railroad company or light rail transit agency should occur before work starts.*

Section 6G.24 Slow Roll Temporary Traffic Control Operations

Support:

- 01 The following guidelines have been developed to ensure consistency for Slow Roll Temporary Traffic Control (Slow Roll TTC) on Limited Access highways. Activities which may warrant the use of Slow Roll TTC on Limited Access highways include, but are not limited to: setting of bridge beams, pulling wires or cables across the roadway, placing overhead or cantilever signs, and performing traffic switches from one half of the roadway to the other half.

Standard:

- 02 **Any Slow Roll TTC operation shall be approved by the Regional Traffic Engineer prior to use and shall be performed as follows:**
- 03 **Slow Roll TTC shall only be performed during non-peak travel periods and must be planned to not exceed periods of 15 minutes in duration.**
- 04 **The performance of Slow Roll TTC shall include the use of the Virginia State Police (VSP) or other law enforcement personnel unless an exception is granted by the Regional Traffic Engineer.**
- 05 **Prior to utilizing Slow Roll TTC, a coordination meeting shall be held with all entities involved in the operation to discuss each person's role.**
- 06 **At a minimum, a portable changeable message sign (PCMS) or, if available, an overhead changeable message sign (CMS) shall be used a minimum of 1 mile in advance of the beginning of the Slow Roll TTC operation with the following messages: ROAD WORK AHEAD; BE PREPARED TO STOP.**
- 07 **A control vehicle (contractor, state, or VSP) shall occupy each travel lane of the route affected by the Slow Roll TTC. All entrance ramps within the Slow Roll TTC operation shall be temporarily closed. A drive through of the route shall be performed prior to beginning the Slow Roll TTC operation to ensure there are no parked vehicles along the roadway which could enter the travel lane during the Slow Roll TTC operation (Once the Slow Roll TTC operation has passed a closed entrance ramp, the ramp may be reopened).**
- 08 **Determining where to begin a Slow Roll TTC shall include an evaluation of all factors unique to the road system in question. As a minimum the following items shall be considered in the evaluation:**

- A. The time lapse expected for the last uncontrolled vehicle to pass by the site of the planned work.
 - B. The assumed maximum time needed for the work operation to be completed.
 - C. The projected travel time of the Slow Roll. For example, a travel speed of 10 mph will cover 1 mile in six minutes.
 - D. The number of entrance ramps requiring closing at interchanges.
 - E. The starting point for the Slow Roll TTC shall be in a tangent section (both horizontal and vertical) of the approach roadway with adequate sight distance.
- 09 Upon a sufficient gap in traffic, each slow roll vehicle will pull out and occupy a travel lane with their warning lights and hazard lights operating and will travel at a minimum of 10 miles per hour. A shadow vehicle shall follow the last motorist vehicle traveling in advance of the slow roll operation vehicles to notify the work crew when the roadway is closed and free of approaching motorist.
- 10 The lead vehicle in the slow roll operation shall have radio/telephone communication with the work crew. Once the need for the road closure is complete, the work crew shall notify the lead vehicle in the slow roll operation, who in turn will notify the other work vehicles. The slow roll vehicles shall gain speed and pull over to the right side of the roadway; starting from the vehicle occupying the left lanes first (the VSP should continue with the flow of traffic to ensure controlled acceleration by the released vehicles).
- 11 If the slow roll operation vehicles reach the work site before receiving notification that the operation has been completed, they shall slow down and/or stop until signaled that the roadway is safe to release traffic.
- 12 Once the slow roll operation is complete and free flow travel conditions have been re-established, the PCMS or overhead CMS messages shall be modified to remove the BE PREPARED TO STOP message.

Section 6G.25 Installing/Removing Temporary Traffic Control

Guidance:

- 01 Care must be exercised when installing and removing temporary traffic control devices. Installing TTC begins and ends as a mobile operation. A shadow vehicle or shadow vehicle with a TMA should be used to protect workers installing and removing TTC devices from a work vehicle such as signs, arrow boards, and channelizing devices.

Standard:

- 02 TTC devices shall not be stored, installed or removed from a shadow vehicle or a shadow vehicle with a TMA. Temporary traffic control devices shall be stored, installed or removed from a work operation vehicle.

Guidance:

- 03 On a two-lane roadway, where pull off areas are limited, a TTC Spotter using a red flag and proper flagger procedures should temporarily stop traffic while TTC devices are being installed. The spotter must be highly visible to oncoming traffic. At nighttime, road flares, a red glow-cone flashlight, or a red traffic wand can be used to increase the visibility of the flagger.
- 04 On a multi-lane roadway a pick-up truck with a trailer-mounted arrow board should be placed on the shoulder to direct traffic out of the closed lane. A shadow vehicle with an arrow board or amber light closes the lane while TTC devices are being installed or removed. The shadow vehicle should be 80' to 120' in advance of the work operation vehicle.

Standard:

- 05 A shadow vehicle with a TMA shall be used to protect the workers and their work vehicle installing and removing TTC devices on multi-lane roadway with a posted speed of 45 mph or greater.

Guidance:

- 06 Stationary lane closures on a multi-lane roadway should be installed with the flow of traffic in the following sequence:
- A. Install all advance warning signs, beginning with the ROAD WORK AHEAD (W20-1) sign and ending with the END ROAD WORK (G20-2 (V)) sign. Install all signs beginning with the opposite side which will be closed (for a right lane closure; first, install all signs on the left side (shoulder) and then install all signs on the right side (shoulder).
 - B. Install shoulder taper if required.
 - C. Install arrow board on the shoulder prior to the merging taper or as close to the beginning of the merging taper as possible.

- D. Install channelizing devices to form a merging taper. Use of a shadow vehicle (with or without a TMA, depending on the type of roadway) is recommended during installation.*
 - E. Install traffic control devices along the buffer space.*
 - F. Continue placing devices along the work space at the appropriate spacing.*
 - G. Install devices for the termination area. Install an END ROAD WORK sign, if necessary.*
 - H. Review the lane closure by performing a drive through inspection, correcting any deficiencies and documenting necessary adjustments.*
- 07 *All TTC devices for a stationary lane closure on a multi-lane roadway, except advance warning signs, should be removed against the flow of traffic in the following sequence:*
- A. Remove the channelizing devices starting from the end of the activity area working back to the widest part of the merging taper.*
 - B. Place the removal vehicle on the shoulder, and remove the channelizing devices from the merging taper by hand onto the work vehicle.*
 - C. Remove the arrow board.*
- 08 *Advance warning signs should be removed with the flow of traffic beginning with the ROAD WORK AHEAD sign and ending with the END ROAD WORK sign. Remove signs beginning with the lane closure side (for a right lane closure; first, remove all signs from the right side (shoulder) and then remove all signs left side (shoulder)).*
- 09 *Workers running across an open travel lanes of traffic to install TTC devices is a dangerous practice that should not be performed unless slow roll temporary traffic control operations as described in Section 6G.24 are being performed.*

Option:

- 10 When traffic delays have exceeded expectations, a worker on each shoulder may disassemble the advance warning signs and their portable sign support in reverse order to allow delayed traffic to clear. The disassembled signs and their supports may be stored beyond the shoulder until such time traffic delays have dispersed and signs can be removed safely.
- 11 A TTC Spotter may be used in this operation.

Section 6G.26 Temporary Traffic Control During Nighttime Hours

Support:

- 01 Chapter 6D and Sections 6F.82 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Standard:

- 02 **Nighttime hours shall be defined as the time from 30 minutes prior to sunset to 30 minutes after sunrise on the next calendar day.**

Support:

- 03 Conducting highway construction and maintenance activities during night hours could provide an advantage when traditional daytime traffic control strategies cannot achieve an acceptable balance between worker and public safety, traffic and community impact, and constructability. The two basic advantages of working at night are reduced traffic congestion and less involvement with business activities. However, the two basic conditions that must normally be met for night work to offer any advantage are reduced traffic volumes and easy set up and removal of the traffic control patterns on a nightly basis.
- 04 Shifting work activities to night hours, when traffic volumes are lower and normal business is less active, might offer an advantage in some cases, as long as the necessary work can be completed and the worksite restored to essentially normal operating conditions to carry the higher traffic volume during non-construction hours.
- 05 Although working at night might offer advantages, it also includes safety issues. Reduced visibility inherent in night work impacts the performance of both drivers and workers. Because traffic volumes are lower and congestion is minimized, speeds are often higher at night necessitating greater visibility at a time when visibility is reduced. Finally, the incidence of impaired (alcohol or drugs), fatigued, or drowsy drivers might be higher at night.
- 06 Working at night also involves other factors, including construction productivity and quality, social impacts, economics, and environmental issues. A decision to perform construction or maintenance activities at night normally involves some consideration of the advantages to be gained compared to the safety and other issues that might be impacted.

Guidance:

- 07 *Considering the safety issues inherent to night work, consideration should be given to enhancing traffic controls (see Section 6G.04) to provide added visibility and driver guidance, and increased protection for workers.*
- 08 *In addition to the enhancements listed in Section 6G.04, consideration should be given to providing additional lights and retroreflective markings to workers, work vehicles, and equipment.*

Option:

- 09 Where reduced traffic volumes at night make it feasible, the entire roadway may be closed by detouring traffic to alternate facilities, thus removing the traffic risk from the activity area, see Figures TTC-46 through TTC-48.

Guidance:

- 10 *Because typical street and highway lighting is rarely adequate to provide sufficient levels of illumination for work tasks, temporary lighting should be provided where workers are active to supply sufficient illumination to reasonably and safely perform the work tasks.*
- 11 *Temporary lighting for night work should be designed such that glare does not interfere with driver visibility, or create visibility problems for truck drivers, equipment operators, flaggers, or other workers.*
- 12 *Consideration should be given to stationing uniformed law enforcement officers and lighted patrol cars at night work locations where there is a concern that high speeds or impaired drivers might result in undue risks for workers or other drivers (see Appendix C, Guidelines for Use of Virginia State Police in Construction/Maintenance Work Zones).*

Support:

- 13 *Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of 5 foot candles can be adequate for general activities. An average horizontal luminance of 10 foot candles can be adequate for activities around equipment. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 20 foot candles.*

Standard:

- 14 **Except in emergencies, temporary lighting providing a minimum horizontal luminance of 5 foot candles (50 lux) shall be provided at all flagger stations during nighttime operations.**
- 15 **Floodlighting shall not produce a disabling glare condition for approaching road users, flaggers, or workers.**
- 16 **The adequacy of the floodlight placement and elimination of potential glare shall be determined by driving through and observing the floodlighted area from each direction on all approaching roadways after the initial floodlight setup, at night, and periodically during each shift.**

Guidance:

- 17 *Consideration should be given to the use of non-glare type lighting such as non-glare balloon lights for nighttime activities.*
- 18 *Advance warning signs used during night hours should be reviewed on a periodic basis during the shift to ensure moisture/condensation has not obscured the retroreflectivity or visibility of the sign text.*

Standard:

- 19 **Group 2 channelizing devices shall be used in all unmanned work zone locations, and drums shall be used in all merging and shifting tapers on Limited Access highways for nighttime operations.**

Section 6G.27 Work Area Ingress/Egress Considerations*Guidance:*

- 01 *The Temporary Traffic Control Plan (TTCP) should address the need for access to and from the work area. This is a constructability issue in which the designer should address the question of how the contractor will safely move materials and equipment into the work area with a minimum of disruption to traffic. This is a particularly critical issue on high speed roadways such as Limited Access highways, especially if temporary traffic barrier is used to protect work areas.*

Option:

- 02 Consideration may be given to the design and construction of temporary acceleration and deceleration lanes for use by construction equipment.

Guidance:

03 *The following should be considered in the planning, design, and operation of work zones:*

- *Designers and contractors should anticipate types of work zones that typically create ingress/egress problems. Examples are work spaces requiring work vehicles to merge in/out of high-speed traffic and work activities that will generate frequent delivery of materials such as paving projects, bridge projects, and the delivery/movement of fill materials.*
- *Access into/out of the work space should be included in the Temporary Traffic Control Plan.*
- *Adequate acceleration/deceleration space for work vehicles should be provided.*
- *The location of access openings should meet the sight distance requirements listed in Table 6G-1 (Intersection Sight Distance for Construction Entrances). In extreme conditions such as downgrades, lane closures may need to be considered.*
- *Construction access openings in traffic barrier service should be planned per Appendix A to ensure that blunt ends of barrier walls are properly protected. The barrier channelization devices should be planned in a manner as to not create a sight distance problem for equipment operators or motorists.*
- *Warning signs (CONSTRUCTION ENTRANCE (W11-V2) or TRUCKS ENTERING HIGHWAY (W11-V4)) are available for ingress/egress conditions at work area accesses and should be used when appropriate. All warning sign(s) noting work zone access activities should be covered or removed when the daily work activity ceases.*
- *For nighttime operations, illuminating the construction access should be considered.*

Standard:

04 **A WORK VEHICLE DO NOT FOLLOW (G20-V1) vehicle-mounted signs shall be placed on the rear of trucks hauling/delivering material to the work space (see Section 6F.64).**

Guidance:

05 *During night operations, work vehicles entering and exiting the work area should be equipped with and have operating at least one high intensity amber rotating, oscillating, or strobe light visible from 360 degrees.*

Option:

06 Ingress/egress conditions may justify lowering the speed limit during this activity. Any reduction in the posted speed limit must be authorized by the Regional Traffic Engineer and based on an engineering study per TE-350.

Table 6G-1, Intersection Sight Distance (ISD) for Construction Entrances

Posted Speed (mph)	20	25	30	35	40	45	50	55	60	65	70
Minimum ISD (Feet)	195	240	290	335	385	430	480	530	575	625	670
Height of eye – 3.5 ft. Height of object – 3.5 ft.											

Section 6G.28 Work During Inclement Weather**Support:**

01 Inclement weather (rain, snow, fog, etc.) creates the following conditions for road users:

- Lack of visibility to the road and temporary traffic control devices;
- Greater distance required for slowing and stopping a motor vehicle;
- An increase in the difficulty of controlling a motor vehicle, and;
- An increase in the distraction and anxiety for road users while traveling on the roadway.

Guidance:

02 *Therefore, planned work activities should be avoided, if possible, during inclement weather conditions.*

Option:

03 Emergency operations (snow removal, debris cleanup, etc.), however, may be performed where inaction would be worse for motorists than allowing the condition to remain unattended.

Support:

04 See Chapter 6I, Control of Traffic Through Traffic Incident Management Areas, for TTC.

CHAPTER 6H. TYPICAL APPLICATIONS

Section 6H.01 Typical Applications

Support:

- 01 Whenever the acronym “TTC” is used in this Chapter, it refers to “temporary traffic control.”

Standard:

- 02 **The needs and control of all road users (motorists, bicyclists, motorcyclists, and pedestrians within the highway, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.**

Support:

- 03 Chapter 6G contains discussions of typical TTC activities. Chapter 6H presents typical applications for a variety of situations commonly encountered. While not every situation is addressed, the information illustrated can generally be adapted to a broad range of conditions. In many instances, an appropriate TTC plan is achieved by combining features from various typical applications. For example, work at an intersection might present a near-side work zone for one street and a far-side work zone for the other street. These treatments are found in two different typical applications, while a third typical application shows how to handle pedestrian crosswalk closures. For convenience in using the typical application diagrams, Tables 6C-4, 6C-2, 6F-2, and 6C-1 are reproduced in this Chapter as Tables 6H-2, 6H-3, 6H-4, and 6H-5, respectively.
- 04 Procedures for establishing TTC zones vary with such conditions as road configuration, location of the work, work activity, duration of work, road user volumes, road vehicle mix (buses, trucks, cars, motorcycles, and bicycles), and road user speeds. Examples are presented in this Chapter showing how to apply principles and standards. Applying these guidelines to actual situations and adjusting to field conditions requires judgment. In general, the procedures illustrated represent minimum solutions for the situations depicted.

Option:

- 05 Other devices may be added to supplement the devices and device spacing may be adjusted to provide additional reaction time or delineation. Fewer devices may be used based on field conditions.

Support:

- 06 Figures and tables found throughout this Manual and Part 6 of the 2009 MUTCD provide information for the development of TTC plans. Table 6H-2 is used for the determination of taper lengths, Table 6H-3 for buffer lengths and flagger placement.
- 07 Table 6H-1 is an index of the 63 Typical Traffic Control (TTC) figures. Typical traffic control figures are shown on the right page with notes on the facing page to the left. The legend for the symbols used in the TTC figures is provided in Figure 6H-1. In many of the typical applications, sign spacing and other dimensions are indicated in the notes to the left of the figure.
- 08 Most of the typical applications show TTC devices for only one direction.
- 09 The following TTC applications illustrate mobile, short duration, short-term and intermediate-term stationary work activities utilizing portable (self-erecting) sign stands placed on the shoulder.

Standard:

- 10 **For long-term stationary work activities or as directed by the engineer, post-mounted signs placed outside of the shoulder per Figure 6F-1 shall be required.**

Table 6H-1, Index to Typical Temporary Traffic Control Figures and Notes

Type of Operation	Figure Number	Page Numbers
Work Outside the Shoulder		
Work Beyond the Shoulder Operation	TTC-1.0	6H-8, 6H-9
Blasting Zone Operation	TTC-2.0	6H-10, 6H-11
Work On the Shoulder		
Mobile or Short Duration Shoulder Operation	TTC-3.0	6H-12, 6H-13
Stationary Operation on a Shoulder	TTC-4.0	6H-14, 6H-15
Shoulder Operation with Minor Encroachment	TTC-5.0	6H-16, 6H-17
Shoulder Closure with Barrier Operation	TTC-6.0	6H-18, 6H-19
Shoulder Closure with Barrier and Lane Shift Operation	TTC-7.0	6H-20, 6H-21
Pull-Off Areas on Limited Access Highways	TTC-8.0	6H-22, 6H-23
Mowing Operation with Encroachment on Non-Limited Access Roadways	TTC-9.0	6H-24, 6H-25
Non-Licensed Vehicle Operation with Encroachment on Limited Access Highways	TTC-10.0	6H-26, 6H-27
Work Within the Travelway		
Moving/Mobile Operations on Limited Access Highways (Single Lane Closure)	TTC-11.0	6H-28, 6H-29
Moving/Mobile Operations on Limited Access Highways (Multiple Lane Closure)	TTC-12.0	6H-30, 6H-31
Moving/Mobile Operations on a Multi-Lane Roadway	TTC-13.0	6H-32, 6H-33
Moving/Mobile Operations on a Two-Lane Roadway	TTC-14.0	6H-34, 6H-35
Short Duration Operation on a Multi-Lane Roadway	TTC-15.0	6H-36, 6H-37
Outside Lane Closure Operation on a Four-Lane Roadway	TTC-16.0	6H-38, 6H-39
Inside Lane Closure Operation on a Four-Lane Roadway	TTC-17.0	6H-40, 6H-41
Multi-Lane Closure Operation	TTC-18.0	6H-42, 6H-43
Lane Closure Operation with Lane Weave	TTC-19.0	6H-44, 6H-45
Lane Closure Operation with Concrete Traffic Barrier	TTC-20.0	6H-46, 6H-47
Center Turn Lane Closure Operation	TTC-21.0	6H-48, 6H-49
Right Lane Closure Operation on a Three-Lane Roadway	TTC-22.0	6H-50, 6H-51

Table 6H-1, Index to Typical Temporary Traffic Control Figures and Notes

Type of Operation	Figure Number	Page Numbers
Lane Closure on a Two-Lane Roadway Using Flaggers	TTC-23.0	6H-52, 6H-53
Non-Stationary Operation on a Two-Lane Roadway Using Flaggers	TTC-24.0	6H-54, 6H-55
Lane Closure Operation on a Two-Lane Roadway Using Traffic Control Signals	TTC-25.0	6H-56, 6H-57
Work Within the Travelway at an Intersection and Sidewalks		
Lane Closure Operation – Near Side of an Intersection	TTC-26.0	6H-58, 6H-59
Lane Closure Operation – Far Side of an Intersection	TTC-27.0	6H-60, 6H-61
Lane Closure Operation in an Intersection	TTC-28.0	6H-62, 6H-63
Turn Lane Closure Operation	TTC-29.0	6H-64, 6H-65
Flagging Operation at a Signalized Intersection	TTC-30.0	6H-66, 6H-67
Flagging Operation on a Single Lane Roundabout	TTC-31.0	6H-68, 6H-69
Inside Lane Closure Operation on a Multi-Lane Roundabout	TTC-32.0	6H-70, 6H-71
Outside Lane Closure Operation on a Multi-Lane Roundabout	TTC-33.0	6H-72, 6H-73
Street Closure Operation with Detour	TTC-34.0	6H-74, 6H-75
Sidewalk Closure and Bypass Sidewalk Operation	TTC-35.0	6H-76, 6H-77
Crosswalk Closure and Pedestrian Detour Operation	TTC-36.0	6H-78, 6H-79
Work Within the Travelway of Multi-Lane Highways		
Work Operation in the Vicinity of an Exit Ramp	TTC-37.0	6H-80, 6H-81
Partial Exit Ramp Closure Operation	TTC-38.0	6H-82, 5H-83
Work Operation in the Vicinity of an Entrance Ramp	TTC-39.0	6H-84, 6H-85
Multi-Lane Shift Operation	TTC-40.0	6H-86, 6H-87
Half Road Closure Operation on a Multi-Lane Roadway	TTC-41.0	6H-88, 6H-89
Interior Lane Closure Operation on a Multi-Lane Roadway	TTC-42.0	6H-90, 6H-91
Road Closure Operation with a Diversion	TTC-43.0	6H-92, 6H-93
Median Cross-Over Operation on a Multi-Lane Roadway	TTC-44.0	6H-94, 6H-95
Total Limited Access Highway Closure Operation	TTC-45.0	6H-96, 6H-97

Table 6H-1, Index to Typical Temporary Traffic Control Figures and Notes

Type of Operation	Figure Number	Page Numbers
Limited Access Highway Closure Operation with a Short Term Detour	TTC-46.0	6H-98, 6H-99
Limited Access Highway Closure Operation with a Long Term Detour	TTC-47.0	6H-100, 6H-101
Road Closure Operation with a Detour	TTC-48.0	6H-102, 6H-103
Specialty Operations Within or Near the Travelway		
Surveying Operation	TTC-49.0	6H-104, 6H-105
Disruption Operation on a Multi-Lane Roadway	TTC-50.0	6H-106, 6H-107
Haul Road Crossing Operation	TTC-51.0	6H-108, 6H-109
Signing for Speed Limit and Fine Signs in Work Zones	TTC-52.0	6H-110, 6H-111
Signing for Project Limits	TTC-53.0	6H-112, 6H-113
Motorist Survey Operation on a Two-Lane Roadway	TTC-54.0	6H-114, 6H-115
Eradication of Pavement Markings in a Work Zone	TTC-55.0	6H-116, 6H-117
Work in the Vicinity of a Highway-Rail Crossing	TTC-56.0	6H-118, 6H-119
End of Day Signing for Partial Paving Operations on a Multi-Lane Roadway	TTC-57.0	6H-120, 6H-121
End of Day Signing for Full Paving Operations on a Multi-Lane Roadway	TTC-58.0	6H-122, 6H-123
End of Day Signing for Paving Operations on a Two-Lane Roadway	TTC-59.0	6H-124, 6H-125
Temporary Pavement Marking and Marker Guidelines	TTC-60.0	6H-126, 6H-127
Pre-Storm Treatment Operation	TTC-61.0	6H-128, 6H-129
Litter Pick-Up on Limited Access Highways	TTC-62.0	6H-130, 6H-131
Logging Operations	TTC-63.0	6H-132, 6H-133

Table 6H-2, Taper Length (L)

Posted Speed Limit (mph)	Width of Offset (Feet)				Remarks
	9	10	11	12	
≤ 25	95	105	115	125	$L = S^2W/60$
30	135	150	165	180	“
35	185	205	225	245	“
40	240	270	295	320	“
45	405	450	495	540	$L = SW$
50	450	500	550	600	“
55	495	550	605	660	“
60	540	600	660	720	“
65	585	650	715	780	“
70	630	700	770	840	“
Limited Access Highway merging taper length (L) shall be 1000 feet regardless of the posted speed. SW=L is desired for the shifting taper length with $\frac{1}{2}L$ being the minimum.					

Table 6H-3, Buffer Space/ Flagger Distance from Work Area

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 – 120
25	155 – 165
30	200 – 210
35	250 – 260
40	305 – 320
45	360 – 380
50	425 – 445
55	500 – 520
60	570 – 590
65	645 – 675
70	730 – 760

Table 6H-4, Channelizing Device Spacing

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Spot Construction Access *	80'	120'
* For easier access by construction vehicles into the work area, spacing of devices may be increased to this distance, but shall not exceed one access per 0.25 mile unless approved by the engineer and documented.		

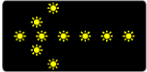
















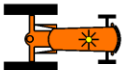


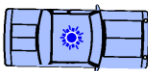







Table 6H-5, Advance Warning Sign Spacing

Road Type	Spacing (Feet)
Urban street with 25 mph or less posted speed	100 – 200
Urban street with 30 to 40 mph posted speed	250 – 350
* All Other Roadways with 45 mph or less posted speed	350 – 500
All Other Roadways with greater than 45 mph posted speed	500 – 800
Limited Access highways	1300 – 1500

* Urban streets with greater than 40 mph posted speed limits fall into this category.

Note: For urban conditions, it is generally better to place all advanced warning signs within a one block area versus spreading out the signs over several blocks, however, motorist must have time to recognize and react to each warning sign see Section 6G.11.

Figure 6H-1, Symbols Used In Typical Temporary Traffic Control Figures Application

	ARROW BOARD		CHANGEABLE MESSAGE SIGN SUPPORT OR TRAILER
	ARROW BOARD ON TRAILER		ARROW BOARD ON VEHICLE
	CHANNELIZING DEVICE		TEMPORARY CONCRETE BARRIER
	ACTIVE TRAFFIC SIGNAL		LONGITUDINAL CHANNELIZING DEVICE
	INACTIVE TRAFFIC SIGNAL		TYPE 3 BARRICADE
	TRAFFIC OR PEDESTRIAN SIGNAL		SIGN
	FLAGGER		HIGH-LEVEL WARNING DEVICE (FLAG TREE)
	1 WAY PAVEMENT MARKER		2 WAY PAVEMENT MARKER
	WORK VEHICLE		TRACTOR
	TRUCK MOUNTED ATTENUATOR		SLOW MOVING VEHICLE EMBLEM
	LAW ENFORCEMENT VEHICLE		WARNING LIGHT
	WORK SPACE		MILLED PAVEMENT
	RUMBLE STRIPS		DIRECTION OF TRAFFIC
	IMPACT ATTENUATOR		AUTOMATED FLAGGER ASSISTANCE DEVICE

Typical Traffic Control
Work Beyond the Shoulder Operation
(Figure TTC-1.0)

NOTES

Guidance:

1. *The minimum distance between the sign and work vehicle should be 1300'-1500' on Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limited is 45 mph or less.*

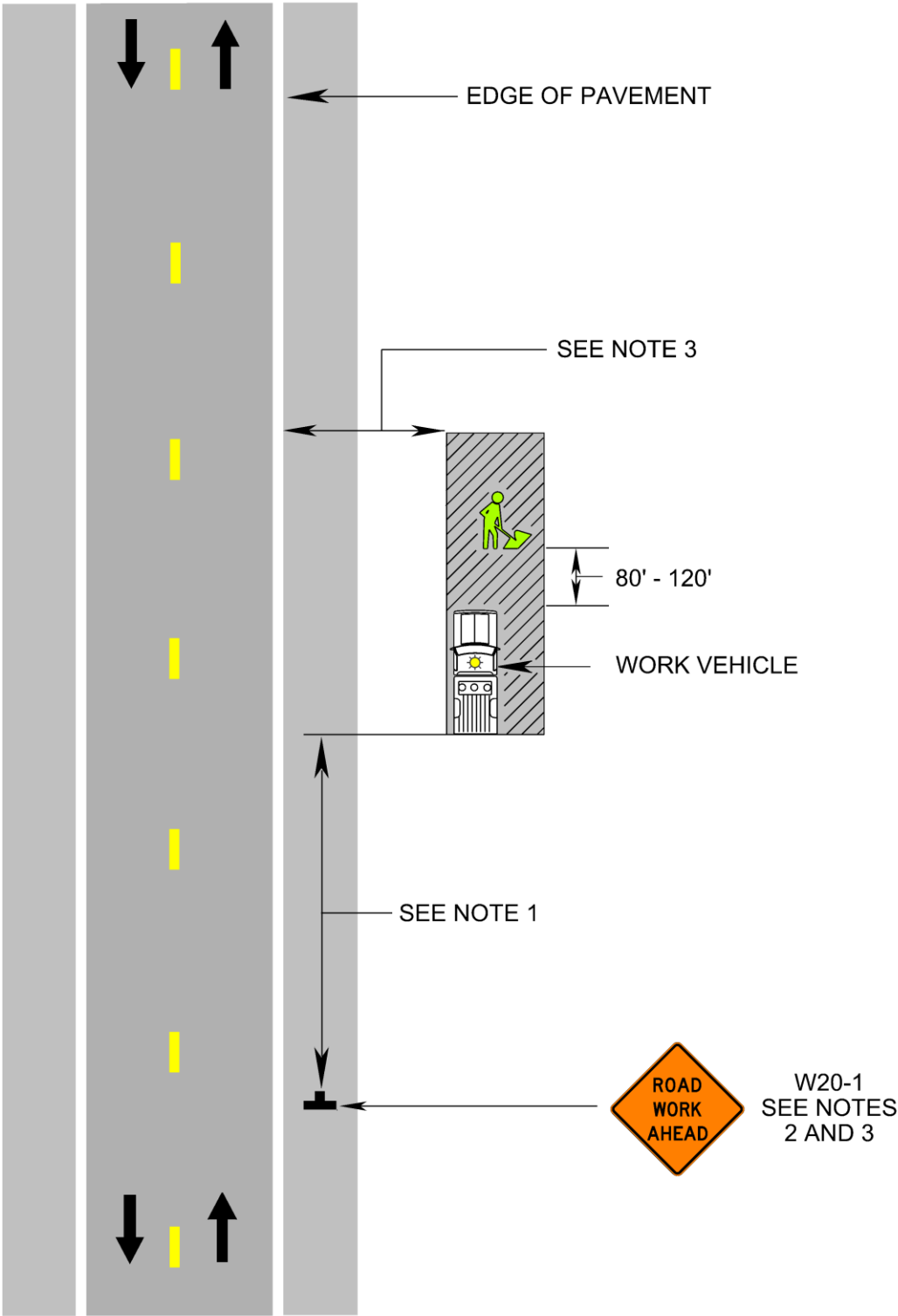
Option:

2. The ROAD WORK AHEAD (W20-1) sign may be replaced with other appropriate signs such as the SHOULDER WORK (W21-5) sign. The SHOULDER WORK sign may be used for work adjacent to the shoulder.
3. The ROAD WORK AHEAD sign may be omitted where the work space is behind a barrier, more than 4 feet behind vertical curb (Standard CG-2 and CG-6) on urban roadways, or outside of the clear zone for all other roadways. For clear zone values see Page A-4 of Appendix A.
4. For short-term, short duration or mobile operation, all signs and channelizing devices may be eliminated if a vehicle with activated high-intensity amber rotating, flashing, oscillating, or strobe lights is used.

Standard:

5. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.**
6. **If the work space is in the median of a divided highway, an advance warning sign shall also be placed on the left side of the directional roadway.**

**Work Beyond the Shoulder Operation
(Figure TTC-1.0)**



Typical Traffic Control
Blasting Zone Operation
(Figure TTC-2.0)

NOTES

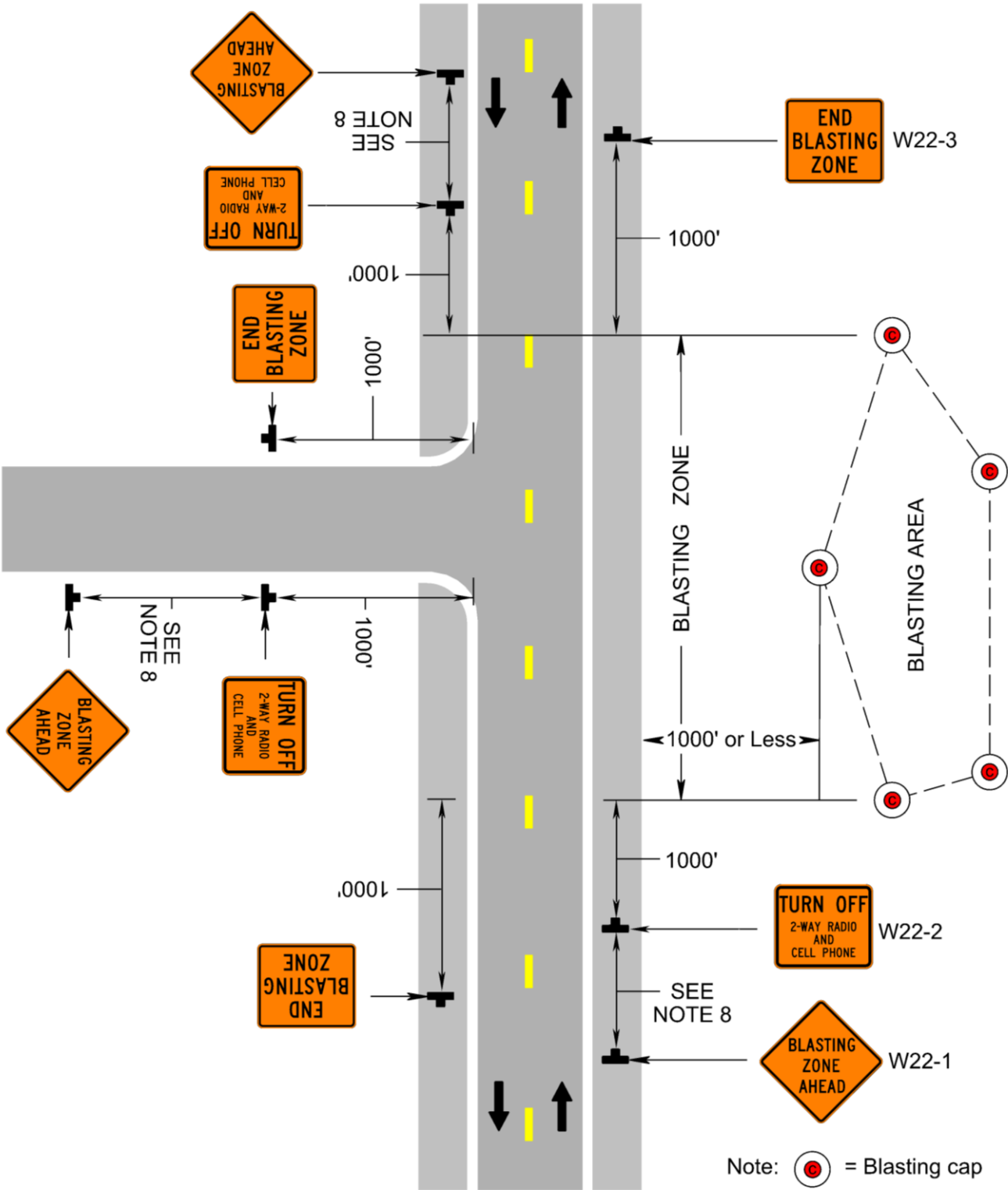
Standard:

1. Whenever blasting caps are used within 1000 feet of a roadway, the signing shown shall be used.
2. Sign spacing distance shall be a minimum of 1000 feet from the blasting area.
3. The signs shall be covered or removed when there are no explosives in the area or the area is otherwise secure.
4. Whenever a side road intersects the roadway between the **BLASTING ZONE AHEAD (W22-1)** sign and the **END BLASTING ZONE (W22-3)** sign, or a side road is within 1000 feet of any blasting cap, similar signing, as on the mainline, shall be installed on the side road.
5. Prior to blasting, the blaster in charge shall determine whether road users in the blasting zone will be endangered by the blasting operation. If there is danger, road users shall not be permitted to pass through the blasting zone during blasting operations.
6. On divided highways having a median wider than 8', right and left sign assemblies shall be required.

Guidance:

7. *On a divided highway, the signs should be mounted on both sides of the directional roadways.*
8. *Spacing between signs should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Blasting Zone Operation
(Figure TTC-2.0)



Typical Traffic Control
Mobile or Short Duration Shoulder Operation
(Figure TTC-3.0)

NOTES

Guidance:

1. *In those situations where multiple work locations within a limited distance make it practical to place stationary signs, the distance between the advance warning sign and the work should not exceed 5 miles.*
2. *The ROAD WORK NEXT 2 MILES (W21-V2) sign should be used instead of the ROAD WORK AHEAD (W20-1) sign if the work locations occur over a distance of more than 2 miles.*

Option:

3. Stationary warning signs may be omitted for short duration or mobile operations if the work vehicle displays high-intensity rotating, flashing, oscillating, or strobe lights.

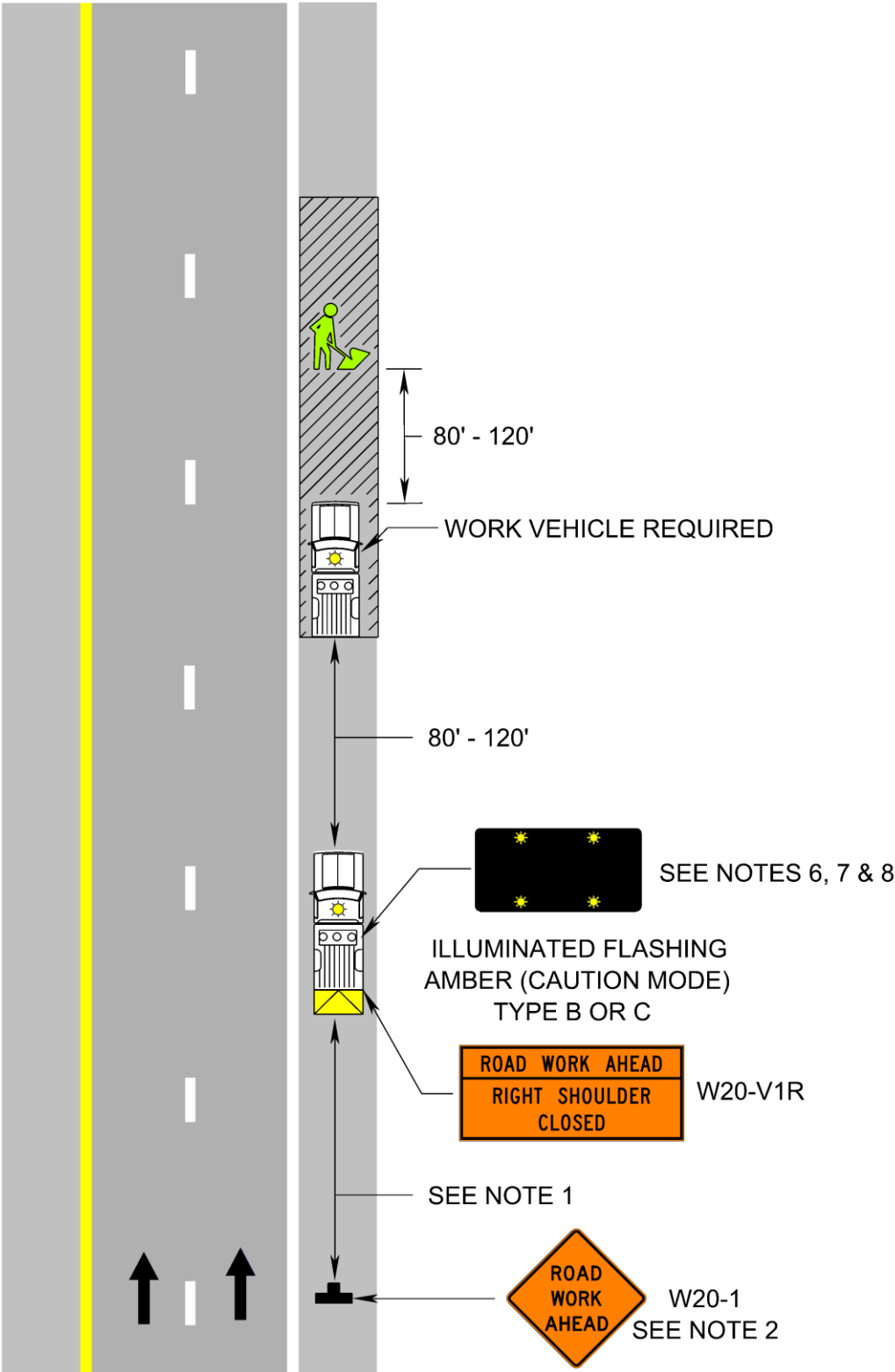
Standard:

4. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.**
5. **If an arrow board is used for an operation on the shoulder, the caution mode shall be used.**
6. **Vehicle-mounted signs shall be mounted in a manner such that they are not obscured by equipment or supplies. Sign legends on vehicle-mounted signs shall be covered or turned from view when work is not in progress.**
7. **If multiple work crews are active at various locations throughout the 2 mile work zone, a shadow vehicle shall be used for each work crew.**

Option:

8. The shadow vehicle may be used with a truck-mounted attenuator (TMA) on Limited Access highways.

Mobile or Short Duration Shoulder Operation
(Figure TTC-3.0)



Typical Traffic Control
Stationary Operation on a Shoulder
(Figure TTC-4.0)

NOTES

Standard

1. For long-term stationary work (more than 3 days) on divided highways having a median wider than 8', sign assemblies on both sides of the roadway shall be required as shown (ROAD WORK AHEAD (W20-1), RIGHT SHOULDER CLOSED AHEAD (W21-5bR)), even though only one shoulder is being closed. For operations less than 3 days in duration, sign assemblies will only be required on the side where the shoulder is being closed and a RIGHT SHOULDER CLOSED AHEAD (W21-5bR) sign shall be added to that side.

Guidance

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Option:

3. The SHOULDER WORK (W21-5) sign on an intersecting roadway may be omitted where drivers emerging from that roadway will encounter another advance warning sign prior to this activity area.
4. For short duration operations of 1 hour or less, all signs and channelizing devices may be eliminated if a vehicle with activated high-intensity amber rotating, flashing, oscillating, or strobe lights is used.

Standard:

5. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
6. Taper length (L) and channelizing device spacing shall be at the following:

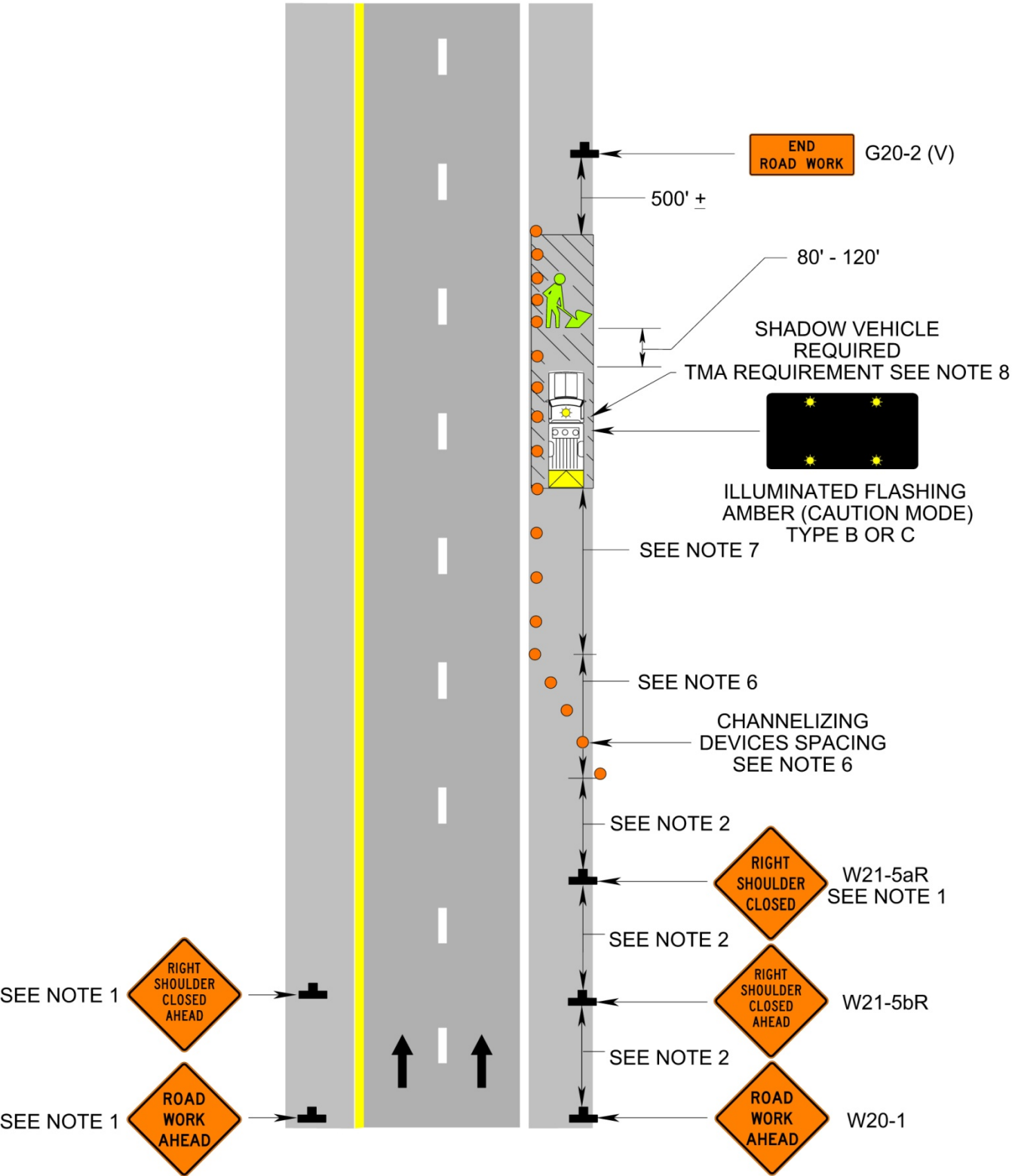
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

7. The buffer space length shall be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
8. A shadow vehicle shall be used whenever a person is required to operate equipment mounted on or in the work vehicle such as buckets, augers, post drivers, etc. For work operations on the shoulder with a duration greater than 1 hour where workers are present, a shadow vehicle shall be used. A truck-mounted attenuator (TMA) shall be used on the shadow vehicle on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.
9. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.

Stationary Operation on a Shoulder
(Figure TTC-4.0)



Typical Traffic Control
Shoulder Operation with Minor Encroachment
(Figure TTC-5.0)

NOTES

Standard

1. On divided highways having a median wider than 8', right and left sign assemblies shall be required. See Note 1, TTC-4 for addition sign information.

Guidance

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. When work takes up part of a lane on a high volume roadway; vehicular traffic volumes, vehicle mix, speed and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment analysis permits a remaining lane width of 10 feet, the lane should be closed. If the closure operation is on a Limited Access highway, the minimum lane width is 11 feet.

Option:

4. The ROAD WORK AHEAD (W20-1) sign on an intersecting roadway may be omitted where drivers emerging from that roadway will encounter another advance warning sign prior to this activity area.

Standard:

5. A shadow vehicle with either an arrow board operating in the caution mode, or at least one high-intensity amber rotating, flashing, oscillating, or strobe light shall be parked 80' - 120' in advance of the first work crew.
6. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
7. Taper length (L) and channelizing device spacing shall be at the following:

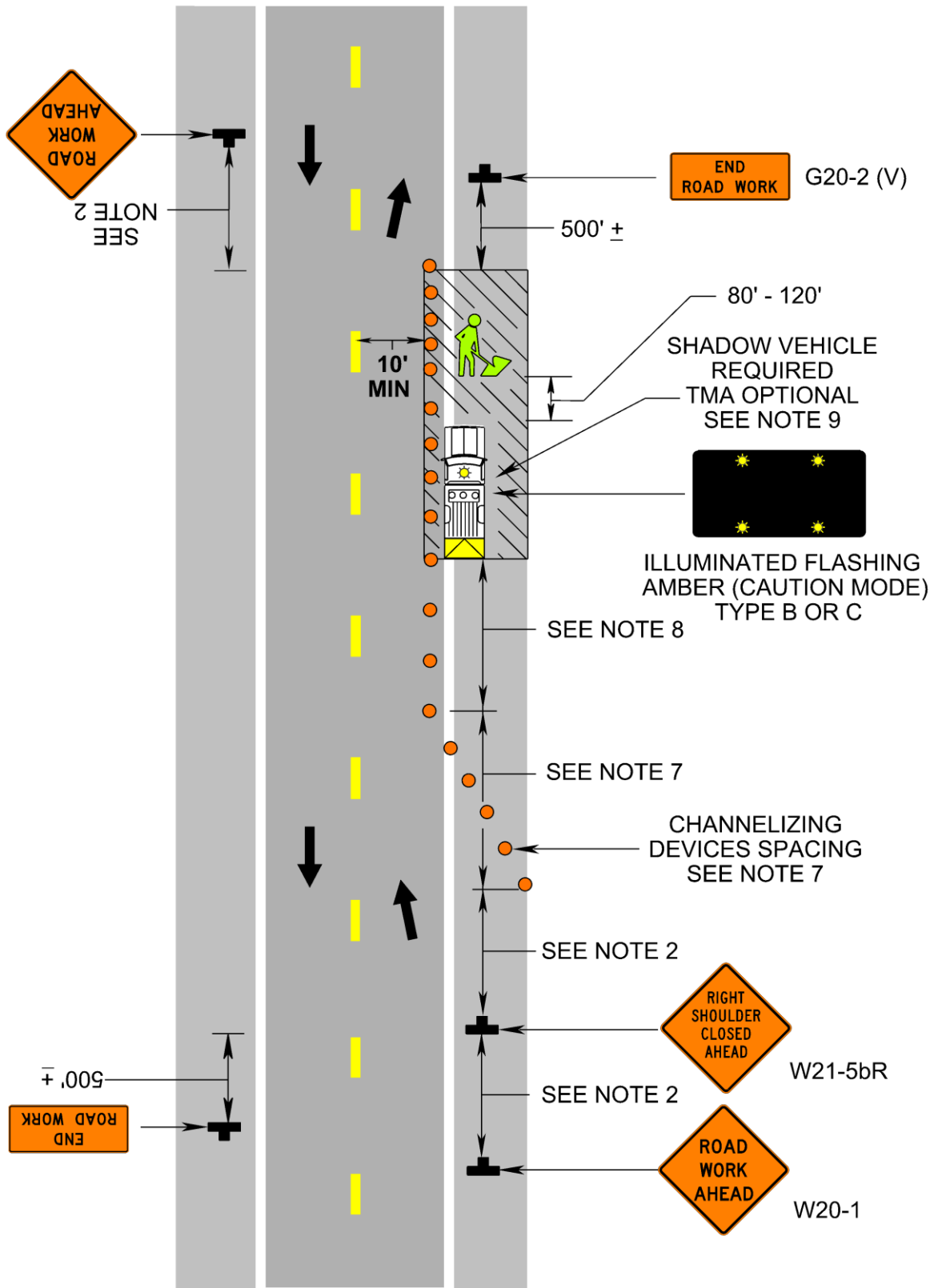
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

8. The buffer space length shall be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
9. A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.
10. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.

Shoulder Operation with Minor Encroachment
(Figure TTC-5.0)



Typical Traffic Control
Shoulder Closure with Barrier Operation
(Figure TTC-6.0)

NOTES

Guidance:

1. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Standard:

2. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
3. Group 2 channelizing device spacing shall be at the following:

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

4. The minimum length for a shoulder taper should be 320' on Limited Access highways, and $\frac{1}{3}$ L for all other roadways (see Note 7 of TTC-5 for values of L).
5. Barrier transition slope ratio shall be as follows:

Speed Limit (mph)	Slope Ratio	Speed Limit (mph)	Slope Ratio	Speed Limit (mph)	Slope Ratio
70	22:1	55	17:1	40	13:1
65	20:1	50	16:1	35	11:1
60	19:1	45	14:1	≤30	10:1

When the barrier transition slope is on a horizontal alignment, the total offset shall be prorated around the curve in lieu of a straight-line slope.

6. End treatment of a barrier in order of preference:
 - a. Where guardrail exists, attach to barrier with appropriate fixed object attachment.
 - b. Where cut slope exists, bury barrier into cut slope and provide for drainage as needed.
 - c. Extend end of barrier until it is beyond the established clear zone (see Figure 2 on Page A-4 in Appendix A for clear zone values).
 - d. When barrier end is inside the established clear zone, attenuator service Type I or Type II shall be used. Contact L&D Standards/Special Design Section for approved attenuators.
7. Barrier panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 80' on centers along the parallel or tangent sections and 40' on centers along the transition or taper sections. ReflectORIZED surface shall be fluorescent orange prismatic lens sheeting. The light at the beginning of the barrier run and at the breakpoint where the barrier becomes parallel to the roadway shall be a Type B flashing light. Barrier delineators shall be installed along the traffic side of the concrete barriers in-between and at the same spacing as the barrier panels approximately 24 inches up from the roadway surface.

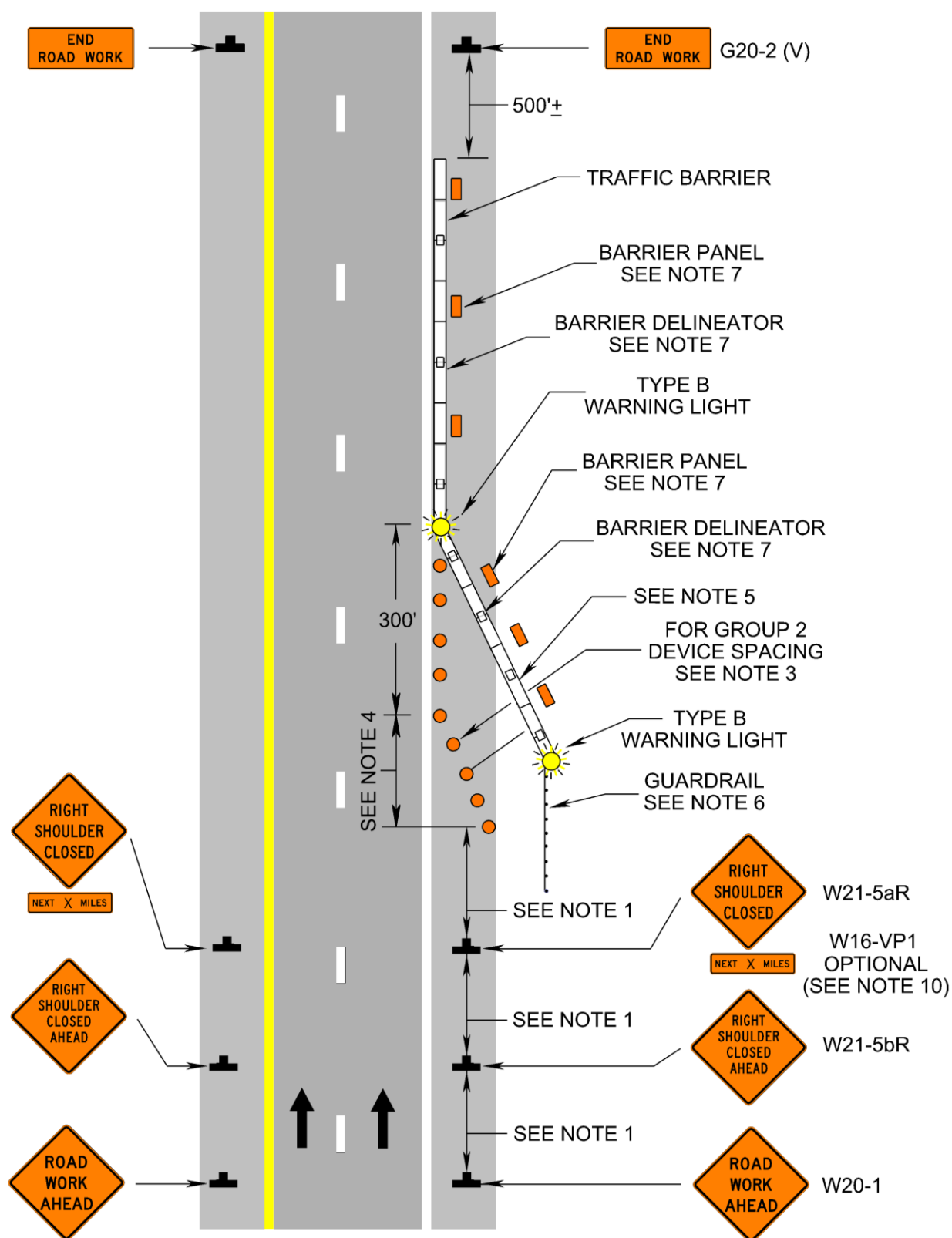
Option:

8. The barrier shown in this typical application is an example of one method that may be used to close a shoulder of a long-term project.
9. The RIGHT SHOULDER CLOSED (W21-5aR) sign may be eliminated from all roadways except Limited Access highways.

Guidance:

10. If drivers cannot see a pull-off area beyond the closed shoulder, information regarding the length of the shoulder closure shall be provided in feet or miles, as appropriate.
11. An emergency pull-off area should be provided per Section 6G.18 and Temporary Traffic Control Figure TTC-8.

Shoulder Closure with Barrier Operation (Figure TTC-6.0)



Typical Traffic Control
Shoulder Closure with Barrier and Lane Shift Operation
(Figure TTC-7.0)

NOTES

Guidance:

1. *The lane shift should be used when the work space extends into either the right or left lane of a divided highway and it is not practical, for capacity reasons, to reduce the number of available lanes.*
2. *When a lane shift is accomplished by using: (1) geometry that meets the design speed at which the permanent highway was designed, (2) full normal cross-section (full lane width and full shoulders), and (3) complete pavement markings, then the Reverse Curve signs are not required.*
3. *Sign spacing distance should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

4. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
5. **Length of pavement marking transition (L) is equal to posted speed (S) times the width of transition (W) (Example: 55 mph x 2' = 110').**
6. **Channelizing device spacing shall be at the following:**

Location	Posted Speed Limit (mph)	
	0 – 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

7. **For end treatment of the barrier in order of preference see Note 6 of TTC-6.**
8. **Barrier panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 80' on centers along the parallel or tangent sections and 40' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the beginning of the barrier run and at the breakpoint where the barrier becomes parallel to the roadway shall be a Type B flashing light. Barrier delineators shall be installed along the traffic side of the concrete barrier in-between and at the same spacing as the barrier panels approximately 24 inches up from the roadway surface.**
9. **Unless approved by the Regional Traffic Engineer, the minimum width of the travel lanes shall be 11 feet.**
10. **For long-term work zones existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per TTC-60.**

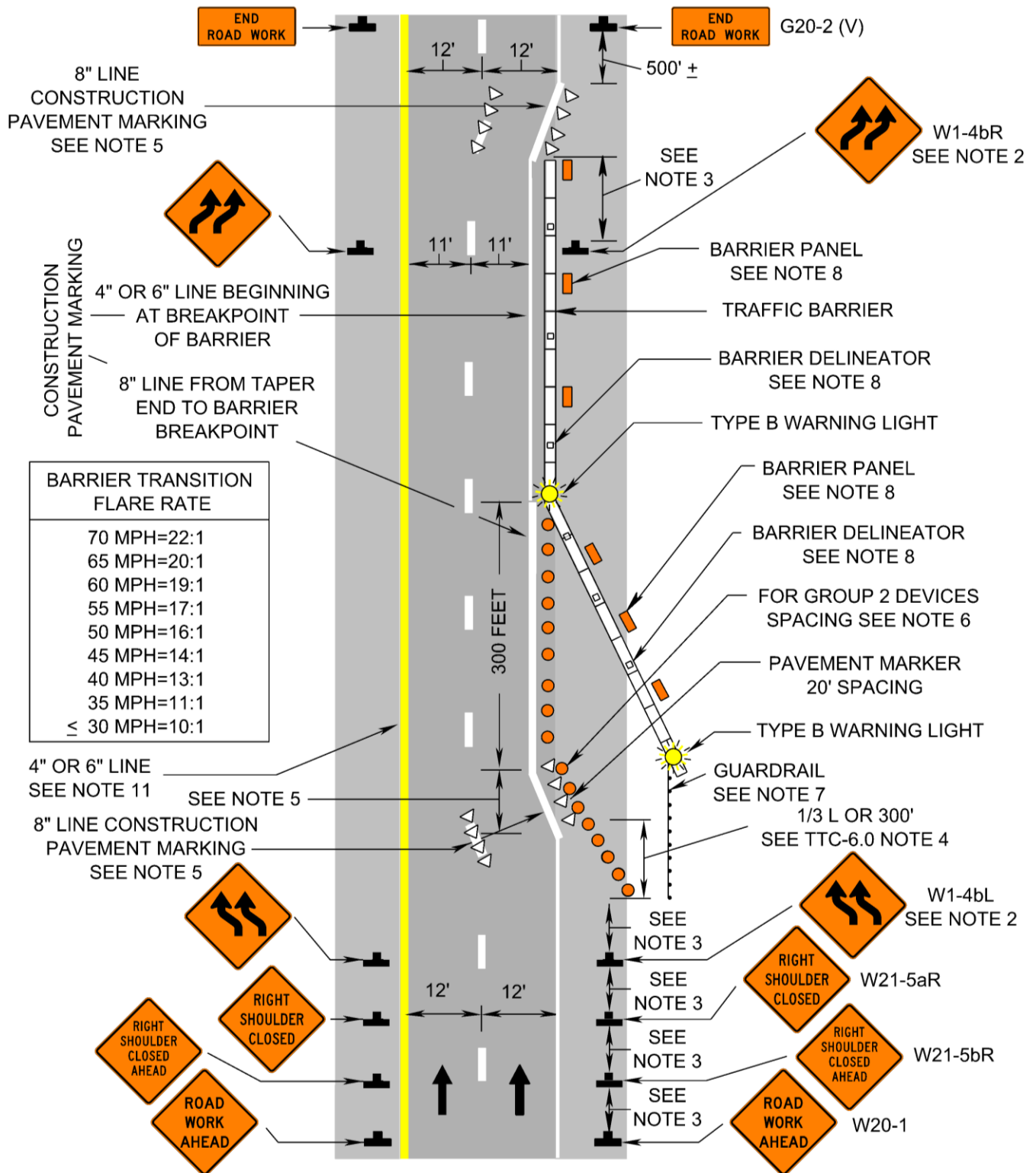
Option:

11. Temporary pavement may be needed to maintain traffic with 11' minimum width lanes.

Guidance:

12. *Eradication of existing pavement markings should be as shown in Typical Traffic Control Figure TTC-55.*
13. *If drivers cannot see a pull-off area beyond the closed shoulder, information regarding the length of the shoulder closure should be provided in feet or miles, as appropriate.*
14. *An emergency pull-off area should be provided per Section 6G.18 and Temporary Traffic Control Figure TTC-8.*

Shoulder Closure with Barrier and Lane Shift Operation (Figure TTC-7.0)



Typical Traffic Control
Pull-Off Areas on Limited Access Highways
(Figure TTC-8.0)

NOTES

Guidance:

1. *Work zone pull-off areas should be provided in work zones along Limited Access highways where one or both shoulders are closed due to construction.*

Option:

2. Work zone pull-off areas may be considered in work zones for other roadways where one or both shoulders are closed due to construction.

Guidance:

3. *The spacing of pull-off areas should be as follows:*
 - *For projects with activity areas up to 2.0 miles in length, one every 0.5 to 0.75 mile.*
 - *For projects with activity areas greater than 2.0 miles in length, one every mile.*
4. *Pull-off areas should be a minimum of 1320 feet long. The width of pull-off areas should be a desirable distance of 15 feet.*

Option:

5. The width of the work zone pull-off areas may be reduced to a minimum of 12 feet on roadways with Right-of-Way constraints.

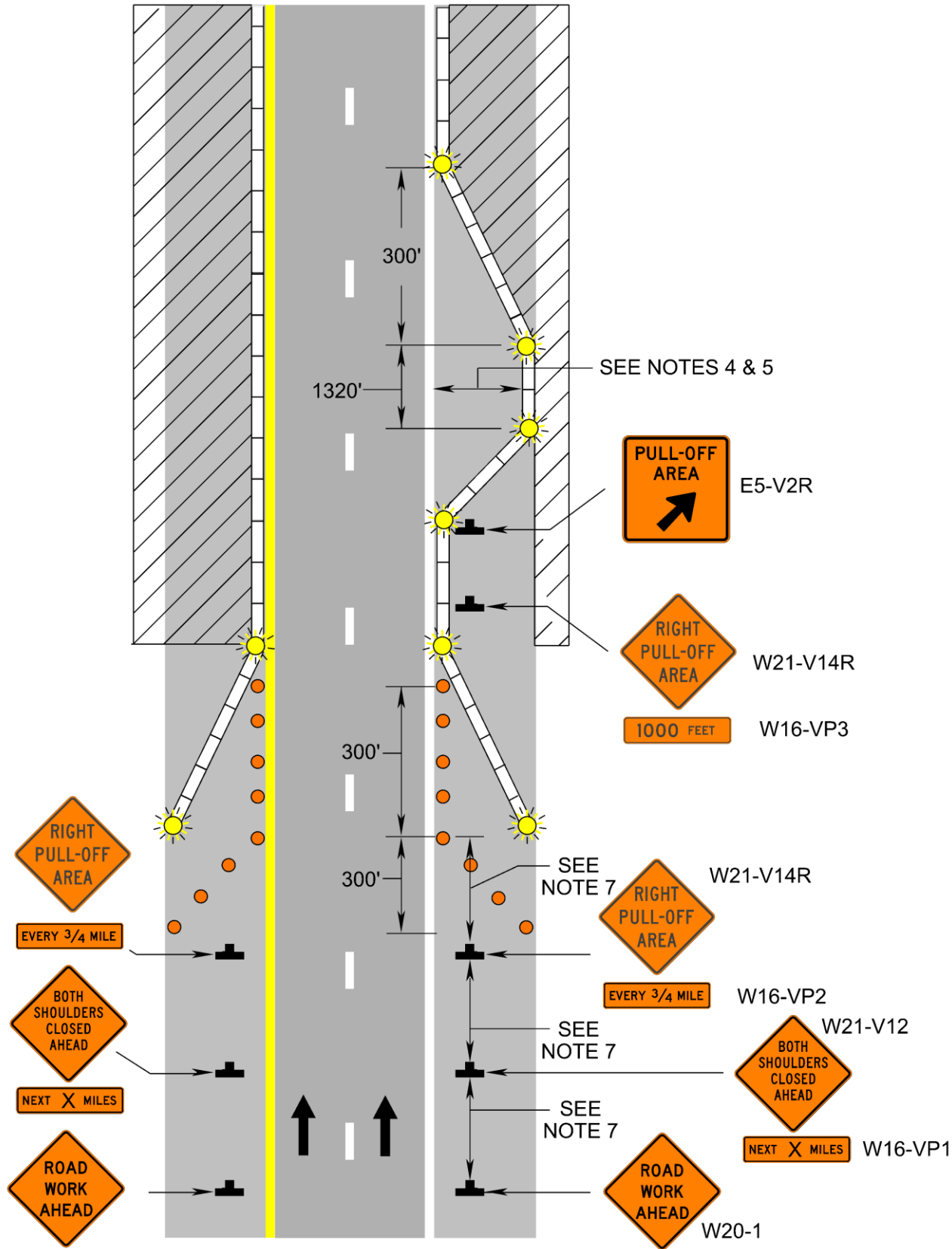
Guidance:

6. *Advance warning signs placed after the ROAD WORK AHEAD sign, should be installed as follows:*
 - a. *A NEXT XX MILES (W16-VP1) supplemental plaque should be provided with the first SHOULDER CLOSED AHEAD (W21-5b or W21-V12) sign in the sequence.*
 - b. *The third sign in the sequence should be either:*
 - *A NO PULL-OFF AREA (W21-V15) sign with NEXT XX MILES (W16-VP1) supplemental plaque, if there are no pull off areas throughout the work area, or*
 - *A LEFT (RIGHT) PULL-OFF AREA (W21-V13, W21-V14L, or W21-14R) sign with EVERY X MILE (W16-VP2) supplemental plaque, if pull-off areas are provided.*
 - c. *A LEFT (RIGHT) PULL-OFF AREA warning sign with a 1000 FEET (W16-VP3) supplemental plaque should be placed in advance of each pull-off area to give distance information to a driver as to the location of the emergency pull-off area. Additional options for the supplemental plaque below PULL-OFF AREA (W21-V13, W21-V14L, or W21-14R) sign that could be considered for these locations include a distance message appropriate for the design speed of the roadway (for example 500 FT or 1000 FT), NEXT EXIT, EXIT XX, NEXT LEFT or NEXT RIGHT (see Section 6F.43).*
 - d. *A Pull-Off Area Entrance (E5-V2) sign should be placed immediately prior to the pull-off area to help a driver navigate to it safely.*
 - e. *A PULL-OFF AREA (W21-V13) sign /NEXT EXIT (W16-VP4) plaque signing should be provided within 0.5 mile of a limited access interchange exit if the exit is clearly signed and the interchange facilities provide adequate places for refuge (see Section 6F-43 for additional guidance).*
7. *Sign spacing should be 1300'-1500' for Limited Access highways.*

Standard:

8. **Minimum lane closure taper length on all Limited Access highways, regardless of posted speed, shall be 1000 feet. Minimum shoulder taper length of Limited Access highways shall be 300 feet.**
9. **Barrier panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 80' on centers along the parallel or tangent sections and 40' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the beginning of the barrier run and at the breakpoint where the barrier becomes parallel to the roadway shall be a Type B flashing light. Barrier delineators shall be installed along the traffic side of the concrete barrier in-between and at the same spacing as the barrier panels approximately 24 inches up from the roadway surface.**

Pull-Off Areas on Limited Access Highways
(Figure TTC-8.0)



Typical Traffic Control
Mowing Operation with Encroachment on Non-Limited Access Roadways
(Figure TTC-9.0)

NOTES

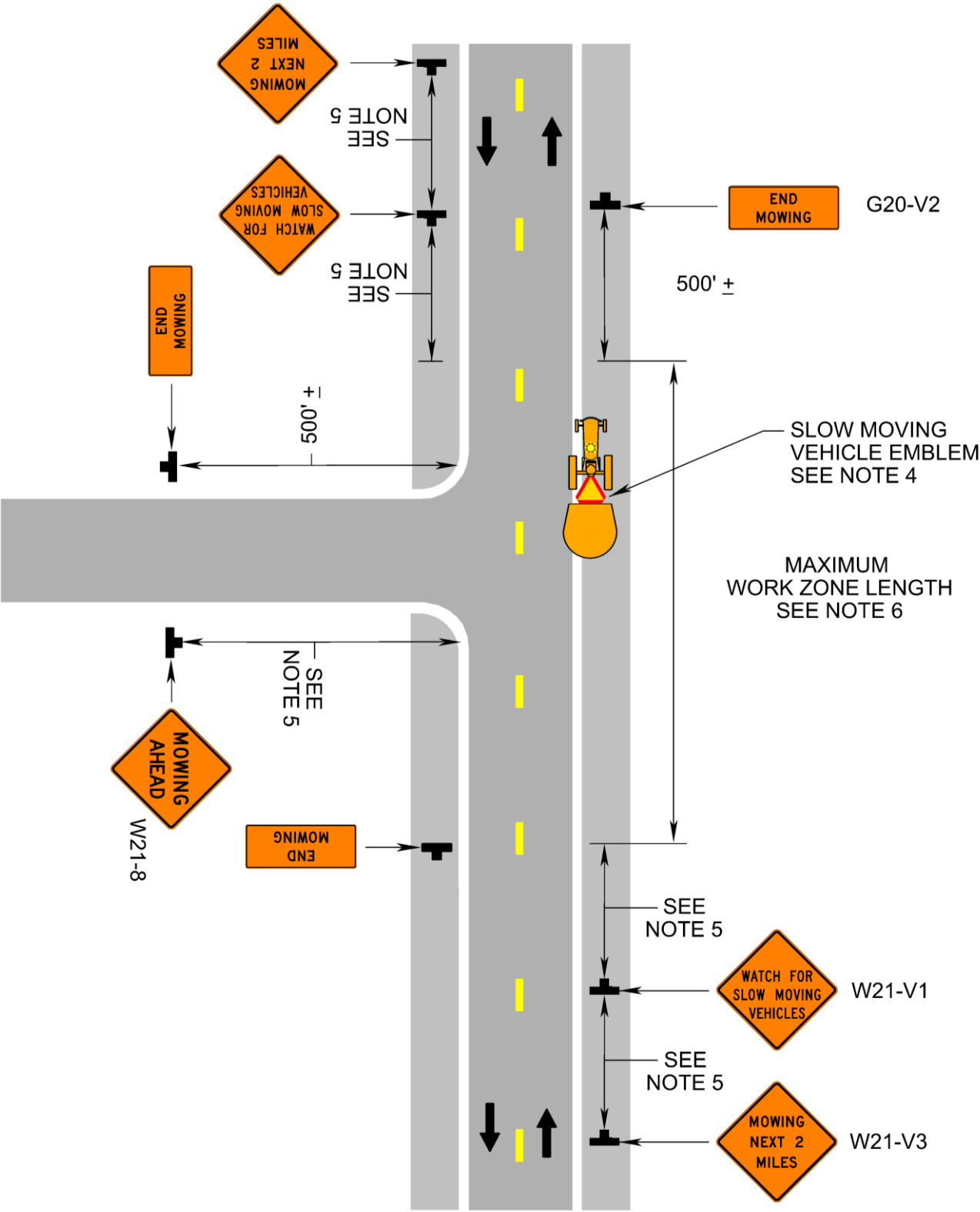
Standard:

- 1. Each vehicle involved in the operation shall be equipped with at least one rotating amber light or high intensity amber strobe or oscillating light, visible from 360°.**
- 2. On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
- 3. Connecting roads entering into the work area shall be signed as shown.**
- 4. All vehicles traveling at speeds below 25 mph shall display a slow moving vehicle emblem per OSHA regulation 1910.145(d)(10).**

Guidance:

- 5. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*
- 6. No more than 2 complete setups (2 miles each) should be exposed to motorist at any one time.*
- 7. To prevent multiple lane changing by motorists and constriction of traffic flow, mowing operations should be limited to one side of the roadway at a time, or separated by a minimum of 1000 feet between right and left side operations.*
- 8. For high volume, high speed multi-lane highways, if the mower encroaches into the roadway for extended periods of time, or prevents vehicles from passing, TTC 15.0, Short Duration Operation on a Multi-Lane Roadway should be considered.*

Mowing Operation with Encroachment on Non-Limited Access Roadways
(Figure TTC-9.0)



Typical Traffic Control
Non-Licensed Vehicle Operation with Encroachment on Limited Access Highways
(Figure TTC-10.0)

NOTES

Standard:

1. Each vehicle involved in the operation shall be equipped with at least one rotating amber light or high intensity amber strobe or oscillating light, visible from 360°.
2. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
3. Entrance ramps within the work area shall be signed as shown.
4. All vehicles traveling at speeds below 25 mph shall display a slow moving vehicle emblem per OHSA regulation 1910.145(d)(10).

Guidance:

5. Sign spacing distance should be 1300'-1500' for Limited Access highways.
6. No more than 2 complete setups (2 miles each) should be exposed to motorist at any one time.
7. To prevent multiple lane changing by motorists and constriction of traffic flow, mowing operations should be limited to one side of the roadway at a time, or separated by a minimum of 1000 feet between right and left side operations.

Option:

8. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow may be deleted.
9. The vehicle static warning sign and arrow board may be replaced with a vehicle-mounted CMS with a minimum character height of 10". The arrow display using a CMS may be a Type B. Arrow direction and lane designation may change as needed.
10. The Shadow Vehicle 2 may be eliminated if the operation does not encroach in the travel lane.

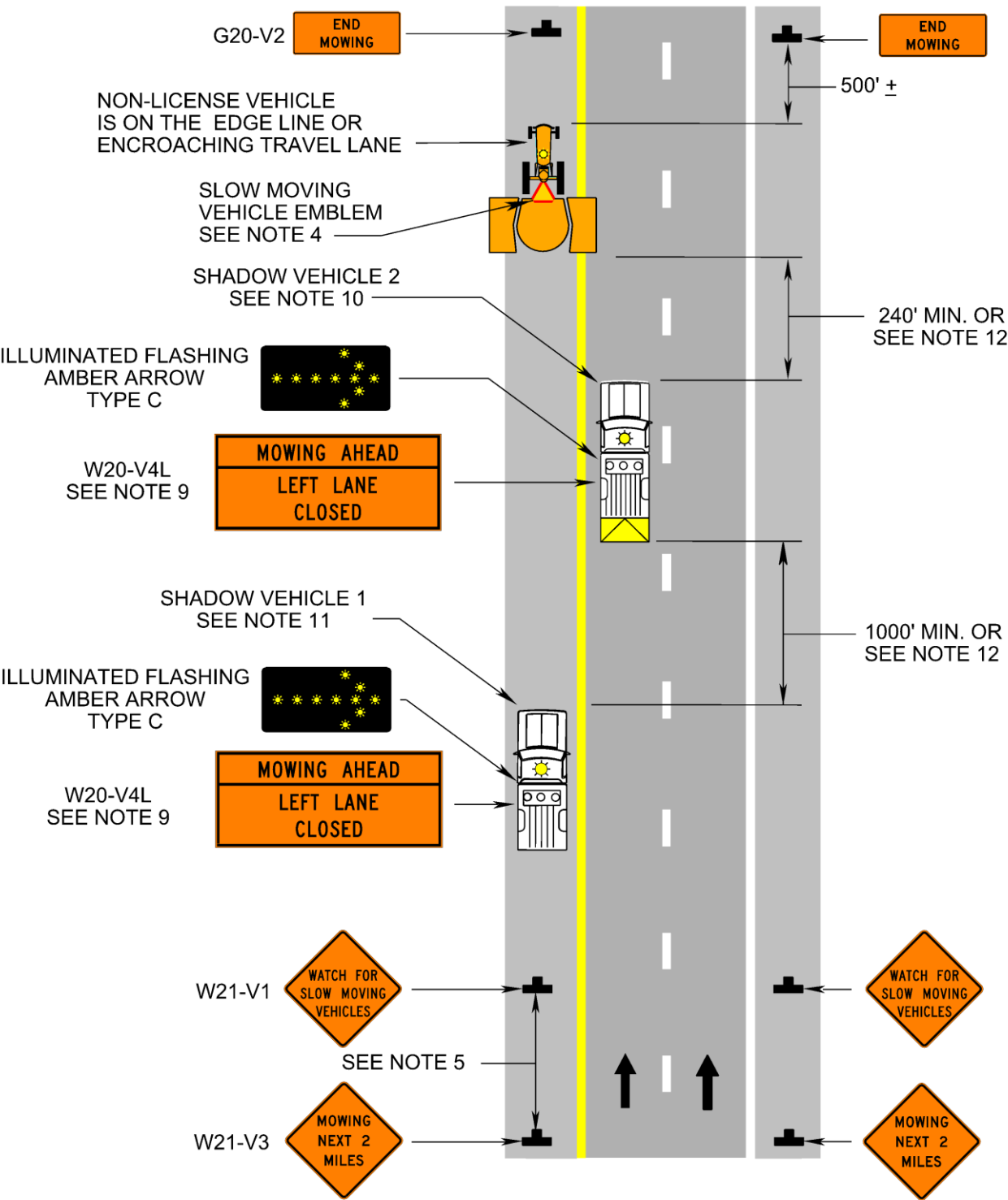
Standard:

11. **If Shadow Vehicle 1 cannot run completely on the shoulder out of the travel lane and would be partially in the travel lane, it shall be equipped with a truck-mounted attenuator.**

Guidance:

12. *When using a CMS to replace the static sign and arrow board, each word message phase should be followed by the Type B arrow display.*

**Non-Licensed Vehicle Operation with Encroachment on Limited Access Highways
(Figure TTC-10.0)**



Typical Traffic Control
Moving/Mobile Operations on Limited Access Highways (Single Lane Closure)
(Figure TTC-11.0)

NOTES

Standard:

1. Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the advance warning vehicles shall be Type C (96" x 48"), and on the work operations vehicle a Type B (60" x 30") or Type C.
2. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.

Option:

3. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow may be deleted.
4. The static warning sign and arrow board may be replaced with a vehicle-mounted CMS with a minimum character height of 10". The arrow display using a CMS may be a Type B. Arrow direction and lane designation may change as needed.

Standard:

5. Shadow Vehicle 1 shall travel along the paved shoulder with either a flashing arrow, or a portable changeable message sign with 18" high characters advising of the operation ahead (LINE PAINTING AHEAD), and lane closure information (RIGHT LANE CLOSED, MERGE LEFT). Shadow Vehicle 2, with a truck-mounted attenuator (TMA), shall either straddle the edgeline, partially on the shoulder and partially in the lane, or travel fully in the travel lane. Shadow Vehicle 3, with a TMA, shall be in the travel lane.
6. If Shadow Vehicle 1 cannot run completely on the shoulder out of the travel lane and would be partially in the travel lane, it shall be equipped with either a truck-mounted attenuator or follow option in Note 7.

Option:

7. When Shadow Vehicle 1 cannot run completely on the shoulder, it may be replaced with a PCMS with the messages in Note 5 displayed, or with a static warning sign with the appropriate message (LINE PAINTING NEXT 2 MILES (W21-V4)). For inside lane closure operations, the Shadow Vehicle 1 may be positioned on the right shoulder without arrow designation.

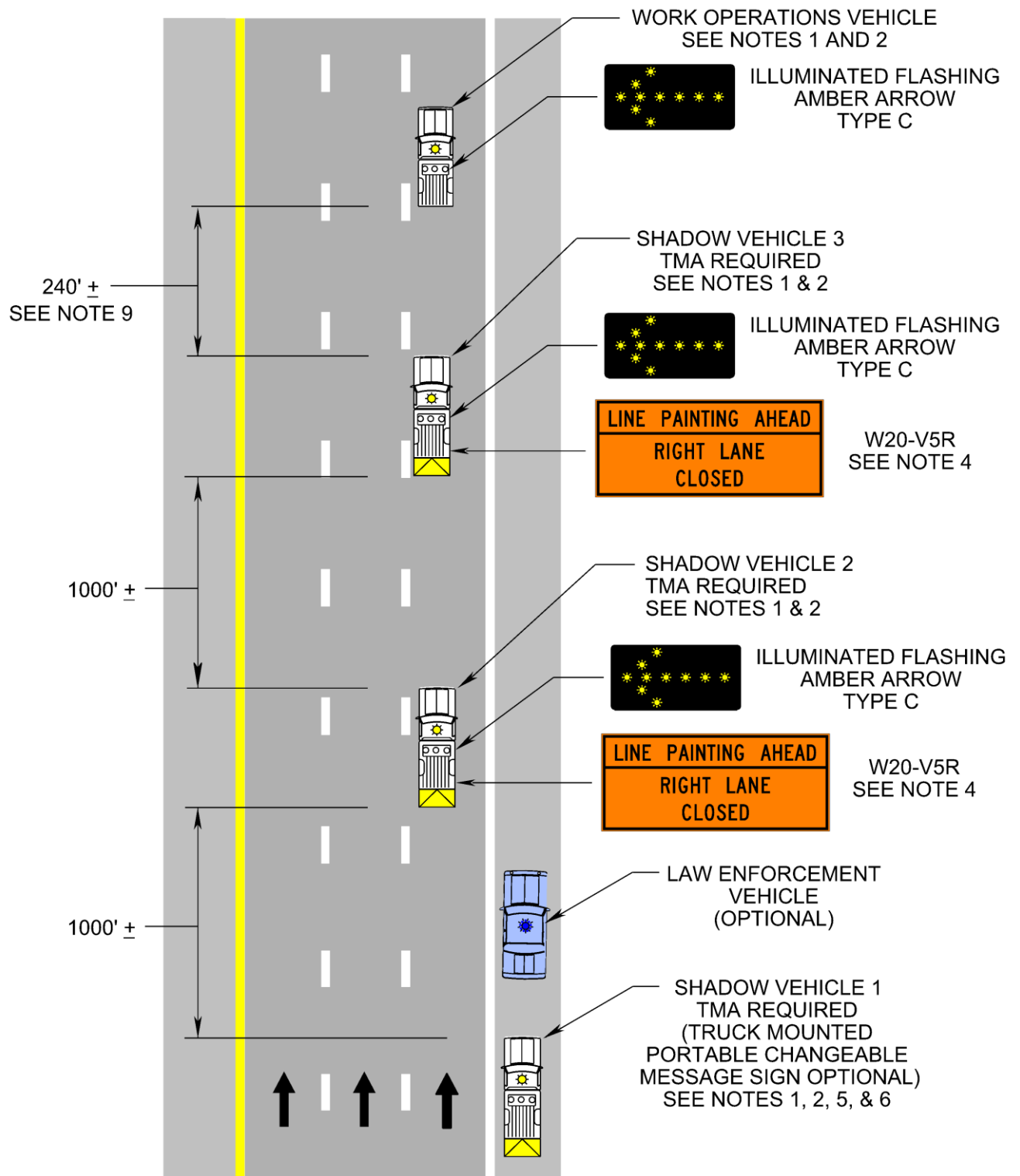
Standard:

8. Each vehicle involved in the moving operation shall have radio communication between vehicles.
9. When the work operations vehicle is stationary, Shadow Vehicle 3 following the operations vehicle shall be in a position 80'-120' in advance of the work operations vehicle to provide protection. When the work operations vehicle is moving, the Shadow Vehicle 3 following the operations vehicle shall follow at a distance of 240'±.

Guidance:

10. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of operation. Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
11. *When using a CMS to replace the static sign and arrow board, each word message phase should be followed by the Type B arrow display.*

Moving/Mobile Operations on Limited Access Highways (Single Lane Closure)
(Figure TTC-11.0)



Typical Traffic Control
Moving/Mobile Operations on Limited Access Highways (Multiple Lane Closure)
(Figure TTC-12.0)

NOTES

Standard:

1. Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the advance warning vehicles shall be Type C (96" x 48"), and on the work operations vehicle a Type B (60" x 30") or Type C.
2. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.

Option:

3. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow may be deleted.
4. The static warning sign and arrow board may be replaced with a vehicle-mounted CMS with a minimum character height of 10". The arrow display using a CMS may be a Type B. Arrow direction and lane designation may change as needed.

Standard:

5. Shadow Vehicle 1 shall travel along the paved shoulder with either a flashing arrow, or a portable changeable message sign with 18" high characters advising of the operation ahead (LINE PAINTING AHEAD), and lane closure information (RIGHT LANE CLOSED, MERGE LEFT). Shadow Vehicle 2, with a truck-mounted attenuator (TMA), shall either straddle the edgeline, partially on the shoulder and partially in the lane, or travel fully in the travel lane.
6. If Shadow Vehicle 2 cannot run completely on the shoulder out of the travel lane and would be partially in the travel lane, it shall be equipped with either a truck-mounted attenuator or follow option in Note 7.

Option:

7. When Shadow Vehicle 2 cannot run completely on the shoulder, it may be replaced with a PCMS with the messages in Note 5 displayed, or with a static warning sign with the appropriate message (LINE PAINTING NEXT 2 MILES (W21-V4)). For inside lane closure operations, the Shadow Vehicle 2 may be positioned on the right shoulder without arrow designation.

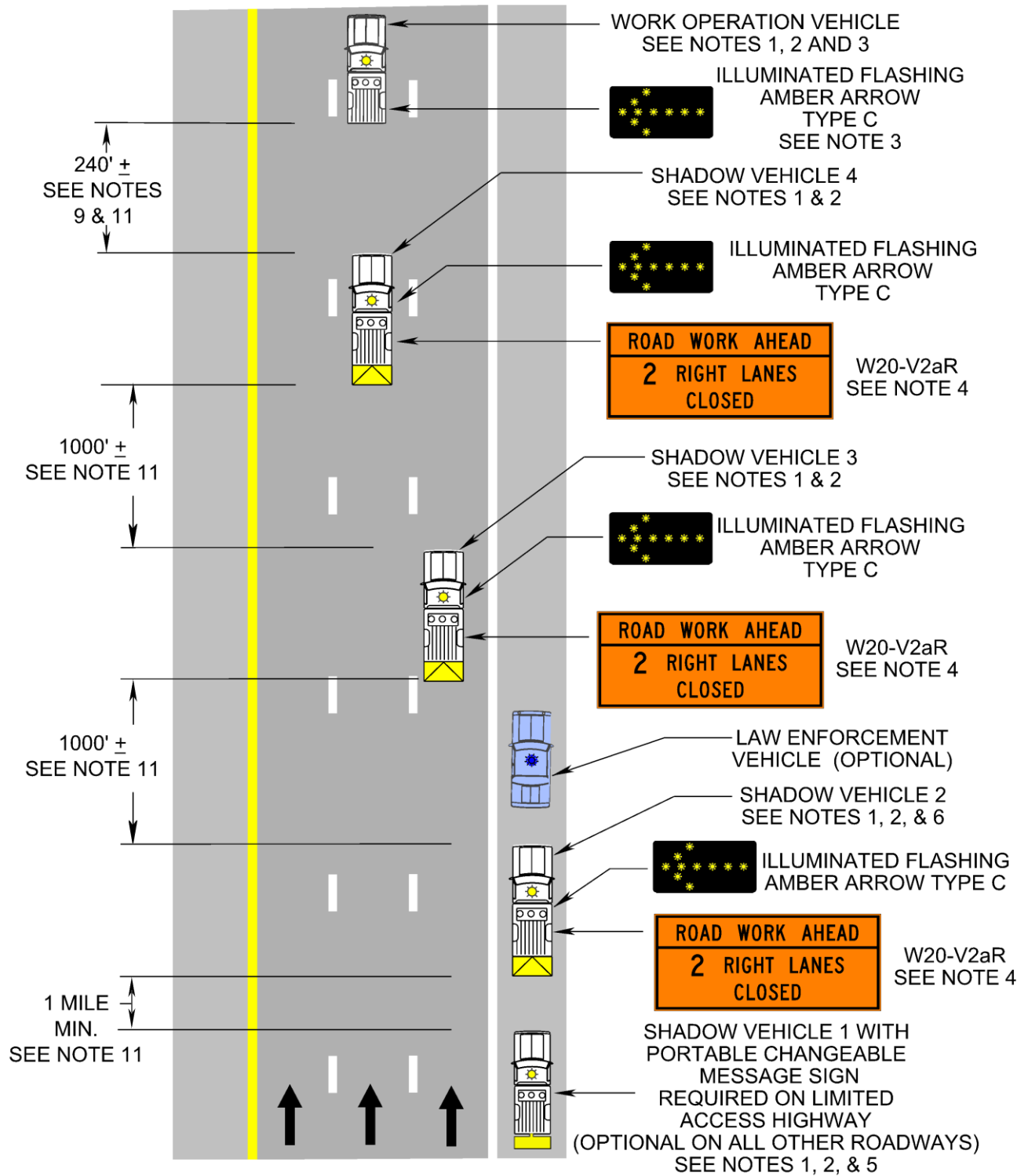
Standard:

8. Shadow Vehicles 3 and 4, with a TMA, shall be in their respective travel lane.
9. When the work operations vehicle is stationary, Shadow Vehicle 4 following the operations vehicle shall be in a position 80'-120' in advance of the work operations vehicle to provide protection. When the work operations vehicle is moving, the Shadow Vehicle 4 following the operations vehicle shall follow at a distance of 240'±.
10. Each vehicle involved in the moving operation shall have radio communication between vehicles.

Guidance:

11. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of operation. Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
12. *When using a CMS to replace the static sign and arrow board, each word message phase should be followed by the Type B arrow display.*
13. *Section 6G-02 should be referenced for information on vehicle spacing for application on other classification of roadways.*

Moving/Mobile Operations on Limited Access Highways (Multiple Lane Closure)
(Figure TTC-12.0)



Typical Traffic Control
Moving/Mobile Operations on a Multi-Lane Roadway
(Figure TTC-13.0)

NOTES

Standard:

1. **Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the shadow vehicles and work operations vehicle shall be a Type B (60" x 30") or Type C (96" x 48"). Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.**

Option:

2. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow will not be required.
3. The static warning sign and arrow board may be replaced with a vehicle-mounted CMS with a minimum character height of 10".
4. Arrow direction and designation may change as needed.

Guidance:

5. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of moving operation. Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
6. *Actual conditions could dictate more traffic control device needs in the operation. On high speed, high volume roads, a shadow vehicle on the shoulder with an arrow board and sign should be used. Also, in certain situations, appropriate stationary signing (SPRAYING NEXT 5 MILES (W21-V5)) could be used to further enhance safety.*

Standard:

7. **If Shadow Vehicle 1 cannot run completely on the shoulder and is partially in the travel lane, it shall be equipped with a truck-mounted attenuator (TMA).**
8. **When the work operations vehicle is stationary, Shadow Vehicle 2 following the work operations vehicle shall be in a position 80'-120' in advance of the work operations vehicle to provide protection. When the work operations vehicle is moving, Shadow Vehicle 2 following the work operations vehicle shall follow at a distance of 240'±.**

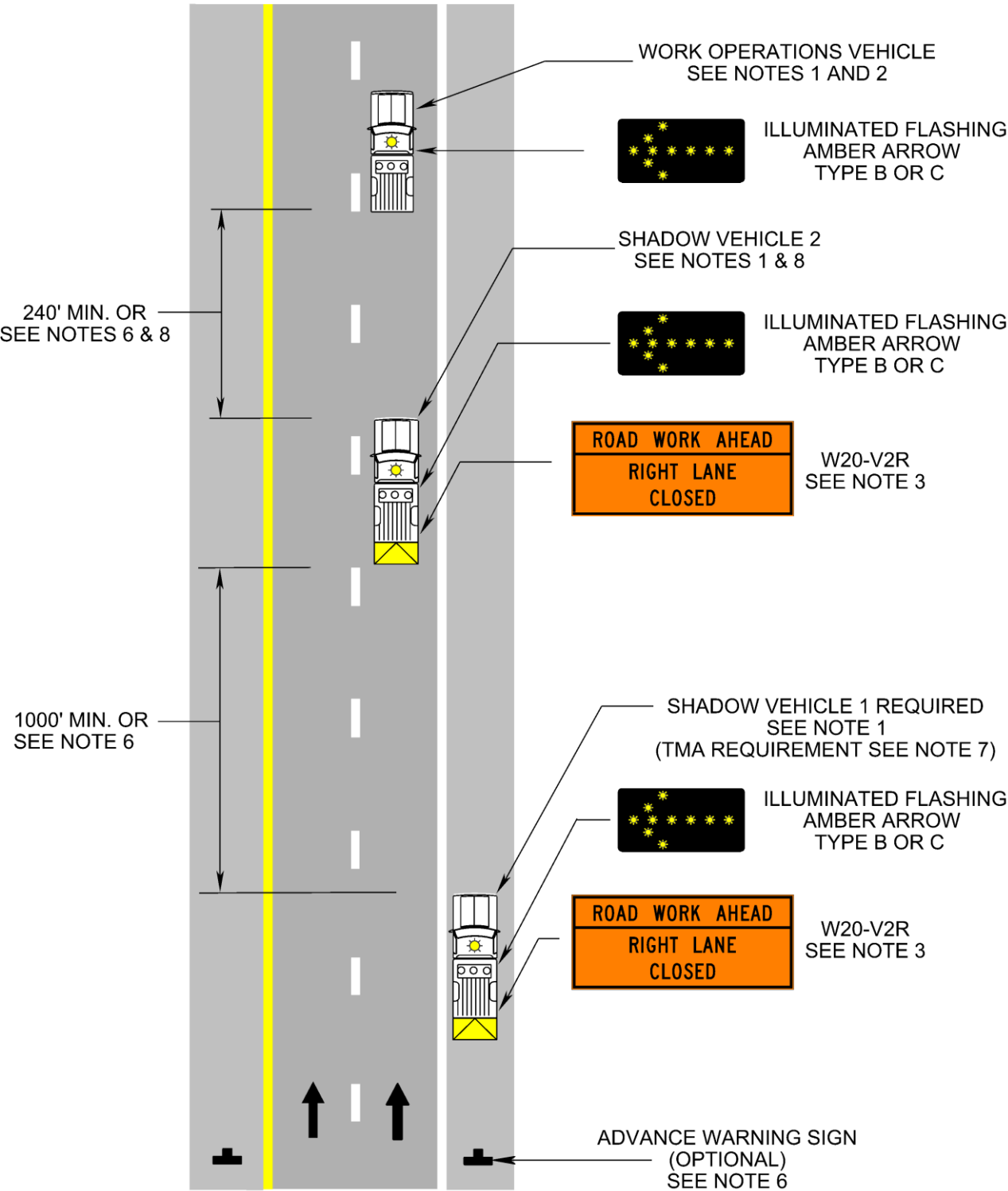
Option:

9. For inside lane closure operations, Shadow Vehicle 1 may be positioned on the right shoulder without arrow designation but displaying the caution mode.
10. When the operation is completely off the travelway, only one shadow vehicle will be required. A truck-mounted attenuator will not be required. The second line of the sign message shall be changed to "Right Shoulder" and the arrows shall be changed to the four corner caution mode.

Guidance:

11. *When using a CMS to replace the static sign and arrow board, each word message phase should be followed by the Type B arrow display.*

Moving/Mobile Operations on a Multi-Lane Roadway
(Figure TTC-13.0)



Typical Traffic Control
Moving/Mobile Operations on a Two-Lane Roadway
(Figure TTC-14.0)

NOTES

Standard:

- 1. Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the advance warning vehicles and work operations vehicle shall be a Type B (60" x 30") or Type C (96" x 48"). Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.**
- 2. Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inches above the pavement and mounted in a manner such that equipment or supplies do not obscure them. Sign legends shall be covered or turned from view when work is not in progress.**
- 3. If using an arrow board on the shadow vehicle, it shall operate in the four corner caution mode.**

Guidance:

- 4. Where practical and when needed, the work and shadow vehicles should pull over periodically to allow motor vehicle traffic to pass.*
- 5. Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance from the work vehicle and proceed at the same speed. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
- 6. A truck-mounted attenuator should be used on the shadow vehicle.*

Option:

7. The distance between the work and shadow vehicles may vary according to speed, terrain, paint drying time, and other factors.

Guidance:

- 8. If the work and shadow vehicles cannot pull over to allow motor vehicle traffic to pass frequently, a DO NOT PASS (R4-V6) sign should be placed on the rear of the shadow vehicle blocking the lane.*

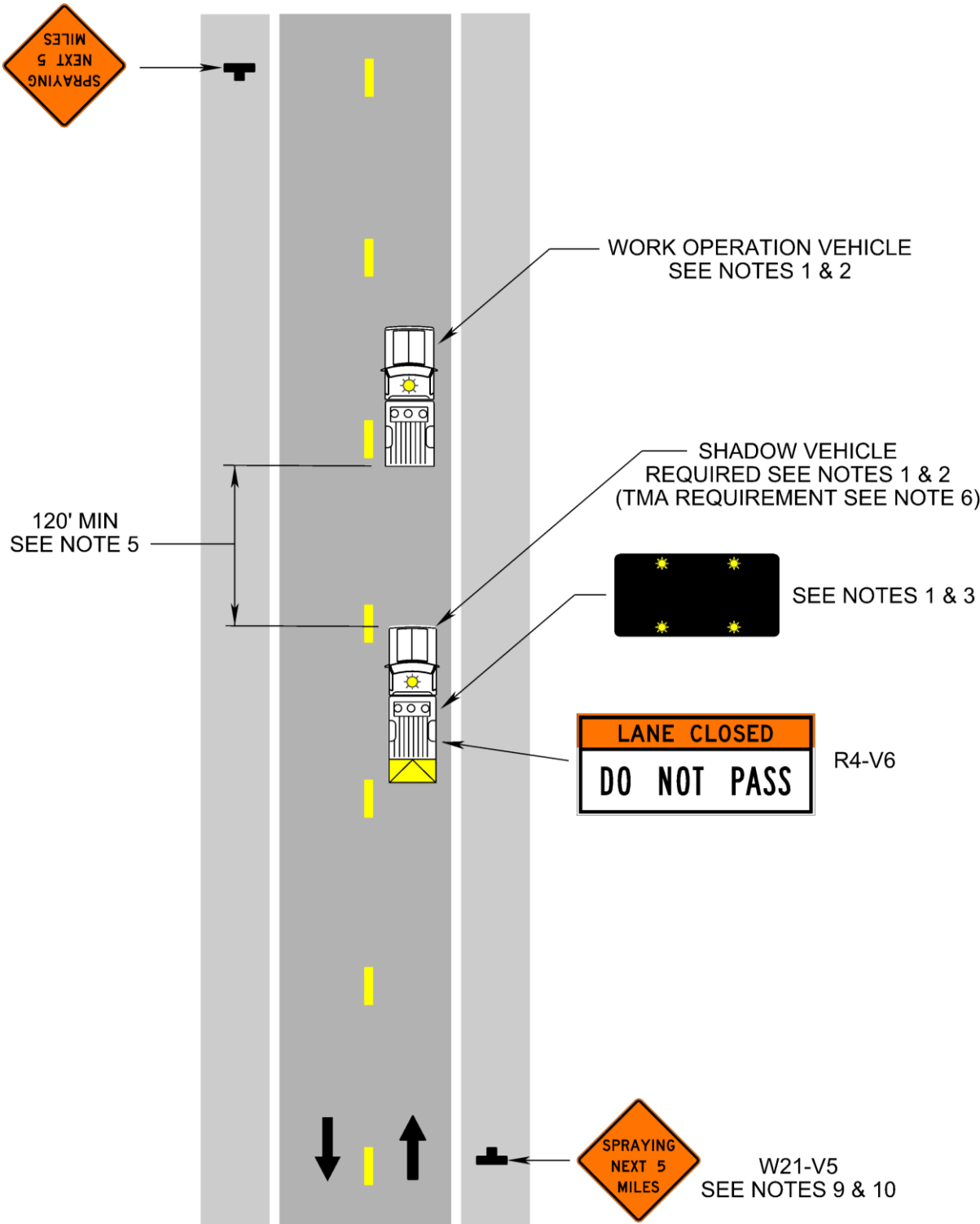
Option:

9. Signs may be fabricated to permit change of the message in the field to identify the type of moving operation (LINE PAINTING NEXT 5 MILES (W21-V4)). The maximum distance between the sign and protection vehicle is 5 miles.
10. Stationary signing may be eliminated on low volume (less than 500 vehicles per day), low speed (30 mph or less) roadways.
11. The static warning sign and caution mode arrow board may be replaced with a vehicle-mounted CMS with a minimum character height of 10".

Guidance:

- 12. When using a CMS to replace the static sign and arrow board, each word message phase should be followed by the Type B arrow board displaying the caution mode.*

Moving/Mobile Operation on a Two-Lane Roadway
(Figure TTC-14.0)



Typical Traffic Control
Short Duration Operation on a Multi-Lane Roadway
(Figure TTC-15.0)

NOTES

Standard:

1. This typical traffic control layout shall be used only during non-peak travel periods with the approval of the Regional Traffic Engineer. This typical traffic control layout shall not be used for Limited Access highways or two-lane roadways.
2. Each vehicle involved in the operation shall have either an arrow board operating in the caution mode, or at least one high-intensity amber rotating, oscillating, or strobe light. Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.
3. Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inches above the pavement.

Guidance:

4. *The minimum distance between the sign/shadow vehicle and the truck-mounted attenuator (TMA) vehicle should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Option:

5. The static warning sign and arrow board may be replaced with a vehicle-mounted CMS with a minimum character height of 10".

Standard:

6. If Shadow Vehicle 1 occupies any part of the travel lane, it shall be equipped with a TMA. A truck-mounted attenuator (TMA) shall be used on Shadow Vehicle 2 in the travelway regardless of the posted speed limit.

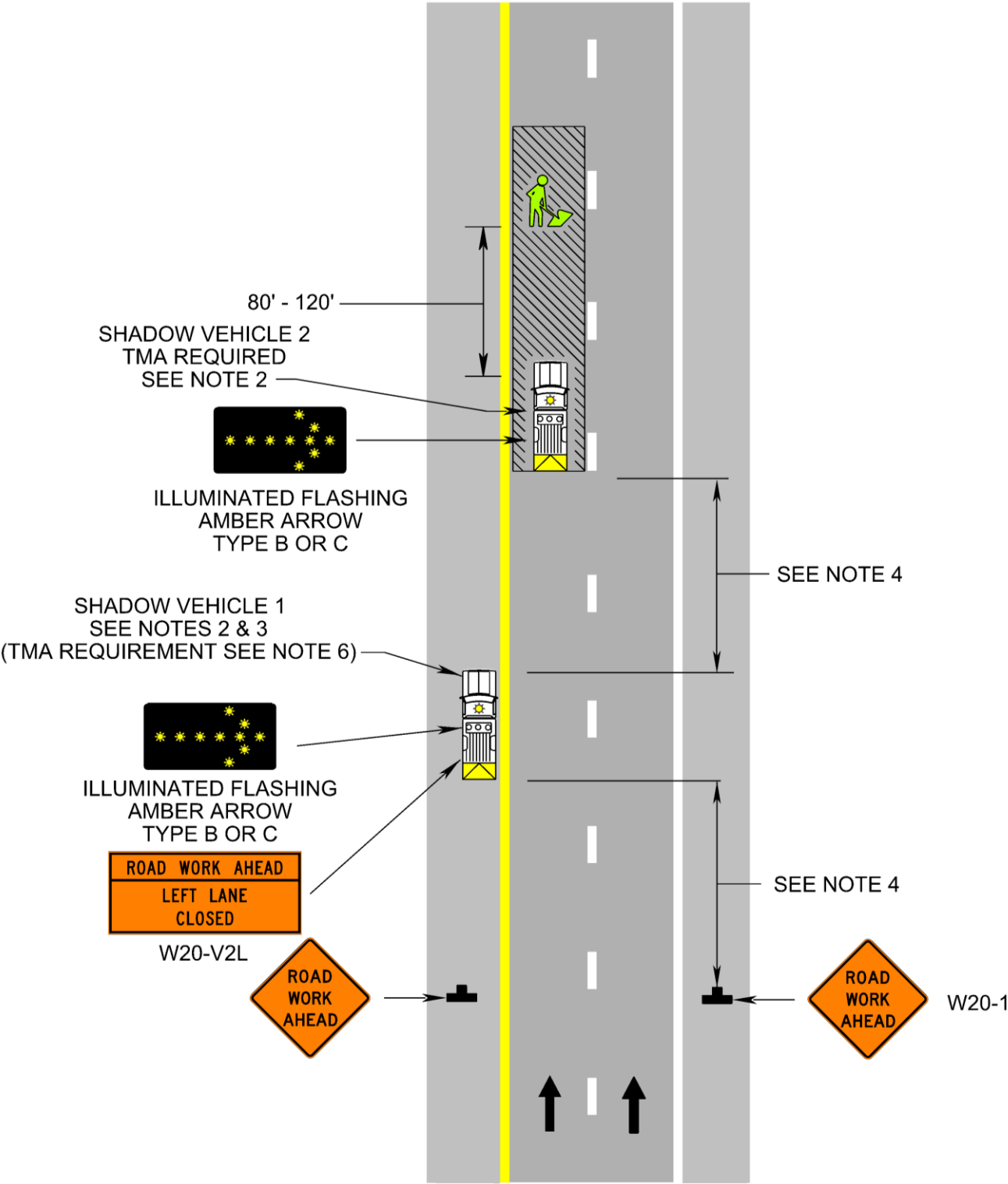
Guidance:

7. *When using a CMS to replace the arrow board, each word message phase should be followed by the Type B arrow display.*

Support:

8. A short duration operation is defined as an operation that requires 16 minutes to 60 minutes to perform in the immediate area. (The immediate area is defined as a 1000' \pm linear distance.)

Short Duration Operation on a Multi-Lane Roadway
(Figure TTC-15.0)



Typical Traffic Control
Outside Lane Closure Operation on a Four-Lane Roadway
(Figure TTC-16.0)

NOTES

Standard:

1. On divided highways having a median wider than 8', right and left sign assemblies shall be required.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers, and their activities should be restricted to one side of the pavement.

Standard:

5. Taper Length (L) and Channelizing Device Spacing shall be:

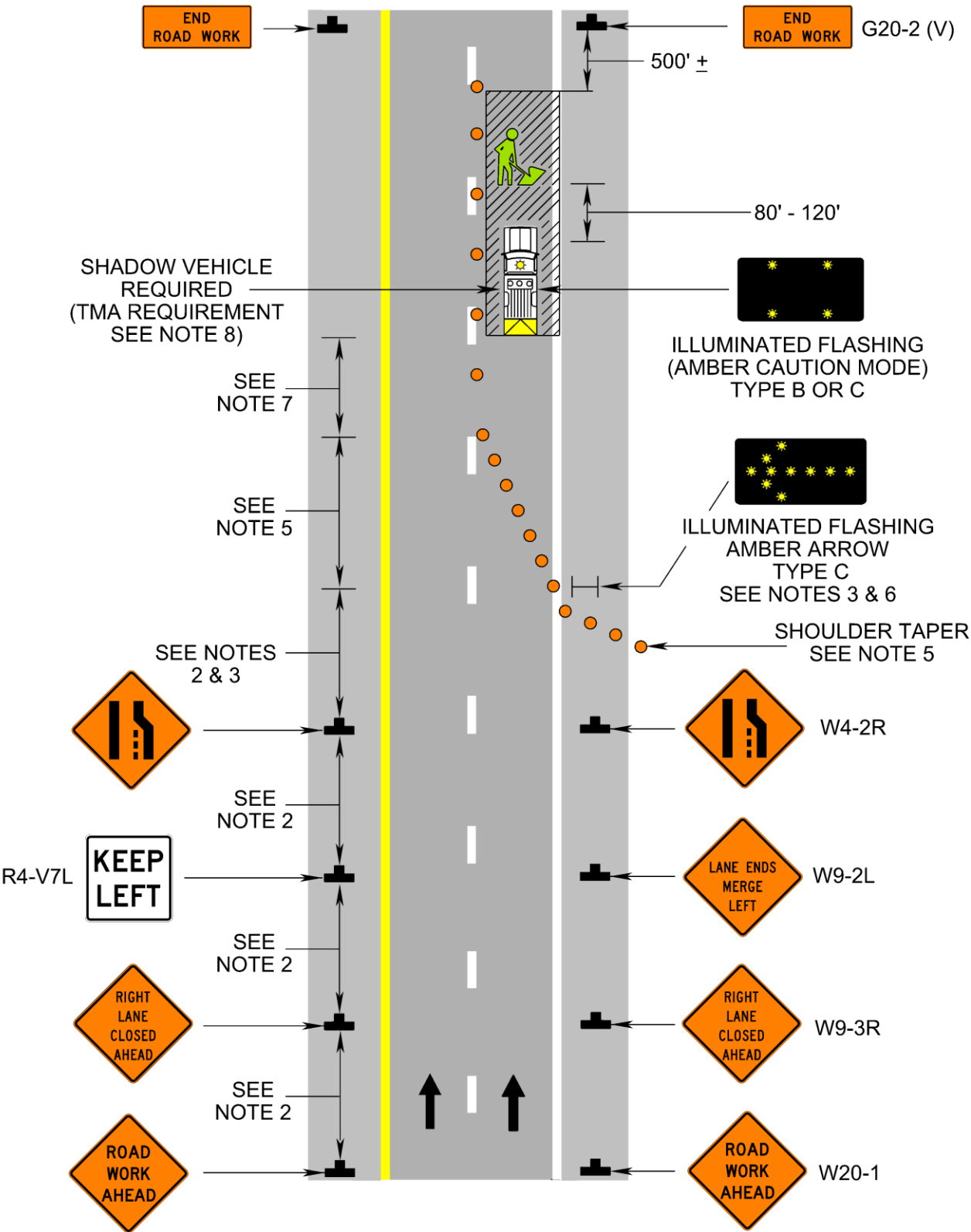
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. An arrow board shall be used when a lane is closed. When more than one lane is closed, a separate arrow board shall be used for each closed lane (see Figure TTC-18).
7. The buffer space length shall be shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
8. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity amber rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
9. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
10. When a side road intersects the highway within the TTC zone, additional TTC devices shall be placed as needed.

Outside Lane Closure Operation on a Four-Lane Roadway
(Figure TTC-16.0)



Typical Traffic Control
Inside Lane Closure Operation on a Four-Lane Roadway
(Figure TTC-17.0)

NOTES

Standard:

1. On divided highways having a median wider than 8', right and left sign assemblies shall be required.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers, and their activities should be restricted to one side of the pavement.

Standard:

5. Taper length (L) and channelizing device spacing shall be:

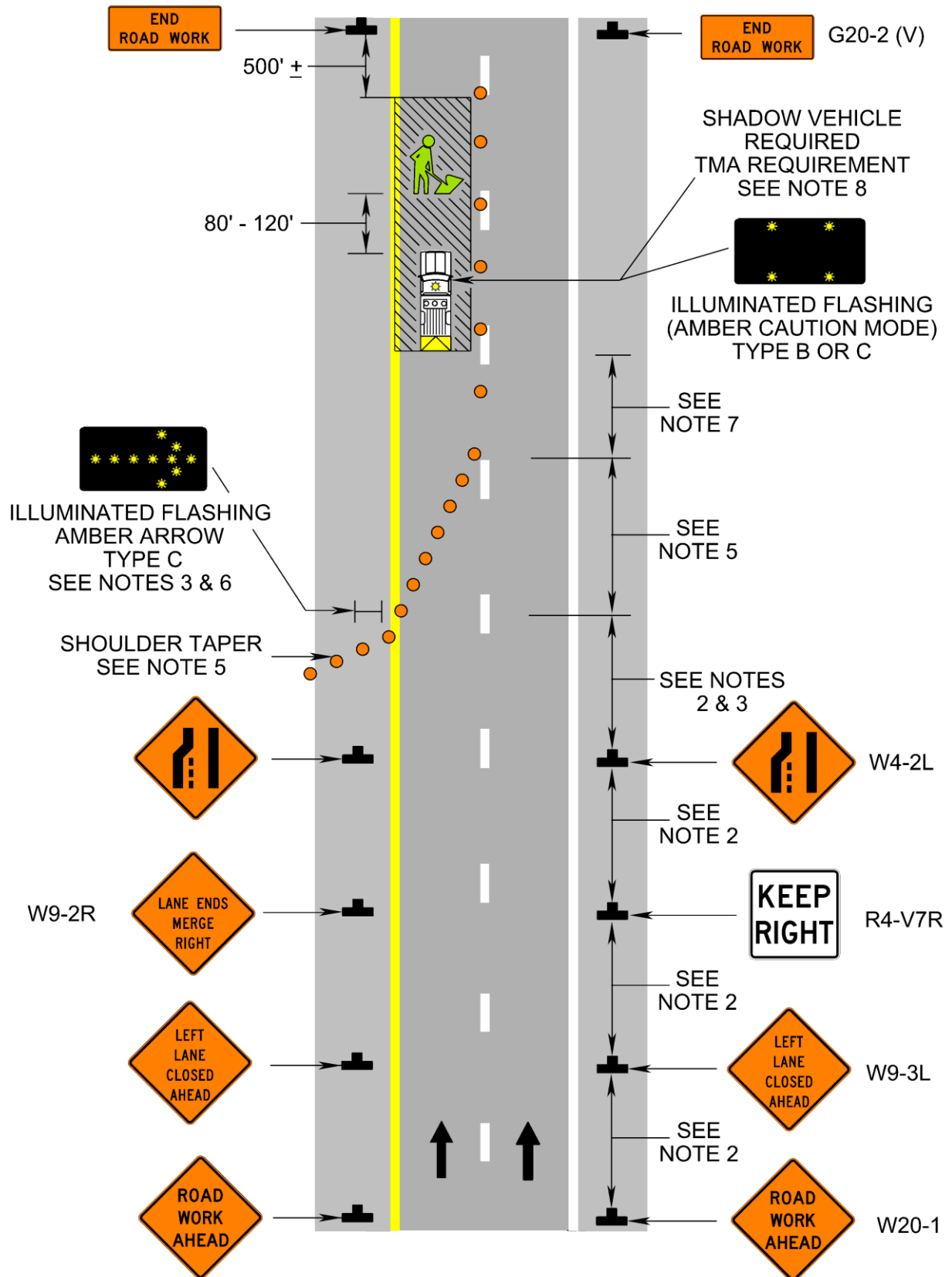
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. An arrow board shall be used when a lane is closed. When more than one lane is closed, a separate arrow board shall be used for each closed lane (see Figure TTC-18).
7. The buffer space length shall be shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
8. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
9. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
10. When a side road intersects the highway within the TTC zone, additional TTC devices shall be placed as needed.

Inside Lane Closure Operation on a Four-Lane Roadway (Figure TTC-17.0)



Typical Traffic Control
Multi-Lane Closure Operation
(Figure TTC-18.0)

NOTES

Standard:

1. On divided highways having a median wider than 8', right and left sign assemblies shall be required.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers, and their activities should be restricted to one side of the pavement.

Standard:

5. Taper length (L) and channelizing device spacing shall be:

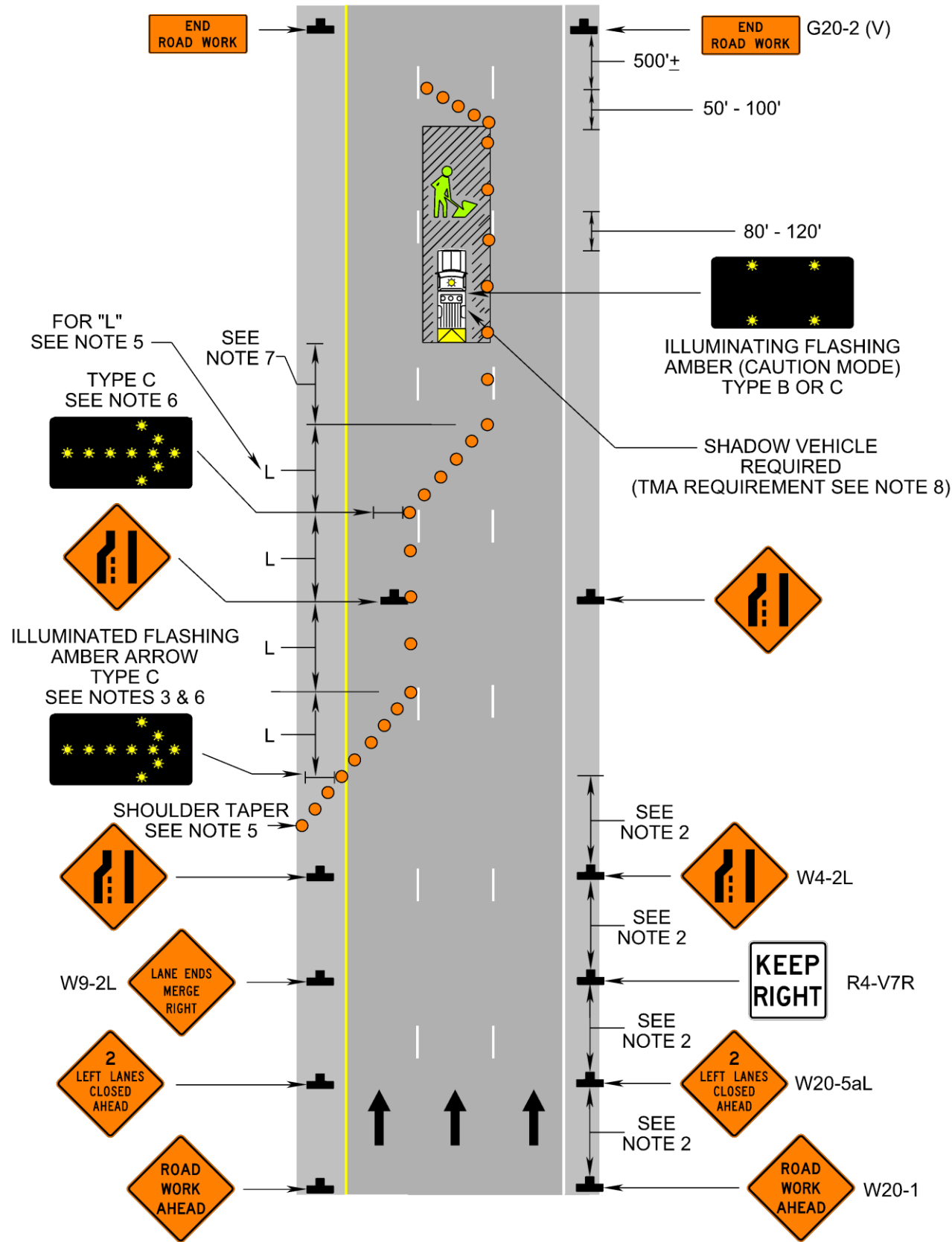
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. An arrow board shall be used when a lane is closed. When more than one lane is closed, a separate arrow board shall be used for each closed lane.
7. The buffer space length shall be shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
8. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
9. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
10. When a side road intersects the highway within the TTC zone, additional TTC devices shall be placed as needed.

Multi-Lane Closure Operation
(Figure TTC-18.0)



Typical Traffic Control
Lane Closure Operation with Lane Weave
(Figure TTC-19.0)

NOTES

Standard:

1. On divided highways having a median wider than 8', right and left sign assemblies shall be required.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers, and their activities should be restricted to one side of the pavement.

Standard:

5. Taper length (L) and channelizing device spacing shall be:

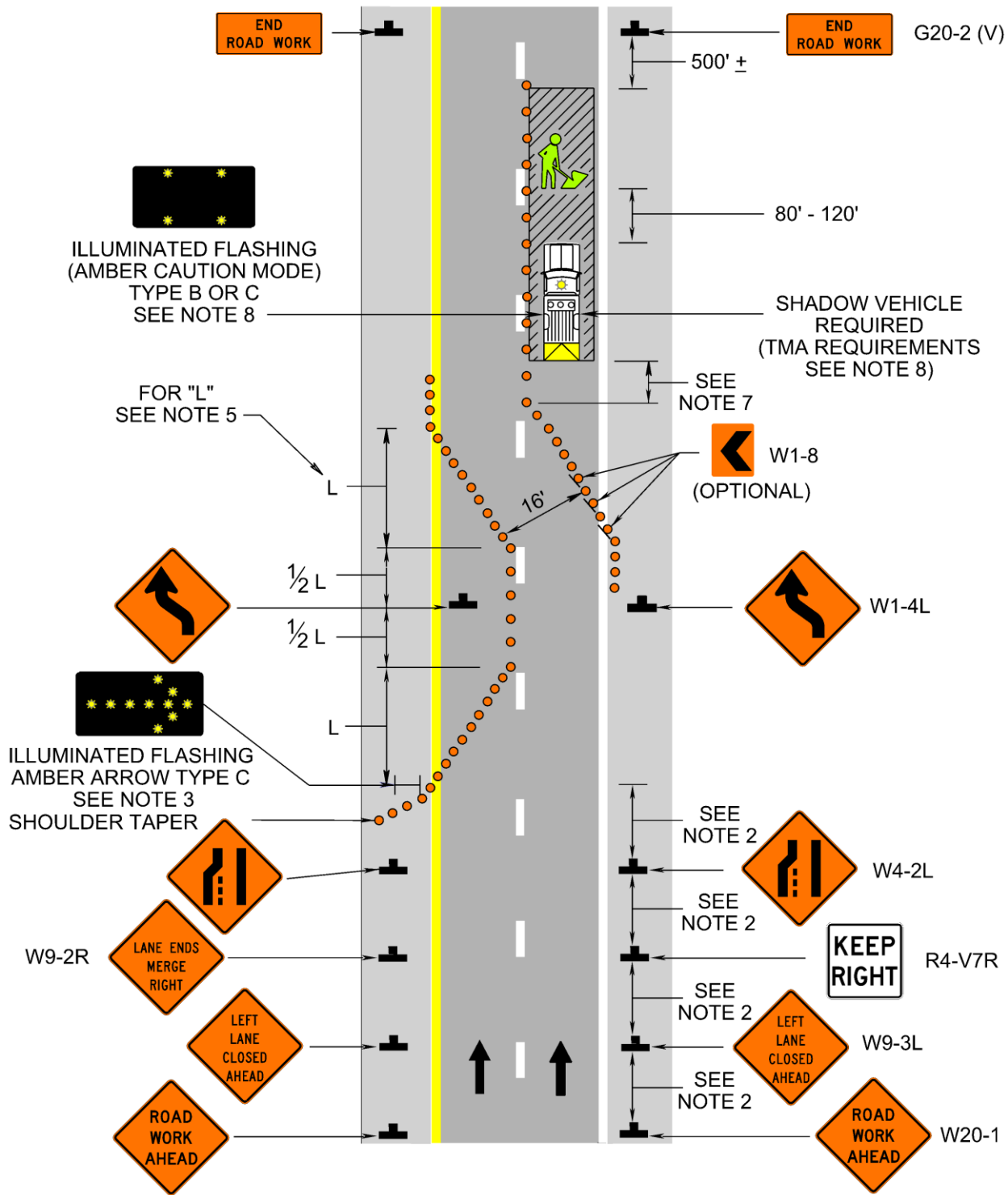
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	9	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. An arrow board shall be used when a lane is closed. When more than one lane is closed, a separate arrow board shall be used for each closed lane.
7. The buffer space length shall be shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
8. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
9. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
10. When a side road intersects the highway within the TTC zone, additional TTC devices shall be placed as needed.

Lane Closure Operation with Lane Weave
(Figure TTC-19.0)



Typical Traffic Control
Lane Closure Operation with Concrete Traffic Barrier
(Figure TTC-20.0)

NOTES

Guidance:

1. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. **SHOULDER CLOSED (W21-5a)** signs should be used on Limited-Access Highways where there is no opportunity for disabled vehicles to pull off the roadway (see Figure TTC-6).
3. If drivers cannot see a pull-off area beyond the closed shoulder, information regarding the length of the shoulder closure should be provided in feet or miles, as appropriate.
4. An emergency pull-off area should be provided per Section 6G.18 and Temporary Traffic Control Figure TTC-8.

Standard:

5. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
6. Group 2 channelizing device spacing shall be at the following:

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

7. Length of pavement marking transition (L) is equal to Posted Speed (S) times the Width of Transition (W) (Example: 55 mph x 12'=660'), 1000' minimum for Limited Access highways.
8. Barrier transition slope ratio shall be as follows:

Speed Limit (mph)	Slope Ratio	Speed Limit (mph)	Slope Ratio	Speed Limit (mph)	Slope Ratio
70	22:1	55	17:1	40	13:1
65	20:1	50	16:1	35	11:1
60	19:1	45	14:1	≤30	10:1

When the barrier transition slope is on a horizontal alignment, the total offset shall be prorated around the curve in lieu of a straight-line slope.

9. End treatment of a barrier in order of preference:
 - a. Where guardrail exists, attach to barrier with appropriate fixed object attachment.
 - b. Where cut slope exists, bury barrier into cut slope and provide for drainage as needed.
 - c. Extend end of barrier until it is beyond the established clear zone (see Figure 2 on Page A-4 of Appendix A for clear zone values).
 - d. When barrier end is inside the established clear zone, attenuator service Type I or Type II shall be used. Refer to L&D special design drawings.
10. Barrier panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 80' on centers along the parallel or tangent sections and 40' on centers along the transition or taper sections. ReflectORIZED surface shall be fluorescent orange prismatic lens sheeting. The light at the beginning of the barrier run and at the breakpoint where the barrier becomes parallel to the roadway shall be a Type B flashing light. Barrier delineators shall be installed along the traffic side of the concrete barrier in-between and at the same spacing as the barrier panels approximately 24 inches up from the roadway surface.

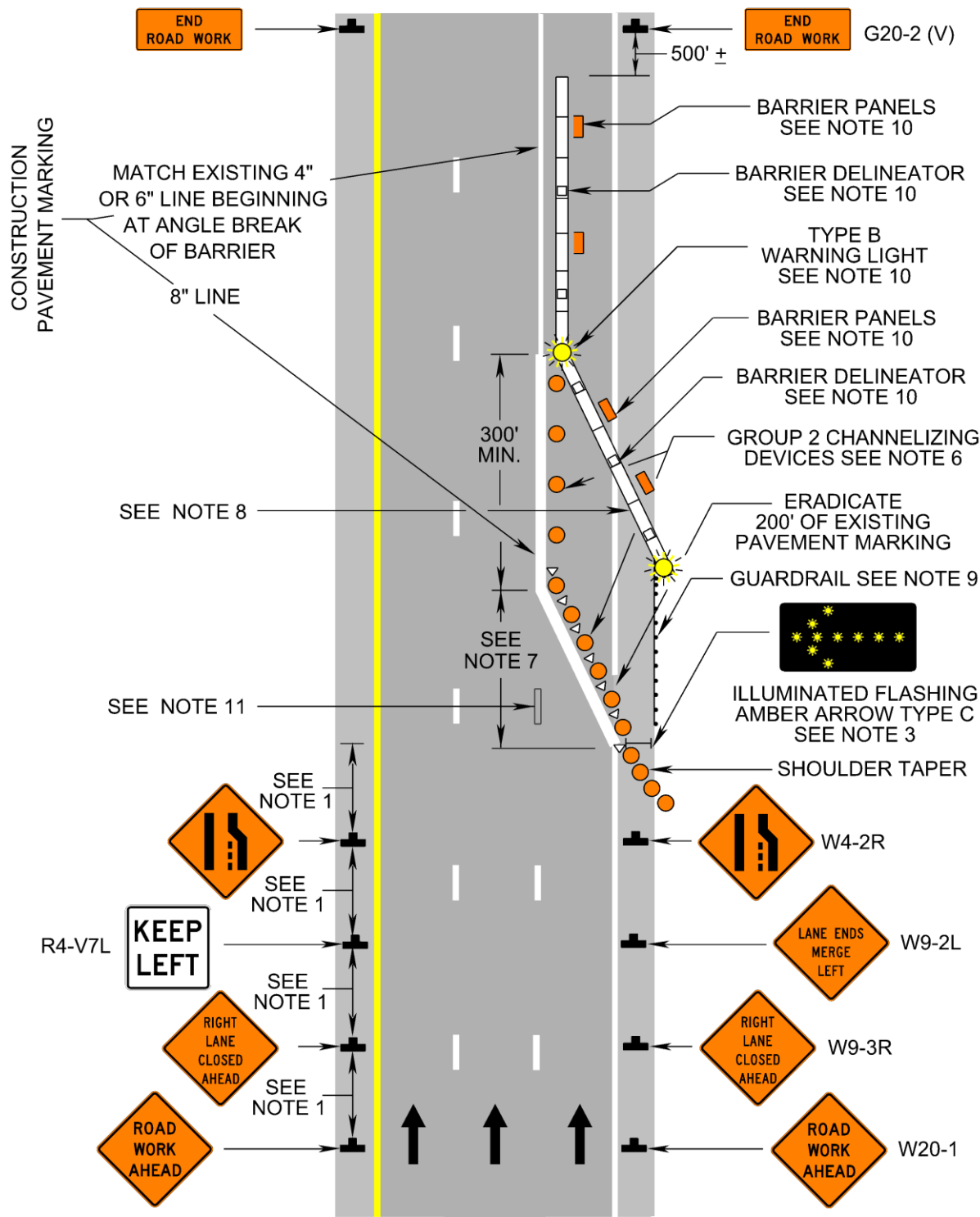
Guidance:

11. Eradication of existing pavement markings should be as shown in Figure TTC-55.

Option:

12. The barrier shown in this typical application is an example of one method that may be used to close a shoulder on a long-term project.

Lane Closure Operation with Concrete Traffic Barrier
(Figure TTC-20.0)



Typical Traffic Control
Center Turn Lane Closure Operation
(Figure TTC-21.0)

NOTES

Guidance:

1. *The distance between signs and beginning of channelizing device transition should be a minimum of 500' and a maximum of 800'.*
2. *The buffer space length should be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.*
3. *For locations with a high volume of left turning movements, the graphic NO LEFT TURN (R3-2) signs should be used within the closed lane.*

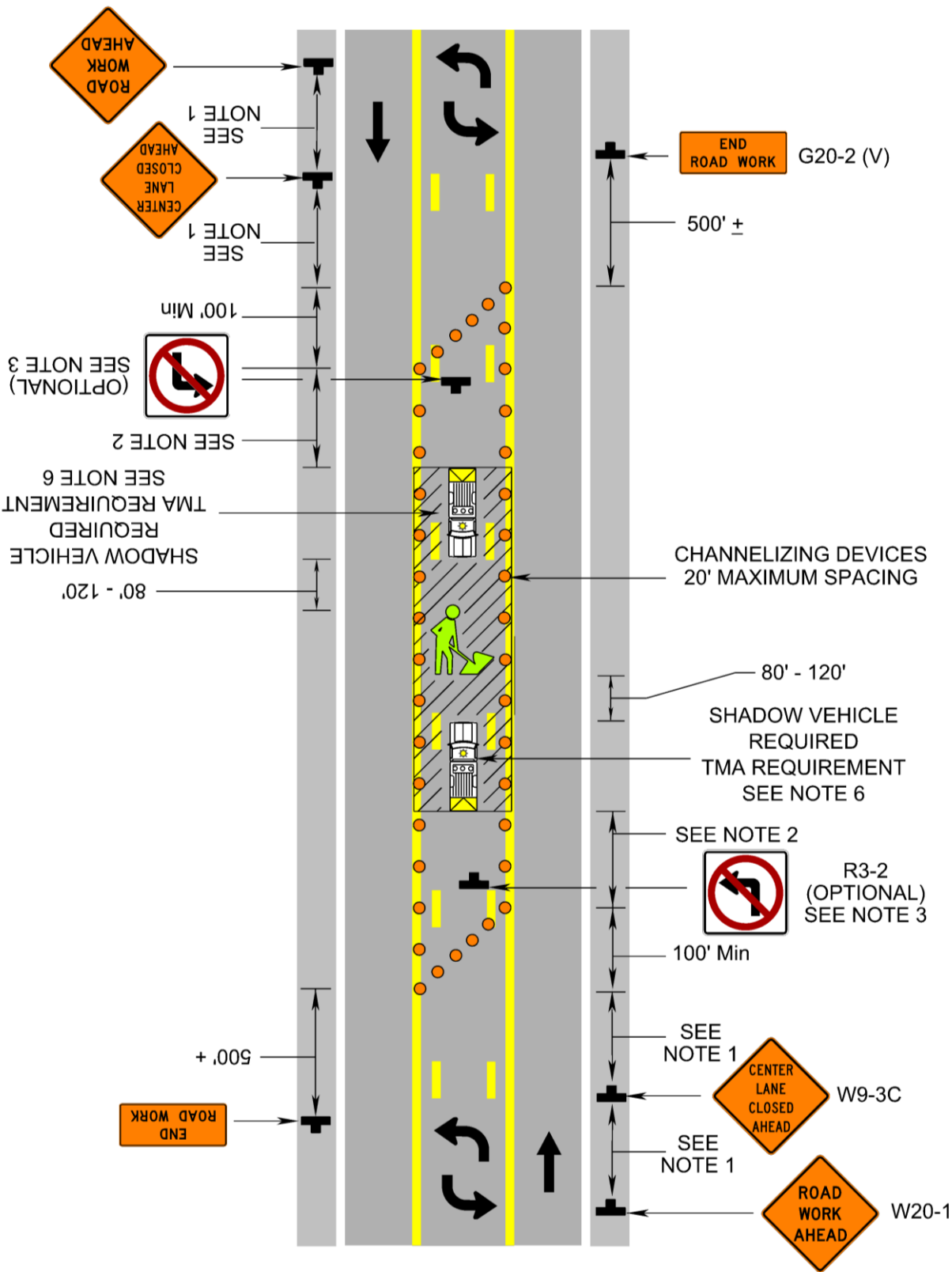
Option:

4. Where Right-of-Way or geometric conditions prevent use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

5. **To prevent vehicles from entering into the work zone, channelizing device spacing shall be a maximum of 20' on center.**
6. **A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 80'-120' in advance of the work crew in both directions of travel. If multiple lanes are present (four or more lanes, excluding the center turn lane) and the posted speed limit is 45 mph or greater, the vehicles shall be equipped with a truck-mounted attenuator (TMA).**
7. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**

Center Turn Lane Closure Operation
(Figure TTC-21.0)



Typical Traffic Control
Right Lane Closure Operation on a Three-Lane Roadway
(Figure TTC-22.0)

NOTES

Guidance:

1. The distance between signs and beginning of channelizing device transition should be a minimum of 500' and a maximum of 800'.
2. The buffer space length should be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
3. For locations with a high volume of left turning movements, the graphic NO LEFT TURN (R3-2) signs should be used within the closed lane.

Option:

4. Where Right-of-Way or geometric conditions prevent use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

5. Taper length (L) and channelizing device spacing shall be :

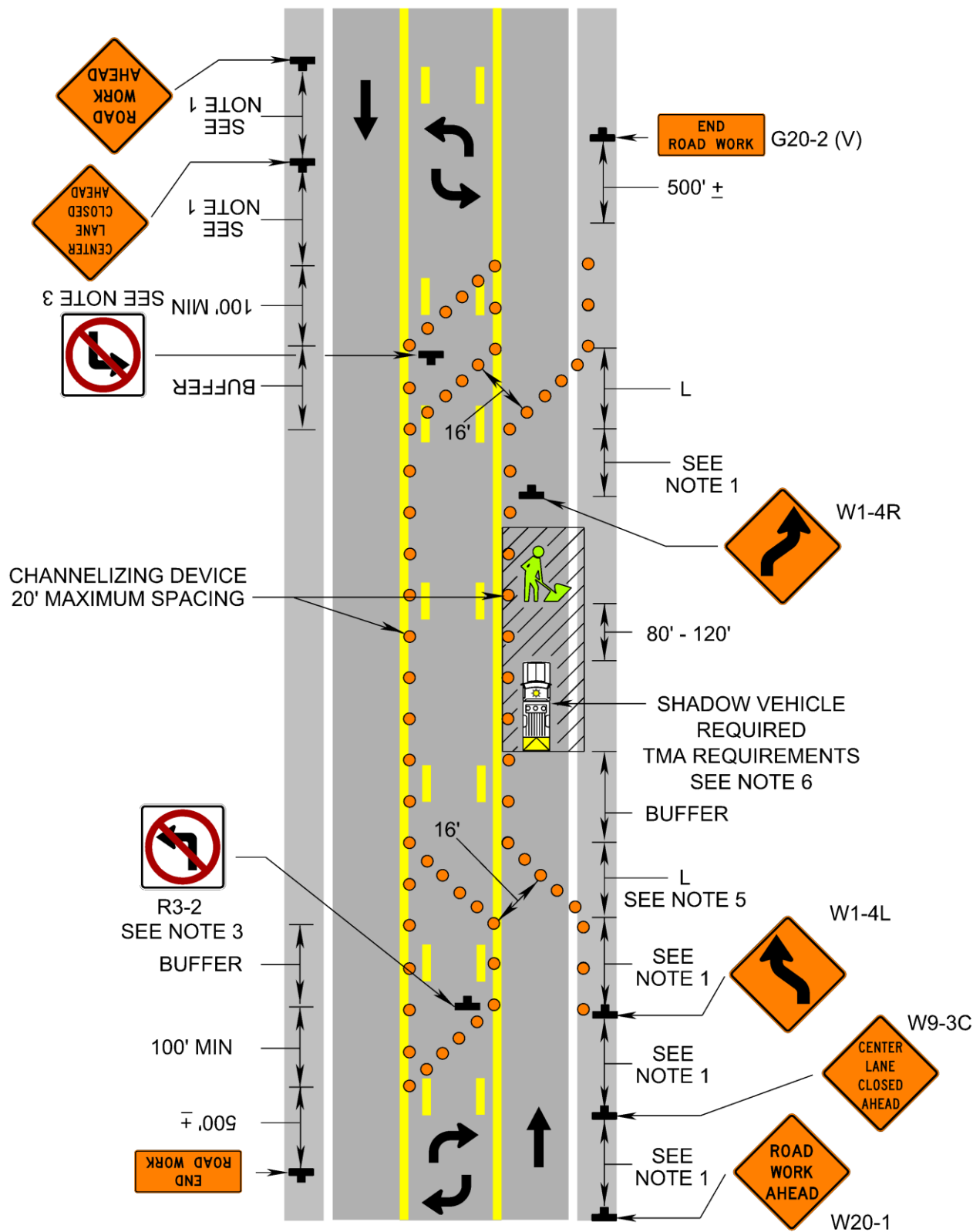
Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. To prevent vehicles from entering into the work zone, channelizing device spacing shall be a maximum of 20' on center.
7. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 80'-120' in advance of the work crew in both directions of travel. If multiple lanes are present (four or more lanes, excluding the center turn lane) and the posted speed limit is 45 mph or greater, the vehicles shall be equipped with a truck-mounted attenuator (TMA).
8. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.
9. For long-term work zones existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per Figure TTC-60.

Right Lane Closure Operation on a Three-Lane Roadway
(Figure TTC-22.0)



Typical Traffic Control
Lane Closure on a Two-Lane Roadway Using Flaggers
(Figure TTC-23.0)

NOTES

Guidance:

1. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.
2. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. Generally speaking, motorists should have a clear line of sight from the graphic flagger symbol sign to the flagger.

Option:

3. Where Right-of-Way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

4. Flagging stations shall be located far enough in advance of the work space to permit approaching traffic to reduce speed and/or stop before passing the work space and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-3 on Page 6H-5).
5. All flaggers shall be state certified and have their certification card in their possession when performing flagging duties (see Section 6E.01, Qualifications for Flaggers).
6. Cone spacing shall be at the following:

Location	Posted Speed Limit (mph)	
	0 – 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

7. A shadow vehicle with at least one high intensity amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first work crew.

Option:

8. A supplemental flagger may be required in this area to give advance warning of the operation ahead by slowing approaching traffic prior to reaching the flagger station or queued traffic.

Guidance:

9. If the queue of traffic reaches the BE PREPARED TO STOP (W3-4) sign, then the signs should be readjusted at greater distances.
10. When a highway-rail crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the highway-rail grade crossing, the temporary traffic control zone should be extended so that the transition area precedes the highway-rail crossing (see Figure TTC-56 for additional information on highway-rail crossings).

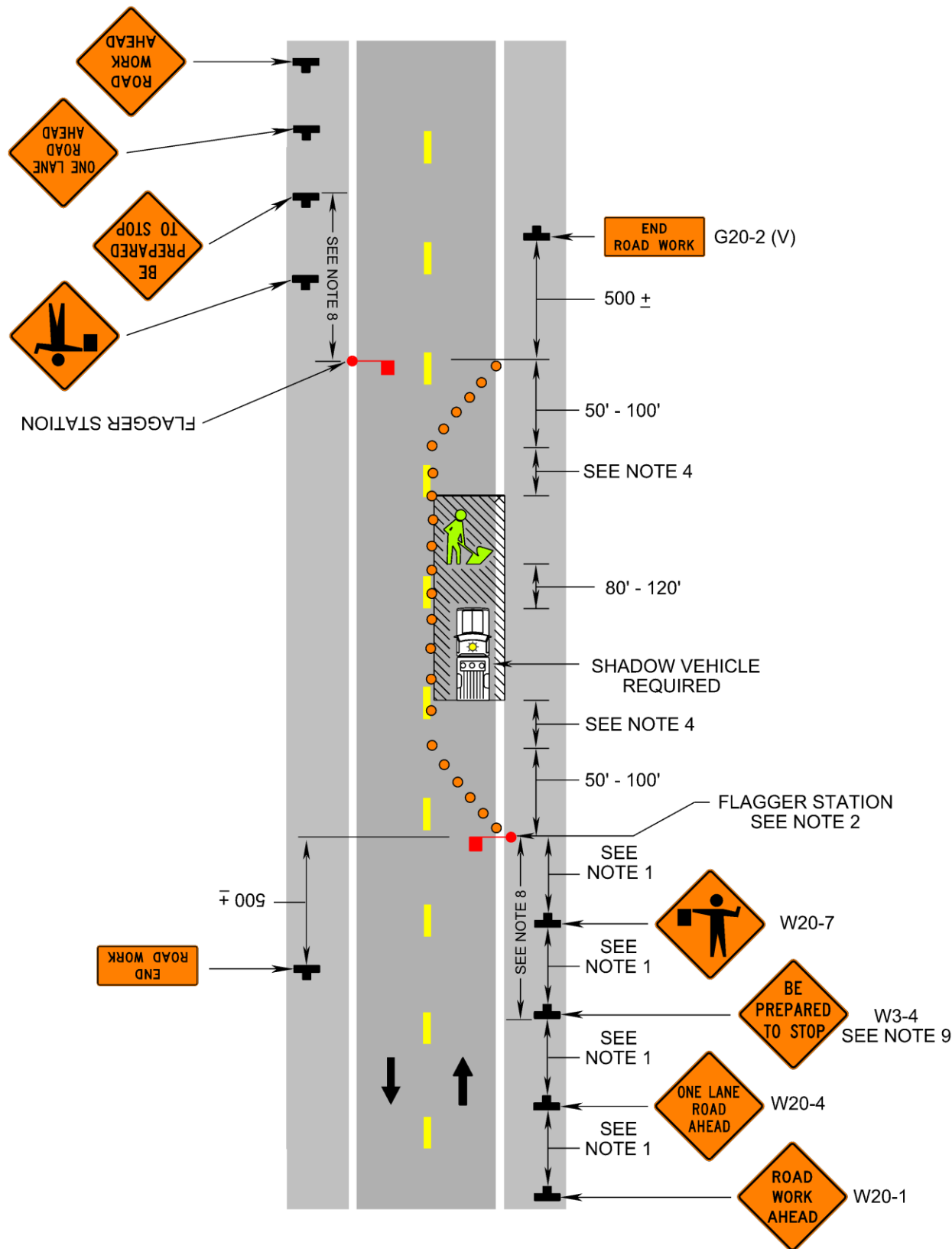
Standard:

11. At night, flagger stations shall be illuminated, except in emergencies (see Section 6E.08).

Option:

12. Cones may be eliminated when using a pilot vehicle operation or when the total roadway width is 20 feet or less.
13. For low-volume situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions, a single flagger, positioned to be visible to road users approaching from both directions, may be used (see Chapter 6E).

Lane Closure on a Two-Lane Roadway Using Flaggers
(Figure TTC-23.0)



Typical Traffic Control
Non-Stationary Operation on a Two-Lane Roadway Using Flaggers
(Figure TTC-24.0)

NOTES

Guidance:

1. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. Generally speaking, motorists should have a clear line of sight from the graphic flagger symbol sign to the flagger.*

Option:

3. Where Right-of-Way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

4. **Flagging stations shall be located far enough in advance of the work space to permit approaching traffic to reduce speed and/or stop before passing the work space and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-3 on Page 6H-5).**
5. **The Flagger (W20-7) symbol sign shall stay within ½ mile of each flagger.**

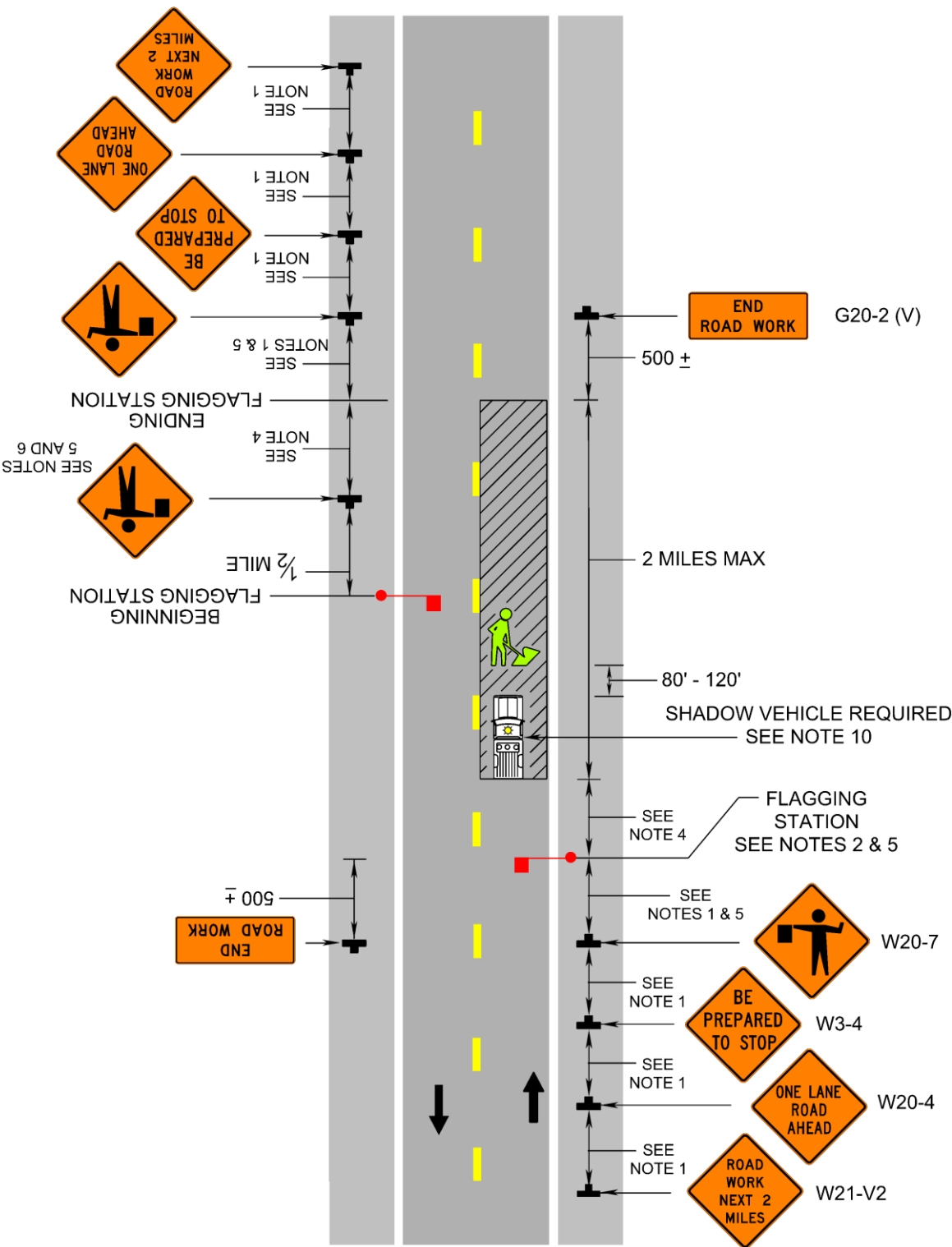
Guidance:

6. *Additional Flagger symbol signs should be placed at ½ mile intervals and either erected by the approaching flagger, or taken down as the operation proceeds past this point.*
7. *When a highway-rail crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the highway-rail grade crossing, the temporary traffic control zone should be extended so that the transition area precedes the highway-rail crossing (see Figure TTC-56 for additional information on highway-rail crossings).*
8. *If the queue of traffic reaches the BE PREPARED TO STOP (W3-4) sign, then the advance warning signs should be readjusted at greater distances.*

Standard:

9. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties (see Section 6E.01, Qualifications for Flaggers).**
10. **A shadow vehicle with at least one amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first work crew.**
11. **The maximum length of the work area shall be two miles.**

Non-Stationary Operation on a Two-Lane Roadway Using Flaggers
(Figure TTC-24.0)



Typical Traffic Control
Lane Closure Operation on a Two-Lane Roadway Using Traffic Control Signals
(Figure TTC-25.0)

NOTES

Standard:

1. TTC signals shall be planned, installed and operated in accordance with the provisions of Part 4 of the 2009 MUTCD, the Road and Bridge Specifications, and the Road and Bridge Standards.
2. TTC signal timing shall be established by the appropriate approving agency. Duration of red clearance intervals shall be adequate to clear the one-lane section of conflicting vehicles.
3. When the TTC signal is changed to the flashing mode, either manually or automatically, red signal indications shall be flashed to both approaches.
4. Stop lines shall be installed with TTC signals for intermediate and long-term closures. Existing conflicting pavement markings and raised pavement marker reflectors between the activity area and the stop lines shall be removed. After the TTC signal is removed, the stop lines and other temporary pavement markings shall be removed and the permanent pavement markings restored.
5. Safeguards shall be incorporated to avoid the possibility of conflicting signal indications at each end of the TTC zone.
6. A RESTRICTED WIDTH ROUTE (R5-V1) sign shall be installed on roadways where construction/maintenance activities exist with physical barriers on both sides of a single lane and the clear distance is less than 14 feet. The signs shall also be installed in advance of the last alternate route.
7. The Regional Traffic Engineer shall determine speed reductions.
8. An engineering study shall be conducted to determine if intersection(s) and entrance(s) within the work zone need signalization and the use of positive barrier versus channelizing devices shall be determined. Group 2 channelizing device spacing shall be at the following:

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per ¼ mile.		

9. The buffer space length shall be shown in Table 6H-3 on Page 6H-5 for the posted speed limit.

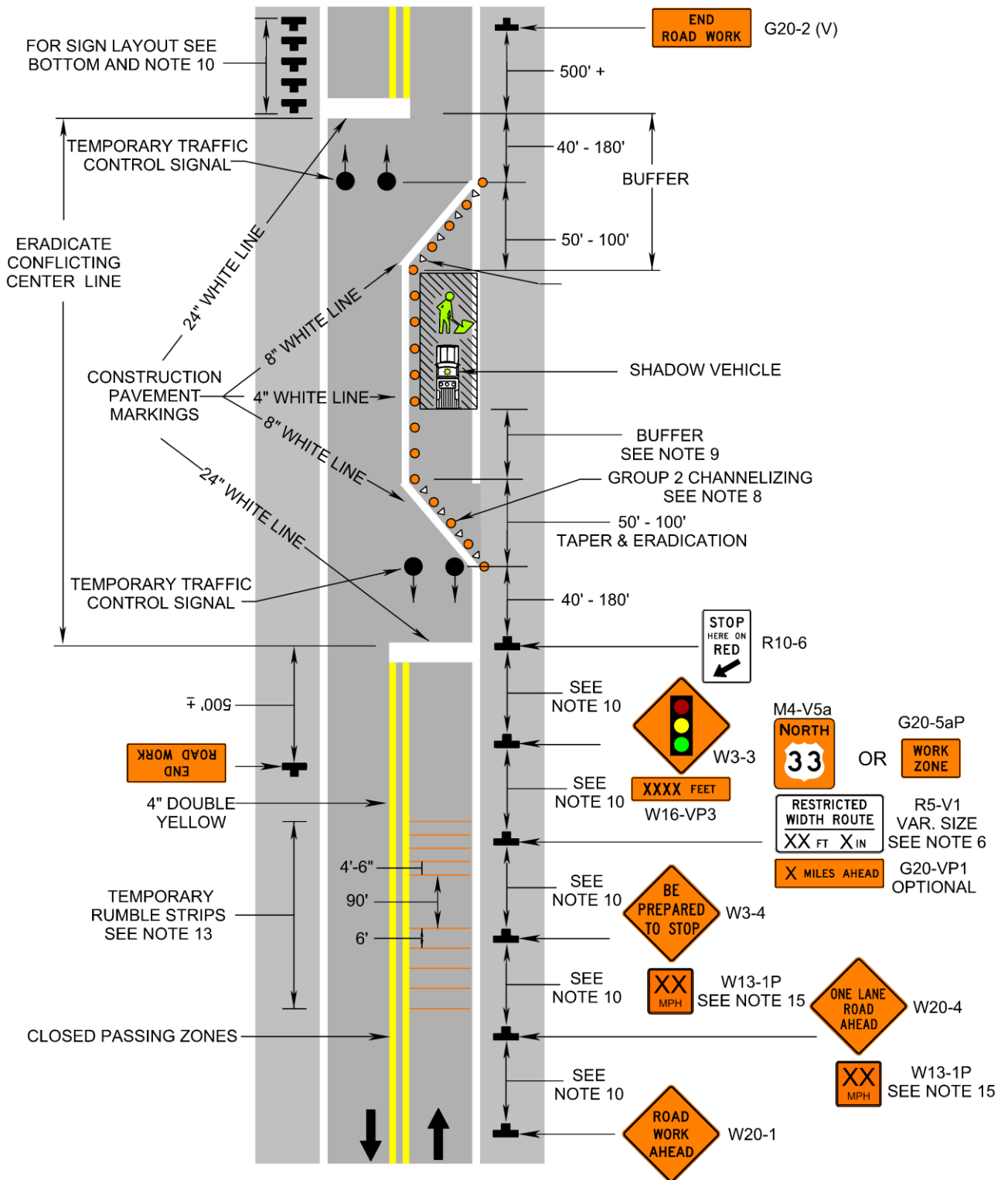
Guidance:

10. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph. Refer to Table 6C-1, Spacing of Advance Warning Signs for urban sign spacing. Adjustments in the location of the advance warning signs should be made as needed to accommodate the horizontal or vertical alignment of the roadway.
11. Where no-passing lines are not already in place, they should be added.
12. Additional RESTRICTED WIDTH ROUTE (R5-V1) signs should be installed on the approaches of the alternate route to alert traffic intending to turn onto the restricted route.

Option:

13. Temporary rumble strips may be used to enhance the work zone.
14. Flashing warning lights may be used on advance warning signs.
15. Advisory Speed (W13-1P) plaques may be added to the ONE LANE ROAD AHEAD (W20-4) and BE PREPARED TO STOP (W3-4) signs as directed by the Regional Traffic Engineer.
16. Temporary Signals may be replaced with either a STOP (R1-1) condition or YIELD (R1-2) condition based on an engineering study and approval of the Regional Traffic Engineer.

Lane Closure Operation on a Two-Lane Roadway Using Traffic Control Signals (Figure TTC-25.0)



Typical Traffic Control
Lane Closure Operation – Near Side of an Intersection
(Figure TTC-26.0)

NOTES

Guidance:

1. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, 500'-800' where the posted speed limit is greater than 45 mph.

Standard:

2. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
3. Taper length (L) and channelizing device spacing shall be:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

On three or more lane roadways, the merging tapers shall be installed as shown in TTC-18.

Guidance:

4. If room permits, a shadow vehicle with at least one rotating, oscillating, or amber strobe light should be parked 80'-120' in advance of the first work crew.

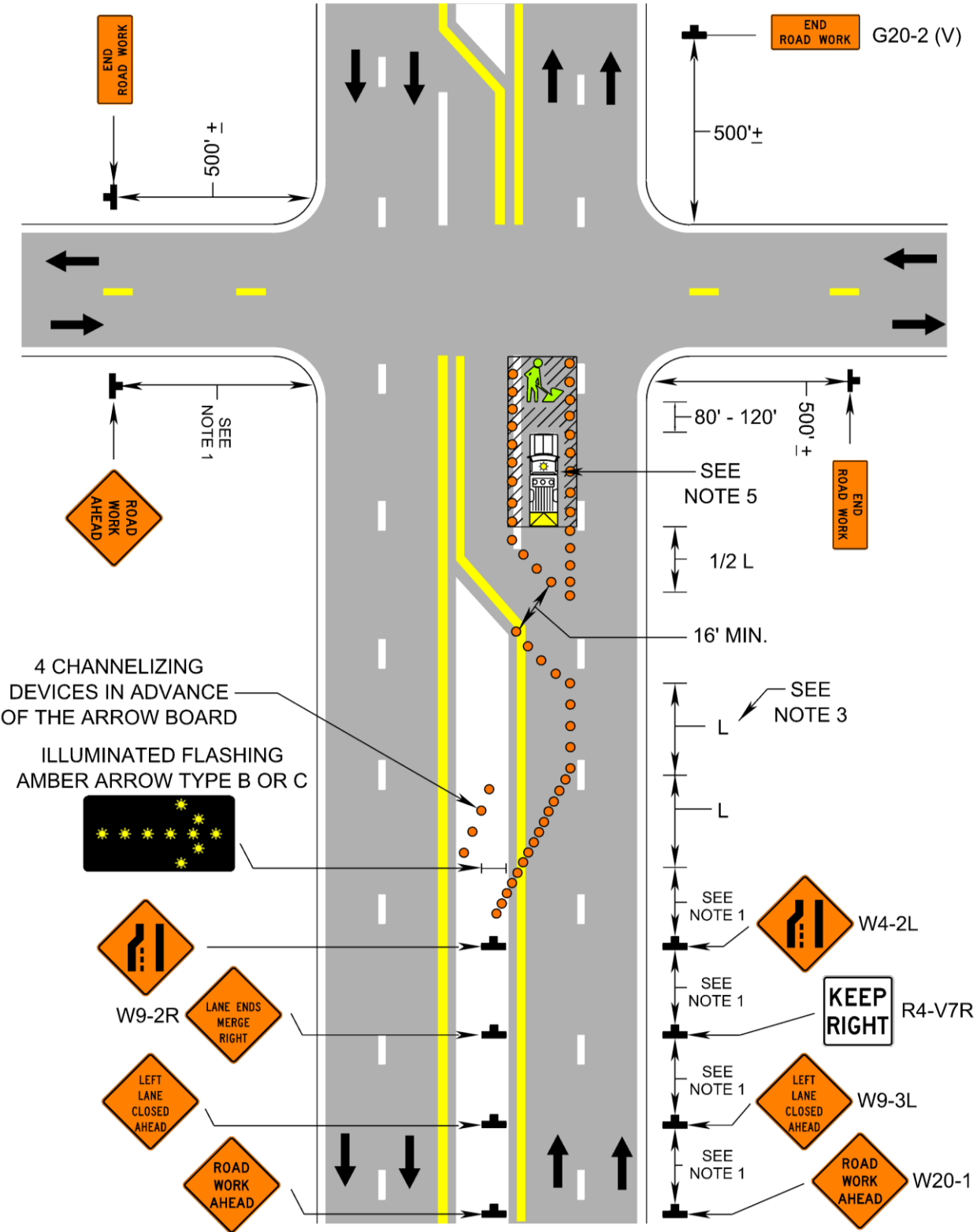
Standard:

5. If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck-mounted attenuator.
6. For emergency situations (any non-planned operation) of 30 minutes or less duration, two rotating amber lights or two high intensity amber strobe lights mounted on the vehicle and visible for 360° shall be required in addition to the channelizing devices shown around the vehicle. Also, vehicle hazard warning signals or amber oscillating lights shall be used.

Guidance:

7. If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-36.

Lane Closure Operation - Near Side of an Intersection
(Figure TTC-26.0)



Typical Traffic Control
Lane Closure Operation – Far Side of an Intersection
(Figure TTC-27.0)

NOTES

Guidance:

1. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, 500'-800' where the posted speed limit is greater than 45 mph.

Standard:

2. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
3. Taper length (L) and channelizing device spacing shall be:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

Guidance:

4. If room permits, a shadow vehicle with at least one rotating, oscillating, or high intensity amber strobe light should be parked 80'-120' in advance of the first work crew.

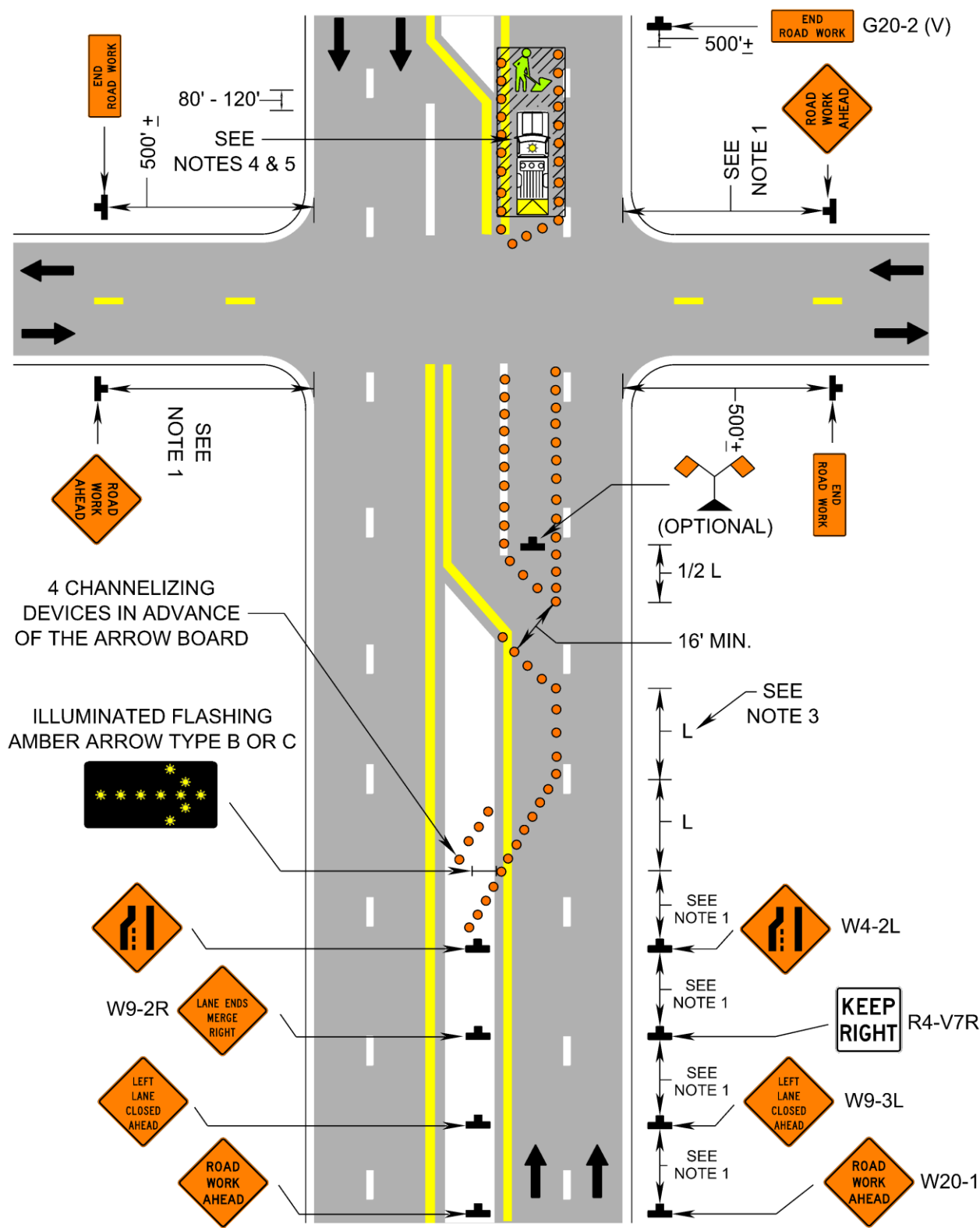
Standard:

5. If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck-mounted attenuator.
6. For emergency situations (any non-planned operation) of 30 minutes or less duration, two rotating amber lights or high intensity amber strobe lights mounted on the vehicle and visible for 360° shall be required in addition to the channelizing devices shown around the vehicle. Also, vehicle hazard warning signals or amber oscillating lights shall be used.

Guidance:

7. If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-36.

Lane Closure Operation - Far Side of an Intersection
(Figure TTC-27.0)



Typical Traffic Control
Lane Closure Operation in an Intersection
(Figure TTC-28.0)

NOTES

Guidance:

1. *The control of traffic through the intersection in order of preference should be:*
 - a. *Obtain the services of law enforcement personnel.*
 - b. *Detour the effective routes to other roads and streets as approved and directed by the Regional Traffic Engineer.*
 - c. *Place a state certified flagger on each leg of the intersection controlling a single lane of traffic.**Appropriate signing as shown should be used for law enforcement and flagging operations. For detour signs see Figure TTC-34.*
2. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, 500'-800' where the posted speed limit is greater than 45 mph.*

Standard:

- 3. Channelizing device spacing shall be on 20' centers or less.**

Guidance:

4. *If room permits, a shadow vehicle with at least one rotating amber light or high intensity amber strobe light should be parked 80'-120' in advance of the first work crew.*

Standard:

- 5. If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck-mounted attenuator.**
- 6. For emergency situations (any non-planned operation) of 30 minutes or less duration, two rotating amber lights or high intensity amber strobe lights mounted on the vehicle and visible for 360° shall be required in addition to the channelizing devices shown around the vehicle. Also, vehicle hazard warning signals or amber oscillating lights shall be used.**

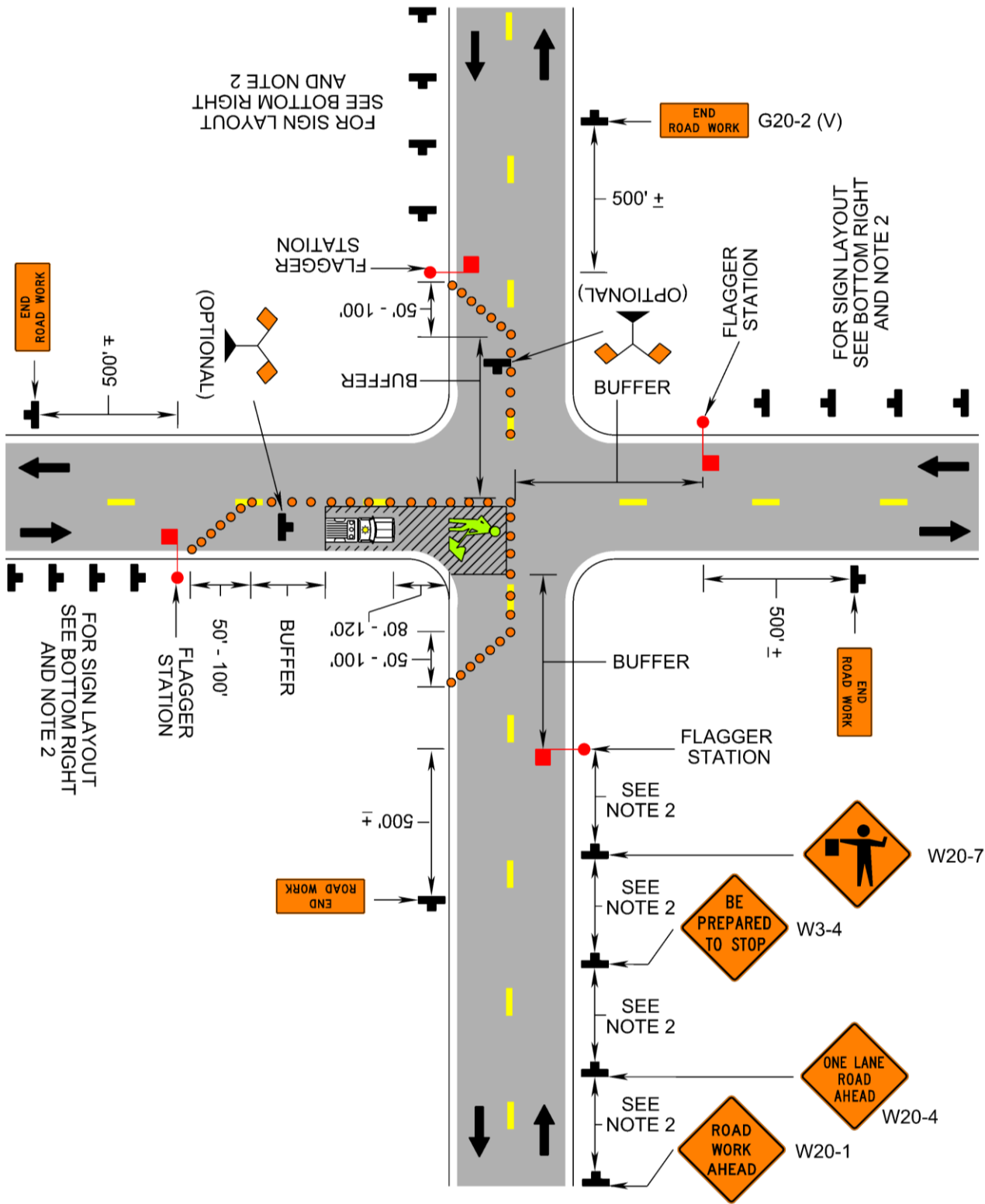
Guidance:

7. *If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-36.*

Support:

8. Turns can be prohibited as required by vehicular traffic conditions. Unless the streets are wide, it might be physically impossible to make certain turns, especially for large vehicles.

Lane Closure Operation in an Intersection
(Figure TTC-28.0)



Typical Traffic Control
Turn Lane Closure Operation
(Figure TTC-29.0)

NOTES

Guidance:

1. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, 500'-800' where the posted speed limit is greater than 45 mph.

Standard:

2. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
3. To prevent accidental intrusion into the work area, channelizing device spacing shall not exceed 20' on centers.

Option:

4. This layout may be used for either right or left turn lane closures.
5. For a high volume of turning movements, additional traffic control devices, such as signs (graphic NO LEFT TURN (R3-2) or LEFT LANE MUST TURN LEFT (R3-7L)), channelizing devices and vehicles may be used

Standard:

6. Taper Length (L) shall be:

Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
≤25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
Shoulder Taper = 1/3 L Minimum				

7. Buffer Space Length shall be:

Posted Speed Limit (mph)	Distance (Feet)
≤20	120±
25	160±
30	200±
35	250±
40	310±
45	360±
50	425±
55	500±
60	570±
65	650±
70	740±

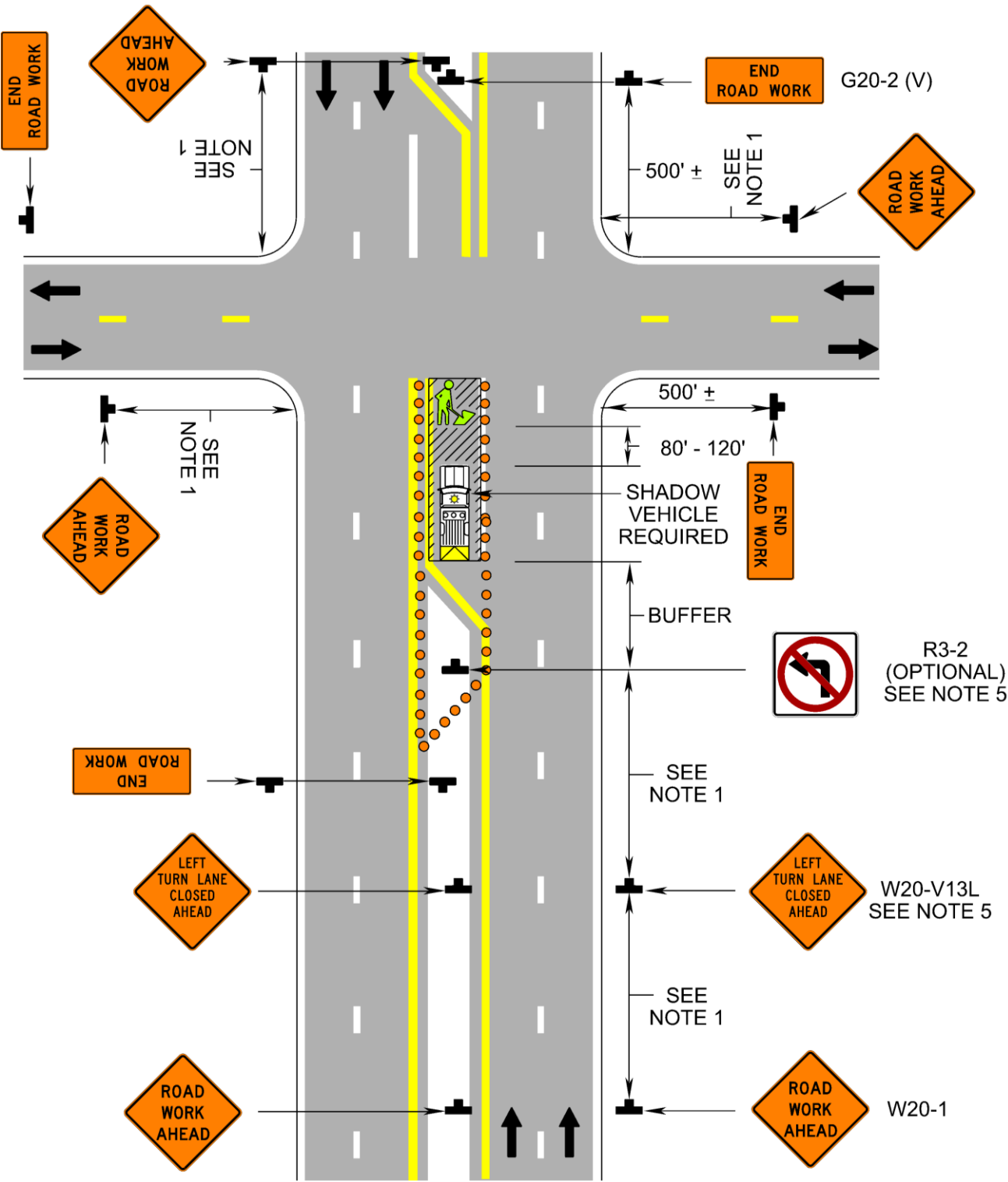
Guidance:

8. If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-36.

Support:

9. Turns can be prohibited as required by vehicular traffic conditions. Unless the streets are wide, it might be physically impossible to make certain turns, especially for large vehicles.

Turn Lane Closure Operation
(Figure TTC-29.0)



Typical Traffic Control
Flagging Operation at a Signalized Intersection
(Figure TTC-30.0)

NOTES

Guidance:

1. *The control of traffic through the intersection in order of preference should be:*
 - a. *Obtain the services of law enforcement personnel.*
 - b. *Divert the effective routes to other roads and streets as approved and directed by the Regional Traffic Engineer.*
 - c. *Place a state certified flagger on each leg of the intersection with the approved signing as shown.*
2. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, 500'-800' where the posted speed limit is greater than 45 mph. For urban streets sign spacing distance should be 225'-275' where the posted speed limit is 30 to 35 mph, and 100' -200' where the posted speed is 25 mph or less .*

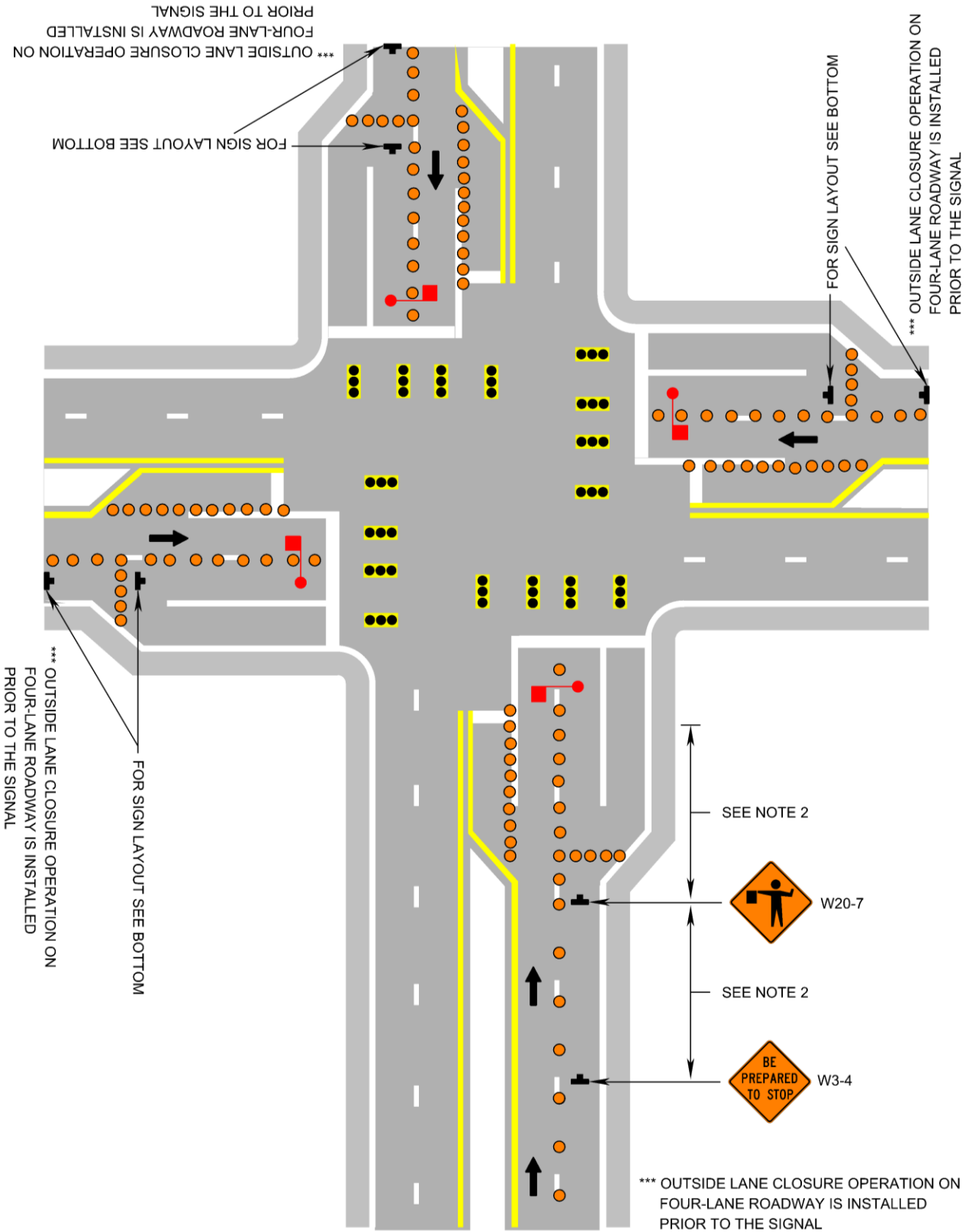
Standard:

3. **A stationary lane closure shall be installed in advance of the signalized intersection for all approaches with two or more lanes for through traffic.**
4. **All turn lanes at the intersection shall be closed.**
5. **Electrical power supply to signals shall be turned off while flaggers are controlling traffic through the intersection.**
6. **To prevent accidental intrusion into the flagger station, cone spacing shall not exceed 10' on centers from the graphic flagger sign to the flagger station. Cones shall be installed in the closed lane, perpendicular to traffic, prior to the flagging station.**
7. **A lead flagger shall be assigned to control all flagger operations. One flagger shall be stationed to control each approach of the intersection. Flaggers shall alternate right-of-way to traffic such that traffic moves through the intersection one approach at a time.**
8. **Flagger stations shall be illuminated during planned night time work operations with a minimum of horizontal luminance of 5-foot candles (50 lux) (see Section 6E.08).**
9. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**

Option:

10. RIGHT TURN LANE CLOSED AHEAD (W20-V13R) and/or LEFT TURN LANE CLOSED AHEAD (W20-V13L) sign(s) may be used when closing the turn lanes.
11. For a high volume of turning movements, additional traffic control devices, such as signs (graphic NO LEFT TURN (R3-2), NO RIGHT TURN (R3-1), RIGHT TURN LANE CLOSED AHEAD (W20-V13R) and/or LEFT TURN LANE CLOSED AHEAD (W20-V13L)), cones and vehicles may be used.

**Flagging Operation at a Signalized Intersection
(Figure TTC-30.0)**



Typical Traffic Control
Flagging Operation on a Single Lane Roundabout
(Figure TTC-31.0)

NOTES

Support:

1. Each roundabout is unique and the traffic control must be developed to meet the specific conditions of the location and the work operation. A detour could possibly better serve traffic movement and must be considered as an alternative to the flagger operation. This traffic control layout can be used on a traffic circle.

Standard:

2. **Flaggers shall control traffic flow on all approaches of the one-lane roundabout.**
3. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. A lead flagger shall be designated and radio communication shall be used by the flaggers.**
4. **Only one quadrant of traffic shall be released at a time.**
5. **Channelizing device spacing shall be as shown in Note 4 in TTC 32.0.**
6. **At night, flagger stations shall be illuminated, except in emergencies. Street lights and vehicle headlights shall not be used to illuminate the flagger station.**
7. **A shadow vehicle with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew.**
8. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.**
9. **A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).**

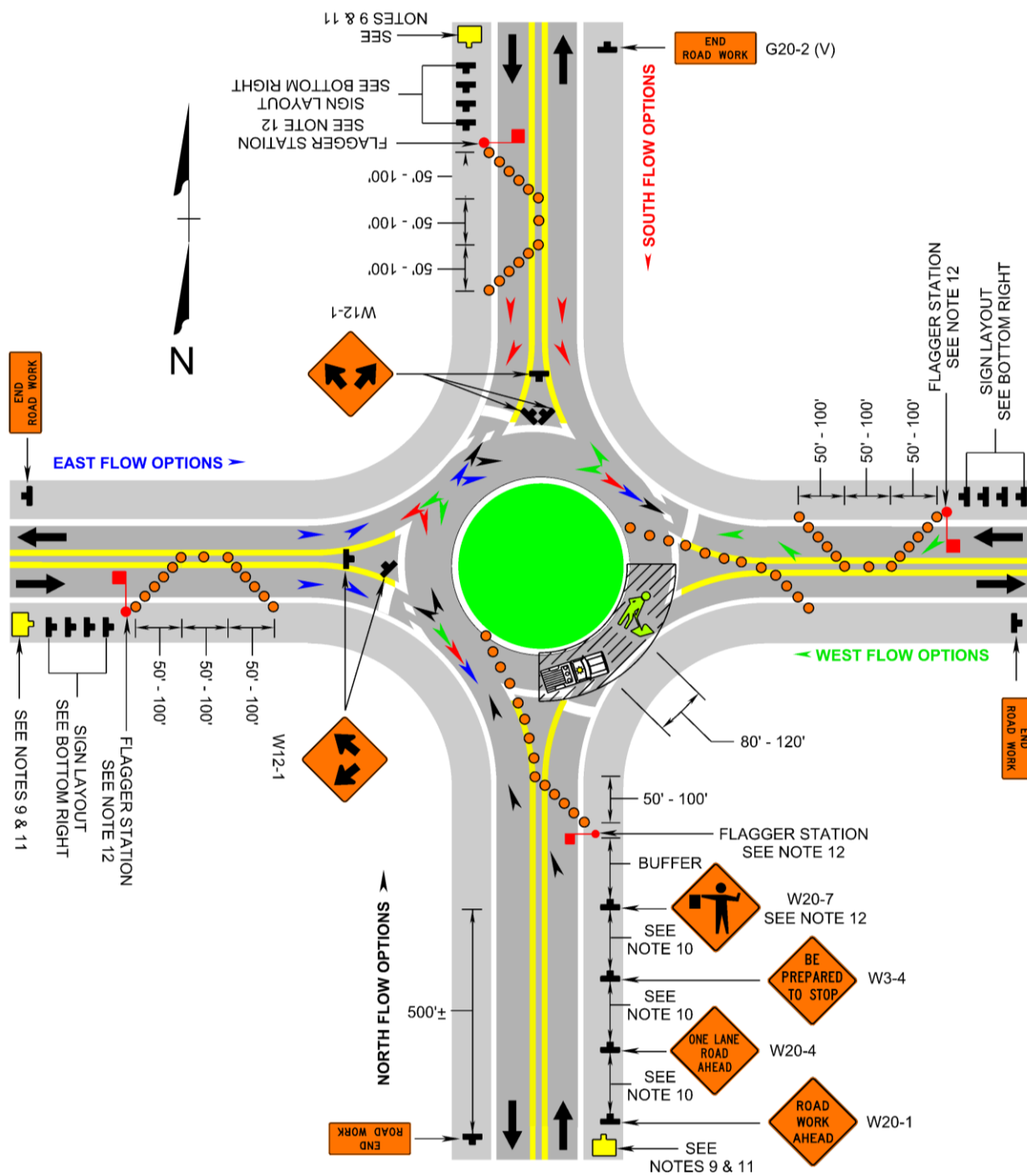
Guidance:

10. *Sign spacing distance should be 350'- 500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*
11. *A PCMS should be considered as part of the traffic control plan to provide clear guidance to motorist on all approaches of the roundabout.*
12. *Care should be exercised when establishing the limits of the work zone to ensure maximum possible sight distance to the flagger station, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. Generally speaking, motorists should have a clear line of sight from the graphic flagger symbol sign to the flagger.*
13. *When designing the traffic control and installing the channelizing devices for work activities at roundabouts, accommodations for the turning radius of tractor trailer vehicles and other large vehicles should be considered and the work zone designed accordingly.*

Option:

14. Periodic adjustments to the channelizing devices may be allowed in an active work zone to accommodate the turning movements of tractor trailer vehicles and other large vehicles.
15. A supplemental flagger may be used in the roundabout island to help direct traffic and may be required on the approaches in advance warning of the flagging operation to slow traffic prior to reaching the flagger station or queued traffic.
16. A guide sign with road names may be used in lieu of the Double Arrow (W12-1) sign.
17. On the approaches where traffic flow will be split, two pilot vehicles may be used to guide traffic through the roundabout.
18. Flagging operations may not be necessary when working on the shoulders or in the island of the roundabout. Necessary signage under other typical application must be followed.

Flagging Operation on a Single Lane Roundabout (Figure TTC-31.0)



Typical Traffic Control
Inside Lane Closure Operation on a Multi-Lane Roundabout
(Figure TTC-32.0)

NOTES

Support:

- Each roundabout is unique and the traffic control must be developed to meet the specific conditions of the location and the work operation. A detour could possibly better serve traffic movement and must be considered as an alternative to the flagger operation. This traffic control layout can be used on a traffic circle.

Standard:

- On divided highways having a median wider than 8', right and left sign assemblies shall be required.
- A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
- Taper length (L) and channelizing device spacing shall be:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	9	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Roundabout Spacing	20'	

- Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.

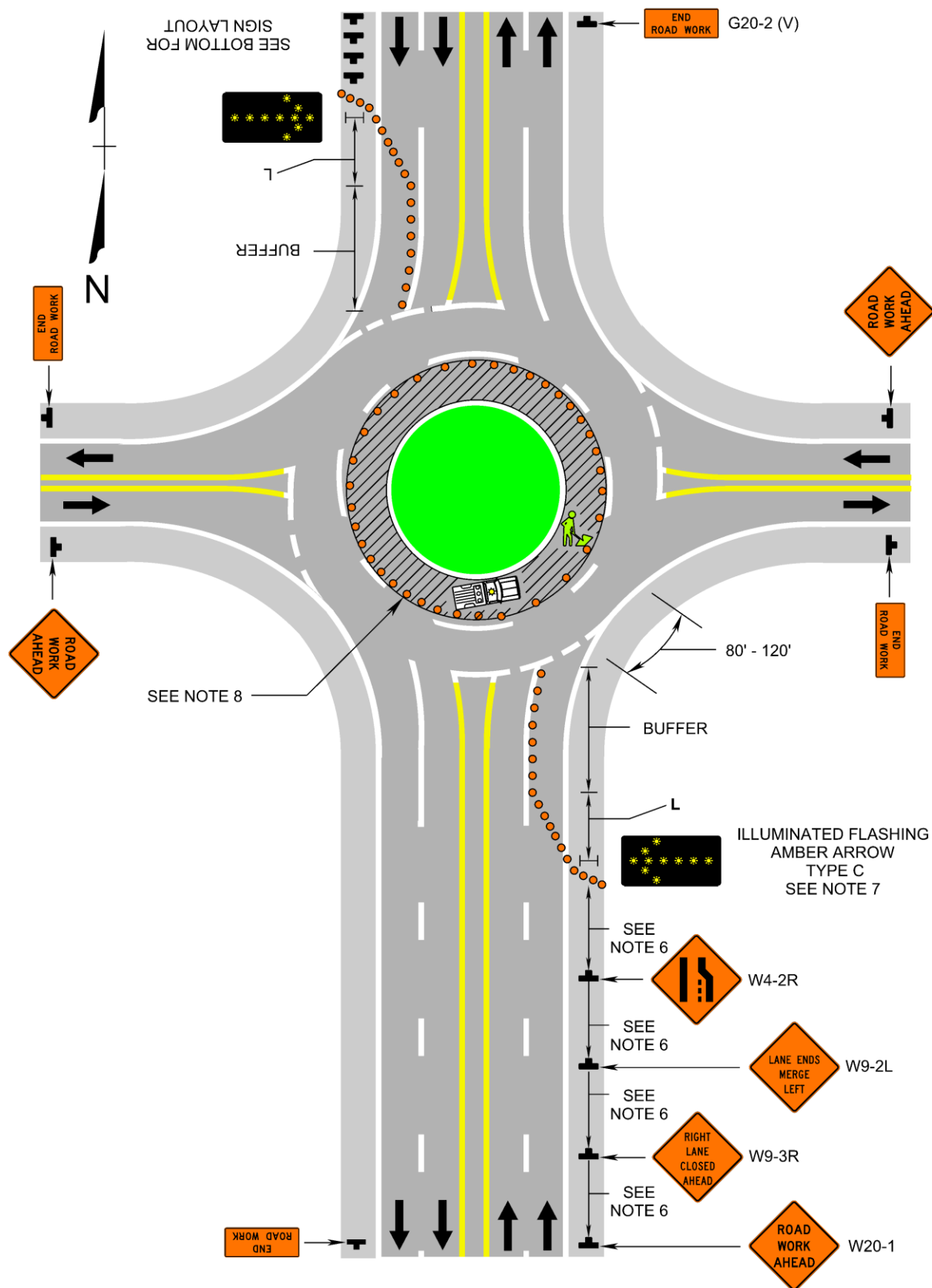
Guidance:

- Sign spacing distance should be 350'- 500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.
- Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. Generally speaking, motorists should have a clear line of sight from the graphic flagger symbol sign to the flagger.
- When designing the traffic control and installing the channelizing devices for work activities at roundabouts, accommodations for the turning radius of tractor trailer vehicles and other large vehicles should be considered and the work zone designed accordingly.

Option:

- Periodic adjustments to the channelizing devices may be allowed in an active work zone to accommodate the turning movements of tractor trailer vehicles and other large vehicles.

Inside Lane Closure Operation on a Multi-Lane Roundabout
(Figure TTC-32.0)



Typical Traffic Control
Outside Lane Closure Operation on a Multi-Lane Roundabout
(Figure TTC-33.0)

NOTES

Support:

1. Each roundabout is unique and the traffic control must be developed to meet the specific conditions of the location and the work operation. A detour could possibly better serve traffic movement and must be considered as an alternative to the flagger operation. This traffic control layout can be used on a traffic circle.

Standard:

2. Multi-lane approaches to the roundabout shall be reduced to one lane and a flagger shall control traffic flow on each approach of the roundabout.
3. All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. A lead flagger shall be designated and radio communication shall be used by the flaggers.
4. Only one quadrant of traffic shall be released at a time.
5. Taper length (L) and channelizing device spacing shall be as shown in Note 4 in TTC 32.0.
6. At night, flagger stations shall be illuminated, except in emergencies. Street lights and vehicle headlights shall not be used to illuminate the flagger station.
7. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
8. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
9. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
10. A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).

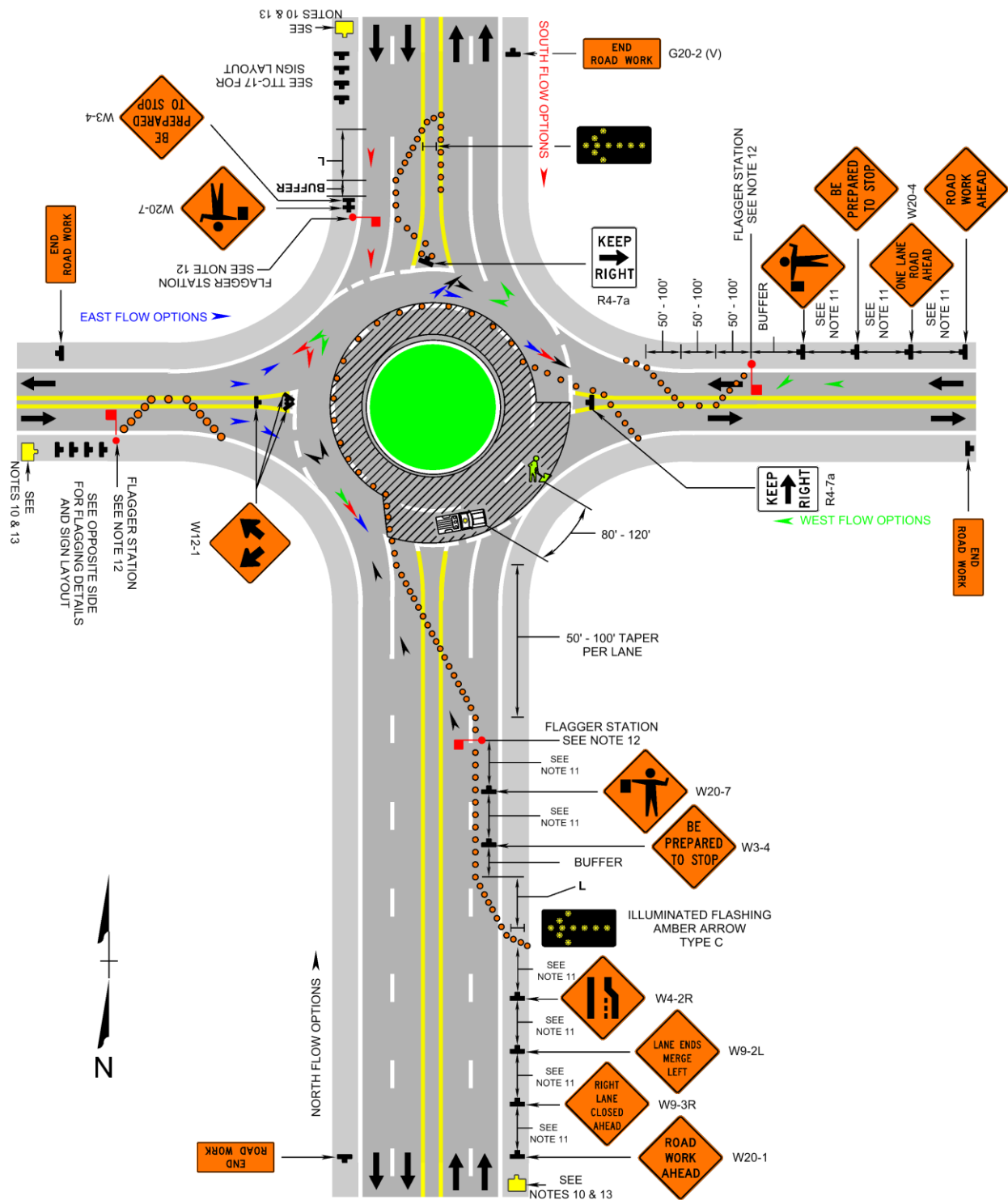
Guidance:

11. Sign spacing distance should be 350'- 500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.
12. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance to the flagger station, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. Generally speaking, motorists should have a clear line of sight from the graphic flagger symbol sign to the flagger.
13. A PCMS should be used as part of the traffic control plan to provide clear guidance to motorist on all approaches of the roundabout that must reverse traffic flow.
14. When designing the traffic control and installing the channelizing devices for work activities at roundabouts, accommodations for the turning radius of tractor trailer vehicles and other large vehicles should be considered and the work zone designed accordingly.

Option

15. Periodic adjustments to the channelizing devices may be allowed in an active work zone to accommodate the turning movements of tractor trailer vehicles and other large vehicles.
16. A supplemental flagger may be used in the roundabout island to help direct traffic and may be required on the approaches in advance warning of the flagging operation to slow traffic prior to reaching the flagger station or queued traffic.
17. A guide sign with road names may be used in lieu of the Double Arrow (W12-1) sign.
18. On the approaches where traffic flow will be split, two pilot vehicles may be used to guide traffic through the roundabout.

Outside Lane Closure Operation on a Multi-Lane Roundabout
(Figure TTC-33.0)



Typical Traffic Control
Street Closure Operation with Detour
(Figure TTC-34.0)

NOTES

Guidance:

1. *This plan should be used for streets without posted route numbers.*
2. *On multi-lane streets, Detour signs with an Advance Turn Arrow should be used in advance of a turn.*
3. *Sign spacing distance should be 225' -275' where the posted speed limit is 30 to 35 mph, and 100' -200' where the posted speed is 25 mph or less.*
4. *If the road is opened for a significant distance beyond the intersection and/or there are significant origin/destination points beyond the intersection, the ROAD CLOSED (R11-2) and Detour Arrow (M4-10) signs on Type 3 Barricades should be located at the corners of intersecting closed roadway or the traveled way.*

Option:

5. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
6. Flashing warning lights may be used on Type 3 Barricades.
7. Detour signs may be located on the far side of intersections. A Detour sign with an advance arrow may be used in advance of a turn.
8. A Street Name (M4-VP1a) plaque may be mounted with the Detour sign. The Street Name plaque may be either white on green or black on orange.

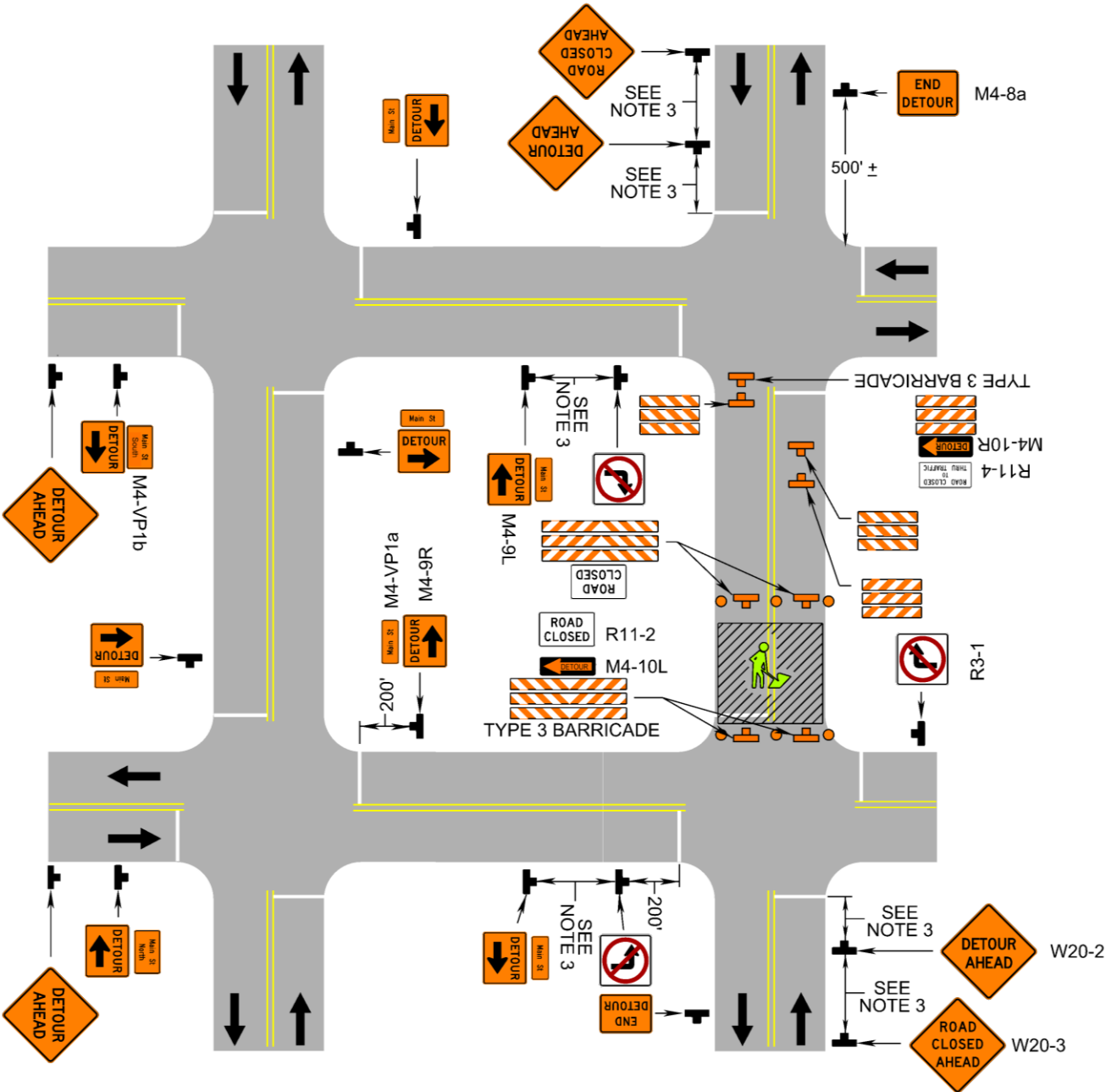
Standard:

- 9. When used, the Street Name plaque shall be placed above the Detour sign.**

Support:

10. See Chapter 6I for additional information on incident management traffic control.

Street Closure Operation with Detour
(Figure TTC-34.0)



Typical Traffic Control
Sidewalk Closure and Bypass Sidewalk Operation
(Figure TTC-35.0)

NOTES

Standard:

- 1. When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.**

Guidance:

- 2. Where high speeds are anticipated, a temporary traffic barrier and, if necessary, a crash cushion should be used to separate the temporary sidewalks from vehicular traffic.*
- 3. Audible information devices should be considered where midblock closings and changed crosswalk areas cause inadequate communication to be provided to pedestrians who have visual disabilities.*
- 4. Temporary markings should be considered for operations exceeding three days in duration.*

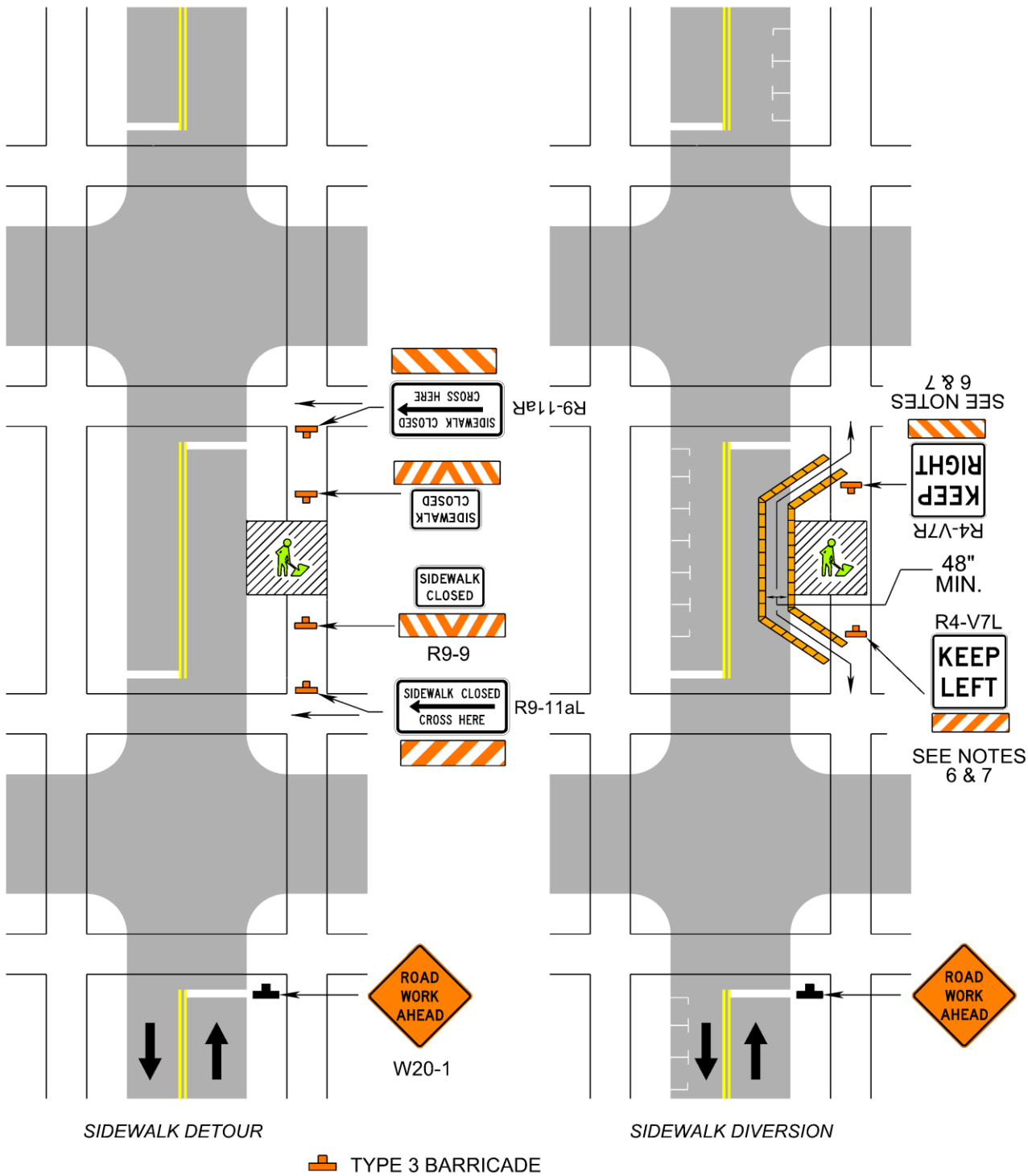
Option:

5. Only the TTC devices related to pedestrians are shown. Other devices, such as lane closure signing or ROAD NARROWS (W5-1) signs, may be used to control vehicular traffic.
6. For nighttime closures, Type A Flashing warning lights may be used on barricades that support signs and close sidewalks.
7. Signs, such as KEEP RIGHT (R4-V7R) and KEEP LEFT (R4-V7L), may be placed along a temporary sidewalk to guide or direct pedestrians.

Standard:

- 8. All sidewalk closures shall be closed with Type 3 Barricades.**

Sidewalk Closure and Bypass Sidewalk Operation
(Figure TTC-35.0)



Typical Traffic Control
Crosswalk Closure and Pedestrian Detour Operation
(Figure TTC-36.0)

NOTES

Standard:

- 1. When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.**
- 2. Curb parking shall be prohibited for at least 50 feet in advance of the midblock crosswalk.**

Guidance:

- 3. Audible information devices should be considered where midblock closings and changed crosswalk areas cause inadequate communication to be provided to pedestrians who have visual disabilities.*
- 4. Pedestrian traffic signal displays controlling closed crosswalks should be covered or deactivated.*
- 5. Temporary markings should be considered for operations exceeding three days in duration.*

Option:

6. Only the TTC devices related to pedestrians are shown. Other devices, such as lane closure signing or ROAD NARROWS (W5-1) signs, may be used to control vehicular traffic.
7. For nighttime closures, Type A Flashing warning lights may be used on barricades supporting signs and closing sidewalks.
8. In order to maintain the systematic use of the fluorescent yellow-green background for pedestrian, bicycle, and school warning signs in a jurisdiction, the fluorescent yellow-green background for pedestrian, bicycle, and school warning signs may be used in TTC zones.

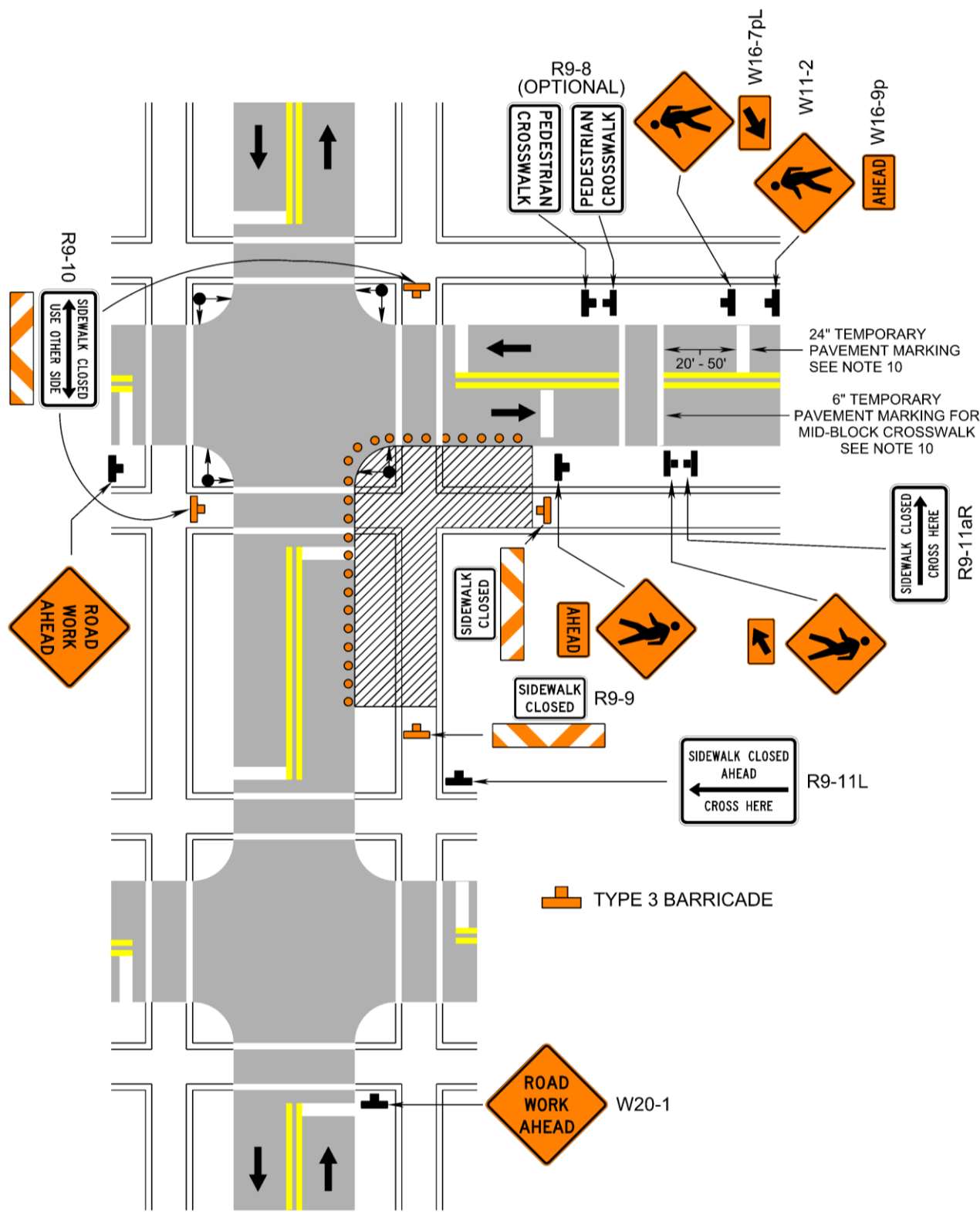
Standard:

- 9. All sidewalk closures shall be closed with Type 3 Barricades.**

Support:

10. Refer to Sections 3B-16 through 3B-18 of the 2009 MUTCD for optional stop lines, yield lines and other related TTC devices that may be used to control vehicular traffic at midblock crosswalks.

Crosswalk Closure and Pedestrian Detour Operation
(Figure TTC-36.0)



Typical Traffic Control
Work Operation in the Vicinity of an Exit Ramp
(Figure TTC-37.0)

NOTES

Guidance:

1. Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. When flaggers are used, care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. Generally speaking, motorists should have a clear line of sight from the graphic flagger symbol sign to the flagger.

Standard:

3. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
4. A temporary EXIT (E5-V1) sign shall be located in the temporary gore. For better visibility, it shall be mounted a minimum of 7 feet from the pavement surface to the bottom of the sign.
5. Taper length (L) and channelizing device spacing shall be:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access Highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. The minimum distance between the end of the taper and the beginning of the off ramp shall be 1000'.
7. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or equipped with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used

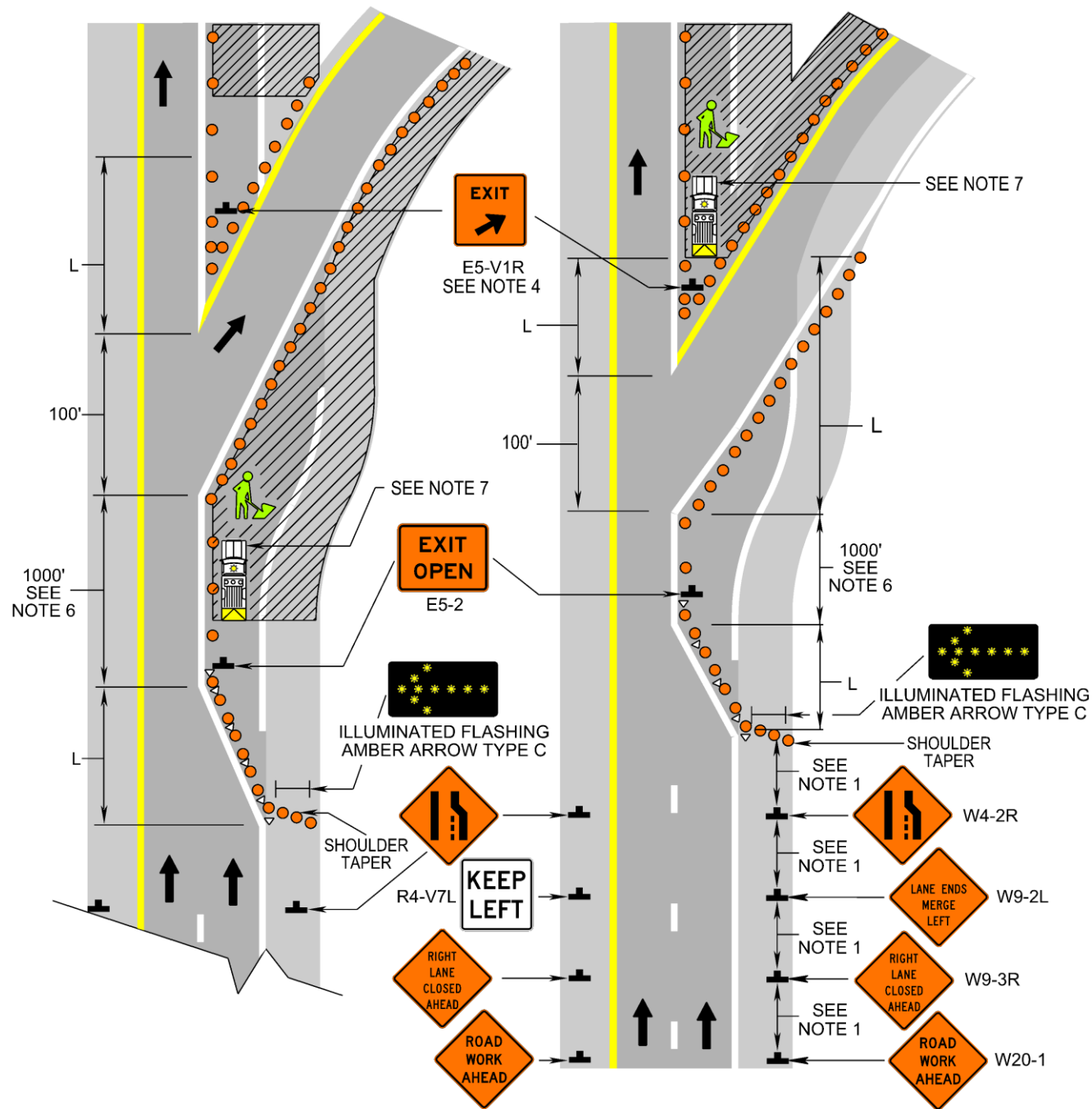
Guidance:

8. The guide signs should indicate that the ramp is open, and where the temporary ramp is located. However, if the ramp is closed, guide signs should indicate that the ramp is closed.
9. When the exit ramp is closed, a black on orange EXIT CLOSED (E5-2a) sign should be placed diagonally across the interchange/intersection guide signs.
10. An END ROAD WORK (G20-2 (V)) sign should be placed 500' past the temporary traffic control devices on the off ramp.

Option:

11. The temporary EXIT sign placed in the temporary gore may be either black on orange or white on green.
12. An alternative procedure that may be used is to channelize exiting vehicular traffic onto the right-hand shoulder and close the lane as necessary.

Work Operation in the Vicinity of an Exit Ramp
(Figure TTC-37.0)



Typical Traffic Control
Partial Exit Ramp Closure Operation
(Figure TTC-38.0)

NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **To prevent accidental intrusion into the work area, channelizing device spacing shall not exceed 20' on centers.**
3. **Cone Taper Length (L) is equal to the Posted Speed Limit (S) times the Width of actual ramp closure (W). (Example: 55 mph x 6' = 330')**
4. **A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or equipped with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.**
5. **If an advisory speed limit sign is used, the Regional Traffic Engineer shall determine the advisory speed limit.**

Guidance:

6. *A minimum 200' buffer space should be provided, when possible.*

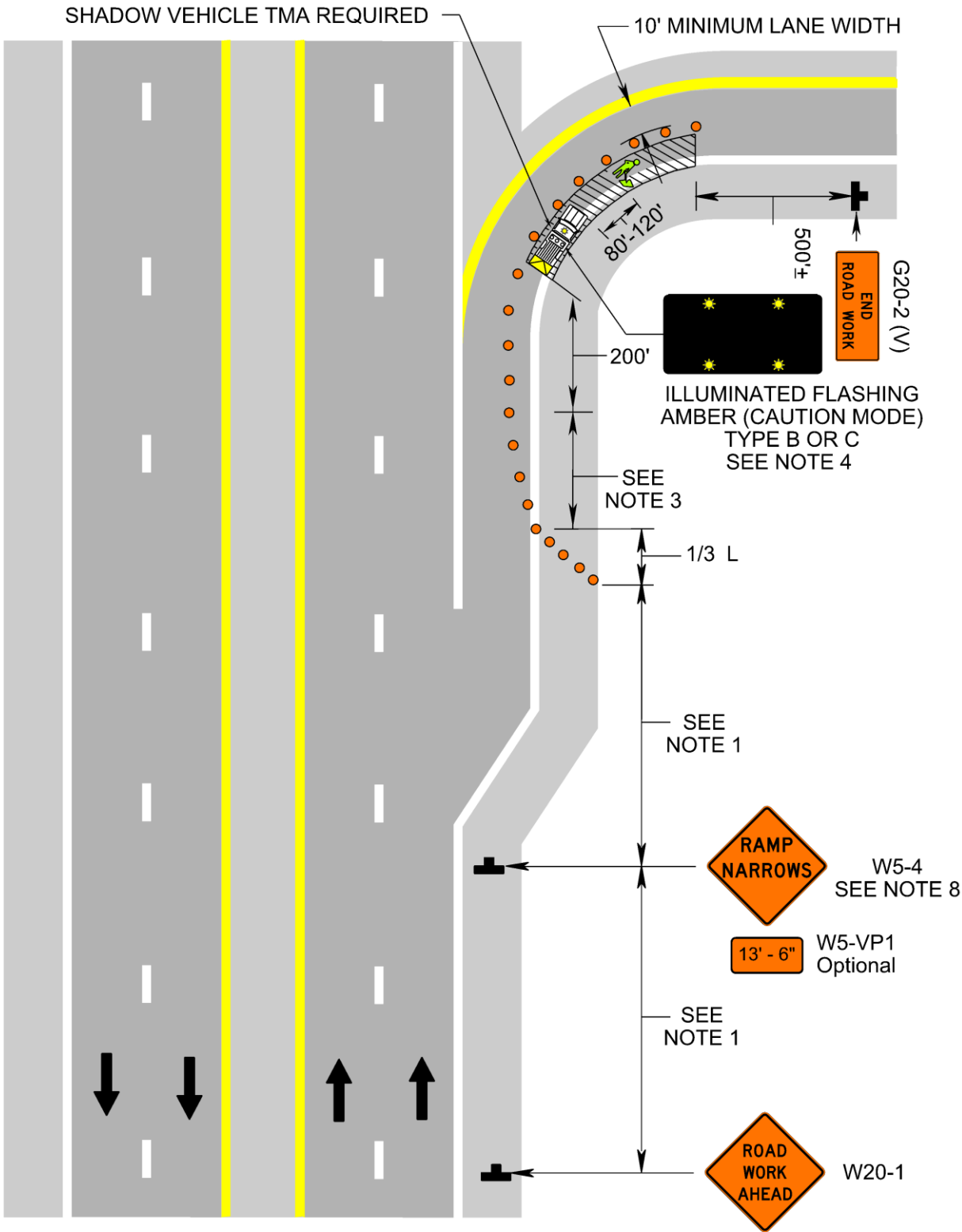
Standard:

7. **Truck off-tracking shall be considered when determining whether the 10 foot minimum lane width is adequate.**
8. **For long term stationary work (occupying a location for longer than three consecutive days) when the distance between the edgeline and the channelizing devices is less than 14 feet, a RAMP NARROWS (W5-4) sign shall be used, along with a LANE WIDTH (W5-VP1) plaque displaying the width from edgeline to the channelizing devices in feet and inches rounded down to the nearest foot or half foot increment.**
9. **Due to blanket permits for over width loads, whenever a travel direction is reduced to less than 14 feet in width from edgeline to the face of channelizing devices, a 96" by 48" black on white sign displaying the message RESTRICTED WIDTH ROUTE, XX FT.- YY INCHES (R5-V1) with WORK ZONE (G20-5aP or G20-5aP (V)) plaque shall be installed 1000 feet ± prior to the last exit from the approached side of the restricted work zone route.**

Guidance:

10. *A traffic engineering study should determine if there is a need for a wide load detour and additional TTC.*

Partial Exit Ramp Closure Operation
(Figure TTC-38.0)



Typical Traffic Control
Work Operation in the Vicinity of an Entrance Ramp
(Figure TTC-39.0)

NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3.*
3. *An acceleration lane of sufficient length should be provided whenever possible as shown on the left diagram.*

Standard:

4. **For the information shown on the diagram on the right-hand side of the typical application, where inadequate acceleration distance exists for the temporary entrance, the YIELD (R1-2) sign shall be replaced with STOP (R-1-1) signs (one on each side of the approach).**
5. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
6. **For taper lengths and channelizing device spacing, Note 5 of TTC-37 shall be used. The minimum length of a lane closure taper on a Limited Access highway shall be 1000'.**
7. **The buffer space length shall be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.**
8. **A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or equipped with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.**
9. **For long-term work zones existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per Figure TTC-60.**

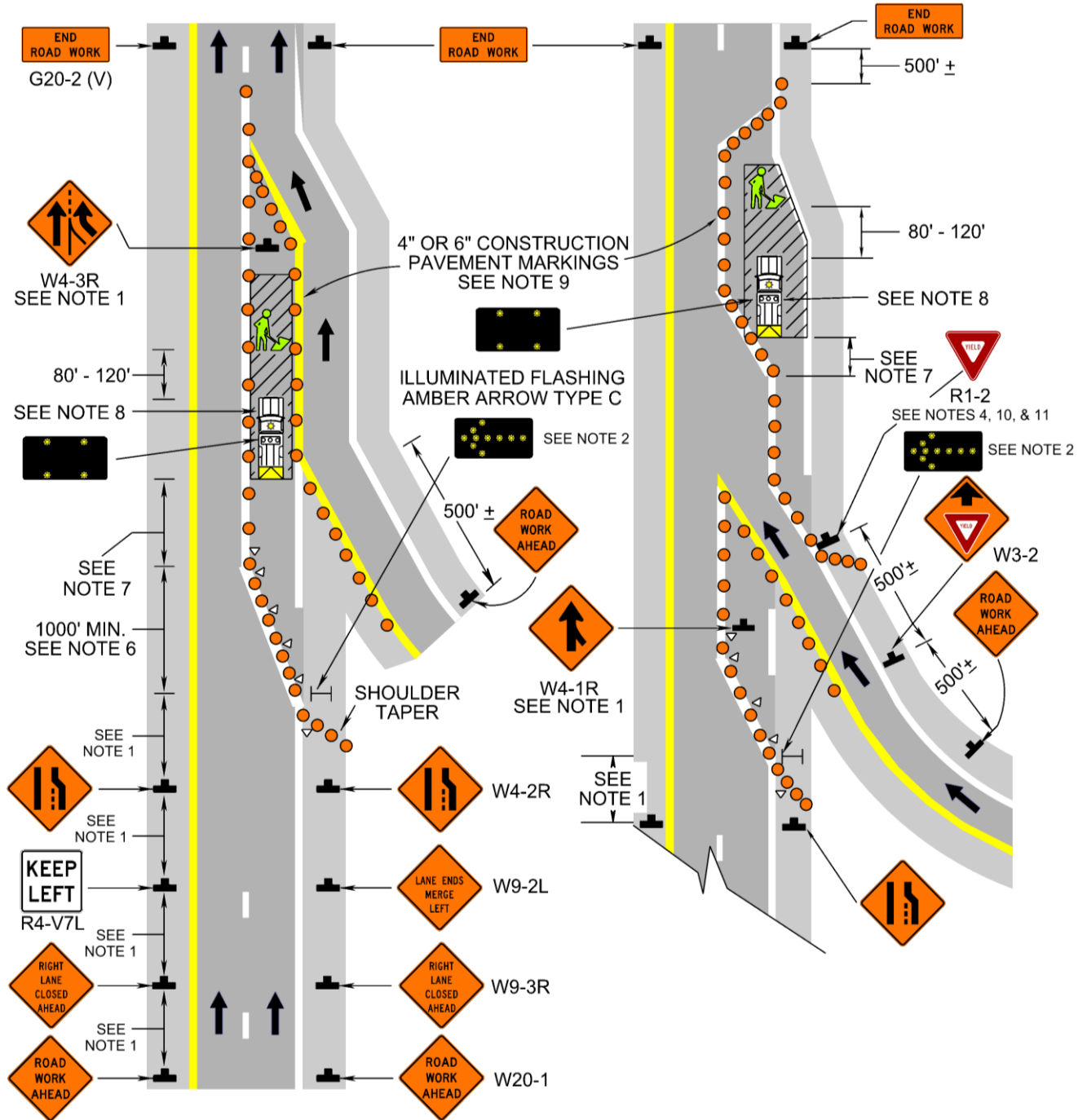
Guidance:

10. *When used, the YIELD or STOP sign should be located so that ramp vehicular traffic has adequate sight distance of oncoming mainline vehicular traffic to select an acceptable gap in the mainline vehicular traffic flow, but should not be located so far forward that motorists will be encouraged to stop in the path of the mainline traffic. Also, a longer acceleration lane should be provided beyond the sign to reduce the gap size needed. If insufficient gaps are available, consideration should be given to closing the ramp.*
11. *Where STOP signs are used, a temporary stop line should be placed across the ramp at the desired stop location.*
12. *The mainline merging taper with the arrow board at its starting point should be located sufficiently in advance so that the arrow board does not confuse the drivers on the entrance ramp, and so that the mainline merging vehicular traffic from the lane closure has the opportunity to stabilize before encountering the vehicular traffic merging from the ramp.*
13. *If the ramp curves sharply to the right, warning signs with advisory speeds located in advance of the entrance terminal should be placed in pairs (one on each side of the ramp).*

Option:

14. Where the acceleration distance is significantly reduced, a NO MERGE AREA (W4-5P) supplemental plaque may be placed below the Yield Ahead (W3-2) sign.
15. A Type B high-intensity flashing warning light with a red lens may be placed above the STOP sign.
16. When operations are 3 days or less in duration, lanes may be delineated by channelizing devices in lieu of temporary markings.

Work Operation in the Vicinity of an Entrance Ramp (Figure TTC-39.0)



Typical Traffic Control
Multi-Lane Shift Operation
(Figure TTC-40.0)

NOTES

Guidance:

1. *The lane shift should be used when the work area extends into either the right or left lane of a divided highway and it is not practical, for capacity reasons, to reduce the number of available lanes.*
2. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *If the STAY IN LANE (R4-9) sign is used, then solid 4 inch wide minimum white lines should be used.*

Standard:

4. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
5. **Shoulder and shifting taper lengths shall be as shown in Table 6C-3 on Page 6C-7.**
6. **Taper Length (L) shall be:**

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
Shoulder Taper = $\frac{1}{3}$ L Minimum				

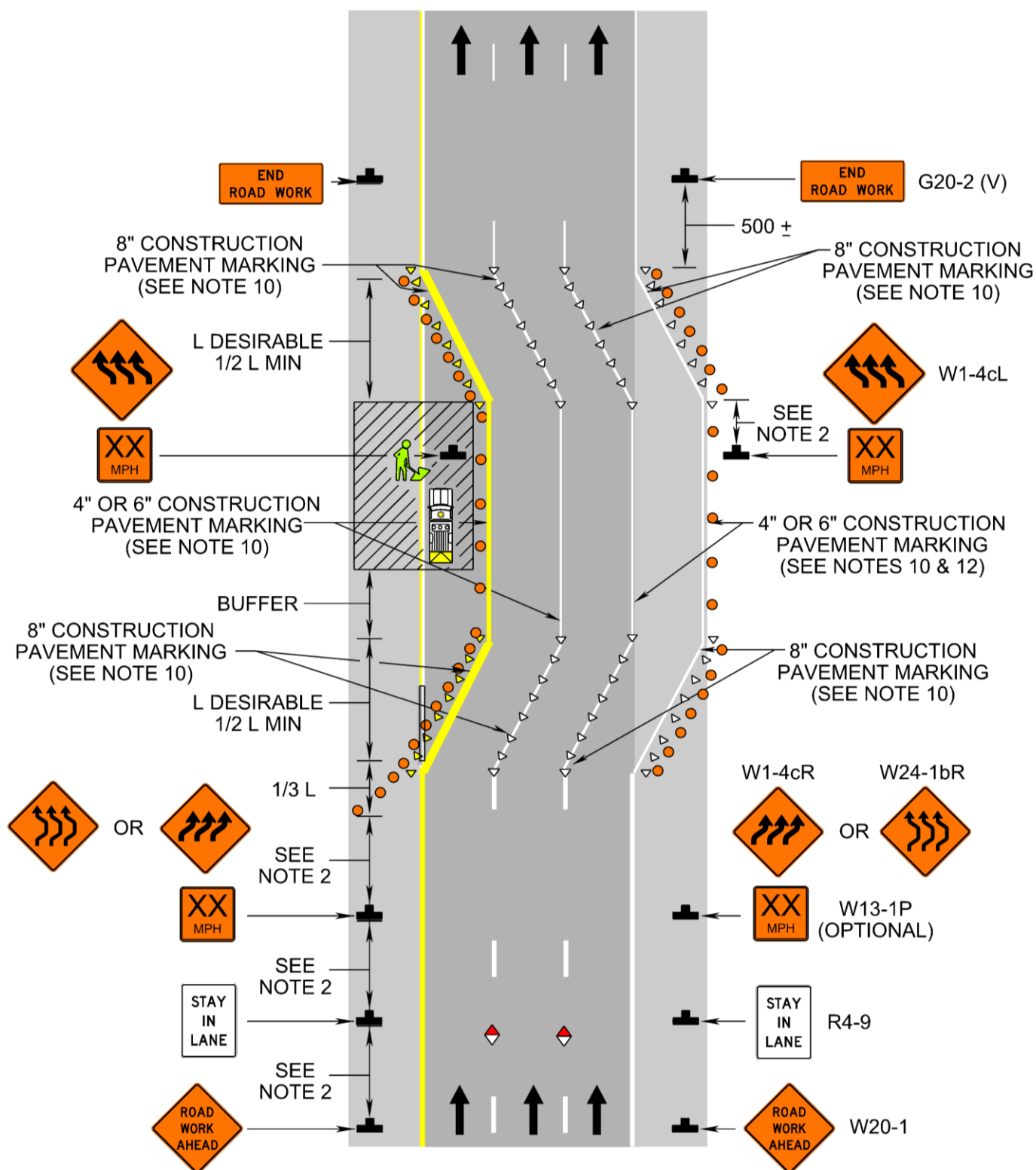
For all Limited Access highways, the desired shifting transition length is 1000', but lesser values not to be less than $\frac{1}{2}$ L, may be used.

7. **The minimum width of the shoulder lane shall be 11'.**
8. **The buffer space length shall be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.**
9. **A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.**
10. **For long-term work zones existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per Figure TTC-60.**

Option:

11. For short-term stationary work (less than 3 days duration), lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.
12. Temporary pavement markers, on a 40' center to center spacing, may be added to the tangent section between lane shifts as directed by the engineer.

Multi-Lane Shift Operation (Figure TTC-40.0)



Typical Traffic Control
Half Road Closure Operation on a Multi-Lane Roadway
(Figure TTC-41.0)

NOTES

Guidance:

1. Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.

Standard:

3. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
4. Taper length (L) and channelizing device spacing shall be:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access Highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

5. On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.
6. The buffer space length shall be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
7. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
8. Existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per Figure TTC-60.

Option:

9. For short-term stationary work (less than 3 days duration), lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.
10. Temporary pavement markers, on a 40' center to center spacing, may be added to the tangent section between lane shifts as directed by the engineer.

The diagram illustrates a lane closure work zone on a two-lane road. Traffic is shown moving from left to right. The work zone is defined by yellow channelizing devices (cones) and includes a 1/2 L MIN. buffer zone. The diagram shows the placement of various traffic signs and pavement markings:

- Upstream Signs (Left Side):**
 - W9-3L: AHEAD ROAD WORK (Orange diamond)
 - W4-2L: Lane closure sign (Orange diamond)
 - W9-3R: RIGHT LANE CLOSED AHEAD (Orange diamond)
 - W4-2R: Lane closure sign (Orange diamond)
 - W20-1: ROAD WORK AHEAD (Orange diamond)
- Channelizing Devices:**
 - GROUP 2 CHANNELIZING DEVICE SPACING SEE NOTE 4
 - CHANNELIZING DEVICE SPACING SEE NOTE 4
- Pavement Markings:**
 - 4" CONSTRUCTION PAVEMENT MARKING SEE NOTE 8
 - 4" OR 6" CONSTRUCTION PAVEMENT MARKING SEE NOTE 8
 - 8" CONSTRUCTION PAVEMENT MARKING SEE NOTE 8
- Downstream Signs (Right Side):**
 - W13-1P (OPTIONAL): XX MPH (Orange rectangle)
 - W14-R: Right turn sign (Orange diamond)
 - W14-L: Left turn sign (Orange diamond)
 - W9-2L: LANE ENDS MERGE LEFT (Orange diamond)
 - W9-3R: RIGHT LANE CLOSED AHEAD (Orange diamond)
 - W20-1: ROAD WORK AHEAD (Orange diamond)
- Other Features:**
 - ILLUMINATED FLASHING AMBER ARROW TYPE C SEE NOTE 2
 - END ROAD WORK (Orange rectangle)
 - 500' ±
 - DESIRABLE 1/2 L MIN.
 - SEE NOTE 1
 - SEE NOTE 4

Typical Traffic Control
Interior Lane Closure Operation on a Multi-Lane Roadway
(Figure TTC-42.0)

NOTES

Guidance:

1. Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.

Standard:

3. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
4. Taper Length (L) and Channelizing Device Spacing shall be:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access Highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Posted Speed (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per $\frac{1}{4}$ mile.		

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

5. The buffer space length shall be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.
6. A shadow vehicle with either a Type B or C arrow board operating in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 80'-120' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck-mounted attenuator shall be used.
7. For long-term work zones existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per Figure TTC-60.

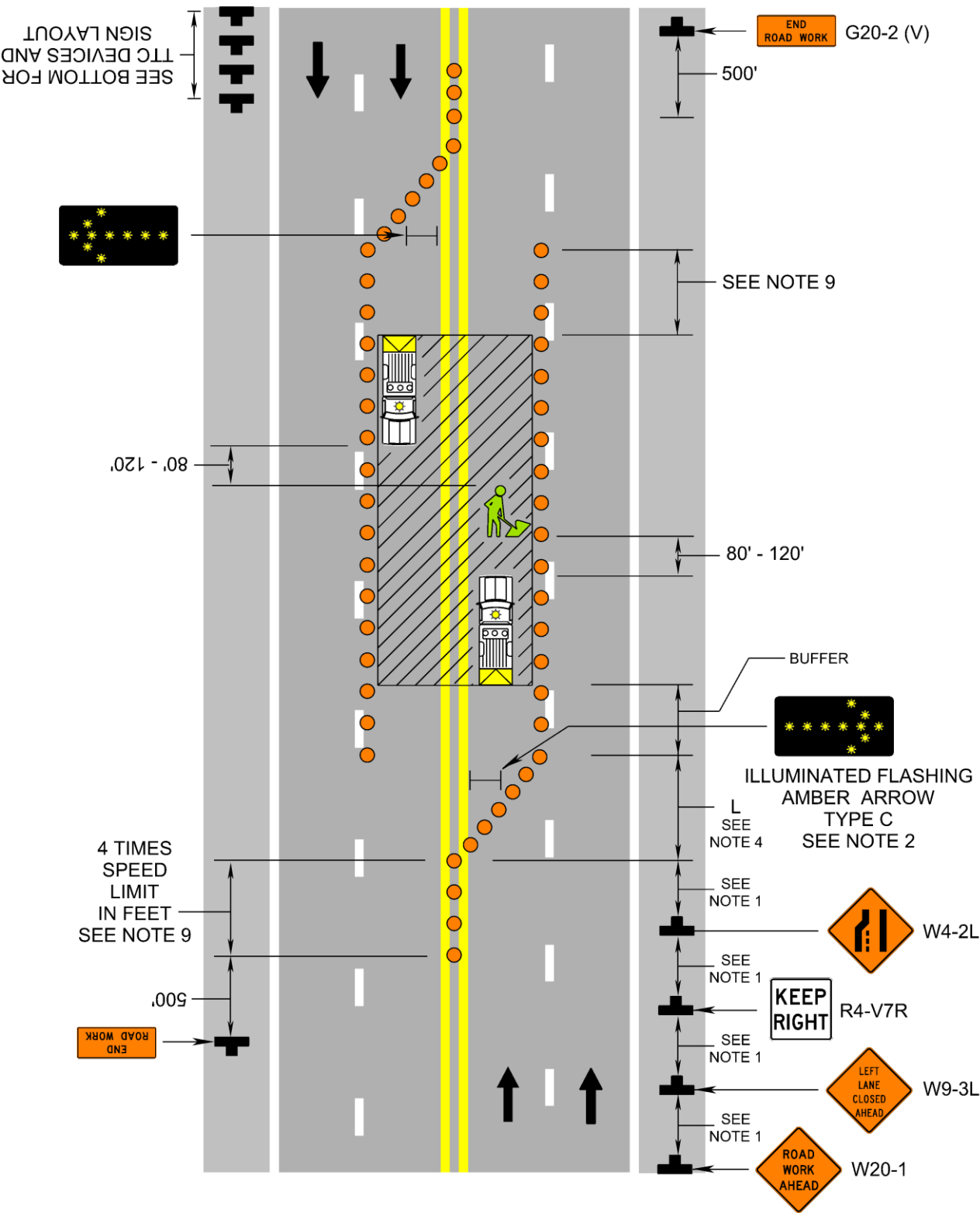
Option:

8. For short-term stationary work (less than 3 days duration), lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.

Guidance:

9. When channelizing devices have the potential of leading vehicular traffic out of the intended traffic space, the channelizing devices should be extended a distance in feet of 4 times the posted speed limit in mph beyond the downstream end of the transition area as depicted.

Interior Lane Closure Operation on a Multi-Lane Roadway
(Figure TTC-42.0)



Typical Traffic Control
Road Closure Operation with a Diversion
(Figure TTC-43.0)

NOTES

Guidance:

1. Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the lane shift, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3.

Option

3. Temporary traffic barriers, temporary asphalt median or temporary tubular markers may be used to separate opposing vehicular traffic based on guidance in Appendix A.

Guidance:

4. The alignment should be designed as a reverse curve.
5. The curved alignment should meet the design criteria contained in the AASHTO "Policy on the Geometric Design of Highways and Streets" (see Section 1A.11) and current Virginia Road and Bridge Standard GS-10.

Standard:

6. Devices similar to those depicted shall be placed for the opposite direction of traffic.
7. Appropriate impact attenuators or terminal end treatments shall be used to protect the end of longitudinal barriers if the barrier is terminated within the clear zone.
8. Channelizing device spacing shall be:

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per ¼ mile.		

9. Pavement markings and markers no longer applicable to the traffic pattern of the roadway shall be removed or obliterated before any new traffic patterns are open to traffic (see Figure TTC-60).

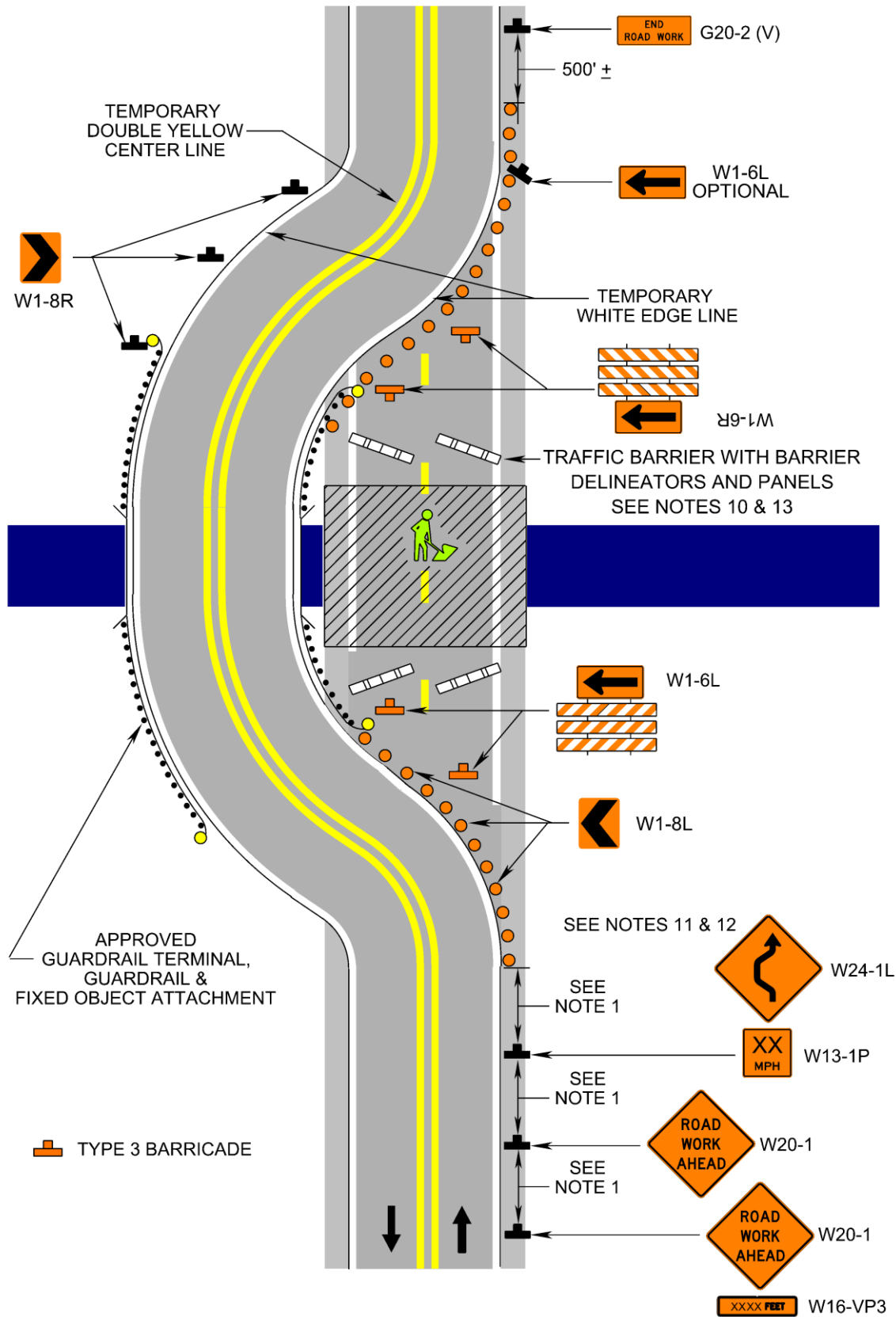
Guidance:

10. Temporary barrier should be placed at a 45° angle to the travelway a sufficient distance beyond the Type 3 Barricade but before the work space while providing equipment access to the work space.
11. If the tangent distance along the temporary diversion is more than 600 feet, a Reverse Curve (W1-4 series) sign, left first, should be used instead of the Double Reverse Curve (W24-1) sign, and a second Reverse Curve sign, right first, should be placed in advance of the second reverse curve back to the original alignment.
12. When tangent section of the diversion is more than 600 feet, and the diversion has sharp curves with recommended speeds of 30 mph or less, Reverse Turn (W1-3) signs, should be used.

Standard:

13. Barrier panels 8 inches in width and 12 inches in height shall be placed on top of the temporary concrete barrier, perpendicular to traffic, and spaced 20' on centers along the taper sections. ReflectORIZED surface shall be fluorescent orange prismatic lens sheeting. Barrier delineators shall be installed along the traffic side of the concrete barrier in-between and at the same spacing as the barrier panels approximately 24 inches up from the roadway surface.

Road Closure Operation with a Diversion
(Figure TTC-43.0)



Typical Traffic Control
Median Cross-Over Operation on a Multi-Lane Roadway
(Figure TTC-44.0)

NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.*

Standard:

3. **Temporary traffic barriers, temporary asphalt median or temporary tubular markers shall be used to separate opposing vehicular traffic based on guidance in Appendix A.**
4. **An arrow board shall not be used to shift a lane of traffic.**

Option:

5. When a temporary traffic barrier is used to separate opposing vehicular traffic, the Two-Way Traffic (W6-3), DO NOT PASS (R4-1), KEEP RIGHT (R4-V7), and DO NOT ENTER (R5-1) signs may be eliminated.

Guidance:

6. *The alignment of the crossover should be designed as a reverse curve.*
7. *When the crossover follows a curved alignment, the design criteria contained in the AASHTO "Policy on the Geometric Design of Highways and Streets" (see Section 1A.11) and current Virginia Road and Bridge Standard GS-10 should be used.*
8. *When channelizing devices are used in lieu of traffic barriers and have the potential of leading vehicular traffic out of the intended traffic space, the channelizing devices should be extended a distance in feet of 4 times the speed limit in mph beyond the downstream end of the transition area.*
9. *Where temporary asphalt medians or tubular markers are used, the Two-Way Traffic (W6-3) signs should be repeated every 1 mile.*

Option:

10. NEXT XX MILES (W16-VP1) Supplemental Distance plaques may be used with the Two-Way Traffic signs, where XX is the distance to the downstream end of the two-way section.

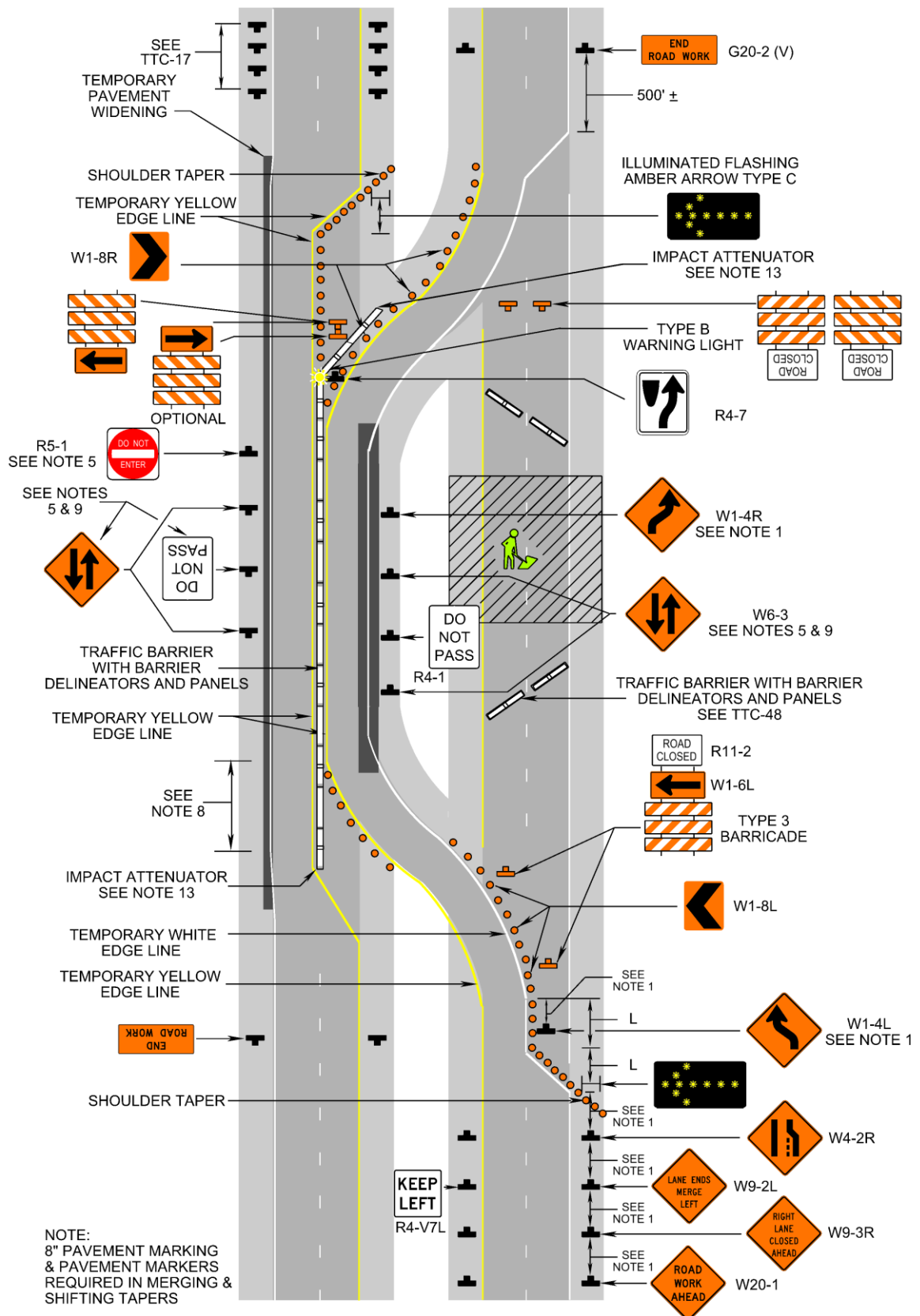
Support:

11. When the distance is sufficiently short that road users entering the section can see the downstream end of the section, they are less likely to forget that there is opposing vehicular traffic.

Standard:

12. **The sign legends for the four pairs of signs approaching the lane closure for the non-crossover direction of travel are not shown. They are similar to the series shown for the crossover direction, except that the left lane is closed.**
13. **Impact attenuators shall be used to protect traffic barrier if the barrier is terminated within the clear zone.**
14. **Taper lengths shall be per Table 6C-3 on Page 6C-7; channelizing device spacing shall be per Table 6H-4 on Page 6H-6.**
15. **Existing conflicting pavement markings and markers shall be removed and temporary pavement markings and markers shall be installed per Figure TTC-60.**

Median Cross-Over Operation on a Multi-Lane Roadway (Figure TTC-44.0)



Typical Traffic Control
Total Limited Access Highway Closure Operation
(Figure TTC-45.0)

NOTES

Support:

1. Conditions in this TTC represent planned work activities. See Chapter 6I for additional information on incident management traffic control.

Guidance:

2. *A Portable Changeable Message Sign (PCMS) should be placed a minimum of one mile in advance of the exit proceeding the beginning of the first lane closure activity or queued traffic advising of the road closure ahead. An additional PCMS should be placed one mile in advance of the stationary signing advising ROAD WORK AHEAD, ALL LANES EXIT RIGHT.*
3. *Sign spacing distance should be 1300'-1500' for Limited Access highways.*

Standard:

4. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
5. **Channelizing device spacing shall be a maximum of 40' in transitions, and 80' along the travelway. Transitions shall be a minimum of 1000' in length.**

Guidance:

6. *When detour signing has been installed along the detour route (see Figures TTC-46 or TTC-47), a DETOUR with directional arrow or Detour with a Route Assembly sign should be placed halfway up the ramp or loop. Additionally, a third message should be added to the one mile Portable Changeable Message Sign advising "DETOUR AHEAD."*

Option:

7. Other sign layouts for "Total Limited Access Highway Closure" may be substituted as directed by the Regional Traffic Engineer.

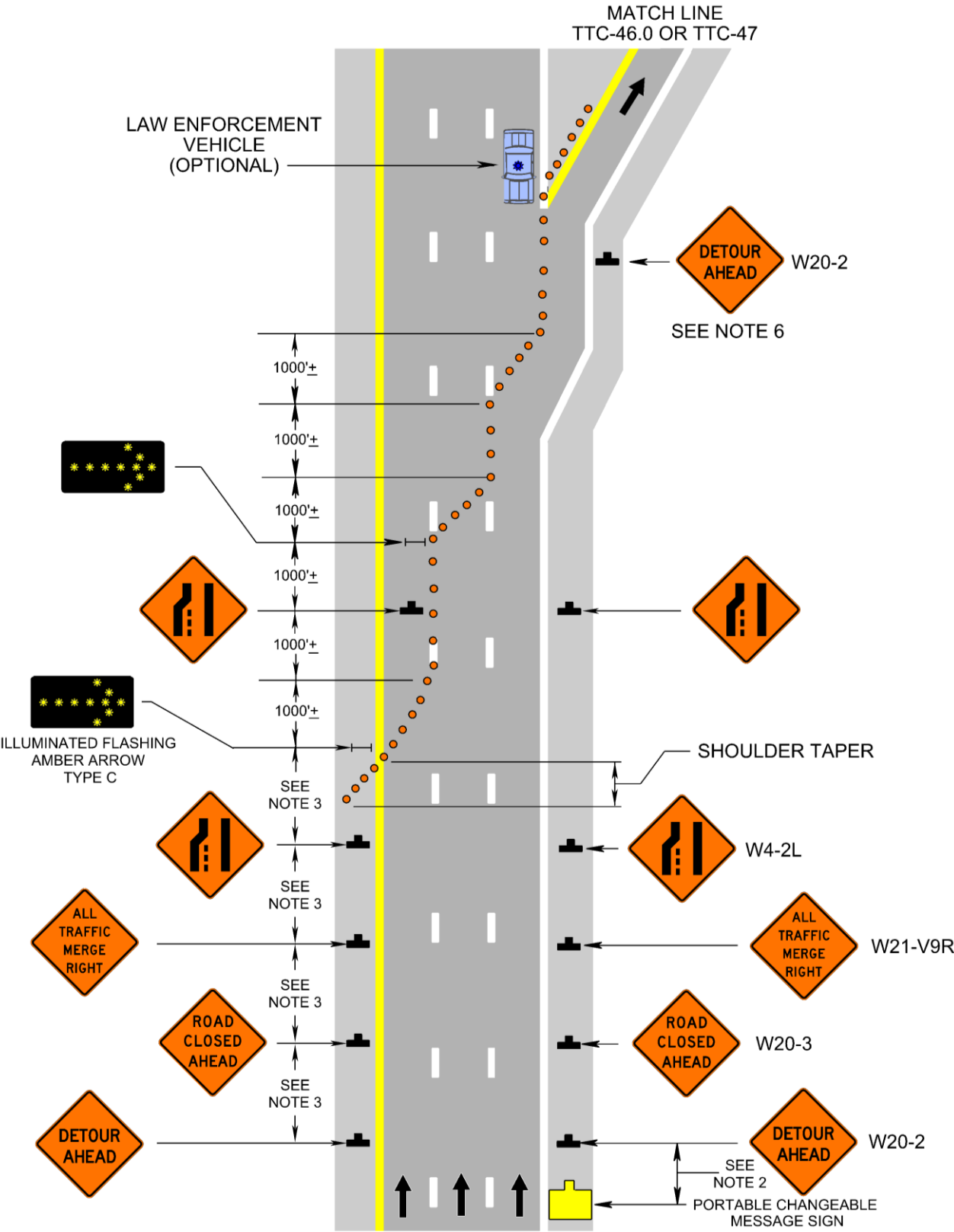
Standard:

8. **A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).**

Guidance:

9. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.*

Total Limited Access Highway Closure Operation
(Figure TTC-45.0)



Typical Traffic Control
Limited Access Highway Closure Operation with a Short Term Detour
(Figure TTC-46.0)

NOTES

Guidance:

1. *Regulatory traffic control devices should be modified as needed for the duration of the detour.*
2. *Figure TTC-46 illustrates a general layout of detour signs. Additional detour signs should be erected at all connecting roadways.*
3. *Detour signs with an Advanced Turn Arrow (M4-V3) should have a spacing distance of 300' minimum in advance of the intersection. The Detour signs with the Point of Turn Arrow (M4-9) should be placed at the intersection.*
4. *When closing a ramp, the channelizing device spacing should be a maximum of 10'.*

Option:

5. Other sign layouts may be substituted as directed by the Regional Traffic Engineer.
6. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.

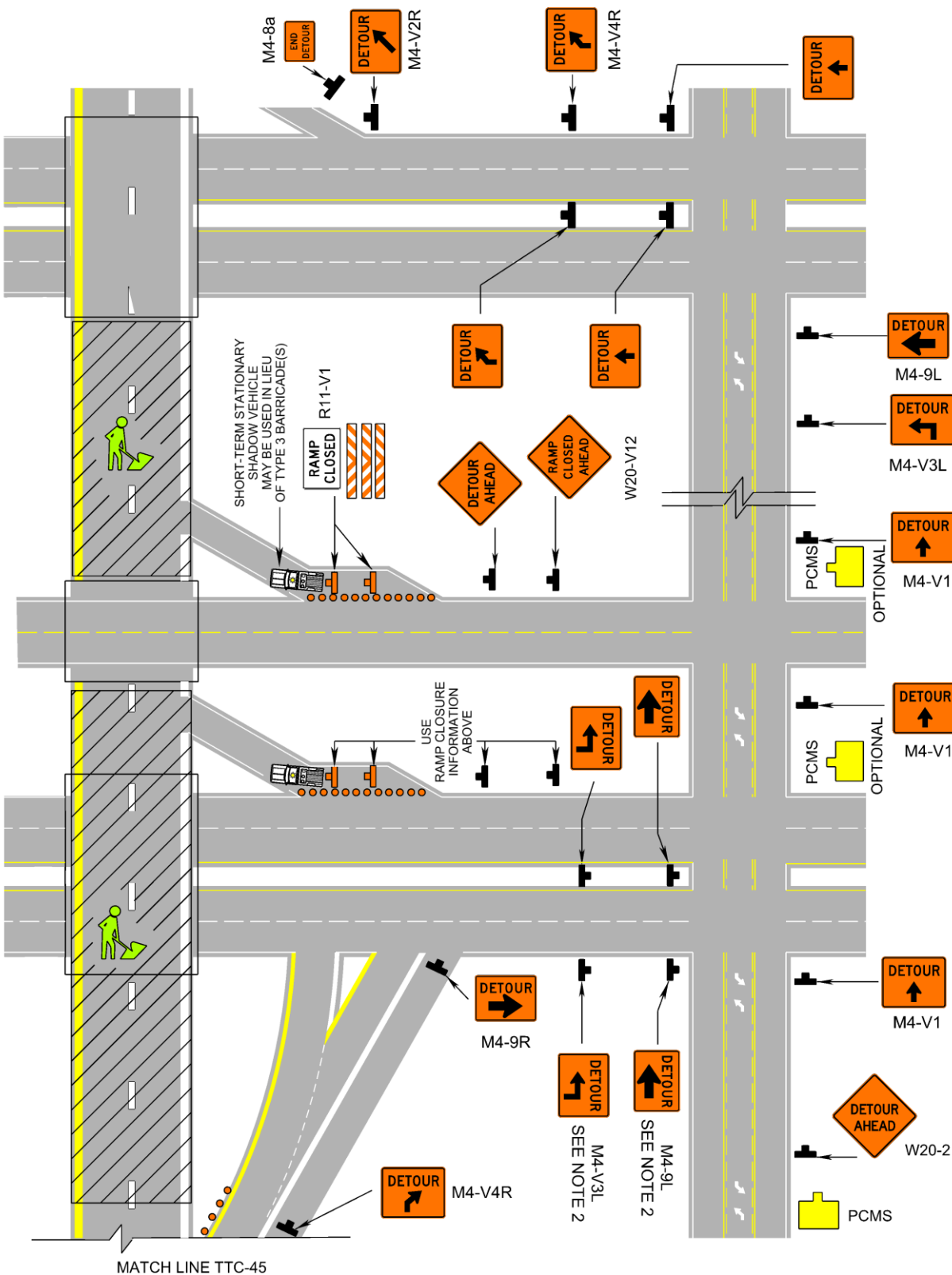
Standard:

7. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
8. **A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).**

Support:

9. Short-term stationary operation is daytime work that occupies a location for more than 1 hour within a single daylight period.
10. See Chapter 6I for additional information on incident management traffic control.

Limited Access Highway Closure Operation with a Short Term Detour
(Figure TTC-46.0)



Typical Traffic Control
Limited Access Highway Closure Operation with a Long Term Detour
(Figure TTC-47.0)

NOTES

Guidance:

1. *Regulatory traffic control devices should be modified as needed for the duration of the detour.*
2. *Figure TTC-47 illustrates a general layout of detour signs. Additional detour signs should be erected at all connecting roadways.*
3. *The detour sign assemblies with the Advanced Turn Arrow (M5-1) sign should have a spacing distance of 300' minimum in advance of the intersection. The detour sign assemblies with the Point of Turn arrow (M6-3 and M6-1) signs should be placed at the intersection.*
4. *When closing a ramp, the channelizing device spacing should be a maximum of 10'.*

Option:

5. Other sign layouts may be substituted as directed by the Regional Traffic Engineer.
6. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
7. Cardinal direction plaques may be used with route signs.

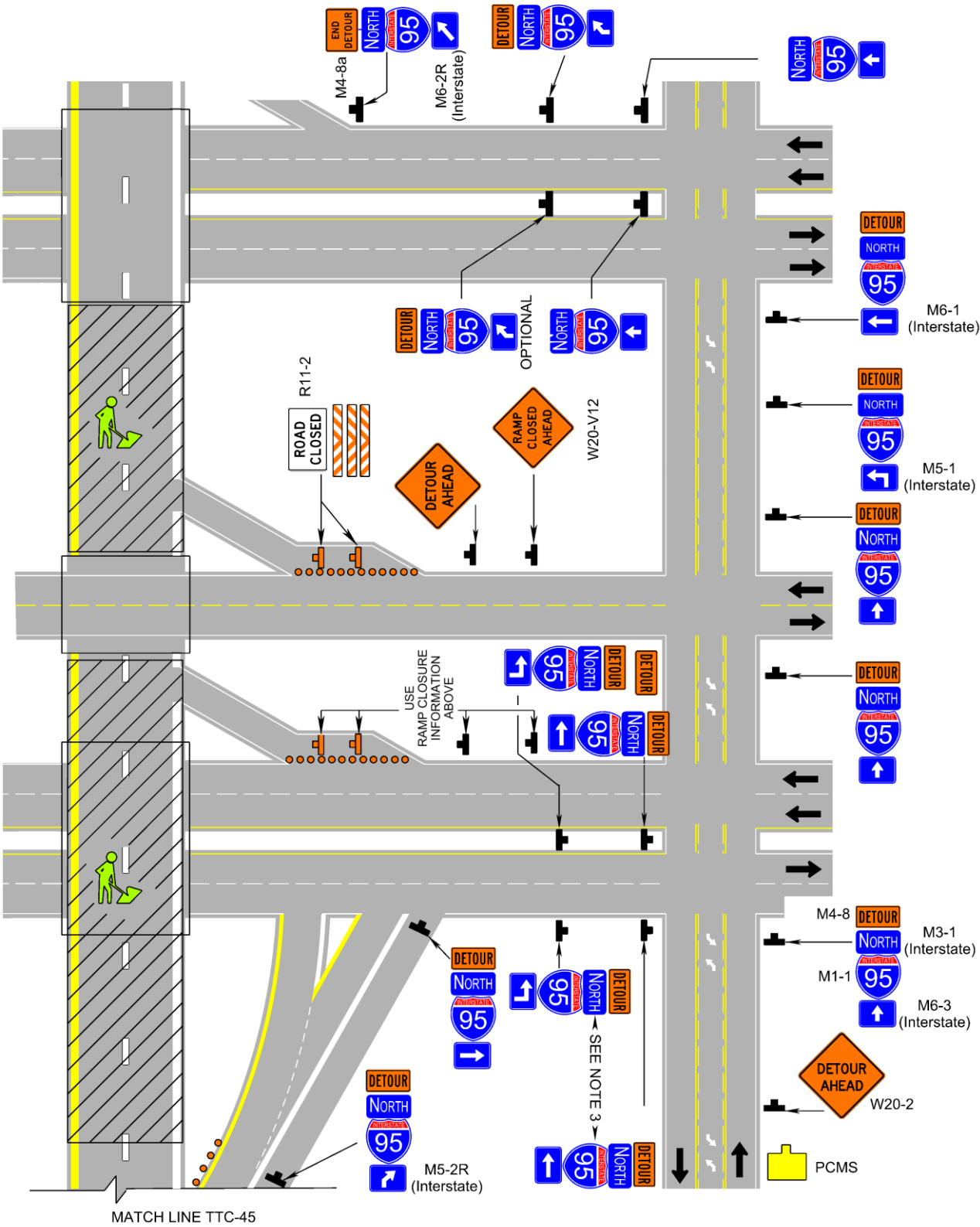
Standard:

8. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
9. **A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).**

Support:

10. Long-term stationary operation is work that occupies a location more than 3 days.
11. See Chapter 6I for additional information on incident management traffic control.

Limited Access Highway Closure Operation with a Long Term Detour
(Figure TTC-47.0)



Typical Traffic Control
Road Closure Operation with a Detour
(Figure TTC-48.0)

NOTES

Guidance:

1. *Regulatory traffic control devices should be modified as needed for the duration of the detour.*
2. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less. The directional sign should be placed at the intersection.*
3. *If the road is opened for some distance beyond the intersection and/or there are significant origin/destination points beyond the intersection, the ROAD CLOSED LOCAL TRAFFIC ONLY (R11-3a) and DETOUR (M4-10) signs on Type 3 Barricades should be located at the corners of intersecting closed roadway or the traveled way.*

Option:

4. If the road is open for some distance beyond the intersection the Route Sign Directional assembly may be placed in the travelway as shown to augment or replace the one shown on the corners.
5. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
6. Cardinal direction plaques may be used with route signs.

Standard:

7. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
8. **For short-term duration work the M4-9 or M4-V3 series of signs shall be used. For long-term duration work the route shield assembly shall be used with the detour sign.**

Option:

9. Long-term detours may be signed with a street name (M4-VP1a or M4-Vp1b) plaque above the DETOUR (M4-9 or M4-V3 series) sign (see Figure TTC-34).

Support:

10. See Chapter 6I for additional information on incident management traffic control.

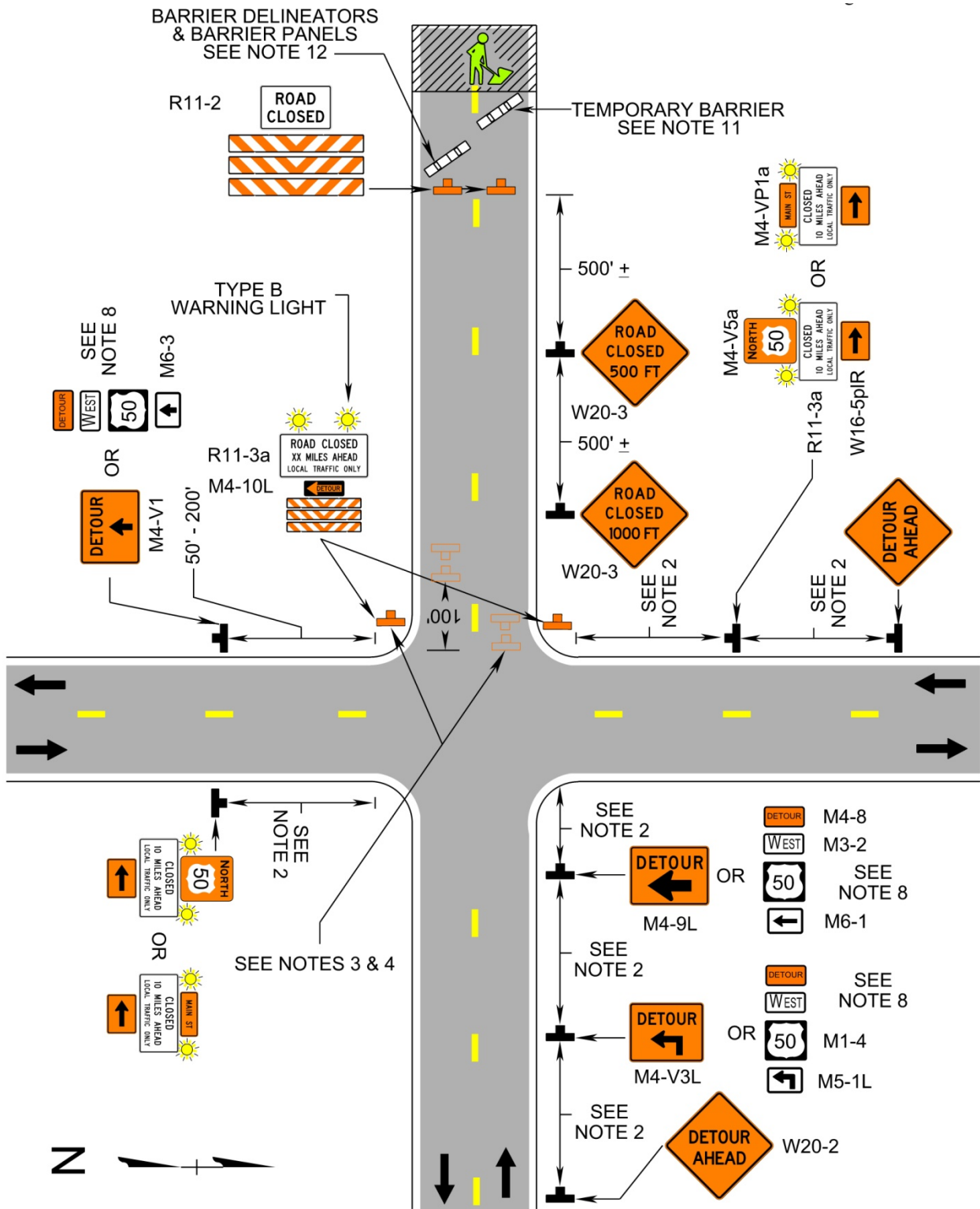
Guidance:

11. *For long-term stationary work (more than 3 days) when a grade differential of 1 foot or greater is present, temporary barrier should be placed at a 45° angle to the travelway a sufficient distance beyond the Type 3 Barricade but before the work space while providing equipment access to the work space.*

Standard:

12. **Barrier panels 8 inches in width and 12 inches in height shall be placed on top of the temporary concrete barrier, perpendicular to traffic, and spaced 20' on centers along the taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. Barrier delineators shall be installed along the traffic side of the concrete barrier in-between and at the same spacing as the barrier panels approximately 24 inches up from the roadway surface.**
13. **An END DETOUR (M4-8a) sign shall be used to terminate the detour route.**

Road Closure Operation with a Detour
(Figure TTC-48.0)



Typical Traffic Control
Surveying Operation
(Figure TTC-49.0)

NOTES

OFF TRAVELWAY -

Guidance:

1. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
3. **Each vehicle involved in the surveying operation shall be equipped with at least one rotating amber light or high intensity amber light.**
4. **Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.**
5. **Maximum length of the work zone shall be two miles.**

Option:

6. Where Right-of-Way and/or geometric conditions do not allow the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

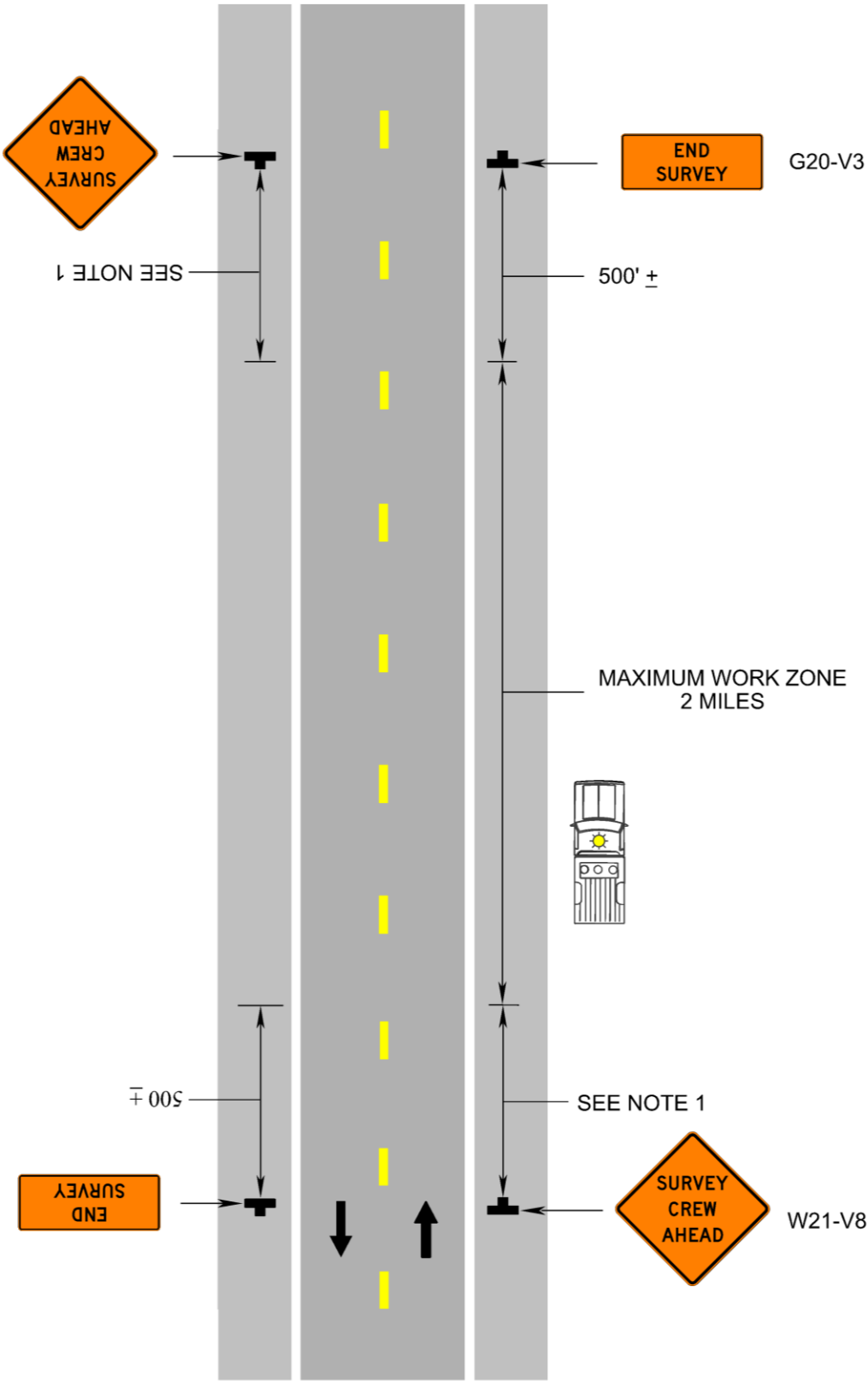
7. **All workers shall wear high visibility clothing per Chapter 6D (see Section 6D.03).**

ON TRAVELWAY -

Guidance:

8. *For surveying operations on the travelway, Typical Traffic Control Figure TTC-23, Lane Closure on a Two-Lane Roadway Using Flaggers, or Typical Traffic Control Figure TTC-16 or TTC-17, Outside or Inside Lane Closure Operation on a Four-Lane Roadway, should be used.*

Surveying Operation
(Figure TTC-49.0)



Typical Traffic Control
Disruption Operation on a Multi-Lane Roadway
(Figure TTC-50.0)

NOTES

Support:

1. Conditions represented are a planned closure not exceeding 20 minutes during the daytime.

Guidance:

2. *On Limited Access highways, the sign spacing distance and flagger distance should be 1300'- 1500'. For all other roadways, the distance between the advance warning signs and between the flagger should be 500'-800' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.*
4. *The buffer space length should be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.*

Standard:

5. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
6. **Flagging stations shall be located far enough in advance of the operation to permit approaching traffic to reduce speed and/or stop before passing into the operation.**
7. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties and shall follow the procedures noted in Sections 6E.04 and 6E.05.**
8. **A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).**

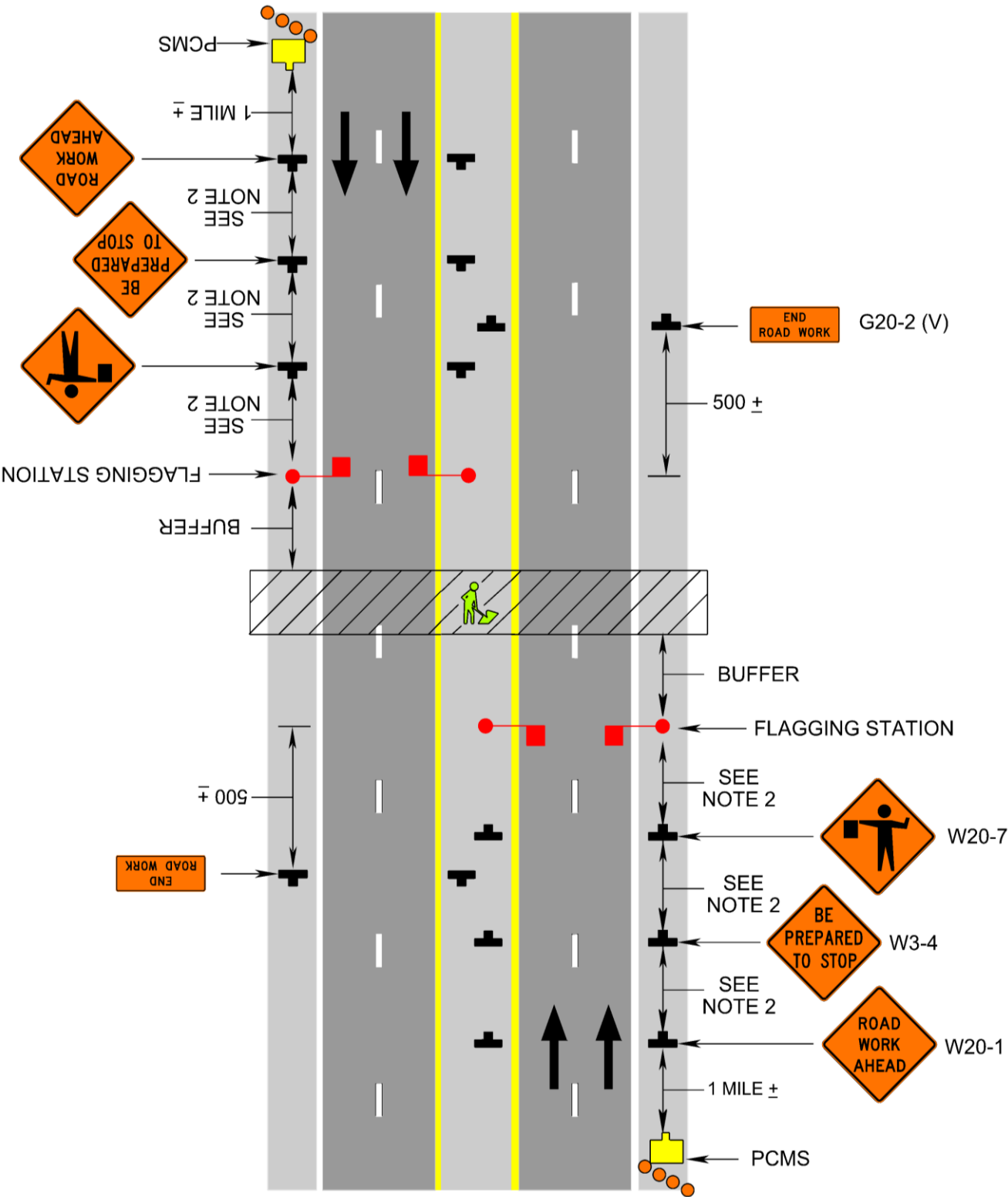
Guidance:

9. *A Portable Changeable Message Sign (PCMS) should be used on Limited Access highways and placed a minimum of one mile in advance of the warning signs warning of the operation ahead (UTILITY WORK AHEAD) and advising of the action required (BE PREPARED TO STOP).*
10. *Disruptions to traffic should be coordinated with all entities involved in advance and performed during off-peak hours to minimize the impact on the motoring public. On Limited Access highways, State Police should assist with the stoppage of traffic.*

Option:

11. A uniformed law enforcement officer may be used for this application in place of the flagger.
12. The ROAD WORK AHEAD (W20-1) sign may be replaced with other appropriate signs such as UTILITY WORK AHEAD (W21-7).

Disruption Operation on a Multi-Lane Roadway
(Figure TTC-50.0)



Typical Traffic Control
Haul Road Crossing Operation
(Figure TTC-51.0)

NOTES

Guidance:

1. *Overhead temporary lighting should be used to illuminate haul road crossings where existing light is inadequate.*
2. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*
3. *Where no passing lines are not already in place, they should be added.*

Standard:

4. **The traffic control signing shall be the same in both directions.**
5. **A NO PASSING ZONE (W14-3) sign shall be used directly across from the DO NOT PASS (R4-1) sign.**
6. **When a road used exclusively as a haul road is not in use, Type 3 Barricades with a ROAD CLOSED (R11-2) sign shall be in place and the Flagger (W20-7) symbol or Signal Ahead (W3-3) and BE PREPARED TO STOP (W3-4) signs covered or removed.**
7. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**

Flagging Method

Guidance:

8. *The buffer space length should be as shown in Table 6H-3 on Page 6H-5 for the posted speed limit.*

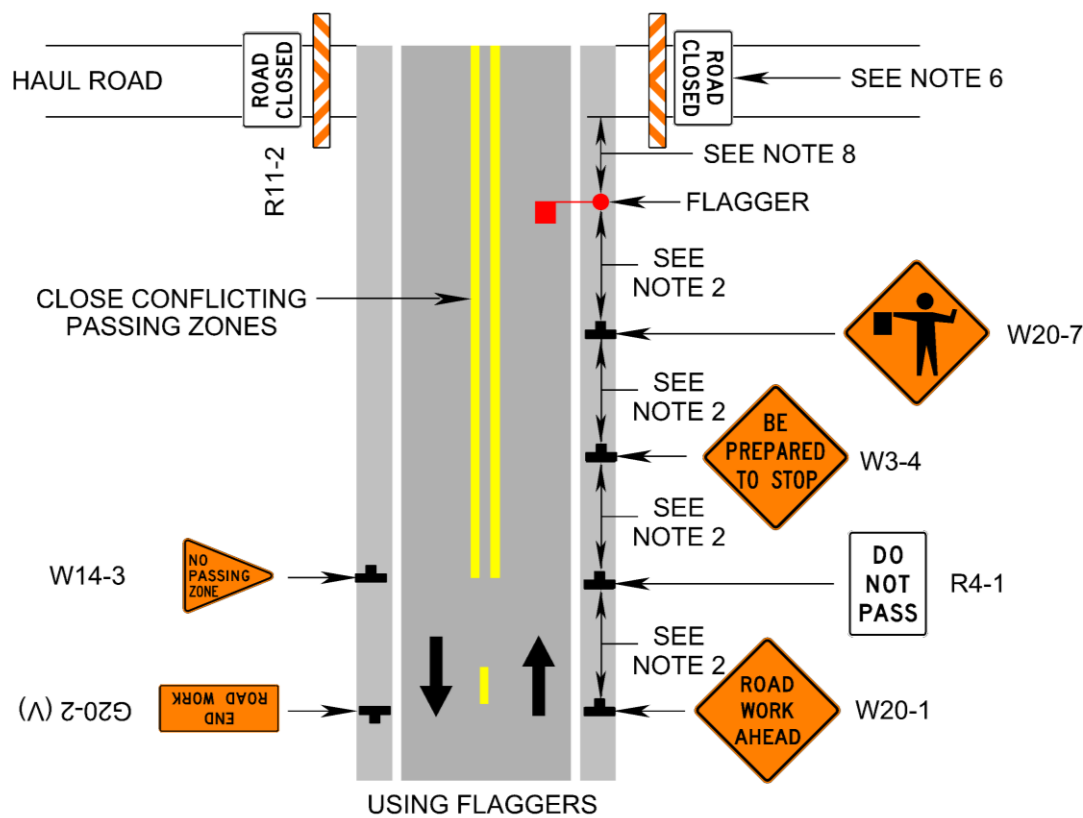
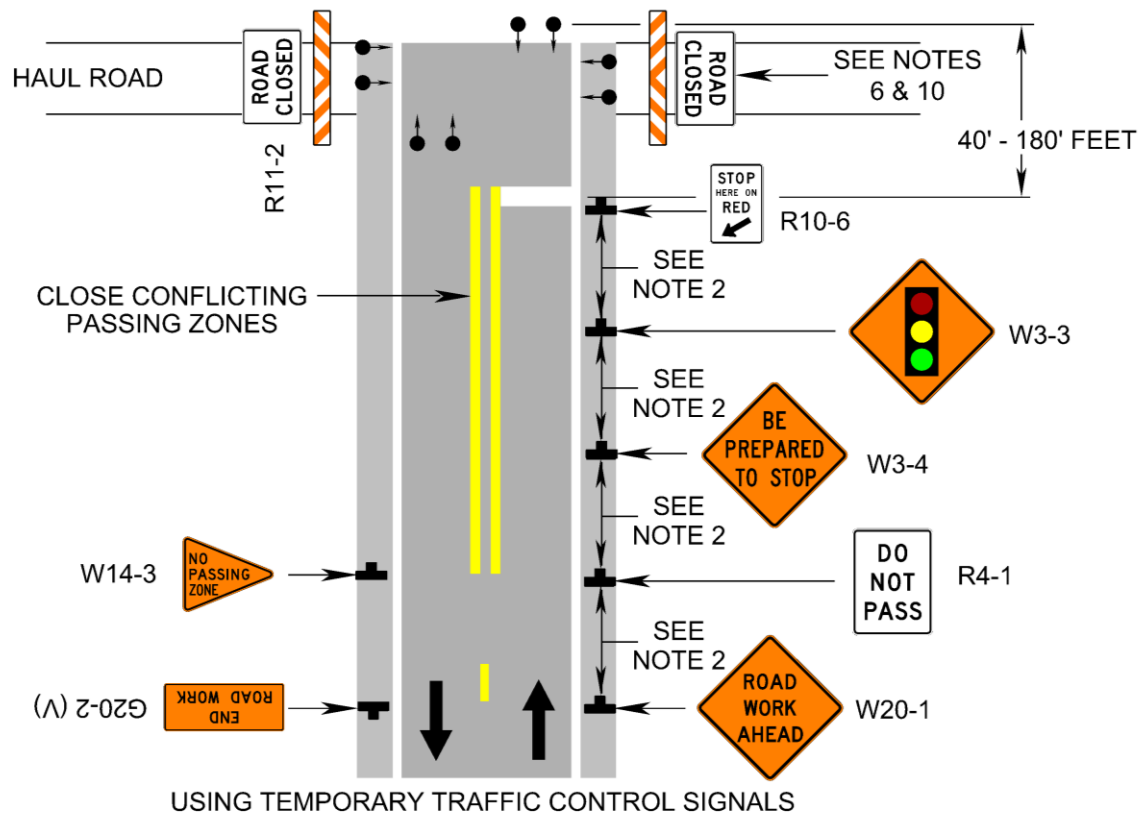
Standard

9. **At night, flagger stations shall be illuminated, except in emergencies.**

Signalized Method

10. **When the haul road is not in use, the signals shall either flash yellow on the main road or be covered, and the Signal Ahead and STOP HERE ON RED (R10-6) signs shall be covered or removed.**
11. **The temporary traffic control signals shall control both the highway and the haul road and shall meet the physical display and operational requirements of conventional traffic control signals as described in Part 4 of the 2009 MUTCD. Authorized officials shall establish traffic control signal timing.**
12. **Stop lines shall be used on existing highway with temporary traffic control signals.**
13. **Existing conflicting pavement markings and raised pavement marker reflectors between the stop lines shall be removed. After the temporary traffic control signal is removed, the stop lines and other temporary pavement markings shall be removed and the permanent pavement markings restored.**
14. **Safeguards shall be incorporated to avoid the possibility of conflicting signal indications at each end of the TTC zone.**

Haul Road Crossing Operation
(Figure TTC-51.0)



Typical Traffic Control
Signing for Speed Limit and Fine Signs in Work Zones
(Figure TTC-52.0)

NOTES

Standard:

1. **The Regional Traffic Engineer must approve reducing the speed limit in a work zone after performing a Traffic Engineering study per Traffic Engineering Division Memorandum TE-350 prior to the use of this layout.**

Option:

2. This layout depicts signing requirements for speed limits and increased fines in work zones. Additional signing and traffic control devices may be required based on the operation being performed.

Guidance:

3. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

4. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
5. **The use of the NOTICE FINES UP TO \$500 FOR EXCEEDING SPEED LIMIT IN WORK ZONE (R2-V1) sign shall be approved by the Regional Traffic Engineer prior to installation. If the R2-V1 sign is used the FINES HIGHER (R2-6P) plaque and END WORK ZONE SPEED LIMIT (R2-12) sign shall be used.**

Option:

6. For Secondary and Minor Primary road systems, a 66" x 42" sign may be used.

Standard:

7. **If the entire project is signed for a reduced speed, and an original speed limit sign is not within 1000 feet of the END ROAD WORK (G20-2 (V)) sign, signs depicting the original speed limit shall be erected 500'± past the END ROAD WORK sign. On secondary roads without posted speed limits, an END WORK ZONE SPEED LIMIT (R2-12) sign shall be used in place of erecting an R2-1 sign. If only part of the project is signed for a reduced speed, then the original speed limit shall be posted 500'± past the work area.**

Option:

8. Experience has shown that compliance to the reduced speed signing is greater if these signs are placed as close to the work as possible, as opposed to placement prior to the advance warning signs (ROAD WORK AHEAD, etc.).

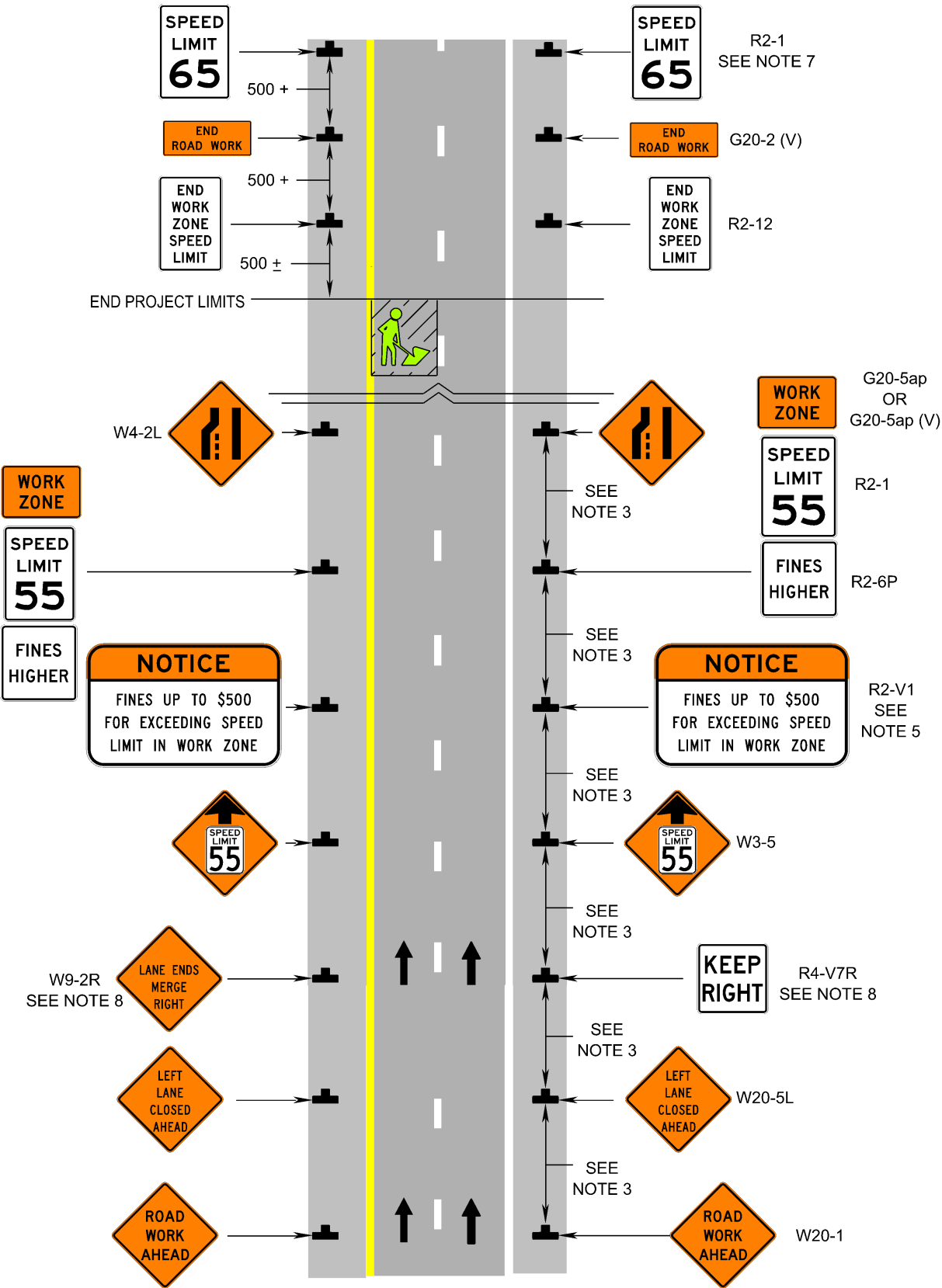
Standard:

9. **The Reduced Speed Limit Ahead (W3-5) graphic signs are only required if the speed limit is being reduced in the work zone.**

Guidance:

10. *The speed limit should be stepped down in advance of the location requiring the lowest speed in ten-mile per hour increments. Additional TTC warning devices should be used.*

Signing for Speed Limit and Fine Signs in Work Zones
(Figure TTC-52.0)



Typical Traffic Control
Signing for Project Limits
(Figure TTC-53.0)

NOTES

Support:

1. This layout depicts signing requirements for notifying motorist when they are entering and exiting a potential construction/maintenance area with a duration equal to or greater than 60 days.

Standard:

2. The **ROAD WORK AHEAD (W20-1)** sign or the **ROAD WORK NEXT XX MILES (G20-1 (V))** sign shall be placed far enough in advance of the project limits so that other warning signs in a series may be adequately placed prior to the condition they are warning about.
3. The **ROAD WORK NEXT XX MILES** sign shall be used for projects with activity areas greater than 2 miles in length, or when multiple work activities (such as pavement patching, guardrail installations, shoulder restoration, etc.) occur along a highway.
4. The distance displayed on the **ROAD WORK NEXT XX MILES** sign shall be stated to the nearest whole mile from the point of installation to the **END ROAD WORK (G20-2 (V))** sign.
5. On divided highways having a median wider than 8', right and left sign assemblies shall be required.

Guidance:

6. *For projects with activity areas 2 miles or less in length, the ROAD WORK AHEAD sign should be the first sign motorist encounter.*
7. *Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
8. *All connections within the project limits should be identified with signs indicating to motorist they are entering or exiting a potential construction/maintenance area.*

The diagram illustrates two traffic control scenarios for a T-intersection where a cross street meets a through street.

Scenario G20-2 (V): This scenario is for a cross street with a stop sign. It shows a 'ROAD WORK NEXT XX MILES' sign at the start of the project limits, followed by a 'ROAD WORK AHEAD' sign. A 'SEE NOTE 7' bracket indicates the placement of four advance warning signs. At the intersection, a 'ROAD WORK AHEAD' sign is placed, with 'SEE NOTES 2 & 8' indicating its placement. A '500 ±' distance is marked from the intersection to the 'END ROAD WORK' sign. A 'PROJECT LIMITS' line is shown on the left side of the diagram.

Scenario G20-1 (V): This scenario is for a cross street with a stop sign. It shows a 'ROAD WORK NEXT XX MILES' sign at the start of the project limits, followed by a 'ROAD WORK AHEAD' sign. A 'SEE NOTE 7' bracket indicates the placement of four advance warning signs. At the intersection, a 'ROAD WORK AHEAD' sign is placed, with 'SEE NOTES 2 & 7' indicating its placement. A '500 ±' distance is marked from the intersection to the 'END ROAD WORK' sign. A 'PROJECT LIMITS' line is shown on the left side of the diagram.

Typical Traffic Control
Motorist Survey Operation on a Two-Lane Roadway
(Figure TTC-54.0)

NOTES

Guidance:

1. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Table 6H-3. For Limited Access highways a minimum of 1000' is desired.*
2. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*

Standard:

3. **Flagging stations shall be located far enough in advance of the survey area to permit approaching traffic to reduce speed and/or stop before passing through the survey area.**

Option:

4. A supplemental flagger may be required in the advance warning of the operation to slow approaching traffic prior to reaching the flagger station or queued traffic.

Guidance:

5. *If the queue of traffic reaches the BE PREPARED TO STOP (W3-4) sign, the flaggers controlling the traffic in both directions should turn their flagging paddles to SLOW to allow the traffic to clear. Also, the advance warning signs should be readjusted at greater distances.*

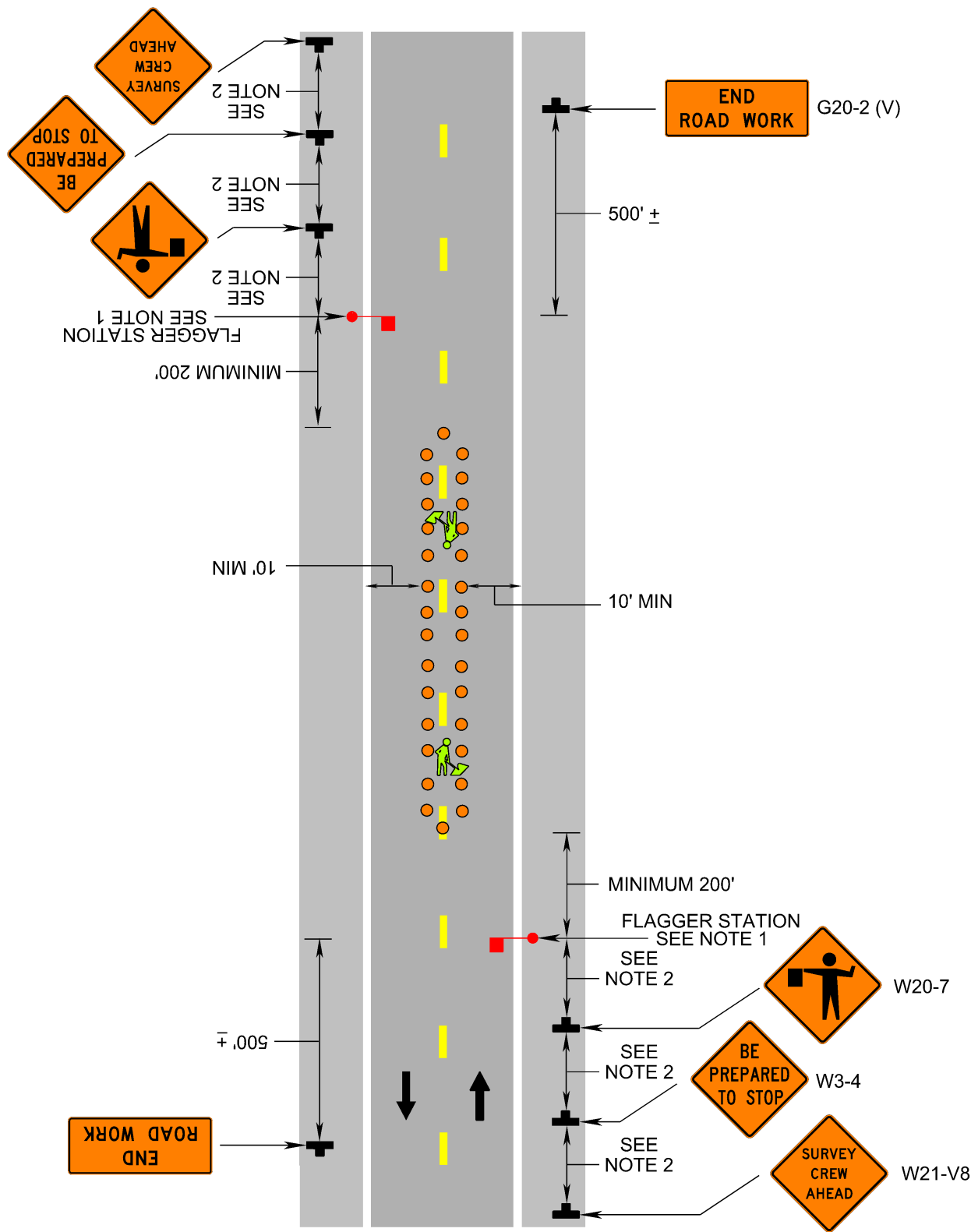
Standard:

6. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**
7. **Cones spaced a maximum of 20' on center shall be used to delineate the survey area.**
8. **The minimum width of the open travel lane shall be 10 feet.**
9. **All workers in or near the roadway shall wear high-visibility clothing (see Section 6D-03).**
10. **For surveying on the centerline of a high-volume road, one lane shall be closed using the information illustrated in Figure TTC-23.**

Option:

11. Additional traffic control devices may be needed as determined by the Regional Traffic Engineer.
12. TTC-54 may be used for law enforcement checkpoints by replacing SURVEY CREW AHEAD (W21-V8) with an appropriate sign (Examples such as LICENSE CHECK AHEAD, CAR SEAT CHECKPOINT AHEAD, SHERIFF STOP AHEAD, etc.).

Motorist Survey Operation on a Two-Lane Roadway
(Figure TTC-54.0)



Typical Traffic Control
Eradication of Pavement Markings in a Work Zone
(Figure TTC-55.0)

NOTES

Support:

1. This figure depicts requirements for pavement marking removal for long-term (over 3 days continuous duration) work zones. These are minimum removal requirements for existing pavement markings.

Standard:

2. All skip lines shall be removed a minimum of 200' in advance of the beginning of a lane closure transition in the lane being closed to the point where the new edge line covers the skips.
3. The existing edge line shall be removed a minimum of 200' past the beginning point where the new edge line is transitioned over.
4. In lane shift situations, all skip lines not behind concrete traffic barriers and within 6' of the new edge line shall be removed.

Option:

5. In lane shift situations, if Group 2 channelizing devices are placed between the barrier service or work area and the travel lanes, removal of skip lines in excess of 6' away from the new edge line is not required and may remain.

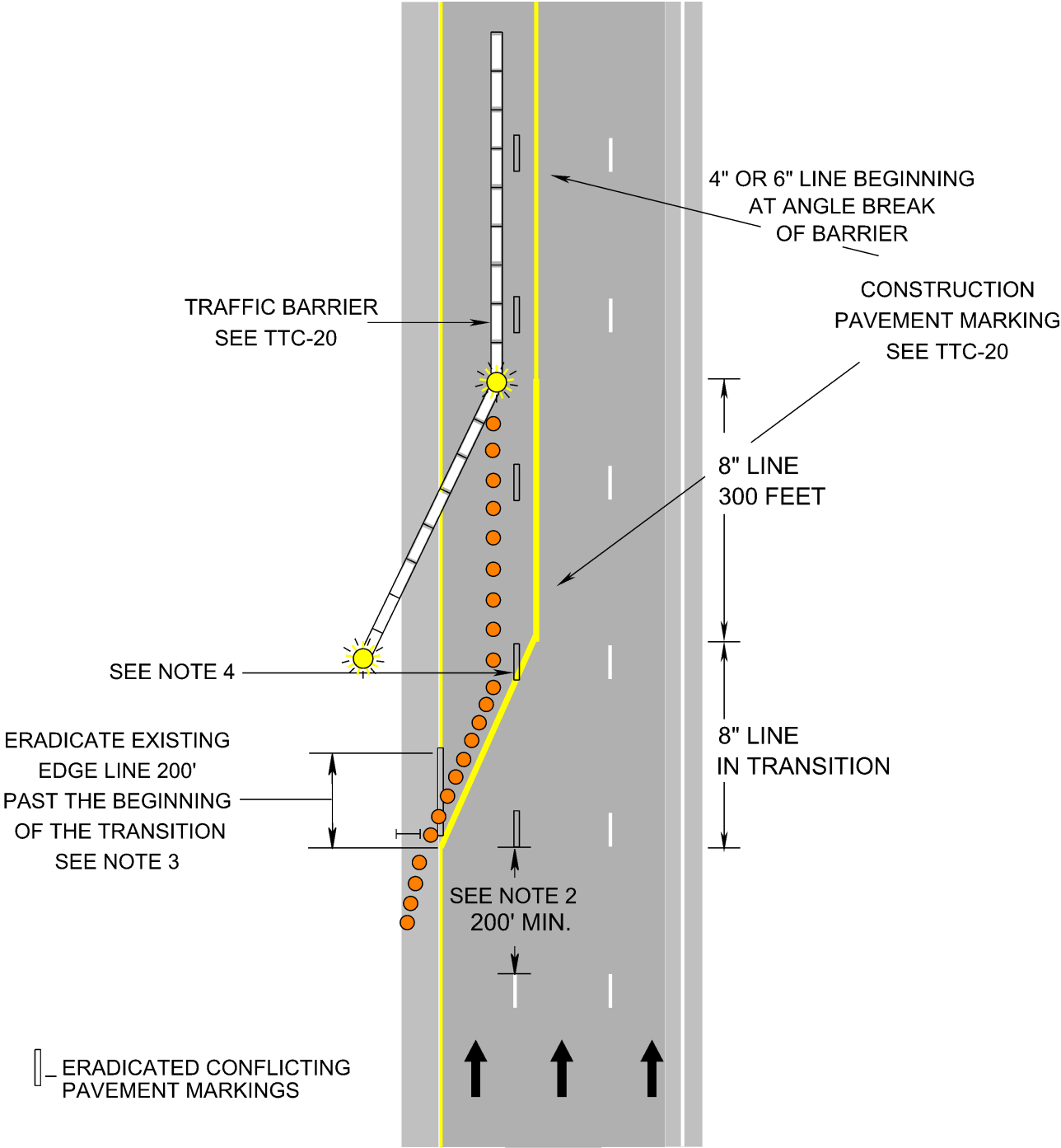
Standard:

6. All existing pavement markers in conflict with the new construction pavement markings shall have the reflective element removed.
7. Work zones shall be reviewed the first night period after changes have been made to the pavement markings to ensure all conflicting markings and markers have been adequately removed, and the new markings and markers properly delineate the intended travel path.

Option:

8. Additional markings may require removal based on the roadway geometrics and night review of the site.

Eradication of Pavement Markings in a Work Zone
(Figure TTC-55.0)



Typical Traffic Control
Work in the Vicinity of a Highway-Rail Crossing
(Figure TTC-56.0)

NOTES

Guidance:

1. When highway-rail grade crossings exist either within or in the vicinity of roadway work activities, extra care should be taken to minimize the probability of conditions being created, either by lane restrictions, flagging or other operations, where vehicles might be stopped within the highway-rail grade crossing, considered as being 15 feet on either side of the closest and farthest rail.

Standard:

2. If the queuing of vehicles across active rail tracks cannot be avoided, a law enforcement officer or flagger shall be provided at the highway-rail grade crossing to prevent vehicles from stopping within the highway-rail grade crossing (as described in Note 1), even if automatic warning devices are in place.

Guidance:

3. Early coordination with the railroad company should occur before work starts.
4. Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.
5. In the example depicted in TTC-56, the buffer space should be extended upstream of the highway-rail grade crossing (as shown) so that a queue created by the flagging operation will not extend across the highway-rail grade crossing.
6. The DO NOT STOP ON TRACKS (R8-8) sign should be used on all approaches to a highway-rail grade crossing within the limits of the temporary traffic control zone.

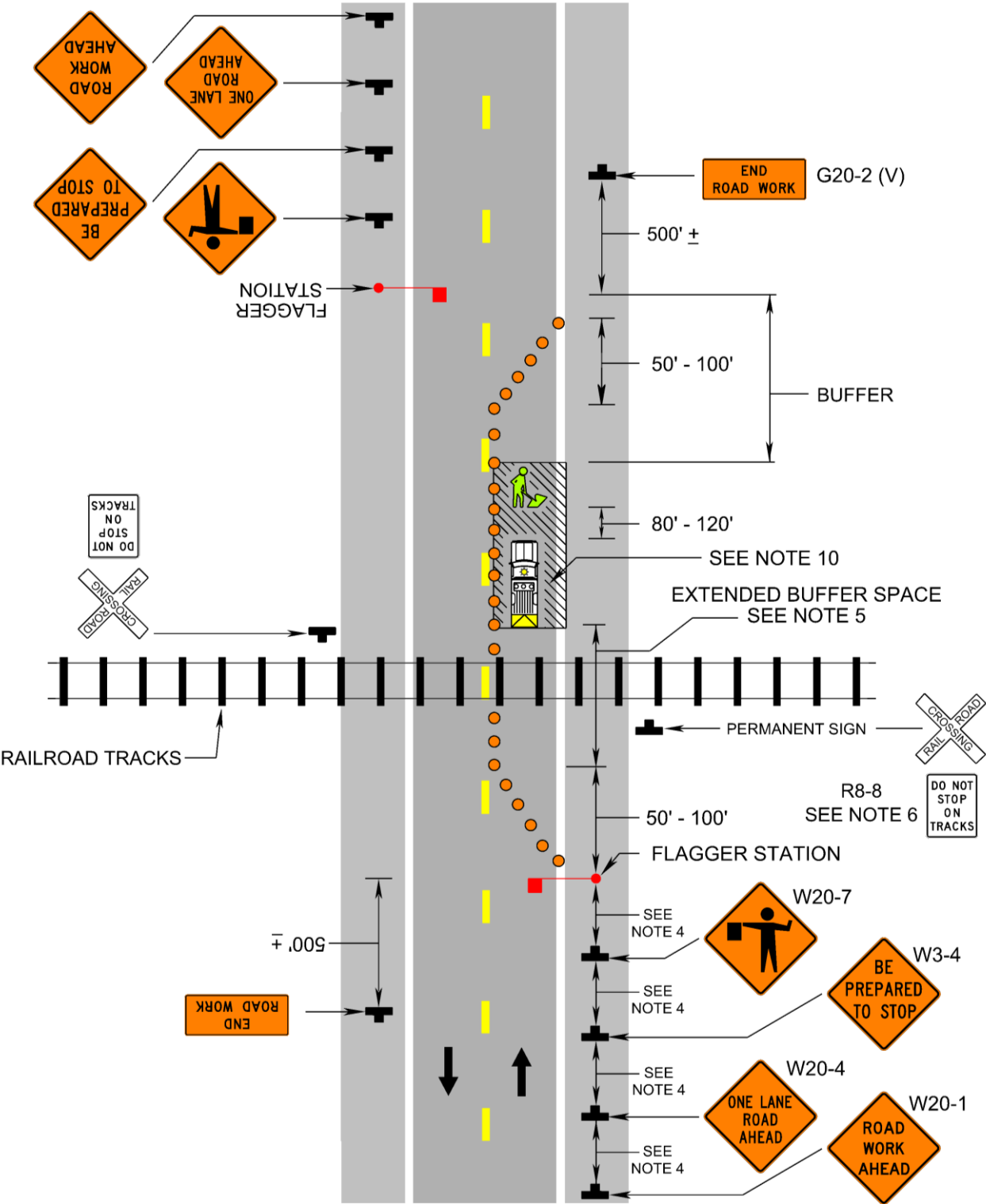
Standard:

7. Flaggers shall be state certified and have their certification card in their possession when performing flagging duties (see Section 6E.01, Qualifications for Flaggers).
8. At night, flagger stations shall be illuminated, except in emergencies. Street lights and vehicle headlights shall not be used to illuminate the flagger station.
9. Cones shall not be required on roadways 20 feet or less in width. For roadways greater than 20 feet in width, cones shall be used at the following spacing:

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
Construction Access*	80'	120'
* Spacing may be increased to this distance, but shall not exceed one access per ¼ mile.		

10. A shadow vehicle with at least one high intensity rotating, oscillating or amber strobe light shall be parked 80'-120' in advance of the first work crew. If the work is performed on a multi-lane highway with posted speeds of 45 mph or greater, it shall be a truck-mounted attenuator.
11. Vehicle hazard warning signals shall not be used instead of the vehicle's high-intensity amber rotating, flashing, oscillating, or strobe lights. Vehicle hazard warning signals can be used to supplement high-intensity amber rotating, flashing, oscillating, or strobe lights.
12. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.

Work in the Vicinity of a Highway-Rail Crossing
(Figure TTC-56.0)



Typical Traffic Control
End of Day Signing for Partial Paving Operations on a Multi-Lane Roadway
(Figure TTC-57.0)

NOTES

Standard:

1. On divided highways having a median wider than 8', right and left sign assemblies shall be used. Median barrier is considered to be part of the shoulder and its measurement shall be used to determine the total width of the shoulder.
2. The maximum pavement edge drop-off between traffic lanes shall be 2 inches or less.
3. Open travel lane(s) shall not be exposed to more than 2 to 3 mile sections of milled or uneven surface.
4. A portable changeable message sign with "ROUGH ROAD AHEAD" and other appropriate messages shall be used.
5. A BUMP (W8-1) sign shall be placed in advance of the end of the pavement drop-off. See Note 10 for sign spacing.
6. The Regional Traffic Engineer shall determine speed reductions.
7. The UNEVEN LANES (W8-11), STAY IN LANE (R4-9), and BUMP (W8-1) signs shall be adjusted daily with the work operation and their sign stand shall be supported with a sand bag weighing approximately 25-pounds on each leg. Additional UNEVEN LANES signs shall be installed every 2 miles and on entrance ramps.
8. Where conditions warrant, ROUGH ROAD (W8-8) and BUMP signs shall be installed 500' ± in advance of the affected roadway surface on entrance ramps, and BUMP signs shall be installed 500' ± in advance of unaffected roadway surface on exit ramps.
9. All signs shall be post-mounted at locations after 72 consecutive hours of non-work activities.

Guidance:

10. Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Option:

11. Only traffic control signing for partial pavement resurfacing is shown. Other devices may be used for the control of traffic through the work area.
12. Temporary pavement markers spaced at 10 foot centers for two-way traffic centerlines or three per skip line for lane division lines may be added as directed by the engineer.
13. The LOW SHOULDER (W8-9) sign may be used to warn of a shoulder condition where there is an elevation difference of less than 2 inches between the shoulder and the travel lane.

Standard:

14. If used, the LOW SHOULDER sign shall be repeated at 1 mile intervals if the condition extends over a distance in excess of 1 mile.
15. The SHOULDER DROP OFF (W8-V5) sign shall be used when an unprotected shoulder drop-off, adjacent to the travel lane, exceeds 2 inches depth between the shoulder and the travel lane. Where the condition extends over a distance in excess of 1 mile, the sign shall be repeated at 1 mile intervals.

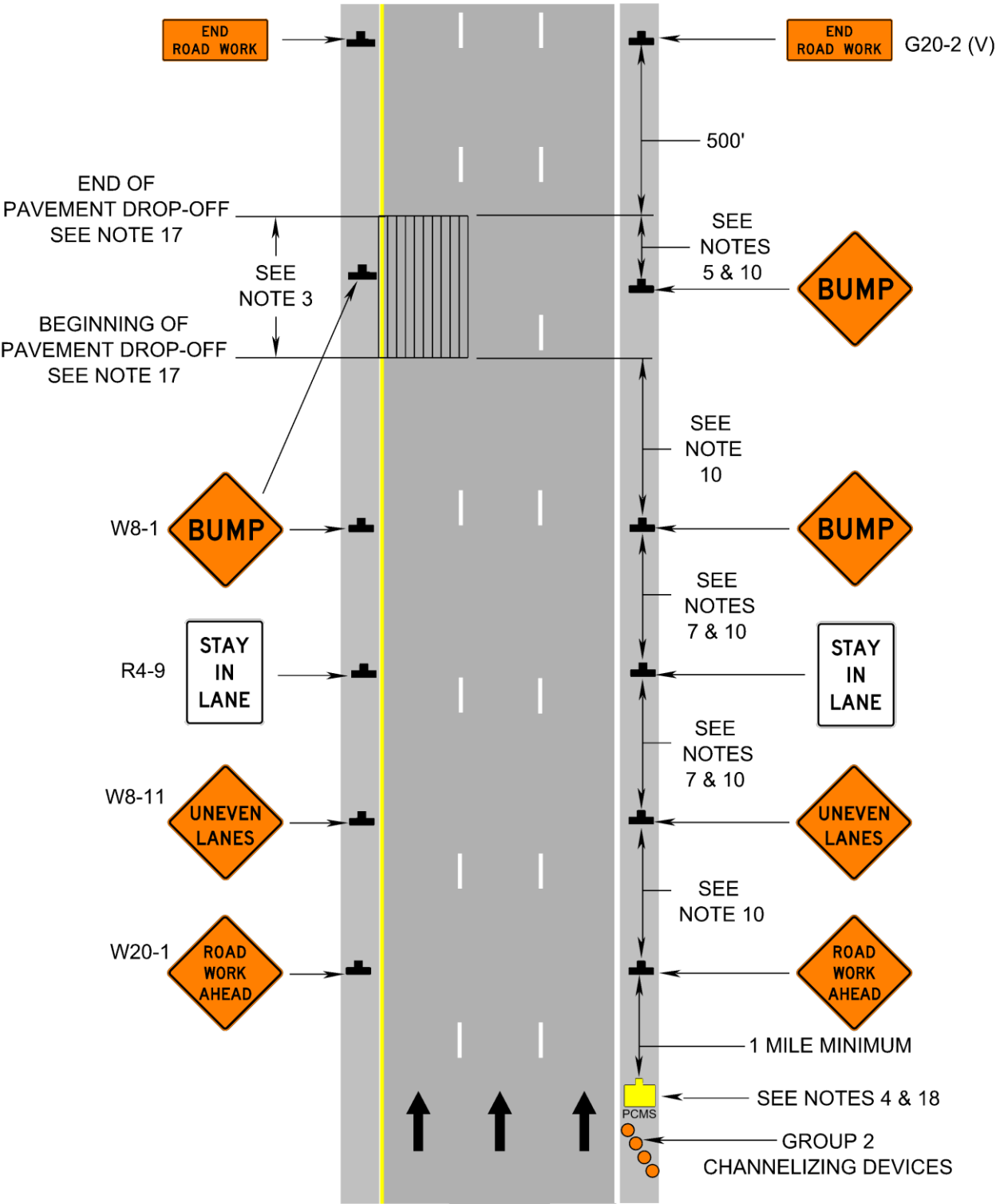
Option:

16. The SHOULDER DROP OFF sign may be eliminated if a 6:1 (desirable) to 4:1 (minimum) wedge is used between the travel lane and the shoulder.

Standard:

17. A temporary pavement wedge shall be constructed of surface mix asphalt a minimum of three (3) feet in length for every inch of depth of pavement milling on the approach and departure end of the milled travel lane(s). Refer to Standard ACOT-1 of the Road and Bridge Standards for details.
18. A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).

End of Day Signing for Partial Paving Operations on a Multi-Lane Roadway
(Figure TTC-57.0)



Typical Traffic Control
End of Day Signing for Full Paving Operations on a Multi-Lane Roadway
(Figure TTC-58.0)

NOTES

Standard:

1. On divided highways having a median wider than 8', right and left sign assemblies shall be used. Median barrier is considered to be part of the shoulder and its measurement shall be used to determine the total width of the shoulder.
2. The maximum pavement edge drop-off between traffic lanes shall be 2 inches or less.
3. Open travel lane(s) shall not be exposed to more than 2 to 3 mile sections of milled or uneven surface.
4. A portable changeable message sign with "ROUGH ROAD AHEAD" and other appropriate messages shall be used.
5. A BUMP (W8-1) sign shall be placed in advance of the end of the pavement drop-off. See Note 10 for sign spacing.
6. The Regional Traffic Engineer shall determine speed reductions.
7. The ROUGH ROAD (W8-8) and UNMARKED PAVEMENT AHEAD (W8-V4) signs shall be adjusted daily with the work operation and their sign stand shall be supported with a sand bag weighing approximately 25-pounds on each leg. Additional ROUGH ROAD and UNMARKED PAVEMENT AHEAD signs shall be installed every 2 miles.
8. Where conditions warrant, ROUGH ROAD and BUMP signs shall be installed 350' ± in advance of the affected roadway surface on entrance ramps, and BUMP signs shall be installed 500' ± in advance of unaffected roadway surface on exit ramps.
9. All signs shall be post-mounted at locations after 72 consecutive hours of non-work activities.

Guidance:

10. Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Option:

11. Only traffic control signing for partial pavement resurfacing is shown. Other devices may be used for the control of traffic through the work area.
12. Temporary pavement markers spaced at 10 foot centers for two-way traffic centerlines or three per skip line for lane division lines may be added as directed by the engineer.
13. The LOW SHOULDER (W8-9) sign may be used to warn of a shoulder condition where there is an elevation difference of less than 2 inches between the shoulder and the travel lane.

Standard:

14. If used, the LOW SHOULDER sign shall be repeated at 1 mile intervals if the condition extends over a distance in excess of 1 mile.
15. The SHOULDER DROP OFF (W8-V5) sign shall be used when an unprotected shoulder drop-off, adjacent to the travel lane, exceeds 2 inches depth between the shoulder and the travel lane. Where the condition extends over a distance in excess of 1 mile, the sign shall be repeated at 1 mile intervals.

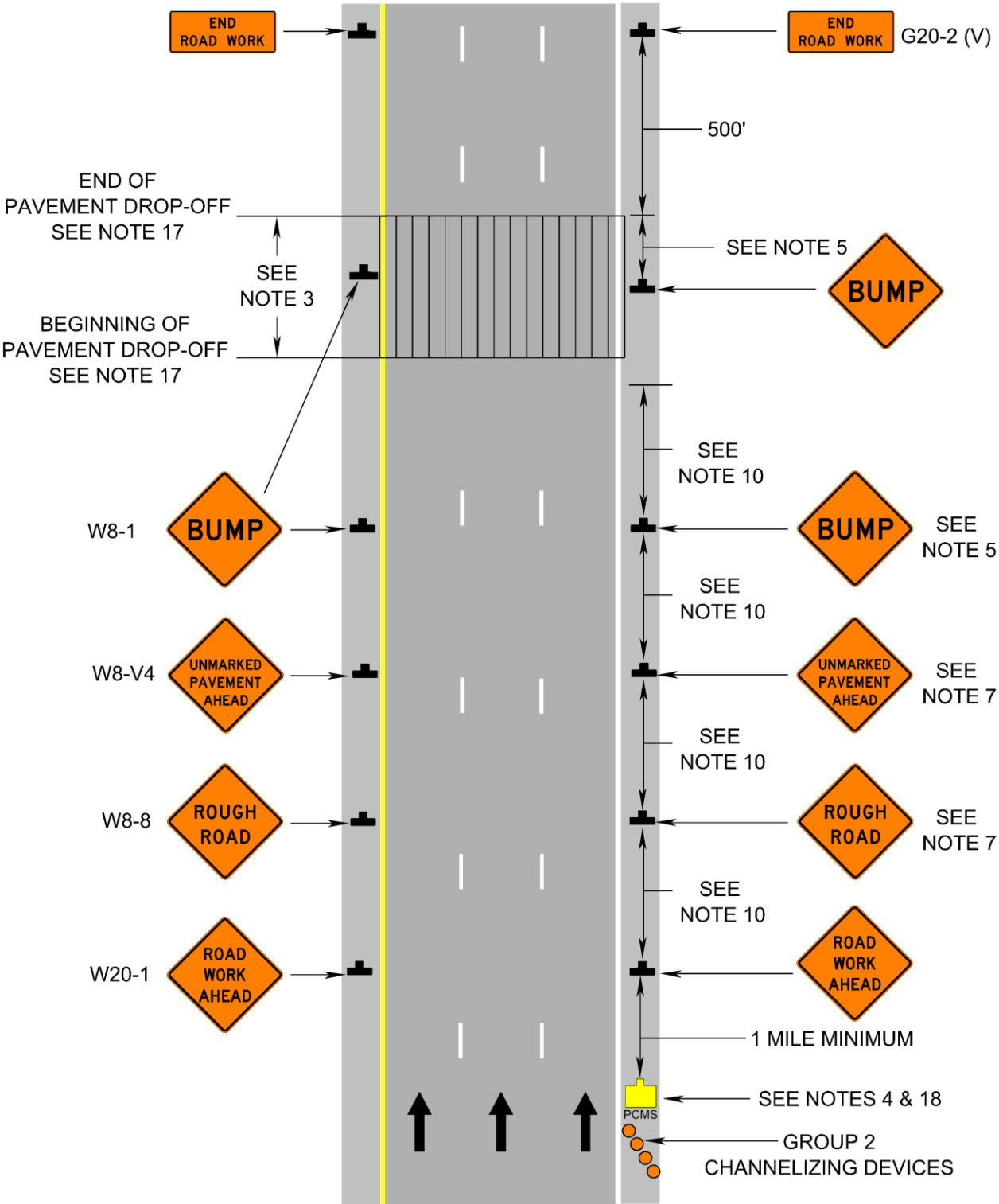
Option:

16. The SHOULDER DROP OFF sign may be eliminated if a 6:1 (desirable) to 4:1 (minimum) wedge is used between the travel lane and the shoulder.

Standard:

17. A temporary pavement wedge shall be constructed of surface mix asphalt a minimum of three (3) feet in length for every inch of depth of pavement milling on the approach and departure end of the milled travel lane(s). Refer to Standard ACOT-1 of the Road and Bridge Standards for details.
18. A minimum of four (4) drum channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).

End of Day Signing for Full Paving Operations on a Multi-Lane Roadway
(Figure TTC-58.0)



Typical Traffic Control
End of Day Signing for Paving Operations on a Two-Lane Roadway
(Figure TTC-59.0)

NOTES

Standard:

1. Open travel lane(s) shall not be exposed to more than 2 to 3 mile sections of milled or uneven surface.
2. The maximum pavement edge drop-off shall be 2 inches or less.
3. NO CENTER LINE (W8-12) sign shall be installed whenever the centerline has been obliterated or until permanent pavement markings have been installed. The sign shall be installed in both directions when the centerline is not present. In addition, NO CENTER LINE signs shall be installed every mile if the unmarked area is less than 3 miles, or every 2 miles if the unmarked area is longer than 4 miles.
4. A DO NOT PASS (R4-1) sign shall be used when the centerline has been obliterated or until pavement markings have been installed. The DO NOT PASS sign shall be installed after the NO CENTER LINE sign and their sign stand shall be supported with a sand bag weighing approximately 25-pounds on each leg. Thereafter the DO NOT PASS sign shall be installed every mile if the unmarked area is less than 3 miles or every 2 miles if the unmarked area is longer than 4 miles.
5. In the vicinity of a turning lane a BUMP (W8-1) sign shall be installed.
6. The UNEVEN LANES (W8-11) sign and BUMP sign shall be adjusted daily with the work operation and their sign stand shall be supported with a sand bag weighing approximately 25-pounds on each leg. Additional UNEVEN LANES signs shall be installed every mile.
7. Signs shall be post-mounted at locations after 72 consecutive hours of non-work activities.

Guidance:

8. *LOOSE GRAVEL (W8-7) signs should be installed on surface treated roadways and should be removed when the roadway has been swept or loose gravels have been removed from the roadway.*
9. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*

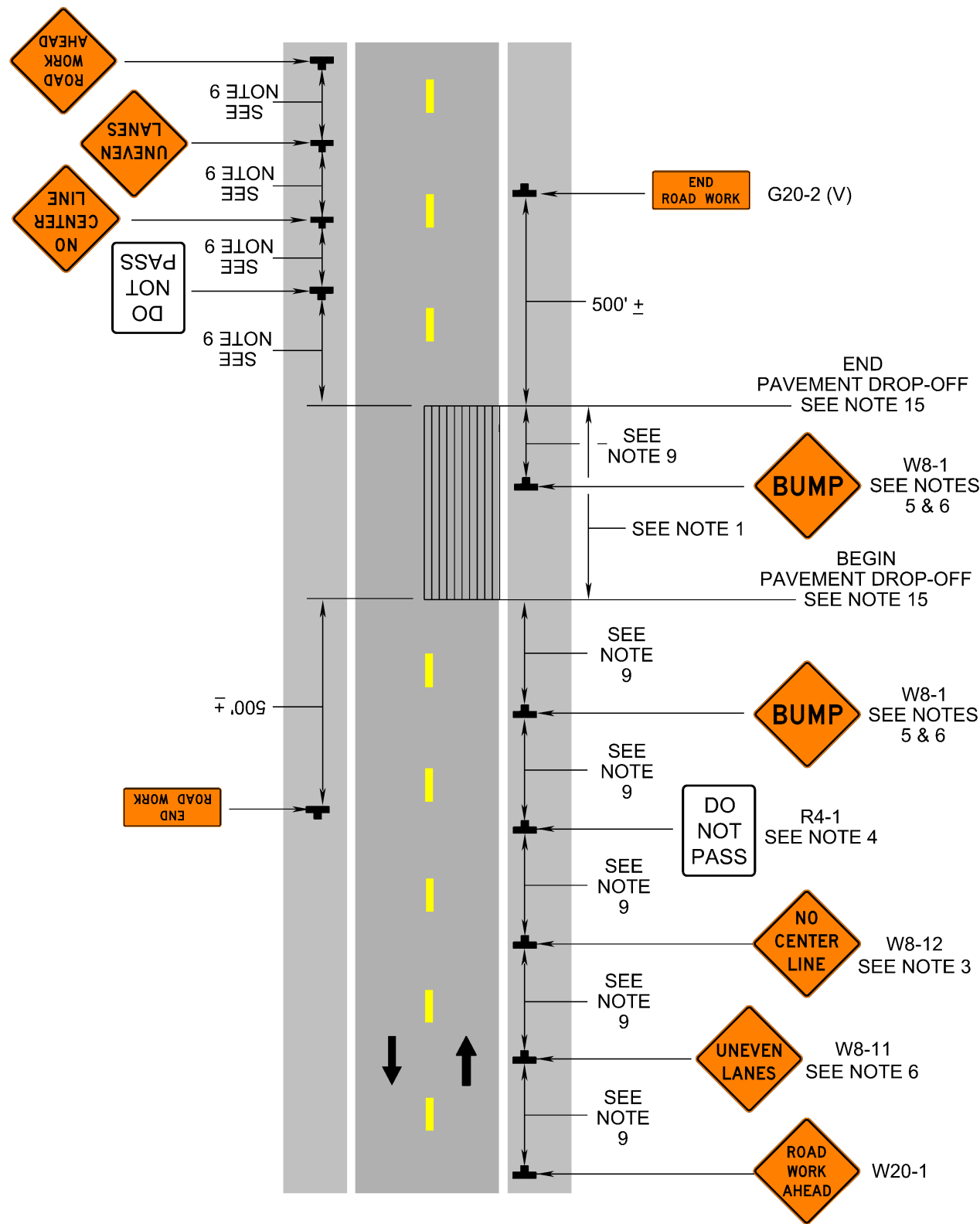
Option:

10. Only traffic control signing for pavement resurfacing is shown. Other devices may be used for the control of traffic through the work area.
11. The LOW SHOULDER (W8-9) sign may be used to warn of a shoulder condition where there is an elevation difference of less than 2 inches between the shoulder and the travel lane.
12. Either the NO CENTER LINE or NO CENTER STRIPE sign may be used until December 31, 2012, in which time only the NO CENTER LINE (W8-12) sign will be allowed.

Standard:

13. The LOW SHOULDER sign shall be repeated at 1 mile intervals where there is an elevation difference of less than 2 inches between the shoulder and the travel lane extends over a distance in excess of 1 mile.
14. If pavement marking cannot be installed in accordance with Section 704.03 of the Road and Bridge Specifications, then yellow temporary pavement markers spaced at 10 foot centers for two-way traffic shall be placed along the centerline for lane division. No edge markers will be required.
15. A temporary pavement wedge shall be constructed of surface mix asphalt a minimum of three (3) feet in length for every inch of depth of pavement milling on the approach and departure end of the milled travel lane(s). Refer to Standard ACOT-1 of the Road and Bridge Standards for details.

End of Day Signing for Paving Operations on a Two-Lane Roadway
(Figure TTC-59.0)



Typical Traffic Control
Temporary Pavement Marking and Marker Guidelines
(Figure TTC-60.0)

NOTES

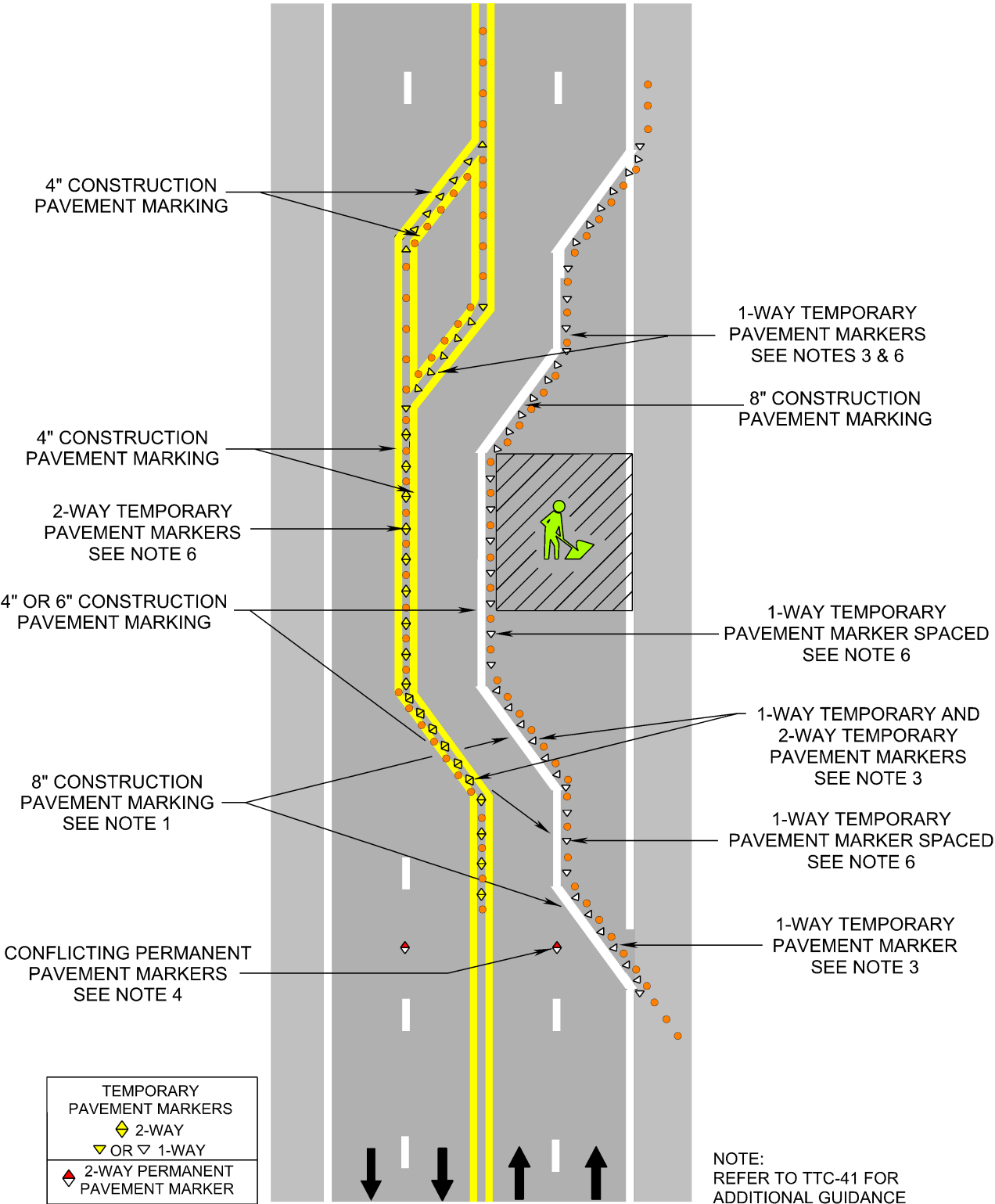
Standard:

1. Unless otherwise noted, construction pavement marking lane lines in transitions shall be 8 inches in width.
2. For long-term stationary work (more than 3 days duration), existing conflicting pavement markings shall be removed and temporary markings shall be installed.
3. Temporary pavement markers, on 20 foot center to center spacing, shall be installed in transitions.
4. Conflicting permanent pavement markers shall be covered or removed.
5. Eradication of existing pavement markings shall be as shown in Figure TTC-55.

Option:

6. Temporary pavement markers, on a 40' center to center spacing, may be added between transitions/shifting tapers as directed by the engineer.
7. For short-term stationary work (less than 3 days duration), lanes may be delineated by retroreflectorized channelizing devices or removable pavement marking instead of temporary pavement markings.

Temporary Pavement Marking and Marker Guidelines
(Figure TTC-60.0)



Typical Traffic Control
Pre-Storm Treatment Operation
(Figure TTC-61.0)

NOTES

Standard:

1. Each vehicle involved in the moving operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. The illuminated flashing arrow on Shadow Vehicle 1 shall be a Type C (96 x 48 inch) arrow board unless replaced with a Changeable Message Sign (CMS). Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.
2. Shadow Vehicle 1 shall be equipped with a truck-mounted attenuator (TMA) for operations on a four or more lane roadway with posted speeds of 45 mph or greater and shall display a PRE-STORM TREATMENT – RIGHT (or LEFT, CENTER) LANE CLOSED (W20-V8aR, W20-V8aL, W20-V8C) sign. A shadow vehicle equipped with a TMA shall be used for each additional lane closed (see Figure TTC-12).
3. For roadways not requiring the use of a TMA on the shadow vehicle, Shadow Vehicle 1 shall display a PRE-STORM TREATMENT (W20-V9) warning sign.
4. The shadow vehicle on two-lane roadways shall not display a flashing arrow. The display shall be either a Type B or C arrow board operating in the caution mode or a high-intensity amber rotating, oscillating, or strobe light.
5. For operations in the center lane of multi-lane roads, Shadow Vehicle 1 shall display a flashing double arrow.
6. Each vehicle involved in the moving operation shall have radio or mobile communication between vehicles.
7. The work operation vehicle shall display the KEEP BACK 100 FT (W20-V10) sign.

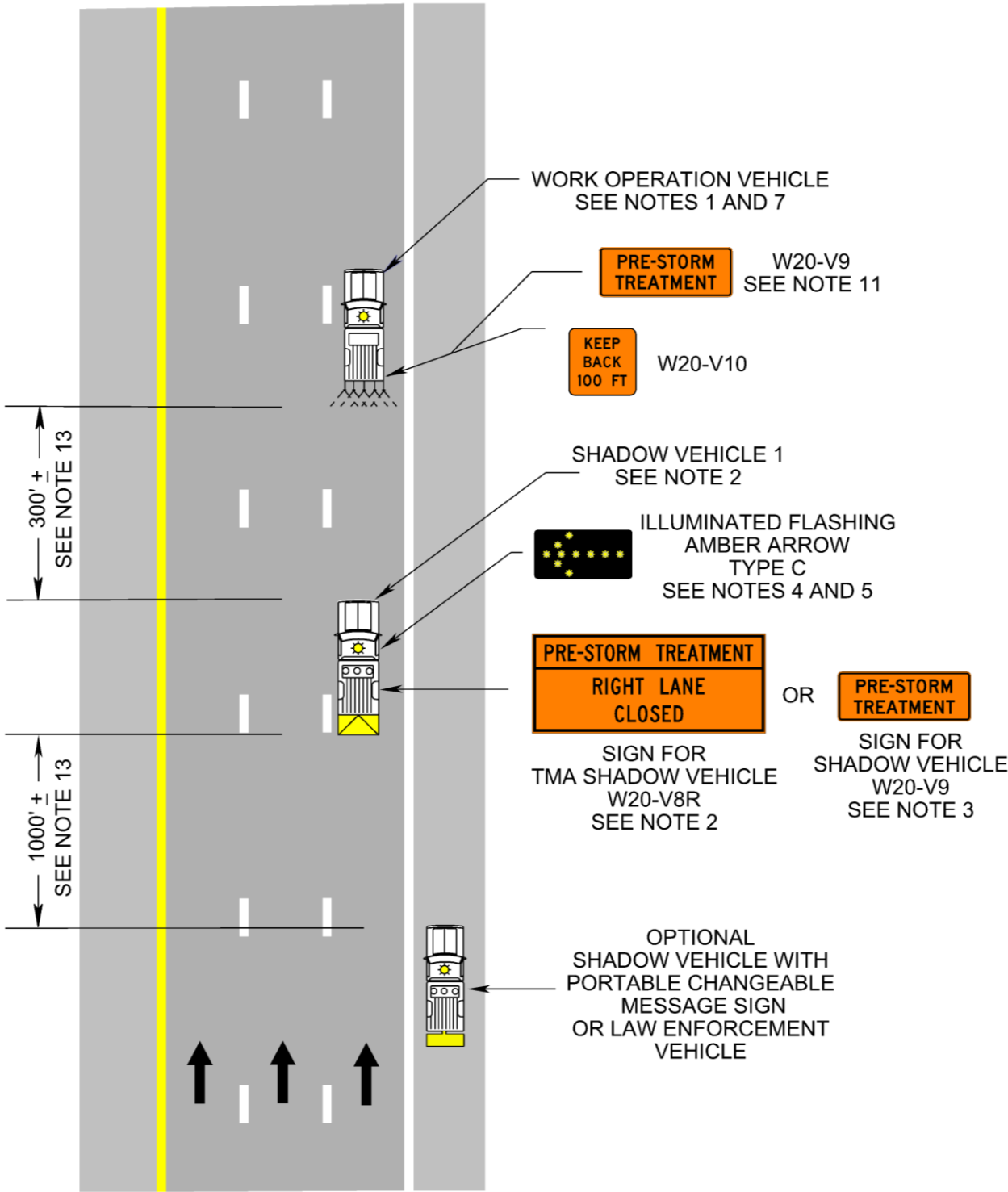
Option:

8. The static warning sign and arrow board on Shadow Vehicle 1 may be replaced with a vehicle-mounted CMS with a minimum character height of 10".
9. Arrow direction may change as needed. The lane designation on W20-V8 sign may be covered due to the rapid lane changes during the brine application.
10. Actual conditions could dictate additional traffic control devices for the operation. On high speed, high volume roads, an optional shadow vehicle on the shoulder with a Portable Changeable Message Sign (PCMS) or a marked law enforcement vehicle driving on the shoulder only may be used to further enhance safety. Suggested messages for the PCMS: "PRE-STORM WORK, RIGHT (or LEFT, CENTER) LANE CLOSED."
11. The PRE-STORM TREATMENT sign may be eliminated from the work operations vehicle if physically impossible to mount the sign to the back of the vehicle.
12. The shadow vehicle may be eliminated on two-lane roadways where the speed limit is posted below 45 mph.

Guidance:

13. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of pre-storm treatment being applied. Whenever adequate stopping sight distance exists to the rear, the shadow vehicle(s) should maintain the minimum distance shown and proceed at the same speed as the work operation vehicle. The shadow vehicle(s) should slow down in advance of vertical or horizontal curves that restrict sight distance.*
14. *When using a vehicle CMS to replace the static sign and arrow board on Shadow Vehicle 1, each word message phase should be followed by a Type B arrow display.*
15. *Advanced warning messages should be considered on overhead Changeable Message Signs to enhance the safety of the operation. Suggested messages: "PRE-STORM TREATMENT AHEAD, RIGHT (or LEFT, CENTER) LANE CLOSED."*

Pre-Storm Treatment Operation
(Figure TTC-61.0)



Typical Traffic Control
Litter Pick-Up on Limited Access Highways
(Figure TTC-62.0)

NOTES

Standard:

1. Each vehicle involved in the mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. The illuminated flashing arrow on Shadow Vehicle 1 shall be a Type C (96 x 48 inch) arrow board unless replaced with a Changeable Message Sign (CMS). Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.
2. If Shadow Vehicle 1 cannot run completely on the shoulder out of the travel lane and would be partially in the travel lane, it shall be equipped with a truck-mounted attenuator.
3. Shadow Vehicle 2 shall be equipped with a truck-mounted attenuator (TMA) for operations on a four or more lane roadway with posted speeds of 45 mph or greater.
4. Each vehicle involved in the mobile operation shall have radio or mobile communication between vehicles.

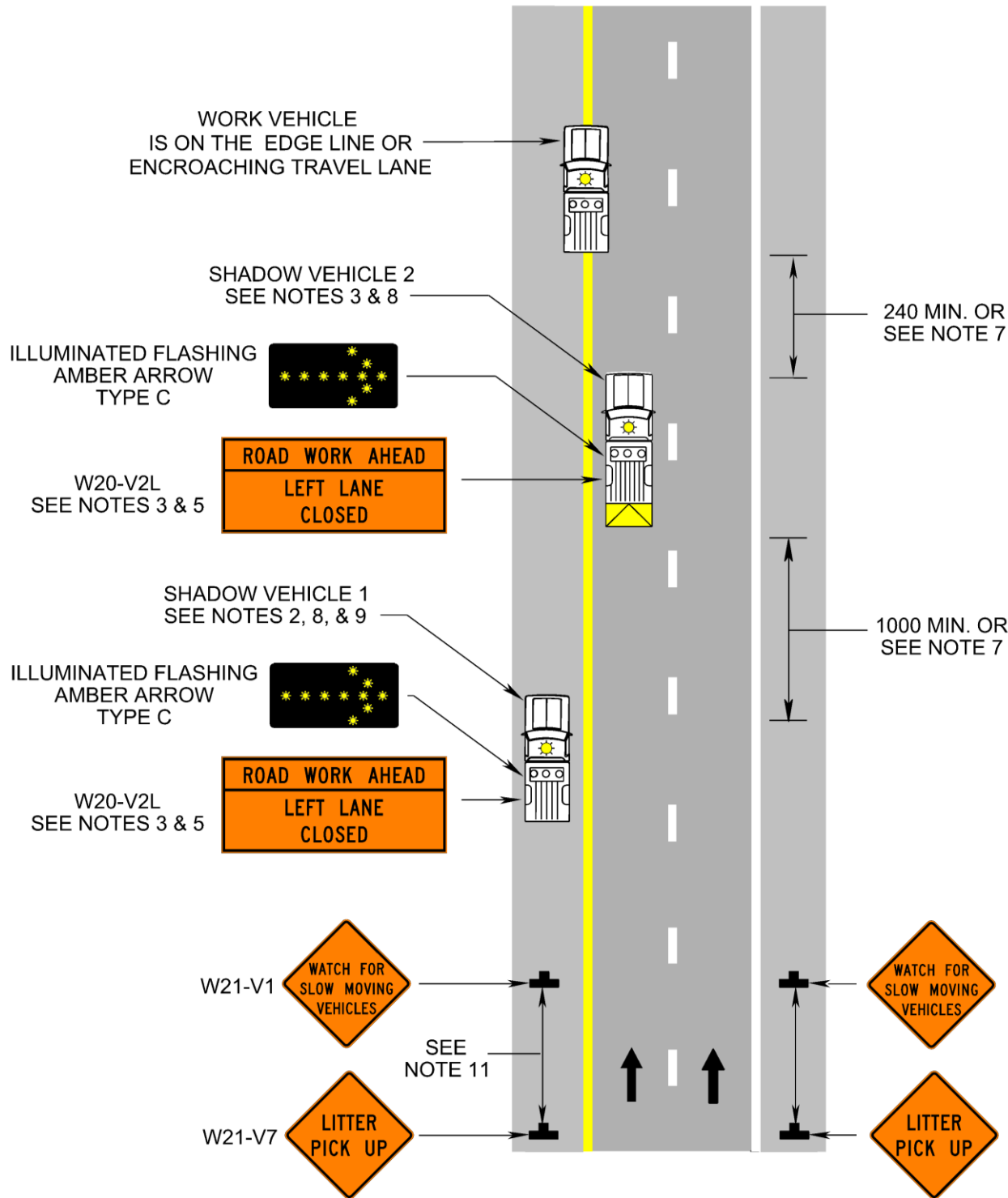
Option:

5. The static warning sign and arrow board on the advanced warning vehicle may be replaced with a vehicle-mounted CMS with a minimum character height of 10".
6. Actual conditions could dictate additional traffic control devices for the operation. On high speed, high volume roads, an optional shadow vehicle on the shoulder with a Portable Changeable Message Sign (PCMS) or a marked law enforcement vehicle driving on the shoulder only may be used to further enhance safety. Suggested messages for the PCMS: ROAD WORK AHEAD, RIGHT (or LEFT) LANE CLOSED.

Guidance:

7. *Spacing between vehicles may vary, depending on the speed, sight distance, and operation type. Whenever adequate stopping sight distance exists to the rear, the shadow vehicle(s) should maintain the minimum distance shown and proceed at the same speed as the work operation vehicle. The shadow vehicle(s) should slow down in advance of vertical or horizontal curves that restrict sight distance.*
8. *When using a vehicle CMS to replace the static sign and arrow board on Shadow Vehicle 1, each word message phase should be followed by a Type B arrow display.*
9. *Advanced warning messages should be considered on overhead Changeable Message Signs to enhance the safety of the operation. Suggested messages: ROAD WORK AHEAD, RIGHT (or LEFT) LANE CLOSED.*
10. *Sign spacing distance should be 1300'-1500' for Limited Access highways.*

Litter Pick-Up on Limited Access Highways
(Figure TTC-62.0)



Typical Traffic Control
Logging Operations
(Figure TTC-63.0)

NOTES

Standard:

1. Prior to the installation of the entrance and placement of any traffic control devices, the appropriate state/local agencies shall be notified.

Guidance:

2. Care should be exercised when establishing the location of the permitted temporary entrance to insure maximum possible sight distance in advance of the entrance, and should be based on the posted speed limit and at least equal to or greater than the values in the Intersection Sight Distance (ISD) table.

Intersection Sight Distance (ISD)

Posted Speed Limit (mph)	20	25	30	35	40	45	50	55	60	65	70
Minimum ISD	195	240	290	335	385	430	480	530	575	625	670

3. Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Standard:

4. On divided highways having a median wider than 8', right and left sign assemblies shall be used. Median barrier is considered to be part of the shoulder and its measurement shall be used to determine the total width of the shoulder.

Guidance:

5. For operations that disrupt (stop) traffic on the travelway, Typical Traffic Control Figure TTC-23, Lane Closure on a Two-Lane Roadway Using Flaggers, or Typical Traffic Control Figure TTC-16 or 17, Outside or Inside Lane Closure Operation on Four-Lane Roadway, should be used.

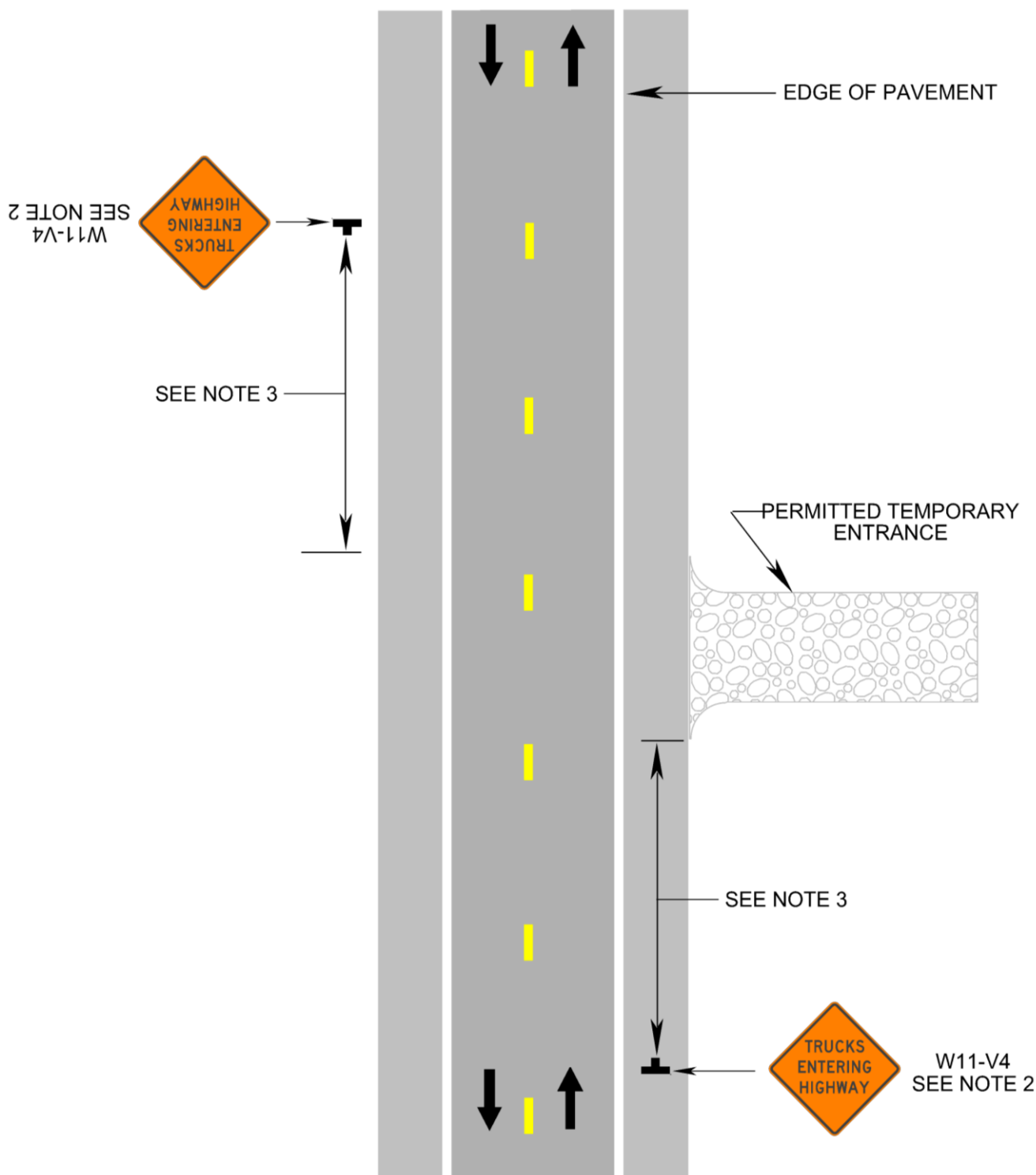
Standard:

6. Flaggers shall be state certified and have their certification card in their possession when performing flagging duties (see Section 6E.01, Qualifications for Flaggers).
7. The organization receiving the entrance permit shall be responsible for the removal of all debris (gravel, mud, dust, hauled materials, etc.), obstructions and irregularities caused by the operation in accordance with Section 105 of the Road and Bridge Specifications.

Guidance:

8. For the removal of debris on the roadway, Typical Traffic Control Figure TTC-14, Moving/Mobile Operation on a Two-Lane Roadway, or Typical Traffic Control Figure TTC-13, Moving/Mobile Operation on a Multi-Lane Roadway, should be used.

Logging Operations
(Figure TTC-63.0)



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CHAPTER 6I. CONTROL OF TRAFFIC THROUGH TRAFFIC INCIDENT MANAGEMENT AREAS

Section 6I.01 General

Support:

- 01 The National Incident Management System (NIMS) has been adopted nationally and is being implemented in Virginia as the federally required incident management system by which communities, states and the federal government will ensure full integration of activities in response to threatened and actual emergencies and disasters of all kinds. The NIMS has been mandated nationally for integrated local, state, tribal, territorial and federal prevention, response and recovery activities in accordance with criteria set forth in Homeland Security Presidential Directive 5 (HSPD 5). When implemented in consonance with the National Response Plan, and other federal, state and local emergency plans, NIMS, with its compliant Incident Command System, provides the established framework to effectively integrate operations at all levels, including but not limited to the implementation of a standardized Incident Command System for any size or scope of event. The National Response Plan (NRP), using NIMS, is an all hazards plan that provides the structure and mechanisms for national-level policy and operational coordination for domestic incident management.
- 02 In accordance with HSPD 5, the Secretary of Homeland Security is the Principal Federal Official responsible for domestic incident management through NIMS. The Governor is the Principal State Official responsible for incident management in the Commonwealth and will do so through the adoption of NIMS.

Standard:

- 03 **The Governor shall accomplish these responsibilities in accordance with existing statutory authorities and through established organizations and structures set forth for these purposes. This designation in no way alters or impedes the authority of local officials, state agencies, private relief and business organizations, or federal agencies to perform responsibilities set forth by law.**

Support:

- 04 The National Incident Management System has four core components:
1. Preparedness
 2. Communications and Information Management
 3. Resource Management
 4. Command and Management
- 05 Within NIMS, the Incident Command System (ICS) operates with a modular organizational structure. Responsibility for the establishment and expansion of the structure lies with the Incident Commander (IC), who bases the expansion on the requirements of the incident.
- 06 An Incident is an occurrence or event, natural or man-made that requires a response to protect life or property. As the incident size and complexity grow, the organization expands from the top down. In addition, as the number of incident management positions increases at a scene, functional responsibilities are delegated.
- 07 Unified Command (UC) allows all agencies with jurisdictional authority or functional responsibility for the incident to jointly provide management direction to an incident through a common set of incident objectives and strategies and a single Incident Action Plan (IAP). Unified Command may be appropriate at a multi-jurisdictional incident, such as a collision that crosses city and county lines, or a multi-departmental incident, such as a collision on an interstate that brings responders from fire, EMS, law enforcement, VDOT, and other agencies. Under UC, all agencies with jurisdictional authority or functional responsibility for any or all aspects of an incident participate in the UC structure, contribute to overall incident management, and develop incident priorities.

Standard:

- 08 **In the Unified Command ICS structure, all operations shall be directed by one person, the Operations Section Chief, who controls tactical resources.**

Section 6I.02 Traffic Incident Management Basics

Support:

- 01 Traffic Incident Management (TIM) is the systematic, planned, and coordinated use of human, institutional, mechanical, and technical resources to reduce the duration and impact of incidents, and improve the safety of motorists, crash victims, and incident responders.

- 02 A traffic incident is any non-recurrent event, such as a vehicle crash, vehicle breakdown, or other special man-made or natural event that causes a reduction in highway capacity and/or an increase in demand.
- 03 A secondary incident is one that occurs as a direct or indirect result of a previous incident. For example, if a crash occurs in the traffic back-up caused by an initial incident, this crash is considered a secondary incident. Secondary incident research reveals a direct correlation with primary incident scene duration. Causes of secondary incidents include driver inattention, changing traffic conditions, and rubbernecking effects. Secondary incidents typically occur within the incident scene or within the traffic queue created by an incident in one or both directions.
- 04 Virginia's Incident Clearance Law (also known as the "Move It" Law) requires motorists involved in crashes where the vehicles can be driven and no one is injured to move the vehicles to a location where they will obstruct traffic as little as possible. Expediting the removal of damaged or disabled vehicles from the travel lanes enhances the overall level of safety on the roadway and reduces associated congestion and delay.
- 05 The Code of Virginia's "Slow Down, Move Over" Law requires motorists to change lanes away from any stopped emergency vehicle that is displaying a flashing, blinking, or alternating blue, red, or amber lights. If changing lanes would be unreasonable or unsafe, motorists must slow down and pass with caution.

Section 6I.03 Traffic Incident Classification

Support:

- 01 Not all traffic incidents are the same. Depending on its nature and location, one incident may impact travel more significantly than another. To assist responders, VDOT has adopted a three-level system to describe incidents on Virginia roadways.

Guidance:

- 02 *When reporting information about an incident, responders should refer to the traffic incident level. This will help the TOC and/or local E911 Communications Center staffs make proper agency notifications and issue appropriate motorist information alerts.*

Table 6I-1, VDOT Traffic Incident Levels

Traffic Incident Levels (Based on Traffic Impact)		
Level 1	Minor	Impact to the traveled roadway is estimated to be less than 30 minutes with no lane blockage or with minor lane blockage
Level 2	Intermediate	Impact to the traveled roadway is estimated to be between 30 minutes and 2 hours with lane blockages, but not full closure of the roadway
Level 3	Major	Impact to the traveled roadway is estimated to be more than 2 hours, OR the roadway is closed in any single direction; significant area-wide congestion is expected

Section 6I.04 Responder Personal Safety

Standard:

- 01 **Until July 1, 2012, all emergency responders, within the right-of-way who are exposed either to traffic (vehicles using the highway for purposes of travel) or to emergency vehicles and equipment within the Incident TTC zone shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107–2004 publication entitled "American National Standard for High-Visibility Safety Apparel and Headwear" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure, except as provided in Paragraph 3.**
- 02 **Beginning July 1, 2012, all emergency responders, within the right-of-way who are either exposed to traffic or to emergency vehicles and equipment within the Incident TTC zone shall wear high-visibility safety apparel that meets Performance Class 3 requirements of the ANSI/ISEA 107–2010 publication entitled "American National Standard for High-Visibility Safety Apparel and Headwear" (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), or equivalent revisions, and labeled as meeting the ANSI 107-2010 standard performance for Class 3 risk exposure, except as provided in Paragraph 3.**

Option:

- 03 Emergency and incident responders and law enforcement personnel within the Incident TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled “American National Standard for High-Visibility Public Safety Vests” (see Section 1A.11 of the Virginia Supplement to the 2009 MUTCD), or equivalent revisions, and labeled as ANSI 207-2006, in lieu of ANSI/ISEA 107-2004 apparel.

Standard:

- 04 **When uniformed law enforcement personnel are used to direct traffic, to investigate crashes, or to handle lane closures, obstructed roadways, and disasters, high-visibility safety apparel as described in this Section shall be worn by the law enforcement personnel. Refer to Section 6E.02, Paragraph 3, for additional guidance.**
- 05 **Except as provided in Paragraph 6, firefighters or other emergency responders working within the right-of-way shall wear high-visibility safety apparel as described in this Section.**
- 06 **Firefighters or other emergency responders working within the right-of-way and engaged in emergency operations that directly expose them to flame, fire, heat, and/or hazardous materials shall wear retroreflective turn-out gear that is specified and regulated by other organizations, such as the National Fire Protection Association. Once the incident is mitigated, first responders shall don approved high-visibility apparel in lieu of turnout gear.**

Guidance:

- 07 *All incident responders should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, placement, and TTC review. Training should be conducted on a continual basis.*

Section 6I.05 Situational Awareness*Guidance:*

- 01 *Situational awareness is the continuous responsibility of all emergency responders. Responders should be aware of the status of all the incident factors that impact safe, quick clearance. Any changes that could potentially negatively impact life safety, incident stabilization, and property/environmental conservation should be brought to the attention of the Incident Commander through the chain-of-command. Unsafe conditions should be mitigated as soon as possible and communicated to all those potentially impacted.*
- 02 *To avoid the errant or distracted driver, responders should never turn their backs to traffic. They should face traffic and remain alert at all times. It often helps to designate another person as a lookout or spotter to watch for dangers and provide warnings. Responders should always have an escape plan to get out of the way of errant drivers.*

Section 6I.06 Initial Scene Response*Guidance:*

- 01 *During the initial scene response, several factors should be considered as part of the overall scene response:*
- *Approach and Vehicle Positioning*
 - *Scene Size-Up*
 - *Equipment and Personnel Needs*
 - *Traffic Safety and Flow*
 - *Risk Assessment*
 - *Establish Command*
 - *Develop and Communicate a Incident Action Plan (IAP)*
- 02 *As soon as practical, this information should be provided to a dispatch center. This information can also be relayed to VDOT’s TOC or the state EOC as needed. This will help VDOT’s TOC make proper agency notifications and issue information alerts to motorists.*

Section 6I.07 Role of VDOT Transportation Operations Center (TOC)*Support:*

- 01 *While not physically on the scene, Transportation Operations Center (TOC) personnel are involved in every TIM phase. Operators at the TOC are able to view conditions on the interstate system via closed-circuit traffic*

cameras (CCTV), and can pan-tilt-zoom the cameras to get various views. During an incident, operators can adjust state-operated traffic signals to help manage overflow traffic on arterial roads.

- 02 TOC personnel also work to make sure all travelers are aware of the incident and any traffic flow changes. Having access to accurate and timely information, allows travelers to make informed en-route decisions, such as when to take an alternate route, and reduces congestion throughout an incident scene.
- 03 The TOC manages numerous intelligent transportation system (ITS) technologies and tools used for traffic and road condition monitoring. There are several ITS methods by which the TOC informs motorists of a change in traffic conditions, including:
 - 511 Virginia,
 - Changeable message signs (CMS), and
 - Highway advisory radio (HAR).
- 04 It is important to continue information dissemination until traffic conditions return to normal; depending on the incident size, this can take several hours.

Section 6I.08 Initial Traffic Incident Management Temporary Traffic Control

Support:

- 01 A traffic incident management area is an area of a highway where temporary traffic controls are installed, as authorized by a public authority or the official having jurisdiction of the roadway, in response to a road user incident, natural disaster, hazardous material spill, or other unplanned incident. It is a type of TTC zone and extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where vehicles return to the original lane alignment and are clear of the incident.
- 02 The primary functions of TTC at a traffic incident management area are to inform road users of the incident and to provide guidance information on the path to follow through the incident area. Alerting road users and establishing a well defined path to guide road users through the incident area will serve to protect the incident responders and those involved in working at the incident scene and will aid in moving road users expeditiously past or around the traffic incident, will reduce the likelihood of secondary traffic crashes, and will preclude unnecessary use of the surrounding local road system. Examples include a stalled vehicle blocking a lane, a traffic crash blocking the traveled way, a hazardous material spill along a highway, and natural disasters such as floods and severe storm damage.

Guidance:

- 03 *In order to reduce response time for traffic incidents, highway agencies, appropriate public safety agencies (law enforcement, fire and rescue, emergency communications, emergency medical, and other emergency management), and private sector responders (towing and recovery and hazardous materials contractors) should mutually plan for occurrences of traffic incidents along the major and heavily traveled highway and street system.*
- 04 *On-scene responder organizations should train their personnel in TTC practices for accomplishing their tasks in and near traffic and in the requirements for traffic incident management contained in this Manual. On-scene responders should take measures to move the incident off the traveled roadway or to provide for appropriate warning. All on-scene responders and news media personnel should constantly be aware of their visibility to oncoming traffic and wear high-visibility apparel (see Section 6I.04).*
- 05 *Emergency vehicles should be safe-positioned (see definition in Section 1A.13 of the Virginia Supplement to the 2009 MUTCD) such that traffic flow through the incident scene is optimized. All emergency vehicles that subsequently arrive should be positioned in a manner that does not interfere with the established temporary traffic flow.*
- 06 *Responders arriving at a traffic incident should estimate the magnitude of the traffic incident, the expected time duration of the traffic incident, and the expected vehicle queue length, and then should set up the appropriate temporary traffic controls for these estimates.*

Standard:

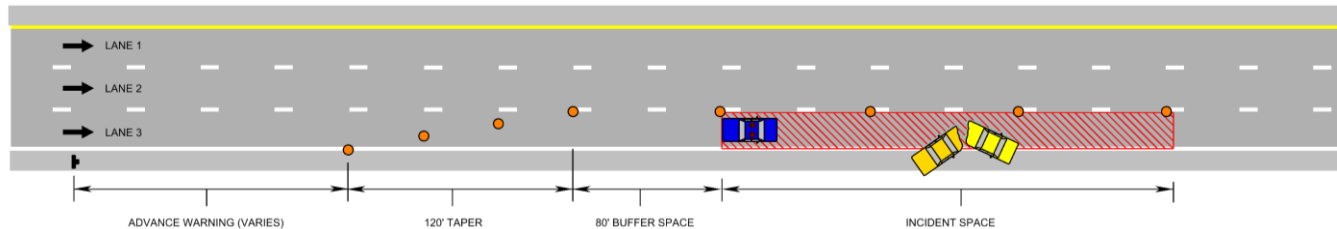
- 07 **Traffic incidents shall be reported to the appropriate Transportation Operations Center as soon as practical once the on-scene evaluation has been performed.**
- 08 **To assist with identifying the location of incidents on the roadway with emergency personnel in a clear manner, lanes shall be identified in the following manner (the example shown is for a three lane, one direction roadway:**

- A. Inside travel lane – Lane 1
- B. Middle travel lanes – Lane 2
- C. Outside travel lane – Lane 3

Support

09 Figure 6I-1 is an example of initial scene setup and identifying an incident by lane numbering.

Figure 6I-1, Desired Initial Incident Scene Setup and Identification by Travel Lane Numbering



Option:

- 10 For traffic incidents, particularly those of an emergency nature, TTC devices on hand may be used for the initial response as long as they do not themselves create unnecessary additional hazards. (See Paragraph 12 for the desired initial setup.)
- 11 If flaggers are used to provide traffic control for an incident management situation, the flaggers may use appropriate traffic control devices that are readily available or that can be brought to the traffic incident scene on short notice.

Guidance:

- 12 *The following definitions should be applied to Figure 6I-1 for the desired initial incident scene setup:*
- *Advanced Warning – Area where signs are placed to warn of an incident situation. The initial sign should be an EMERGENCY SCENE AHEAD (W20-V25) sign. For incidents lasting longer than two hours, additional advance warning signs as shown in the TIMC figures in Section 6I.13 should be used based on the type of incident.*
 - *Taper – an area where devices such as traffic cones, road flares, or light sticks are placed to form a taper from the shoulder to the full width of the travel lane involving the incident. A minimum of four devices should be placed at 40-foot spacing as shown. The taper should be kept clear of vehicles, equipment and personnel.*
 - *Buffer Space – an area from the end of the taper to the beginning of the incident space which should be kept clear of vehicles, equipment, and personnel. The purpose of the buffer is to allow an errant vehicle to gain control and stop before reaching the incident space. For initial setup, the buffer should be 80 feet in length. For incidents lasting longer than two hours, the buffer space should be increased as shown in the TIMC figures as shown in 6I.13.*
 - *Incident Space – the area which contains the emergency situation as well as all incident responder vehicles, including law enforcement, fire and rescue, towing, and media. Initially, there should be a 200 foot clear area from the first device in the taper to the beginning of the incident space. Safe positioning of emergency vehicles will occur in the incident space. If a Truck-Mounted Attenuator (TMA) vehicle arrives on the scene, it should be placed as the first vehicle the traveling public would encounter in the incident closure. Otherwise, law enforcement would usually be the first vehicle seen by motorist in an incident management closure.*

Option:

- 13 Additional TTC devices may be installed than are shown in Figure 6I-1 for the initial scene setup if available.
- 14 Incidents involving hazardous materials may require adjustments to the initial scene setup based on the type of HAZMAT material involved.

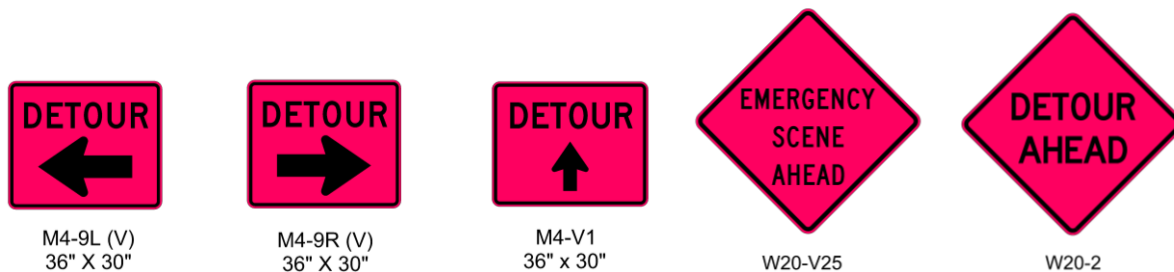
Support:

- 15 While some traffic incidents might be anticipated and planned for, emergencies and disasters might pose more severe and unpredictable problems. The ability to quickly install proper temporary traffic controls might greatly reduce the effects of an incident, such as secondary crashes or excessive traffic delays. An essential part of fire,

rescue, spill clean-up, highway agency, and enforcement activities is the proper control of road users through the traffic incident management area in order to protect responders, victims, and other personnel at the site. These operations might need corroborating legislative authority for the implementation and enforcement of appropriate road user regulations, parking controls, and speed zoning. It is desirable for these statutes to provide sufficient flexibility in the authority for, and implementation of, TTC to respond to the needs of changing conditions found in traffic incident management areas.

- 16 Warning and guide signs used for TTC traffic incident management situations may have a black legend and border on a fluorescent pink background (see Figure 6I-2).

Figure 6I-2, Examples of Traffic Incident Management Area Signs



Section 6I.09 Major Traffic Incidents (Level 3)

Support:

- 01 Major traffic incidents are typically traffic incidents involving hazardous materials, fatal traffic crashes involving numerous vehicles, and other natural or man-made disasters. These traffic incidents typically involve closing all or part of a roadway facility for a period exceeding 2 hours.

Guidance:

- 02 *If the traffic incident is anticipated to last more than 24 hours, applicable procedures and devices set forth in other Chapters of this Manual should be used.*

Support:

- 03 A road closure can be caused by a traffic incident such as a road user crash that blocks the traveled way. Road users are usually diverted through lane shifts or detoured around the traffic incident and back to the original roadway. A combination of traffic engineering and enforcement preparations is needed to determine the detour route, and to install, maintain or operate, and then to remove the necessary traffic control devices when the detour is terminated. Large trucks are a significant concern in such a detour, especially when detouring them from a controlled-access roadway onto local or arterial streets.

- 04 During traffic incidents, large trucks might need to follow a route separate from that of automobiles because of bridge, weight, clearance, or geometric restrictions. Also, vehicles carrying hazardous material might need to follow a different route from other vehicles.

- 05 Some traffic incidents such as hazardous material spills might require closure of an entire highway. Through road users must have adequate guidance around the traffic incident. Maintaining good public relations is desirable. The cooperation of the news media in publicizing the existence of, and reasons for, traffic incident management areas and their TTC can be of great assistance in keeping road users and the general public well informed.

- 06 The establishment, maintenance, and prompt removal of lane diversions can be effectively managed by interagency planning that includes representatives of highway and public safety agencies.

Guidance:

- 07 *All traffic control devices needed to set up the TTC at a traffic incident should be available so that they can be readily deployed for all major traffic incidents. The TTC should include the proper traffic diversions, tapered lane closures, and upstream warning devices to alert traffic approaching the queue and to encourage early diversion to an appropriate alternative route.*

- 08 *Attention should be paid to the upstream end of the traffic queue such that warning is given to road users approaching the back of the queue.*

- 09 *If manual traffic control is needed, it should be provided by certified flaggers (see Section 6E.01) or uniformed law enforcement officers.*
- 10 *When light sticks or road flares are used to establish the initial traffic control at incident scenes, channelizing devices (see Section 6F.71) should be installed as soon thereafter as practical.*

Support:

- 11 Approved colors for light sticks are yellow or lime green. Approved color for road flares is red or orange-red.

Option:

- 12 The light sticks or road flares may remain in place if they are being used to supplement the channelizing devices.

Guidance:

- 13 *The light sticks, road flares, and channelizing devices should be removed after the incident is terminated.*

Section 6I.10 Intermediate Traffic Incidents (Level 2)

Support:

- 01 Intermediate traffic incidents typically affect travel lanes for a time period of 30 minutes to 2 hours, and usually require traffic control on the scene to divert road users past the blockage. Full roadway closures might be needed for short periods during traffic incident clearance to allow traffic incident responders to accomplish their tasks.
- 02 The establishment, maintenance, and prompt removal of lane diversions can be effectively managed by interagency planning that includes representatives of highway and public safety agencies.

Guidance:

- 03 *All traffic control devices needed to set up the TTC at a traffic incident should be available so that they can be readily deployed for intermediate traffic incidents. The TTC should include the proper traffic diversions, tapered lane closures, and upstream warning devices to alert traffic approaching the queue and to encourage early diversion to an appropriate alternative route.*
- 04 *Attention should be paid to the upstream end of the traffic queue such that warning is given to road users approaching the back of the queue.*
- 05 *If manual traffic control is needed, it should be provided by certified flaggers (see Section 6E.01) or uniformed law enforcement officers.*

Option:

- 06 If flaggers are used to provide traffic control for an incident management situation, the flaggers may use appropriate traffic control devices that are readily available or that can be brought to the traffic incident scene on short notice.

Guidance:

- 07 *When light sticks or road flares (see Section 6I.09, Paragraph 11 for approved colors) are used to establish the initial traffic control at incident scenes, channelizing devices (see Section 6F.71) should be installed as soon thereafter as practical.*

Option:

- 08 The light sticks or road flares may remain in place if they are being used to supplement the channelizing devices.

Guidance:

- 09 *The light sticks, road flares, and channelizing devices should be removed after the incident is terminated.*

Section 6I.11 Minor Traffic Incidents (Level 1)

Support:

- 01 Minor traffic incidents are typically disabled vehicles and minor crashes that result in lane closures of less than 30 minutes. On-scene responders are typically law enforcement and towing companies, and occasionally highway agency service patrol vehicles.
- 02 Diversion of traffic into other lanes is often not needed or is needed only briefly. It is not generally possible or practical to set up a lane closure with traffic control devices for a minor traffic incident. Traffic control is the responsibility of on-scene responders.

Guidance:

- 03 *When a minor traffic incident blocks a travel lane, it should be removed from that lane to the shoulder as quickly as possible.*

Option:

- 04 If flaggers are used to provide traffic control for an incident management situation, the flaggers may use appropriate traffic control devices that are readily available or that can be brought to the traffic incident scene on short notice.

Section 6I.12 Use of Emergency-Vehicle Lighting

Support:

- 01 The use of emergency-vehicle lighting (such as high-intensity rotating, flashing, oscillating, or strobe lights) is essential, especially in the initial stages of a traffic incident, for the safety of emergency responders and persons involved in the traffic incident, as well as road users approaching the traffic incident. Emergency-vehicle lighting, however, provides warning only and provides no effective traffic control. The use of too many lights at an incident scene can be distracting and can create confusion for approaching road users, especially at night. Road users approaching the traffic incident from the opposite direction on a divided facility are often distracted by emergency-vehicle lighting and slow their vehicles to look at the traffic incident posing a hazard to themselves and others traveling in their direction.
- 02 The use of emergency-vehicle lighting can be reduced if good traffic control has been established at a traffic incident scene. This is especially true for major traffic incidents that might involve a number of emergency vehicles. If good traffic control is established through placement of advanced warning signs and traffic control devices to divert or detour traffic, then public safety agencies can perform their tasks on scene with minimal emergency-vehicle lighting.

Guidance:

- 03 *Public safety agencies should examine their policies on the use of emergency-vehicle lighting, especially after a traffic incident scene is secured, with the intent of reducing the use of this lighting as much as possible while not endangering those at the scene. Special consideration should be given to reducing or extinguishing forward facing emergency-vehicle lighting, especially on divided roadways, to reduce distractions to oncoming road users.*
- 04 *Because the glare from floodlights or vehicle headlights can impair the nighttime vision of approaching road users, any floodlights or vehicle headlights that are not needed for illumination, or to provide notice to other road users of an incident response vehicle being in an unexpected location, should be turned off at night.*
- 05 *If glare from standard types of floodlight equipment cannot be eliminated, then consideration should be made for the use of non-glare lighting devices such as non-glare air-filled lighting devices.*

Section 6I.13 Traffic Incident Management Control Typical Applications

Support

- 01 This section presents typical applications for a variety of incidental situations commonly encountered. While not every situation is addressed, the information illustrated can generally be adapted to a broad range of conditions. In many instances, an appropriate TIMC plan is achieved by combining features from various typical applications. For example, response at an intersection incident might present near-side TIMC for one street and a far-side TIMC for the other street. These treatments are found in two different typical applications, while a third typical application shows how to handle pedestrian crosswalk closures.
- 02 Procedures for establishing TIMC zones vary with such conditions as road configuration, location of the incident, type of incident and recovery activity, duration of the incident, road user volumes, road vehicle mix (buses, trucks, cars, motorcycles, and bicycles), and road user speeds. Examples are presented in this section showing how to apply principles and standards. Applying these guidelines to actual situations and adjusting to field conditions requires judgment. In general, the procedures illustrated represent minimum solutions for the situations depicted.

Option:

- 03 Other devices may be added to supplement the devices and device spacing may be adjusted to provide additional reaction time or delineation. Fewer devices may be used based on field conditions.









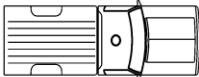


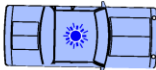
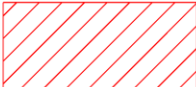

Support

- 04 Most of the TIMC typical applications show TTC devices for only one direction.
- 05 Table 6I-2 is an index of the Traffic Incident Management Control (TTC) figures. TIMC figures are shown on the right page with notes on the facing page to the left. The legend for the symbols used in the TIMC figures is provided in Figure 6I-3 below. In many of the typical applications, sign spacing and other dimensions are indicated in the notes to the left of the figure.

Table 6I-2, Index to Traffic Incident Management Control Figures and Notes

Type of Incident	Figure Number	Page Numbers
Incident on Shoulder with Minor Encroachment	TIMC-1.0	6I-9, 6I-10
Incident in Outside Lane on Four-Lane Roadway	TIMC-2.0	6I-11, 6I-12
Incident in Inside Lane on Four-Lane Roadway	TIMC-3.0	6I-13, 6I-14
Incident in Multiple Lanes on a Multi-Lane Highway	TIMC-4.0	6I-15, 6I-16
Incident Blocking a Lane on a Two-Lane Roadway	TIMC-5.0	6I-17, 6I-18
Incident Partially Blocking a Ramp	TIMC-6.0	6I-19, 6I-20
Incident Closing a Highway	TIMC-7.0	6I-21, 6I-22
Highway Closure Incident with a Temporary Detour	TIMC-8.0	6I-23, 6I-24

Figure 6I-3, Symbols Used in Traffic Incident Management Control Figure Applications

	ARROW BOARD		CHANGEABLE MESSAGE SIGN SUPPORT OR TRAILER
	ARROW BOARD ON TRAILER		ARROW BOARD ON VEHICLE
	CHANNELIZING DEVICE		TYPE 3 BARRICADE
	FLAGGER		SIGN
	SHADOW VEHICLE		DIRECTION OF TRAFFIC
	TRUCK MOUNTED ATTENUATOR		LAW ENFORCEMENT VEHICLE
	INCIDENT SPACE		WARNING LIGHT

Traffic Incident Management Control
Incident on Shoulder with Minor Encroachment
(Figure TIMC-1.0)

NOTES

Option:

1. The following illustrates traffic control for incidents lasting longer than two hours. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-1 can be installed.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Standard:

3. On roadways having a median wider than 8', left and right sign assemblies shall be required.
4. Taper length (L) and channelizing device spacing shall be at the following:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

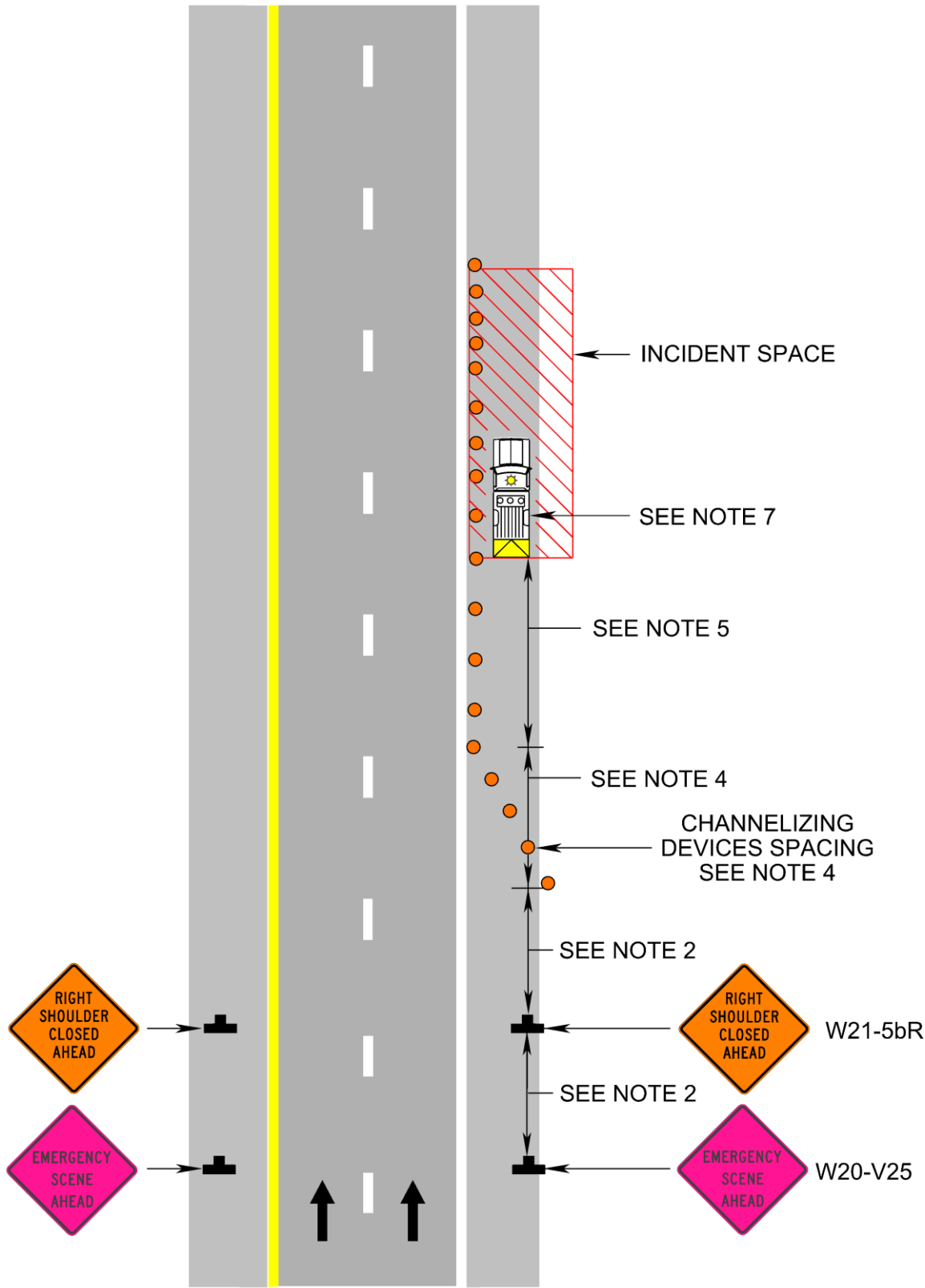
On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

5. The buffer space length shall be at the following:

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 - 120
25	155 - 160
30	200 - 210
35	250 - 260
40	305 - 320
45	360 - 380
50	425 - 445
55	500 - 520
60	570 - 590
65	645 - 675
70	730 - 760
Vehicles and equipment shall not park in the buffer space.	

6. When a side road intersects the highway within the traffic incident management zone, additional traffic control devices shall be placed as needed.
7. A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.

Incident on Shoulder with Minor Encroachment
(Figure TIMC-1.0)



Traffic Incident Management Control
Incident in Outside Lane on Four-Lane Roadway
(Figure TIMC-2.0)

NOTES

Option:

1. The following illustrates traffic control for incidents lasting longer than two hours. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-2 can be installed.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Standard:

3. On roadways having a median wider than 8', left and right sign assemblies shall be required.
4. Taper length (L) and channelizing device spacing shall be at the following:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

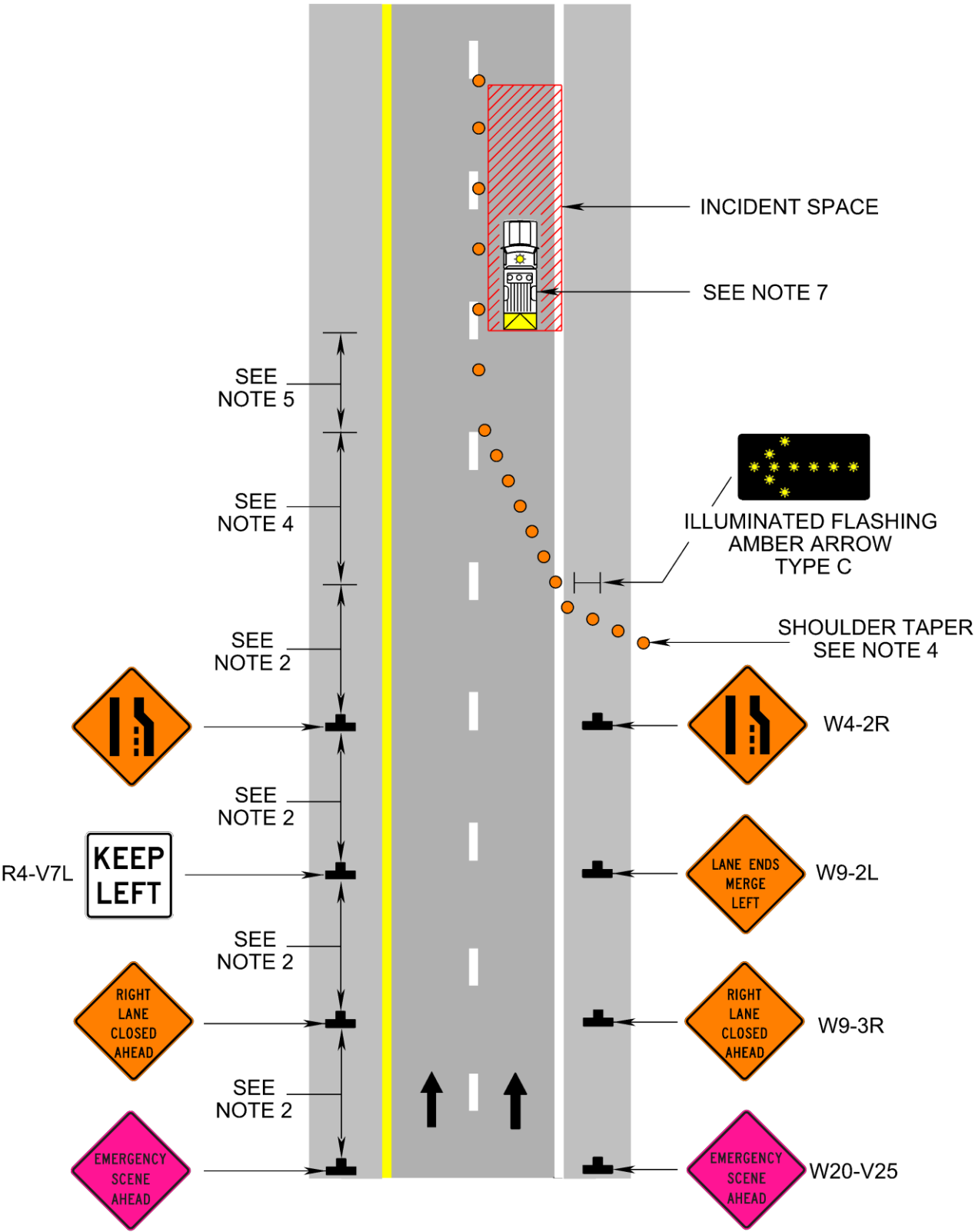
On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

5. The buffer space length shall be at the following:

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 - 120
25	155 - 160
30	200 - 210
35	250 - 260
40	305 - 320
45	360 - 380
50	425 - 445
55	500 - 520
60	570 - 590
65	645 - 675
70	730 - 760
Vehicles and equipment shall not park in the buffer space.	

6. When a side road intersects the highway within the traffic incident management zone, additional traffic control devices shall be placed as needed.
7. A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.

Incident in Outside Lane on Four-Lane Roadway
(Figure TIMC-2.0)



Traffic Incident Management Control
Incident in Inside Lane on Four-Lane Roadway
(Figure TIMC-3.0)

NOTES

Option:

1. The following illustrates traffic control for incidents lasting longer than two hours minutes. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-3 can be installed.

Guidance:

2. Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Standard:

3. On roadways having a median wider than 8', left and right sign assemblies shall be required.
4. Taper length (L) and channelizing device spacing shall be at the following:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

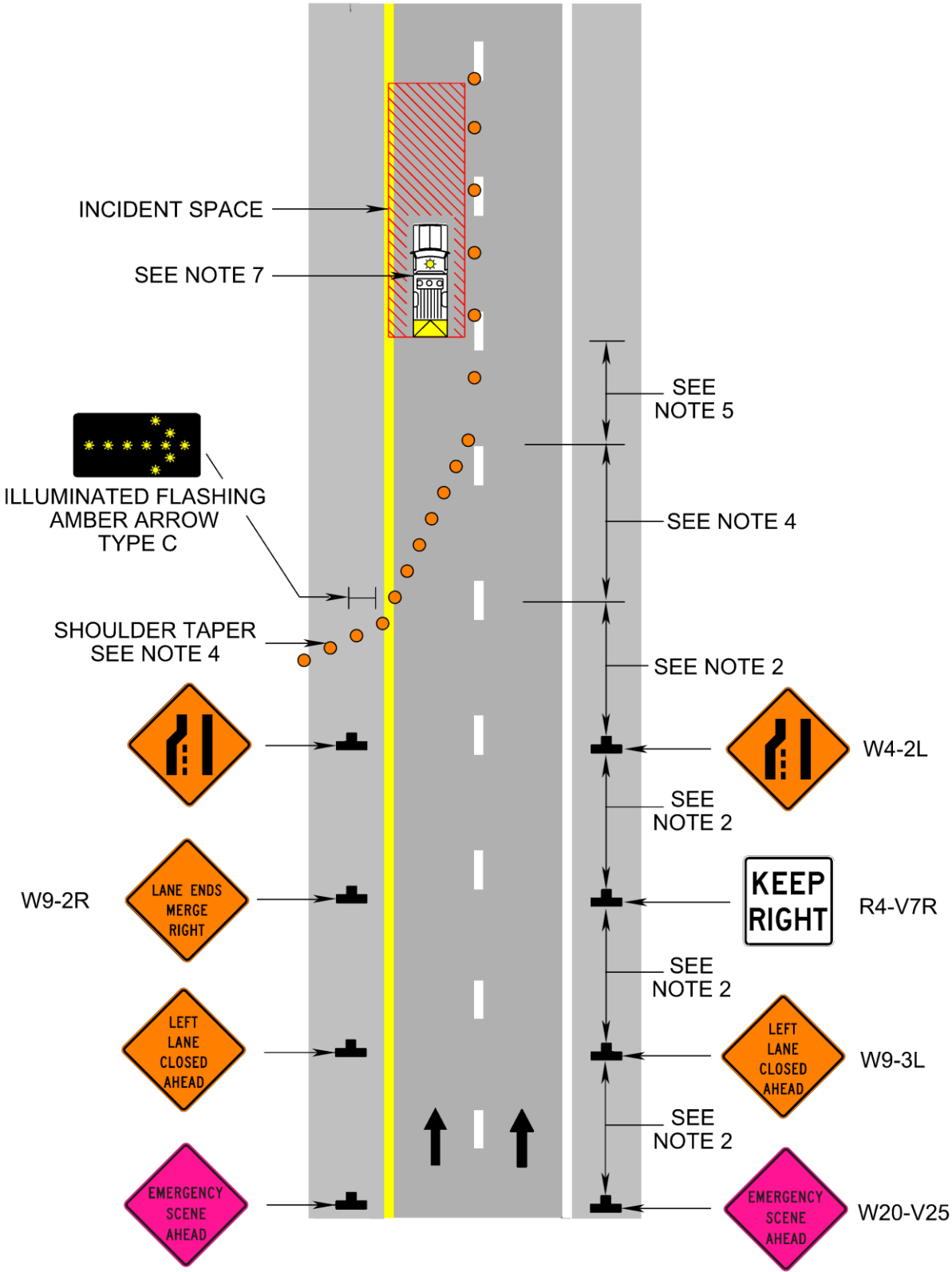
On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

5. The buffer space length shall be at the following:

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 - 120
25	155 - 160
30	200 - 210
35	250 - 260
40	305 - 320
45	360 - 380
50	425 - 445
55	500 - 520
60	570 - 590
65	645 - 675
70	730 - 760
Vehicles and equipment shall not park in the buffer space.	

6. When a side road intersects the highway within the traffic incident management zone, additional traffic control devices shall be placed as needed.
7. A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.

Incident in Inside Lane on Four-Lane Roadway
(Figure TIMC-3.0)



Traffic Incident Management Control
Incident in Multiple Lanes on a Multi-Lane Highway
(Figure TIMC-4.0)

NOTES

Option:

1. The following illustrates traffic control for incidents lasting longer than two hours. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-4 can be installed.

Standard:

2. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**

Guidance:

3. *Sign spacing should be 1300'-1500' for Limited Access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

4. **Taper length (L) and channelizing device spacing shall be at the following:**

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

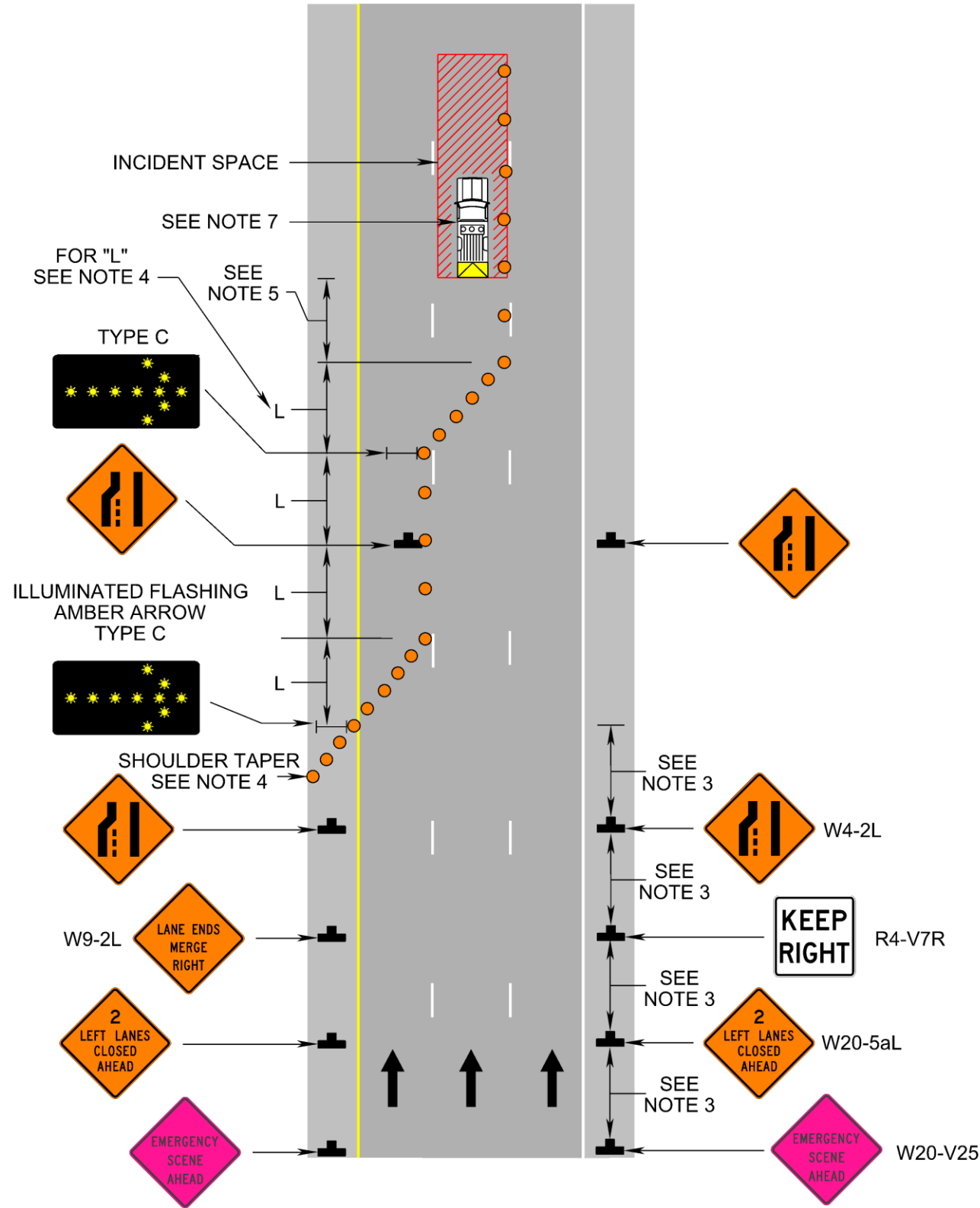
On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

5. **The buffer space length shall be at the following:**

Posted Speed Limit (mph)	Distance (Feet)
≤ 20	115 - 120
25	155 - 160
30	200 - 210
35	250 - 260
40	305 - 320
45	360 - 380
50	425 - 445
55	500 - 520
60	570 - 590
65	645 - 675
70	730 - 760
Vehicles and equipment shall not park in the buffer space.	

6. **When a side road or ramp intersects the highway within the traffic incident management zone, additional traffic control devices shall be placed as needed.**
7. **A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.**

Incident in Multiple Lanes on a Multi-Lane Highway
(Figure TIMC-4.0)



Traffic Incident Management Control
Incident Blocking a Lane on a Two-Lane Roadway
(Figure TIMC-5.0)

NOTES

Option:

1. The following illustrates traffic control for incidents lasting longer than two hours. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-5 can be installed.

Guidance:

2. *Sign spacing distance should be 350'-500' where the posted speed limit is 45 mph or less, and 500'-800' where the posted speed limit is greater than 45 mph.*

Standard:

3. **Flagging stations shall be located far enough in advance of the work space to permit approaching traffic to reduce speed and/or stop before passing the work space and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-3 on Page 6H-5).**
4. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. (See Section 6E.01, Qualifications for Flaggers).**
5. **Cone spacing shall be at the following:**

Location	Posted Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

Option:

6. A supplemental flagger may be required in this area to give advance warning of the operation ahead by slowing approaching traffic prior to reaching the flagger station or queued traffic.

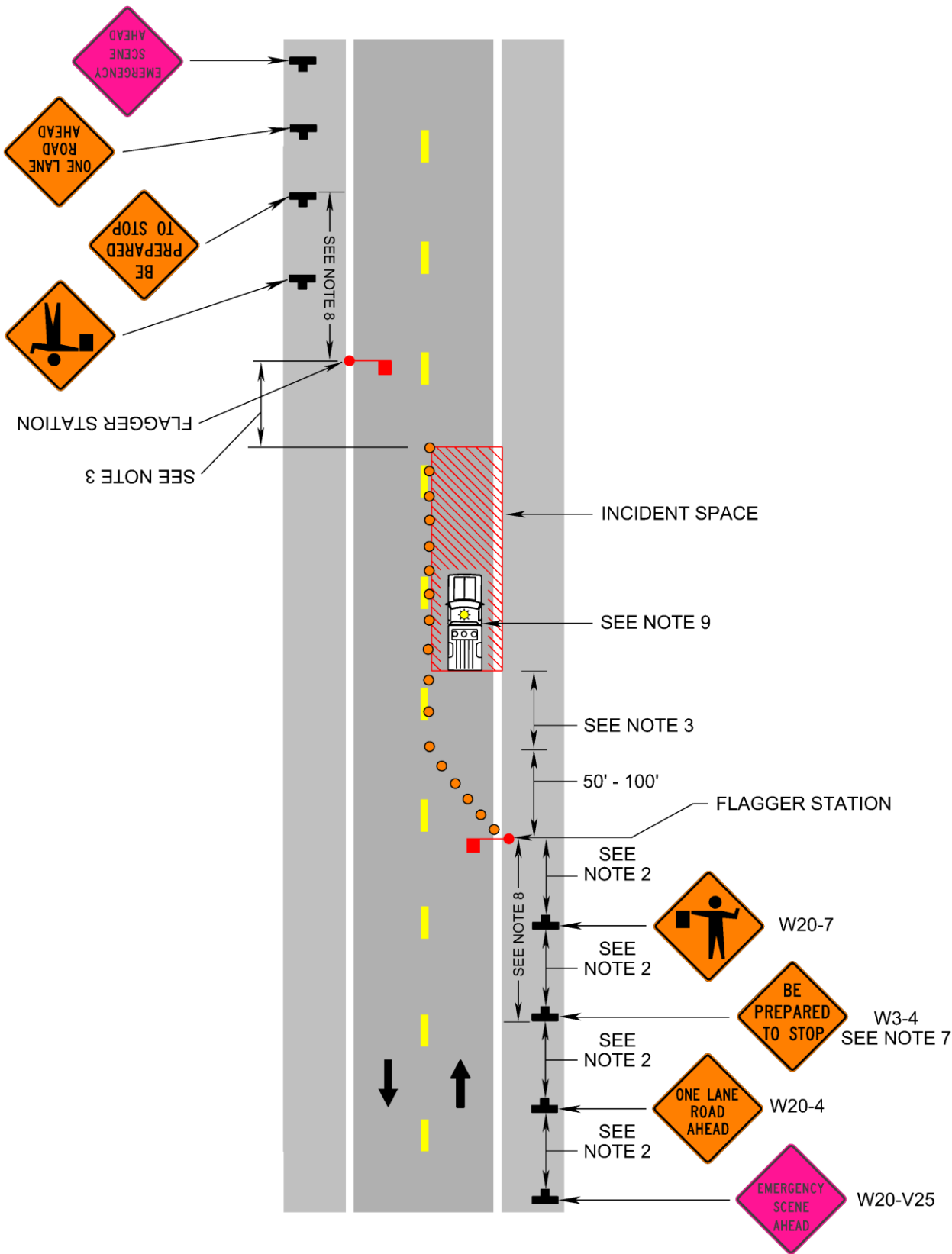
Guidance:

7. *If the queue of traffic reaches the BE PREPARED TO STOP (W3-4) sign, then the signs should be readjusted at greater distances.*
8. *When a highway-rail crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the highway-rail grade crossing, the temporary traffic control zone should be extended so that the transition area precedes the highway-rail crossing (See Figure TTC-56 for additional information on highway-rail crossings).*

Standard:

9. **A shadow vehicle with at least one high intensity amber rotating, oscillating, or strobe light shall be parked 80'-120' in advance of the first incident scene vehicle or road hazard.**

Incident Blocking a Lane on a Two-Lane Roadway
(Figure TIMC-5.0)



Traffic Incident Management Control
Incident Partially Blocking a Ramp
(Figure TIMC-6.0)

NOTES

Option:

1. The following illustrates traffic control for incidents lasting longer than two hours. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-6 can be installed.

Guidance:

2. *Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

3. **To prevent accidental intrusion into the work area, channelizing device spacing shall not exceed 20' on centers.**
4. **Cone Taper Length (L) is equal to the Posted Speed Limit (S) times the Width of actual ramp closure (W). (Example: 55 mph x 6' = 330').**

Guidance:

5. *A minimum 200' buffer space should be provided, when possible.*
6. *Truck off-tracking shall be considered when determining whether the 10 foot minimum lane width is adequate.*

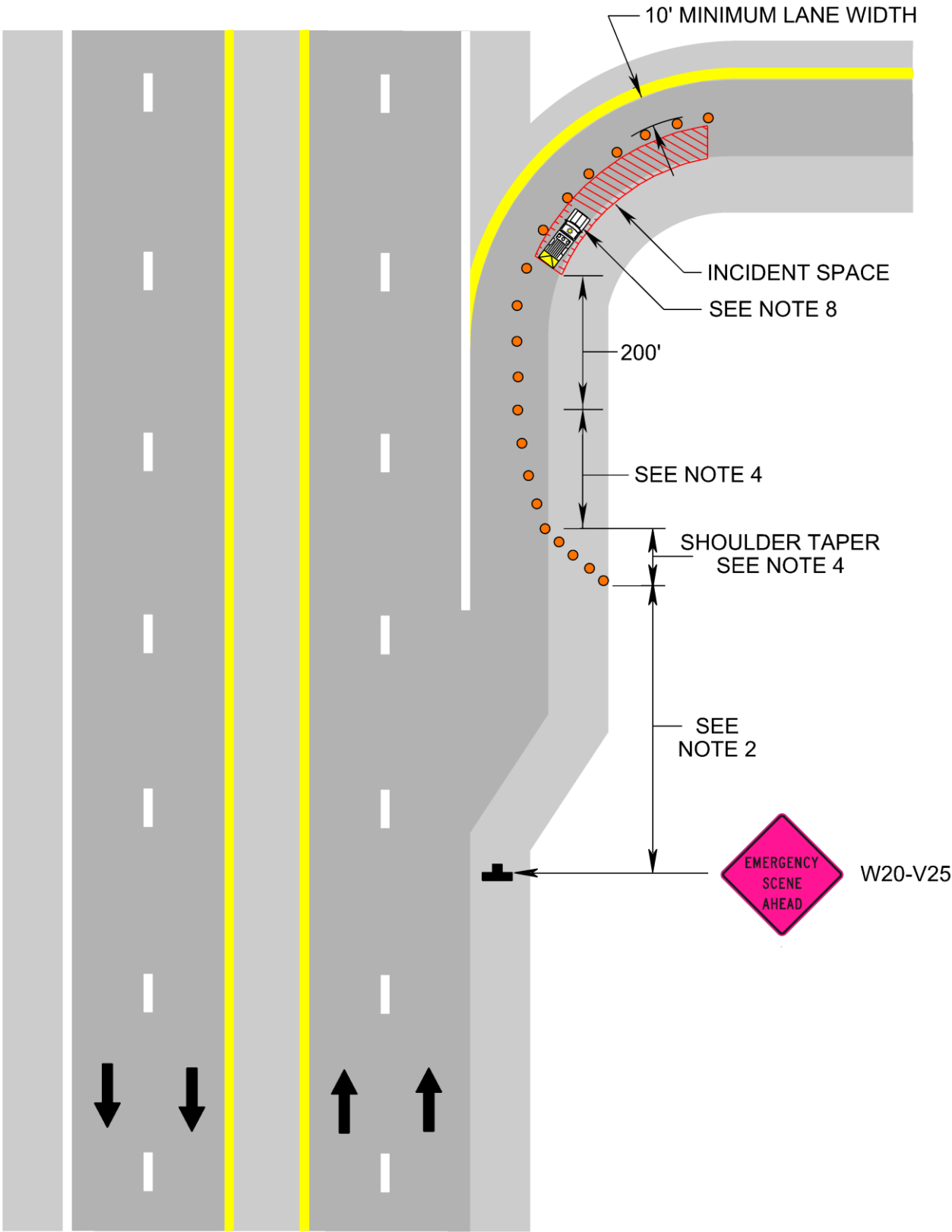
Option:

7. Traffic may be directed onto the shoulder to maintain a minimum 10 foot wide travel lane around the incident.

Standard:

8. **A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.**

Incident Partially Blocking a Ramp
(Figure TIMC-6.0)



Traffic Incident Management Control

Incident Closing a Highway

(Figure TIMC-7.0)

NOTES

Support:

1. The following illustrates traffic control for incidents lasting longer than two hours. For initial setup by the first responder on the scene, Figure 6I-1 may be used as a guide until the appropriate traffic control illustrated in TIMC-1 can be installed.

Guidance:

2. A Portable Changeable Message Sign (PCMS) should be placed a minimum of one mile in advance of the exit proceeding the incident or queued traffic advising of the road closure ahead. An additional PCMS should be placed one mile in advance of the stationary signing advising "ACCIDENT AHEAD", "ALL LANES EXIT RIGHT (or LEFT)".
3. Sign spacing distance should be 1300'-1500' for Limited Access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.

Standard:

4. On divided highways having a median wider than 8', right and left sign assemblies shall be required.
5. Taper length and channelizing device spacing shall be at the following:

Taper Length (L)				
Speed Limit (mph)	Lane Width (Feet)			
	9	10	11	12
25	95	105	115	125
30	135	150	165	180
35	185	205	225	245
40	240	270	295	320
45	405	450	495	540
50	450	500	550	600
55	495	550	605	660
60	540	600	660	720
65	585	650	715	780
70	630	700	770	840
Minimum taper lengths for Limited Access highways shall be 1000 feet.				
Shoulder Taper = $\frac{1}{3}$ L Minimum				

Channelizing Device Spacing		
Location	Speed Limit (mph)	
	0 - 35	36 +
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

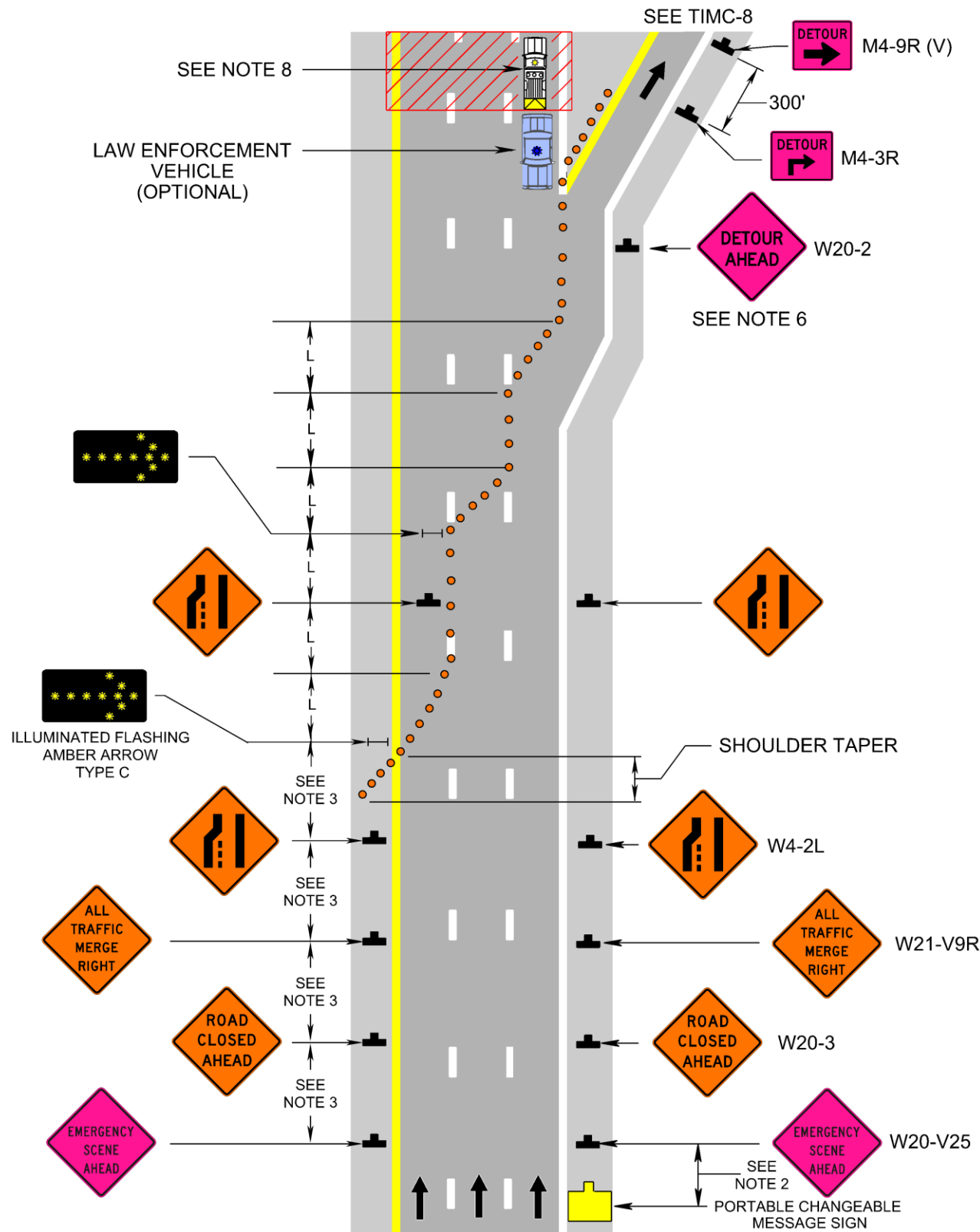
Guidance:

6. When detour signing has been installed along the detour route, a DETOUR with directional arrow sign should be placed halfway up the ramp or loop. Additionally, a third message should be added to the one mile Portable Changeable Message Sign advising "DETOUR AHEAD".

Standard:

7. A minimum of four (4) Group 2 channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).
8. A truck-mounted attenuator (TMA) shall be used on Limited Access highways and multi-lane roadways with posted speed limit equal to or greater than 45 mph.

Incident Closing a Highway
(Figure TIMC-7.0)



Traffic Incident Management Control
Highway Closure Incident with a Temporary Detour
(Figure TIMC-8.0)

NOTES

Guidance:

1. *Regulatory traffic control devices should be modified as needed for the duration of the detour.*
2. *Figure TIMC-8 illustrates a general layout of detour signs. Additional detour signs should be erected at all connecting roadways.*
3. *Sign spacing distance should be 300' minimum in advance of the intersection. The directional sign should be placed at the intersection.*
4. *When closing a ramp, the channelizing device spacing should be a maximum of 10' between devices.*

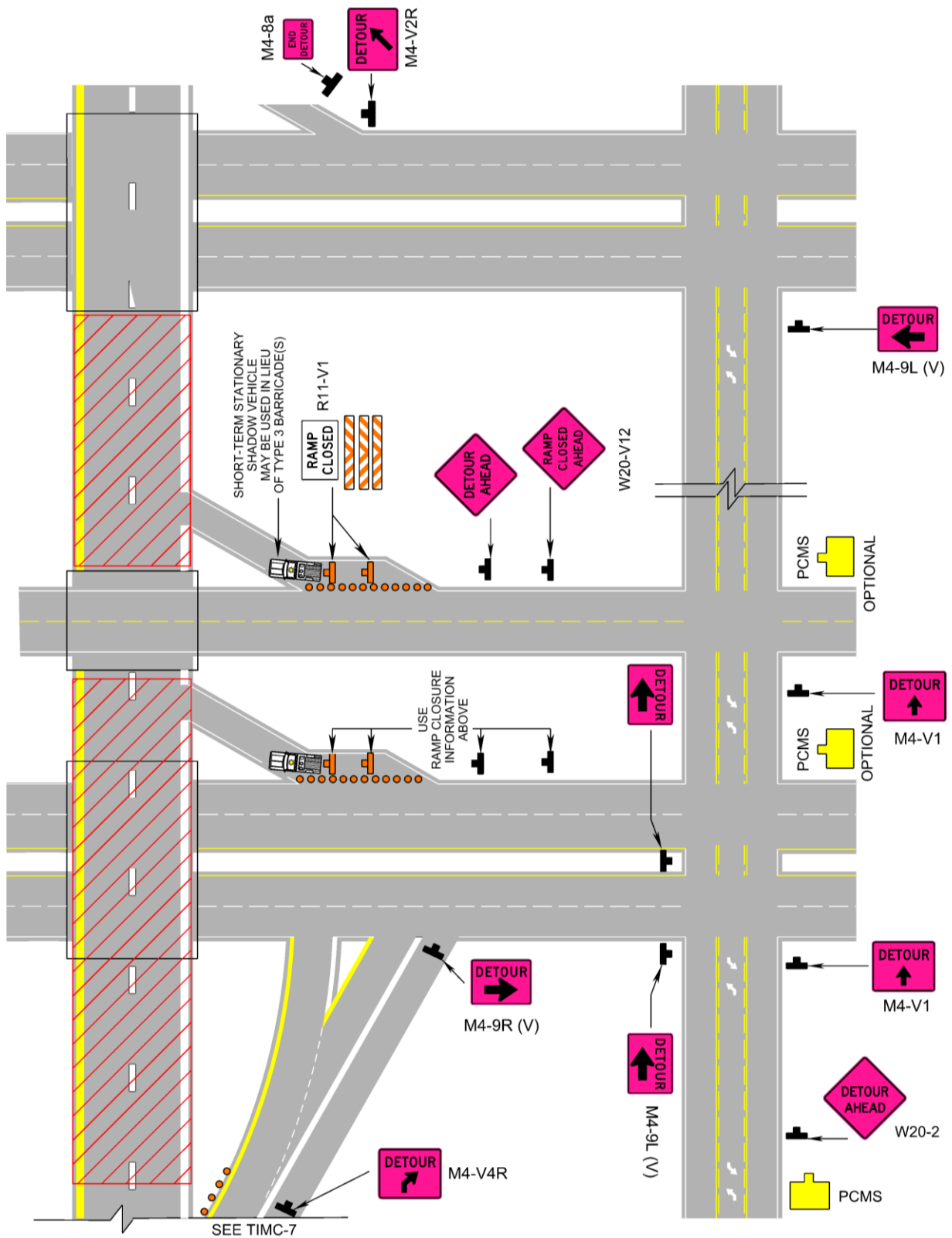
Option:

5. Other sign layouts may be substituted as directed by the Regional Traffic Engineer.
6. A Route Sign Directional assembly may be placed on the far left corner of the intersection to augment or replace the one shown on the near right corner.
7. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.
8. Cardinal direction plaques may be used with route signs.

Standard:

9. **On divided highways having a median wider than 8', right and left sign assemblies shall be required.**
10. **A minimum of four (4) Group 2 channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation (see Figure 6F-6).**

Highway Closure Incident with a Temporary Detour (Figure TIMC-8.0)



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APPENDIX A

GUIDELINES FOR THE USE OF BARRIER/CHANNELIZING DEVICES IN WORK ZONES

INTRODUCTION

- A. The following safety guidelines have been developed to provide a methodical framework from which to assess every project as to the needs for appropriate techniques and devices to be employed during the construction phase. This covers a broad range of traffic conditions, vehicle speed, and duration of construction to insure that motorist and worker safety are addressed in a uniform manner throughout the Commonwealth.

Of particular note is the first strategy to use to avoid the use of barriers: Removal of the hazard or fixed object from the clear zone. If a hazard exists, remove the hazard or consider alternatives. The use of barriers to shield fixed objects should only be employed if it is not economically feasible to provide an alternate method of construction. Because barrier itself is a hazard; prior to including positive protection in a traffic control plan (TCP), careful consideration must be given to alternatives which would avoid or minimize exposure for workers and road users. Alternatives that are often considered include detouring traffic, minimizing exposure time, or maximizing the separation between traffic and workers. Strategies to avoid barrier use should be considered. These strategies include:

1. Removal of the hazard or fixed object from the clear zone or;
2. Encourage designers to eliminate the use of barrier during development of TCPs and Transportation Management Plans (TMPs) using the following techniques;
 - a. Through scheduling or sequencing phases of work (e.g., sequence to install permanent guardrail first when planned as part of project, accelerated construction techniques);
 - b. Designing a full road closure or ramp closure with traffic detoured offsite;
 - c. Designing a road or lane closure with onsite diversion (i.e., median crossover, temporary pavement, use of full depth shoulders; using ramps as a diversion around a work zones at an interchange);
 - d. Adding other options such as closing additional travel lanes to perform certain activities, performing work during non-peak travel periods; or using a slope wedge in lieu of open trenching.

- B. Projects that rarely require temporary barrier are listed below:

- Mobile, short duration, short term, and intermediate term work where typically the worker exposure for the installation and removal time for barrier offsets the safety benefits.
- Projects that involve only maintenance work such as asphalt overlays or surface treatment activities.
- Work zones with short activity areas with insufficient length of need for barriers.
- Work zones where use of barriers would reduce the acceleration/deceleration space required for the ingress and egress of construction vehicles.

- C. Projects that often require temporary barrier are listed below.

The following provides a list of areas where positive protection has been used in the past. However, this list is intended to provide guidance and should not be used in place of performing an engineering study.

- Objects that are within the clear zone such as:
 - Temporary shoring locations

- Bridge piers
- Overhead sign supports including foundations
- Staged pipe or culvert construction
- Stored construction material or equipment
- Pavement edge drop offs
- Non-traversable slope or steep/rough embankments within the clear zone
- Elevated drop inlet construction
- Staged bridge construction
- Worker or pedestrian safety is at risk due to the proximity of work to travel lanes
- Separation of opposing traffic

Positive protection is defined by the Federal Highway Administration (FHWA) as “*devices that contain and/or redirect vehicles and meet the crashworthiness evaluation criteria contained in NCHRP Report 350 and the Manual for Assessing Safety Hardware (MASH).*” By this definition, positive protection barriers should then also prevent intrusion into the work area.

Guidelines for using positive protection in a work zone are based on the premise that positive protection will reduce the severity of potential crashes. Positive protection in work zones is considered warranted when:

- Consequences of striking a fixed object or running off the road are believed to be more serious than striking the positive protection.
- Probabilities of striking a worker or pedestrian are believed to be greater than striking the positive protection.

These guidelines are to be used as a supplement to the 2009 Edition of the “Manual on Uniform Traffic Control Devices” (MUTCD).

D. The next sections include the following:

1. Channelizing Device/Barrier Selection Process
2. Checklist for Guidelines of Channelizing Device/Barrier Selection
3. Barrier Design Considerations
4. References and Other related materials

1. CHANNELIZING DEVICE/BARRIER SELECTION PROCESS

This section describes how to use the information in this appendix. To facilitate the process, it is described in a step by step process below.

Step by Step Channelizing Device/Barrier Selection Process

1. Determine variables:
 - a. Speed (pre-construction), S (mph)
 - b. Traffic Volume, V (vpd)
 - c. Construction Time, T (years)
 - d. Type of roadway (Limited Access, All Other Highways)
 - e. Run off the Road (ROR) Crashes Frequency Factor (Charts), f
 - f. Length of Work Area, L (miles)
2. Check the clear zone and drop-off charts to see if there is a hazard. Determine the location of all work crews and non-removable fixed objects that are close to the road:

- a. Distance to fixed object, D in feet
 - b. Fixed Object Clearance Guide, CZ in feet (Figure 2)
 - c. Drop-off Guide, DO in inches (Figure 2)
- If workers are within the clear zone, then go to Step 3.
3. If a hazard exists, remove the hazard or consider alternatives then return to Step 1. Refer to Section B in the Introduction for examples of alternatives to consider. If a hazard exists, cannot be removed or there are no alternatives, go to Step 4.
4. Determine the Expected Accident Factor, p , by finding the expected frequency of run-off-the-road (ROR) incidents near the fixed object or work crews based on the type of roadway determined in Step 1 and the Length of Construction Time the hazard exists:
 - a. ROR Frequency Factor Charts, f (Figure 3a Limited Access Highways or Figure 3b All Other Highways)
 - b. Fixed object length, L in miles (For singular type fixed objects such as headwalls, piers, and small work sites, use a minimum of 0.2 mi for length of construction zone.
 - c. Construction Time, T in years (use fraction of years if necessary, example 9 months = 0.75 year)
 - d. Expected Accident Factor, $p = f \times L \times T$
5. If $p \leq 0.5$ or there is minimum work crew exposure with no violation of the CZ or DO , select a channelizing device from Figure 4.
6. If $p > 0.5$ or there are violations of the CZ or DO , complete the **Checklist for Guidelines of Channelizing Device/Barrier Selection**. If after completing the checklist, it is decided that barrier is not needed, select a channelizing device from Figure 4. If barrier is needed, then go to step 7.
7. Design the barrier. Check for special situations and consider:
 - a. Barrier anchoring requirements and deflection information
 - b. Access openings and introduced barrier, Figure 5

The flow chart in Figure 1 graphically displays the seven steps process. **The engineer may review the checklist prior to starting the process.**

Figure 1, Channelizing Device/Barrier Selection Process Flow Chart

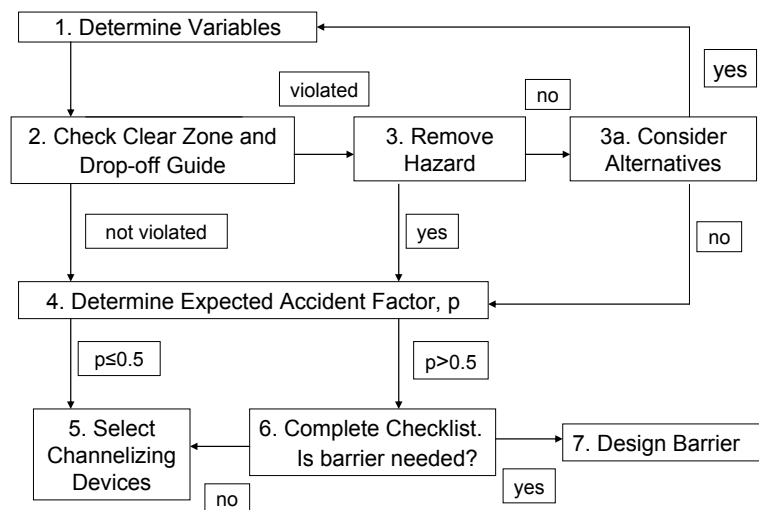
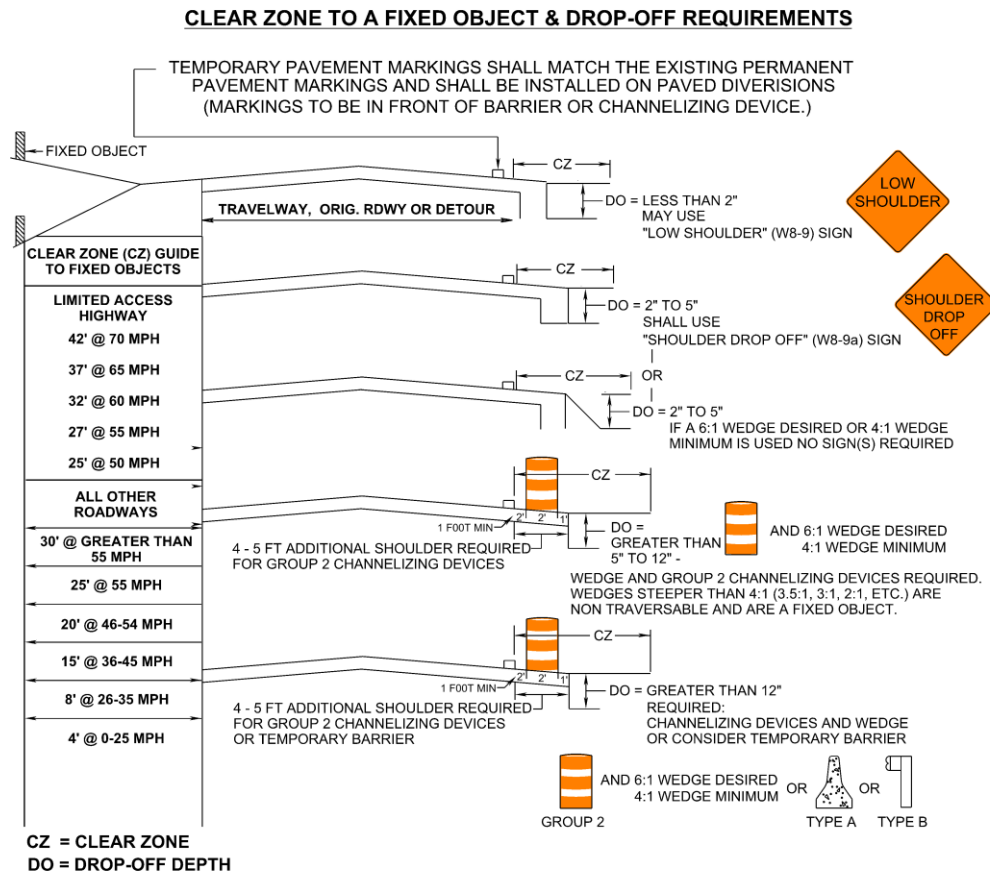


Figure 2, Clear Zone and Drop-Off Requirements

Slopes steeper than 4:1 are considered a fixed object hazard.

Example 1: Excavation on a non-limited access highway leaves a drop off depth of 8 inches during non working hours and it is located 4 feet from the edge line. The ADT is 5,300 and the speed limit is 35.

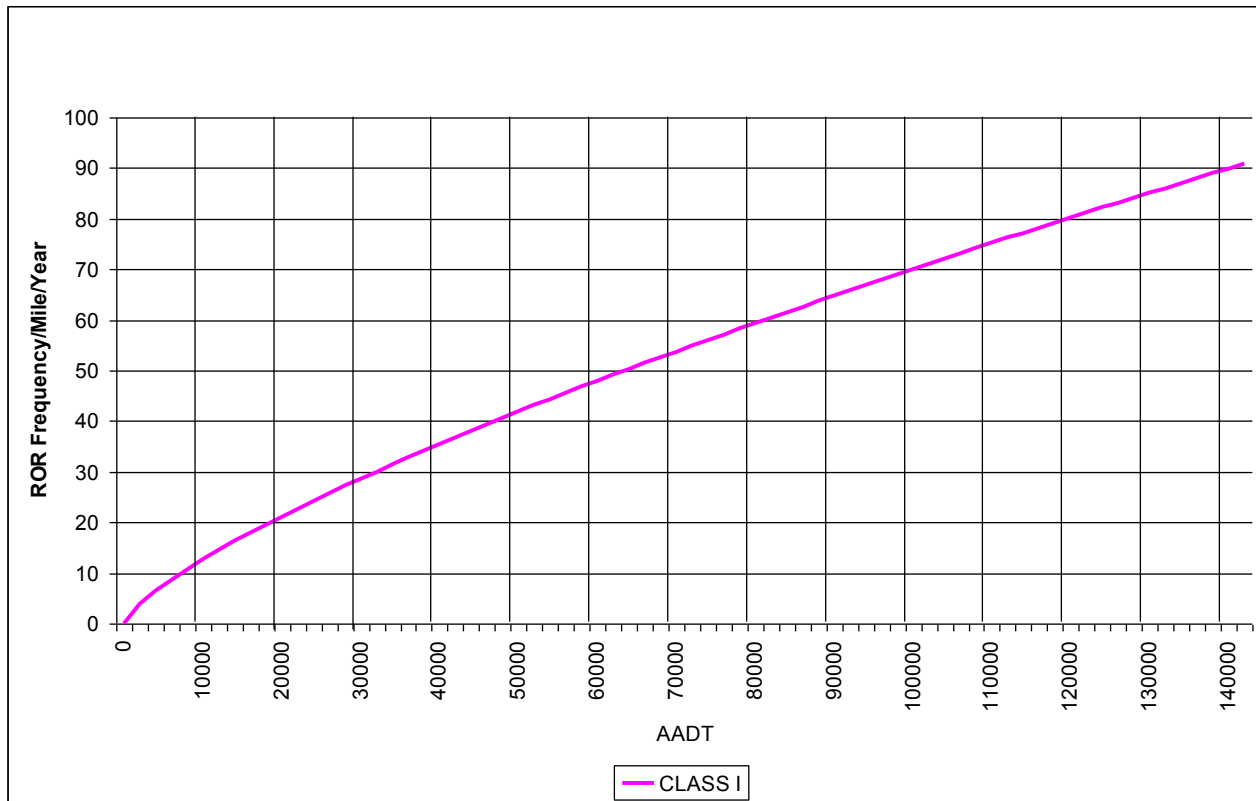
1. Determine the clear zone for 35 mph = 8 feet.
2. Protection needed: Figure 2 above, Group 2 channelizing devices shall delineate the work area and a 6:1 wedge desirable or a 4:1 wedge minimum shall be installed to eliminate the drop-off.

Example 2: A lane is being built parallel to traffic requiring excavation greater than 12 inches. The work is offset 10 feet from the existing traffic. The roadway is a non-limited access highway, ADT is 15,000 and the speed limit is 55.

1. Determine the clear zone for 55 mph = 25 feet.
2. Protection needed: From Figure 2 above,
 - A. Group 2 channelizing devices shall delineate the work area and a 6:1 wedge desirable or a 4:1 wedge minimum shall be installed to eliminate the drop-off or;
 - B. Table 1, Preliminary Channelizing Device, is used to determine a positive barrier, Type A, may be used but Figure 3b, ROR Frequency Factor Chart for All Other Highways, shall be used to determine barrier needs.

Example 3: A Limited Access highway is being built within 10 feet of an existing roadway with an ADT of 20,000 and the speed limit is 60. Fill areas are in excess of 9 feet throughout the work area.

1. Determine the clear zone for 60 mph = 32 ft.
2. Protection needed: Table 1, Preliminary Channelizing Device, is used to determine a positive barrier, Type A, may be used but Figure 3b, ROR Frequency Factor Chart for All Other Highways, shall be used to determine barrier needs

Figure 3a, ROR Frequency Factor Chart for Limited Access Highways**Example:**

Interstate highway (2 lanes NB)

ADT= 34,000 (The ADT is for one direction only.)

Length Of Construction: 1 mile

Construction time: 0.5 yr

55 MPH Work Zone Speed Limit

- (1) From the Limited Access Highways ROR frequency factor chart, ADT of 34,000 indicates 30 ROR encroachments/mi/yr
- (2) Expected Accident Frequency Factor, $p = f \times L \times T = 30 \times 1 \times 0.5 = 15$

Since the expected Accident Frequency factor is greater than 0.5, go to Checklist of Guidelines for Channelizing Device – Barrier Selection to determine if barrier is needed.

Example for Night or Day only Work Zones:

There are projects where lane closures are not continuous for several days. For example, if lane closures are limited to night only, then the traffic volume for the time period of the lane closure should be used instead of ADT. An example is provided below.

A bridge deck on an Interstate highway with 3 lanes in each direction will require patching, milling of the deck and placement of a Latex overlay.

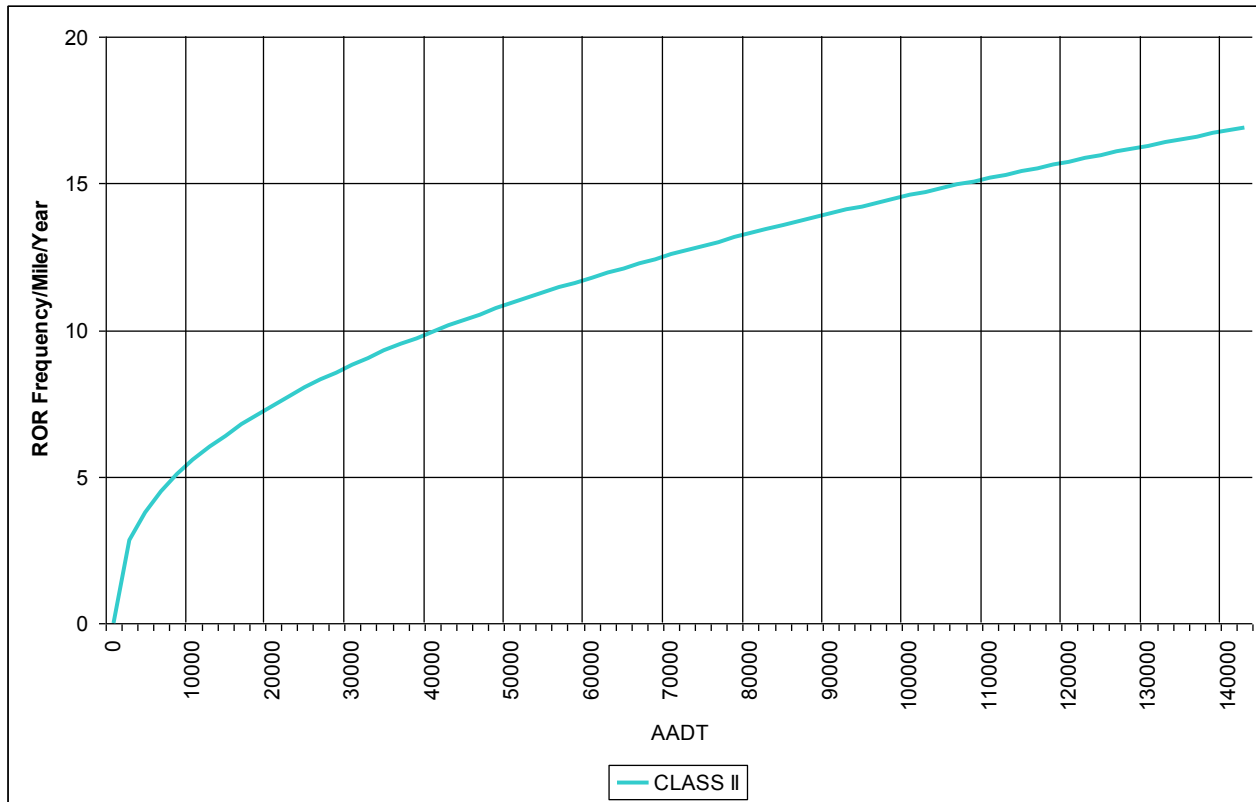
ADT = 50,000 (the ADT is for one direction only). However, the volume required all work to be performed between 9:00 pm and 6:00 am each day. Therefore, the volume to be used will be between these hours, 6,000 vehicles for the 9-hour period.

Length of Construction = Bridge length is 550 feet, therefore, 0.2 mile will be used.

Construction time = 9 hours. This is the actual time traffic is exposed to the hazard. {9 hrs ÷ (365d/yr x 24 hrs/d) = 0.001 yr}
 55 mph posted speed limit
 Expected Accident Frequency Factor, $p = f \times L \times T = 9 \times 0.2 \times 0.001 = 0.002$

Since the expected Accident Frequency Factor is well below 0.5, select a channelizing device from Figure 4.

Figure 3b, ROR Frequency Factor Chart for All Other Highways



Example:

Rural primary highway (1 lane each direction)

ADT= 10,000 (ADT is for both directions.)

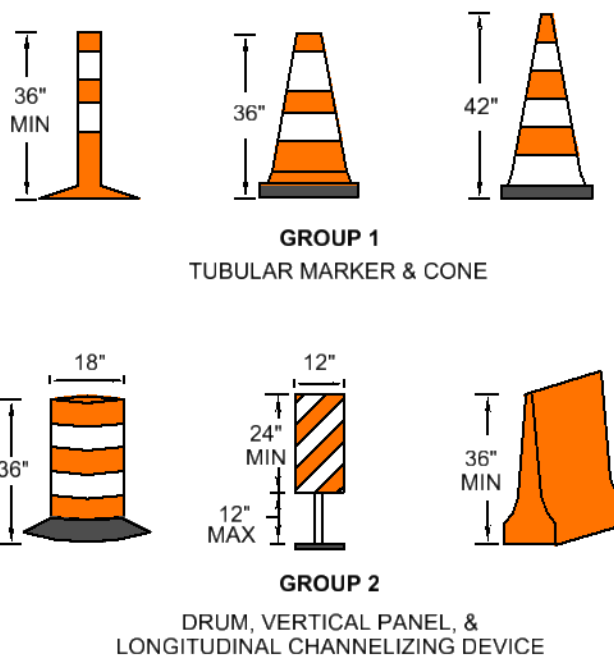
Length Of Construction: 0.5 mile

Construction time: 0.4 yr

55 MPH Work Zone Speed Limit

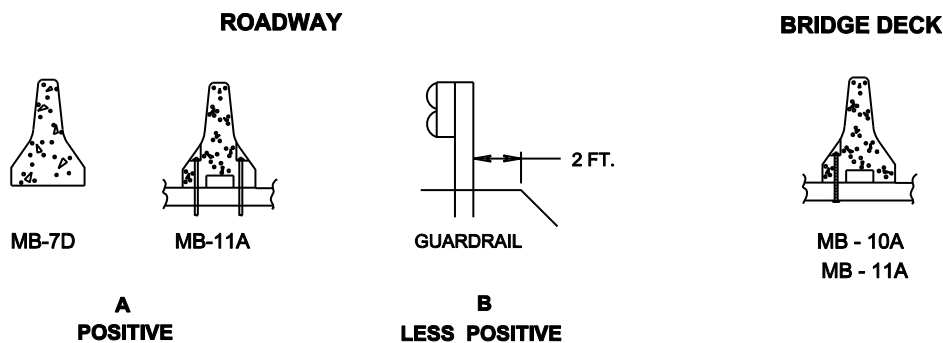
- (1) From the all other highways ROR frequency factor chart, ADT of 10,000 indicates 5 ROR encroachments/mi/yr
- (2) Expected Accident Frequency Factor, $p = f \times L \times T = 5 \times 0.5 \times 0.4 = 1.0$

If the expected Accident Frequency Factor is greater than 0.5, go to Table 1, Barrier-Channelizing Device Chart, to determine type needed.

Figure 4, Types of Barriers, Barricades and Channelizing Devices**Barricades and Channelizing Devices****SPACING GUIDE**

Speed (mph)	0 – 35	36 +
Spacing (Feet)	40	80

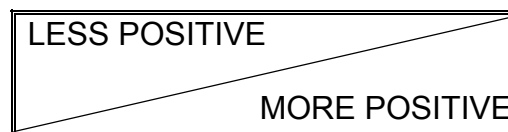
Channelizing device spacing along travelway is in feet. Spacing on curves 6° or greater (radii less than or equal to 955 feet), on transitions, or locations determined by the Regional Traffic Engineer to be $\frac{1}{2}$ of the travelway spacing.

Types of Barriers

Barrier may require anchoring to the pavement or bolting to the bridge deck. Refer to Section 3, Barrier Design Considerations, for additional guidance. If anchoring/bolting is required it shall be on the traffic side(s) of the barrier. All barriers shall be installed in accordance with Section 500 of the current Road and Bridge Standards.

Table 1, Preliminary Channelizing Device - Barrier Chart**Channelizing Device - Barrier Chart**

Existing Traffic ADT	Posted Speed Limit (mph)				
	0-25	26-35	36-45	46-54	55⁺
0-750	1,2	1,2	1,2	1,2	1,2 B
751-5500	1,2	1,2	1,2 B	B	B A
5501-15000	1,2	1,2 B	B	B A	A
Above 15000	1,2	1,2 B	A	A	A



A more positive type of barrier can be substituted for values shown.

For 1 and 2 designations, refer to Group 1 and 2 devices respectively in Figure 4.

For A and B designations, refer to Type A or B barriers respectively in Figure 4.

A temporary asphalt median is an alternative to temporary concrete traffic barriers for separation of traffic on two-lane, two-way roadways. See Page A-17 for additional guidance on the application of temporary asphalt medians.

2. CHECKLIST FOR GUIDELINES OF CHANNELIZING DEVICE/BARRIER SELECTION

The Checklist for Guidelines of Channelizing Device/Barrier Selection shall be used to assist the Designer/Traffic Engineer in determining and documenting the reason barriers are or are not required on a project or work zone operation. This documentation shall be signed and sealed by a registered professional engineer licensed to practice in the Commonwealth of Virginia. The completed Checklist for Guidelines of Channelizing Devices/Barrier Selection shall be filed in the project's preliminary engineering folder.

ENGINEERING AND TRAFFIC INVESTIGATION WORK ZONE CHANNELIZATION/BARRIER ANALYSIS SECTION A

Project No.:	Project's TMP Category:
Review Requested By:	Date of Request:
Project Scope:	Starting MP:
	Ending MP:
VDOT Project/Contract Manager:	Date of Review:

SECTION B – ENGINEERING INVESTIGATION RESULTS

Reviewer(s):	
Channelization/Barrier Device Selected (Check all that apply): <input type="checkbox"/> Cones <input type="checkbox"/> Drums <input type="checkbox"/> Temporary Asphalt Median <input type="checkbox"/> Guardrail <input type="checkbox"/> Traffic Barrier Service Concrete	
Decision Justification (What was decided and why):	(Office) (Office Location) (Title)

The related process is a guideline for aiding the engineer in the selection of barrier or channelizing devices.

Checklist for Guidelines of Channelizing Device/Barrier Selection

Information (Inputs)	Answers
What type of work will be done?	
Will a hazard be located within the clear zone?	YES or NO
What is the speed limit to be used during construction?	mph
What is the design year traffic volume?	
What is the traffic mix for the roadway?	
What Work Zone Clear Zone is to be used?	
Will pedestrian traffic need to be maintained in the work area?	YES or NO
Can they be directed to another area?	YES or NO
What is the crash data for the area? (Attach HTRIS report if available.)	Rate: Frequency: Density: Prevalent Collision Type:
Can work be done when traffic volumes are lower?	YES or NO
Considering worker safety, how close will they be to traffic?	
How long will they be exposed to traffic?	___ hrs per day or ___ Days
How long will the barrier be in place? (If over three days consider the use of barriers.)	___ hrs per day or ___ Days

Decision Process (channelizing devices vs barrier)	Answers
What is the expected ROR frequency, p ($p = f \times L \times T$)?	
If the expected ROR frequency is greater than 0.5, does Table 1, "Channelizing Device/Barrier Chart", indicate the use of barriers based on speed and volume?	YES or NO
Have other alternatives been considered other than the use of barriers? (Like a 6:1 wedge, detour, diversion, time restrictions for the work, elimination of the hazard, or to accelerate the work to reduce exposure time.)	
Consider that barriers may allow the contractor to work anytime, which may reduce construction time. However, use of Group II's or cones may limit his work to off-peak hours only.	
Generally, barriers cannot be placed around radii smaller than 100'. Do you have any small radii to protect?	YES or NO
Is the drop-off behind the barrier within 2' from the back of the barrier with a depth equal to or greater than 4'? If so, can a 6:1 wedge be used instead of the barrier?	YES or NO
What is the length of the barrier run? (Short barrier runs may not be a benefit, when considering the end protection.)	
What is the installation time? (in hours or days)	

<i>Decision Process (channelizing devices vs barrier)</i>	Answers
Will the traffic be exposed to the barriers when they are installed or removed?	YES or NO
Will barriers present any problem to accessing the work area?	YES or NO
Do workers have an escape route from an erratic vehicle?	YES or NO
Generally, traffic will shy away from barriers. Will this present any problems?	YES or NO
Will the barriers be used to separate traffic?	YES or NO
Has connections, crossovers, and entrances been considered?	YES or NO
Can a temporary asphalt median be used instead?	YES or NO
Will the barriers present a problem for either vertical or horizontal sight distance?	YES or NO
For barrier runs greater in length than 2 miles, have safety pull-off areas been provided?	YES or NO
After considering all of the above, is it practical to use barrier?	YES or NO

<i>Barrier Selection and Design (if applicable)</i>	Answers
How many lanes will be next to the barriers?	
And what is the offset from the edgeline to the face of the barrier?	
Where will the barriers be set? (In the lane or on the shoulder)	
If in the lane will the remaining lane width be acceptable?	YES or NO
What is the transition slope ratio?	
Will there be any problem installing the barrier with this ratio?	YES or NO
What type of barriers are to be used, single or double face?	
Can portable steel barriers be used?	YES or NO
What is the deflection of the barrier to be used? (If unknown use 6'.)	
Will the barriers need to be bolted down?	YES or NO
If so, does the entire run need to be bolted down?	YES or NO
What type of material will be under the barriers? (This may affect the stability and bolting, if required.)	
Will a lateral support be required?	YES or NO
If so, is there room to install it?	YES or NO or N/A
Would the barriers be placed on the outside of curves?	YES or NO
How will the barrier ends be protected? (If attenuators are to be used, consider the type, length of need/anchorage, and cost.)	
If the barrier ends are to be installed outside the clear zone, can a turned down end treatment be used?	YES or NO

3. BARRIER DESIGN CONSIDERATIONS

Once it has been determined that a barrier is recommended, the next step is to determine the type of barrier and the barrier design.

The following three factors should be considered in the barrier design:

- a. Barrier anchoring requirements and deflection information
- b. Access openings, Figure 5
- c. Use of a temporary asphalt median/temporary raised island to separate opposing traffic.

A. Barrier Anchoring Requirements and Deflection Information

Temporary Barrier Service Concrete Anchoring Requirements

Traffic Barrier Service Concrete (TBSC) is designed to prevent an errant vehicle from entering a work zone. NCHRP 350 and the “Manual for Assessing Safety Hardware” (MASH) testing have provided lateral deflection distances for various barrier designs. The distances these barriers deflect may pose a hazard to workers and motorists in the work area if materials, equipment and workers are adjacent to and within the deflection area of the barrier. Additionally, TBSC placed on bridge structures are subject to movement caused by the vibration of vehicles, principally large trucks, when they traverse the structure. If TBSC is warranted based on the criteria for determining the application of barrier per the 2011 Virginia Work Area Protection Manual, the following guidelines should be used to determine if anchoring the TBSC is appropriate:

- If the barrier is placed within 2 ft of a trench/drop-off with a depth equal to or greater than 4 ft.
- On bridge decks.
- TBSC used as a bridge parapet.
- Equipment/materials are parked/stored within the TBSC deflection area.
- Site conditions that are deemed hazardous to workers.

An exception to the above guidelines for bridges may be permitted, with the approval of the Regional Traffic Engineer, provided the following conditions are met:

- No through openings in the bridge deck.
- TBSC is not used as a parapet.
- One open lane for traffic with a stop/yield condition or temporary traffic signal controlling traffic.
- Maximum lane width of 10 feet.
- Maximum posted speed of 25 mph.
- Maximum vehicle weight restriction of 22,000 pounds.

As noted above, if equipment/materials are parked/stored or if workers’ are completing work tasks within the TBSC deflection area the TBSC shall be anchored. Designers and engineers should use the VDOT pin and loop positive connection Precast Concrete Median Barrier (MB-INS) 6 ft dynamic deflection as the design criteria in determining anchoring TBSC during the development of the temporary traffic control plans. For field applications the TBSC Deflection Table should be used to determine anchoring requirements.

Designers and engineers should refer to the Road and Bridge Standards for additional guidance on the application of anchoring TBSC as well as specific details on anchoring various types of TBSC. **Designers and engineers should contact the Standards/Special Design section for additional guidance on the application of all longitudinal barriers.**

Traffic Barrier Service Concrete (TBSC) Deflection**Acceptance based on the following NCHRP 350 Test Criteria**

Dynamic deflection is based on:

$\frac{3}{4}$ Ton pick-up truck at 45 mph and 25° impact angle (TL-2).

$\frac{3}{4}$ Ton pick-up truck at 62 mph and 25° impact angle (TL-3).

18,000 lb Single unit truck at 50 mph and 15° impact angle (TL-4).

For additional information on longitudinal barriers, length of need and impact attenuator application, please refer to IIM-LD-93, Construction Work Zone/ Safety Guidelines and Pay Items for Construction Work Zone: <http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM93.pdf>

Table 2, Traffic Barrier Service Concrete Deflection Table

Barrier types most likely to be used on VDOT projects are shown in **bold** and highlighted.

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage (a)
B112	Midwest Roadside Safety Facility	Steel strap tie-down system for PCB on bridge decks.	TL-3	3' - 2"	46'
B108	Barrier Systems, Inc.	Temporary steel barrier.	TL-2 TL-3	3' - 5" 6' - 4"	52' - 6" 105'
B-90	CalTrans	4 m (13') long single-slope barrier with double pin & loop connection.	TL-3	2' - 5"	85' - 4"
B-86	Oregon DOT	42" Tall – 12.5'Lg. F-Shape precast concrete barrier w/pin & loop connection.	TL-3 TL-4	2' - 9" 2' - 9"	125' 100'
B-84	Indiana DOT	10' Long F-Shape barrier w/pin & loop connection.	TL-3	5' - 3"	36'
B-79	Pennsylvania DOT	12.5' Long F-Shape temporary barrier w/plate connection.	TL-3	8' - 7"	80'
B-69	Barrier Systems, Inc.	Steel Reactive Tension System (SRTS) Concrete Reactive Tension System (CRTS)	TL-3 TL-3	2' - 4" 2' - 0"	266' - 8"
B-63	Barrier Systems, Inc.	Quickchange Moveable Barrier (QMB)	TL-3	4' - 6"	10' - 4"
B-62	Gunnar Prefab AB	GPLINK precast temporary concrete barrier.	TL-3	5' - 10"	*
B-54	Virginia DOT	20' Long F-Shape barrier w/pin & loop connection.	TL-3	6'	60'
B-52	Easi-Set Industries	12' Lg. And 20' Lg. F shape barrier w/J-J hook connection.	TL-3	4' - 4"	69' - 7"
B-42	Rockingham Precast	12' Long F-Shape w/T-Bar connection.	TL-3	3' - 10"	60'

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage (a)
B-41	University of Nebraska - Lincoln	9'- 4" Long F-Shape barrier w/pin & loop connection.	TL-3	6'	11' - 5" Run-on 9' - 10" Run-off
B-40	Barrier Systems, Inc.	Narrow Quickchange Moveable Barrier.	TL-3	2'- 11"	(b)
B-36	Texas A&M (TTI)	Low-Profile Concrete Barrier for Work Zones	TL-2	5"	(c)

* No published information is available.

a – Anchorage is defined as the additional length of barrier needed, upstream and downstream of the work zone, to ensure the system does not exceed the maximum dynamic deflection noted in the adjacent column.

b – System was anchored using two 6" steel tubes and two 1" by 4" steel straps w/turnbuckles. These were attached to two 3' diameter by 8' deep reinforced concrete anchors.

c – System was anchored using a non-crashworthy end treatment. System must be terminated outside of clear zone or shielded with a crashworthy device.

Longitudinal Channelizing Devices (Portable Water-Filled Devices)

Please Note: Longitudinal channelizing devices (water-filled plastic devices) can only be used in lieu of Group 2 devices (Drums & Vertical Panels). Longitudinal channelizing devices shall not be substituted for Traffic Barrier Service Concrete (temporary concrete barriers) due to their severe dynamic deflections.

Anchorage is defined as the additional length of barrier needed, upstream and downstream of the work zone, to ensure the system does not exceed the maximum dynamic deflection noted in the adjacent column. All dynamic deflection distances are based on NCHRP 350 test with the barriers filled with fluid per the manufacturer's installation instructions.

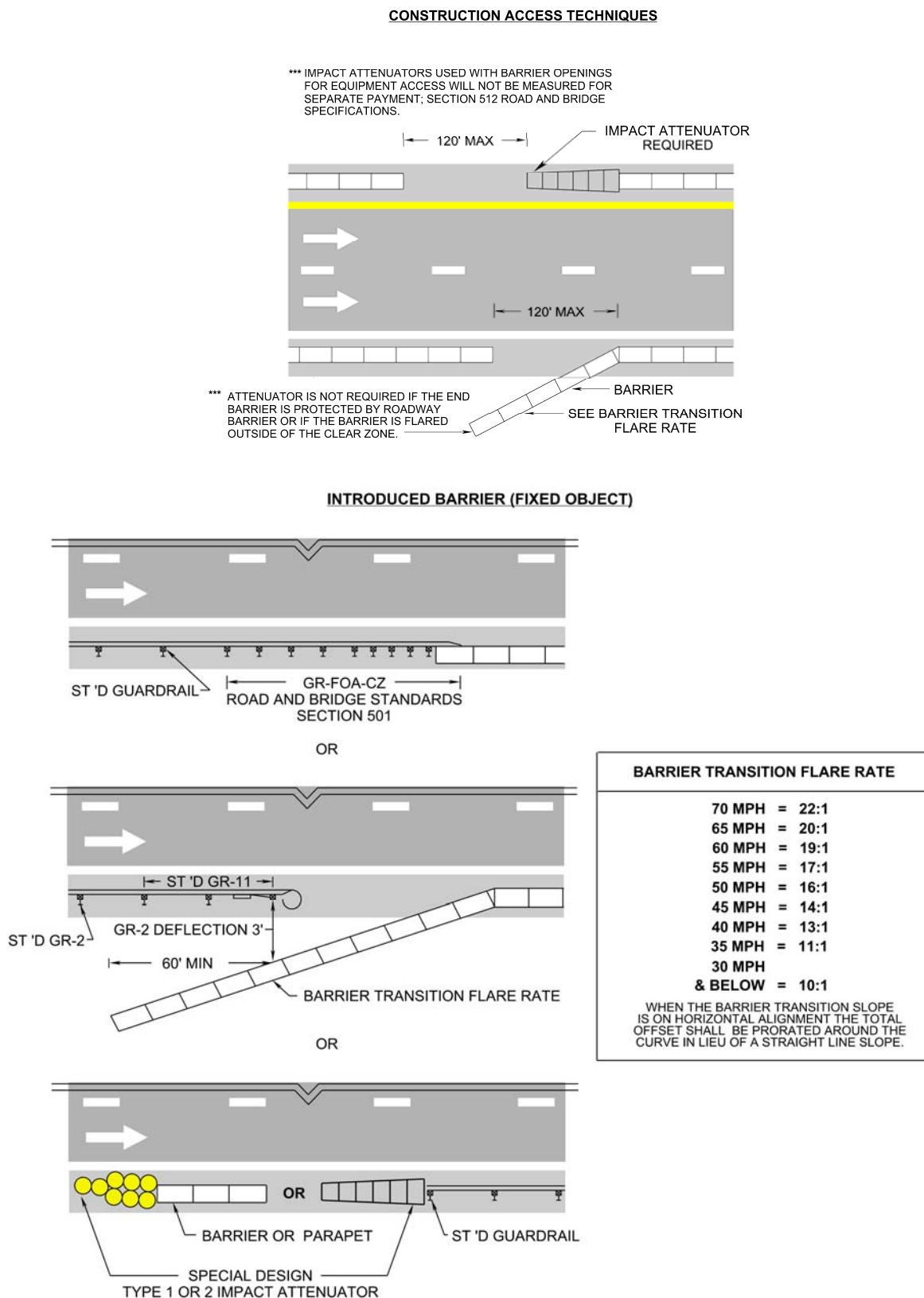
Table 3, Acceptable Longitudinal Channelizing Devices

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage
B111	Creative Building Products	Water Filled Plastic Barrier.	TL-2	10'- 4"	16 - 6' Lg. Segments (96')
B101	Rhino Safety Barrier LLC	Water-Filled Plastic Barrier.	TL-2	13'- 2"	59'
B-97	Yodock Wall Company, Inc.	Yodock Model 2001M/2001 Plastic Barriers w/ steel tubes.	TL-2 TL-3	12' 14'	46'
B-48	Energy Absorption Systems, Inc.	Triton water-filled temporary barrier.	TL-3	19'- 0" 22'- 8"	97' - 6" 65'
B-34 B-30	Armorcast Products Co.	Guardian Safety Barrier System	TL-3 TL-2	11'- 2" 6'- 6"	d

d - Please refer to FHWA acceptance letters for additional information. Manufacturer must supply anchorage information for the specific version to be installed.

B. Construction Access Technique and Introduced Barrier

Figure 5, Construction Access Technique and Introduced Barrier



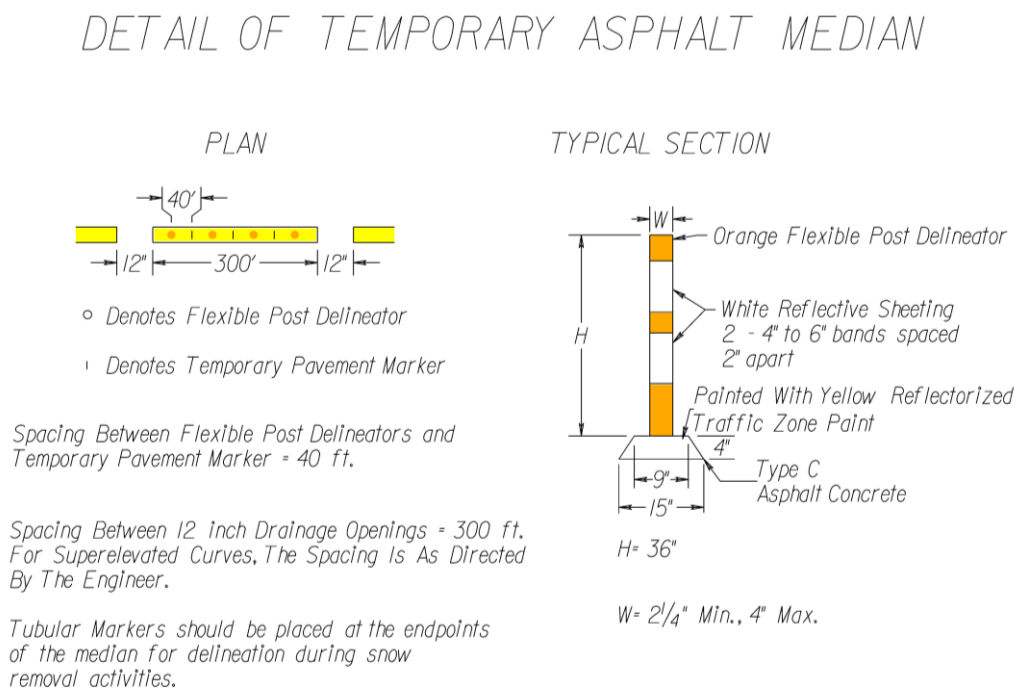
C. Use of Temporary Asphalt Median/Temporary Raised Island

Temporary asphalt medians may be considered as an alternative to temporary concrete traffic barriers for separation of traffic on two-lane, two-way temporary detours on roadways with posted speed limits of 45 mph or less and a vehicular traffic volume range of 4,000 to 15,000 average daily traffic (ADT). Temporary asphalt medians may be used in other two-lane, two-way operations where physical separation of vehicular traffic from the TTC zone is not required. All recommendations for the use of temporary asphalt medians must have the written approval of the Regional Traffic Engineer.

In addition to the information listed in the Checklist for Guidelines of Barrier/Channelizing Devices Selection engineering study, each location for the application of the temporary asphalt median should be reviewed to ensure that the existing roadway's geometrics provide an operating speed equal to or within 10 mph of the existing roadway's posted speed limit. Also, when an intersection is within the two-way, two-lane operation, attention should be given to temporary traffic control at the intersection, especially the side street approaches. This attention may include, but is not limited to, additional advance warning signing and supplemental pavement markings at the approaches to as well as at the intersection.

The Temporary Traffic Control Plan (Maintenance of Traffic/Sequence of Construction Plan) shall include the required temporary asphalt median layout details along with the "Detail of Temporary Asphalt Median", available from the Location and Design Division.

Figure 6, Temporary Asphalt Median Detail



4. REFERENCES AND OTHER RELATED MATERIALS

VDOT Memorandums:

IIM-LD-93, Construction Work Zone/ Safety Guidelines and Pay Items for Construction Work Zone
<http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM93.pdf>

IIM-LD-184, Concrete Median Barrier/Traffic Barrier Service
<http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM184.pdf>

IIM-LD-222/TE-358, Roadway Safety Features/NCHRP 350 Test Requirements
<http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM222.pdf>

IIM-LD-241/TE-351, Work Zone Safety and Mobility/Transportation Management Plan Requirements
<http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM241.pdf>

TE-342, Work Zone/Lane Encroachment and Center Lane Closure Policy for Work Zones on Limited Access Highways
http://www.viriniadot.org/business/resources/traffic_engineering/memos2/TE-342_Lane_Encroachment_and_Center_Lane_Closure_Policy_for_Work_Zone_on_Limited_Access_Highways.pdf

TE-350, Work Zone Safety/Work Zone Speed Analysis
http://www.viriniadot.org/business/resources/traffic_engineering/memos2/TE-350_1_Work_Zone_Speed_Analysis.pdf

TE-352, Work Zone Safety/Slow Roll Temporary Traffic Control (Slow Roll TTC)
http://www.viriniadot.org/business/resources/traffic_engineering/memos2/TE-352_Slow_Roll_Temp_Traffic_Control.pdf

VDOT Manuals:

Virginia Road and Bridge Specifications
<http://www.viriniadot.org/business/const/spec-default.asp>

Virginia Road and Bridge Standards
http://www.viriniadot.org/business/locdes/2008_standards_complete_sections.asp

Virginia Road Design Manual (Index)
<http://www.extranet.vdot.state.va.us/locdes/Electronic%20Pubs/2005%20RDM/index.pdf>

National Manuals and Web Sites:

2009 Manual on Uniform Traffic Control Devices
http://mutcd.fhwa.dot.gov/kno_2009.htm

FHWA Safety (Work Zones)
<http://safety.fhwa.dot.gov/wz>

The National Work Zone Safety Information Clearinghouse
<http://www.workzonesafety.org>

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APPENDIX B

WORK ZONE SAFETY CHECKLIST FORM DOCUMENTATION

The following Work Zone Safety Checklist form has been developed to provide a consistent and helpful way to review and document temporary traffic control in construction, maintenance, utility and permit work zone operations. When used correctly, work zone deficiencies should be noted and detailed information provided to allow rapid and thorough correction of the problem. Therefore, additional sheets may be attached to this form if needed.

Work zones should be carefully monitored under varying conditions of road user volumes, light, construction activities, and weather to check that applicable temporary traffic control devices are effective, clearly visible, clean, and in compliance with the traffic control plan and this Manual. The best time to review temporary traffic control is during nighttime hours, where the retroreflectivity of the traffic control devices can be easily seen and evaluated. Individuals who are knowledgeable (for example, trained and/or certified) in the principles of proper temporary traffic control should be assigned responsibility for safety in temporary traffic control zones. Part of their duties should consist of reviewing daily the traffic control devices and their functionality to ensure that reasonable safe conditions exist for motorists (including motorcyclists), bicyclists, pedestrians, and workers.

As stated in Section 6B.01, “Temporary traffic control installations shall be reviewed daily to ensure the functionality of the temporary traffic control devices and compliance to this Manual and the traffic control plan. These reviews shall be documented on a weekly basis at a minimum using the Work Zone Safety Checklist form found in Appendix B of this Manual, including as much detailed information as warranted for the type of operation.” This required frequency is a minimum, and depending on the type and location of the project, more frequent checks may be necessary. For long duration temporary traffic control installations, periodic nighttime reviews should also be performed. Additional methods of documentation may also be used with this form, including written notes and sketches, project diary entries, photographs, and video recordings.

Changes to the traffic control plan, no matter how small, must also be documented and may be performed using this form. Information should include what the changes were, why they were made, and who was notified and/or authorized the change.

An explanation form to explain the fields found on the Work Zone Safety Checklist form follows on Pages B-5 through B-11.

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Form #TE-97001
 TRAFFIC ENGINEERING
 CONSTRUCTION / MAINTENANCE / UTILITY / PERMIT

WORK ZONE SAFETY CHECKLIST

URGENT CORRECT IMMEDIATELY []
 5 - WORKING DAYS TO CORRECT []

WHEN URGENT IS MARKED
 DENOTE ITEM

RESIDENCY: _____ CONTRACTOR / AREA HEADQUARTERS: _____
 CITY / COUNTY: _____ PROJ. NO. / PERMIT NO. / LOCATION: _____
 TYPE OF OPERATION: _____ DAY / DATE: _____ TIME: _____
 PERSON IN CHARGE: _____ POSTED SPEED: _____ MPH
 WEATHER CONDITION: _____ DAY OR NIGHT WORK ☐ IN ☐ NOT IN PROGRESS

A. DRIVE THRU:

ARE MANEUVERS DIFFICULT OR
 UNEXPECTED? ☐ YES ☐ NO
 ADEQUATE WARNING OF
 HAZARDS? ☐ YES ☐ NO
 IS SIGNING CLEAR / UNCLUTTERED
 AND PROPERLY SPACED? ☐ YES ☐ NO
 ARE TRAFFIC CONTROL DEVICES
 SUFFICIENTLY VISIBLE? ☐ YES ☐ NO

COMMENTS: _____

B. SIGNS:

☐ ADEQUATE ☐ INADEQUATE
 NEED TO BE (REMOVED / REPOSITIONED /
 COVERED) ☐
 NEED (CLEANING / REPLACEMENT) ☐
 CONFLICTING (PERMANENT /
 TEMPORARY SIGNING) ☐
 NON-APPROVED SIGN SUPPORT ☐
 BLOCKED BY VEGETATION ☐

COMMENTS: _____

C. PORTABLE CHANGEABLE MESSAGE SIGN:

☐ ADEQUATE ☐ INADEQUATE
 APPLICATION DOES NOT MEET
 GUIDELINES ☐
 INAPPROPRIATE (MESSAGE) ☐
 TOO MUCH INFORMATION ON P.C.M.S. ☐
 NOT DELINEATED, NO CONES / BARRELS ☐

COMMENTS: _____

D. ARROW BOARD:

☐ ADEQUATE ☐ INADEQUATE
 MALFUNCTION (BULB OUT, ETC.) ☐
 INCORRECT PLACEMENT ☐
 MISALIGNED BULBS ☐
 NOT DIMMED AT NIGHT ☐

COMMENTS: _____

E. DRUMS = D / OTHER = O:

D O

☐ ADEQUATE ☐ INADEQUATE
 INAPPROPRIATE TAPER LENGTH
 SPACING INADEQUATE (TO LONG /
 TOO SHORT
 (REPAIR / CLEAN / REPLACEMENT)
 REFLECTIVE BANDS (DAMAGED/
 MISSING)
 ON DRUMS / OTHER DEVICES)
 ADDITIONAL DEVICES NEEDED
 MISALIGNED

COMMENTS: _____

F. TRAFFIC BARRIER:

☐ ADEQUATE ☐ INADEQUATE
 IMPROPER BARRIER WALL FLARE ☐
 IMPROPER TERMINAL TREATMENT ☐
 BARRIER NEEDS TO BE (REALIGNED /
 REMOVED) ☐
 WARNING LIGHT (SERVICE / CLEAN) ☐
 DELINEATORS (CLEAN / ADDITIONAL) ☐
 8' X 12" VERTICAL BARRIER PANELS
 (CLEAN ADDITIONAL) ☐
 ATTENUATOR (REPAIR / REPLACE) ☐

COMMENTS: _____

FORM #TE - 97002

G. FLAGGING OPERATION:☐ ADEQUATE ☐ INADEQUATE

NEED ADDITIONAL ADVANCE SIGNING

ARE FLAGPERSONSCERTIFIED? ☐ YES ☐ NOPOSITIONED CORRECTLY? ☐ YES ☐ NOHIGHLY VISIBLE? ☐ YES ☐ NOPROPERLY CLOTHED? ☐ YES ☐ NOFLAGGING CORRECTLY? ☐ YES ☐ NO**COMMENTS:****H. PAVEMENT MARKING:**☐ PERMANENT ☐ CONSTRUCTION☐ ADEQUATE ☐ INADEQUATE

REMOVE

REPAIR

NEED ADDITIONAL

UNNECESSARY (MARKINGS /

NOT ERADICATED COMPLETED)

COMMENTS:**I. PAVEMENT MARKERS:**☐ PERMANENT ☐ CONSTRUCTION☐ ADEQUATE ☐ INADEQUATEREPLACE MISSING ☐REMOVE ☐NEED ADDITIONAL ☐**COMMENTS:****J. TRUCK-MOUNTED ATTENUATOR:**PROPERLY POSITIONED? ☐ YES ☐ NO

PROPERLY MAINTAINED /

DELINEATED? ☐ YES ☐ NO**COMMENTS:****K. MISCELLANEOUS:**☐ YES ☐ NOADEQUATE BUFFER SPACE? ☐ YES ☐ NOIS THE WORK AREA PROTECTED? ☐ YES ☐ NOMATERIALS PROPERLY STORED? ☐ YES ☐ NOARE LANE CLOSURES IN ACCORD
WITH ALLOWED HOURS" ☐ YES ☐ NO**ACCIDENTS:**EVIDENCE OF AN ACCIDENT | ☐ YES ☐ NODAMAGED TRAFFIC CONTROL DEVICES ☐SKID MARKS ☐ DEBRIS ☐**COMMENTS / RECOMMENDATION:**

REVIEWED BY:

(SIGN & DATE)

REVIEWED WITH:

(SIGN & DATE)

COPY: CONTRACTOR, INSPECTOR, RESIDENT ENGINEER, OR OTHER

WORK ZONE SAFETY CHECKLIST FORM # TE-97001 & 97002 EXPLANATION SHEET

The box at the upper right-hand corner of the page is used to show the seriousness of the condition at the work site. If this will require immediate attention, (when life-threatening conditions are present) check the ***“URGENT: CORRECT IMMEDIATELY”*** box. If conditions are not life threatening, then check the ***“5 - WORKING DAYS TO CORRECT”*** box.

“WHEN URGENT IS MARKED DENOTE ITEM” - When the urgent box is checked, write the word ***URGENT*** in the appropriate section’s comments line to indicate a life threatening condition is present.

“CONSTRUCTION / MAINTENANCE / UTILITY / PERMIT” - Circle the type of operation being reviewed.

“RESIDENCY:” - Residency managing the work zone.

“CITY / COUNTY:” - Location of the work zone.

“PERSON IN CHARGE:” - Project inspector or supervisor overseeing the project.

“WEATHER CONDITION:” - Type of weather when the inspection is being performed.

“CONTRACTOR / AREA HEADQUARTERS:” - Name of the contractor or, when checking a maintenance operation, name of the Area Headquarters performing the operation.

“PROJ. NO. / PERMIT NO. / LOCATION:” - Circle the applicable title and list the corresponding project or permit number or route number for maintenance operations.

“DAY / DATE:” - The day and date of the review.

“TIME:” - The time when the review is performed.

“POSTED SPEED:” - The posted speed limit on the project.

“DAY OR NIGHT:” - Circle day for daylight or night for darkness during the time the review was conducted.

“WORK (IN/NOT IN) PROGRESS:” - Circle “IN” if operations are being performed during the review or “NOT IN” if operations are not in progress.

A. DRIVE THRU: Drive through the work zone at the prevailing or 85 percentile speed and take notice of the traffic’s movements and reactions to the traffic control devices.

“ARE MANEUVERS DIFFICULT OR UNEXPECTED?” - Based on the drive thru and observation of the traffic, answer yes or no.

“ADEQUATE WARNING OF HAZARDS?” - Are the placement of the advance warning signs in regards to hazards adequate for proper reaction?

“IS SIGNING CLEAR / UNCLUTTERED AND PROPERLY SPACED?” - Are the advance warning signs visible and easy to read and understand?

“ARE TRAFFIC CONTROL DEVICES SUFFICIENTLY VISIBLE?” - Are all the traffic control devices (signs, cones, plastic drums, arrow boards, etc.) visible?

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

B. SIGNS: See Section 6F.02

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the warning signs. When “ADEQUATE” is checked continue to the next section. If “INADEQUATE” is checked one of the conditions below will be checked or other types of problems listed on the comment line.

“NEED TO BE (REMOVED / REPOSITIONED / COVERED):” - Circle one of the statements that describes the condition: “REMOVED” when the sign is not necessary or inappropriate for the traffic control; “REPOSITIONED” when a sign is found in an incorrect location; or “COVERED” when the sign conveys a conflicting message.

“NEED (CLEANING / REPLACEMENT):” - *Circle* one of the statements that describes the condition: “CLEANING” if a sign is dirty and/or “REPLACEMENT” when the sign is no longer legible.

“NEED ADDITIONAL SIGNS:” - Mark when additional signs are needed to comply with the *Virginia Work Area Protection Manual*.

“NON-APPROVED SIGN SUPPORTS:” - Mark when not in compliance with the 2011 WAPM (spring loaded sign stands required unless prevented by roadway geometrics and approved by the District Traffic Engineer).

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

C. PORTABLE CHANGEABLE MESSAGE SIGN (PCMS): See Section 6F.68

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the PCMS. When “ADEQUATE” is checked, continue to the next section. If “INADEQUATE” is checked, one of the conditions below will be checked or other types of problems listed on the comment line.

“APPLICATION DOES NOT MEET GUIDELINES:” - Mark if the message on the PCMS is giving conflicting information or guidance.

“INAPPROPRIATE MESSAGE:” - Mark if the message is unclear or does not pertain to the work zone.

“NOT DELINEATED, NO DRUMS:” - Circle one of the statements that describes the condition: “CONES” should be used to delineate the PCMS during daylight hours and “BARRELS” must be used for night delineation.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

D. ARROW BOARD: See Section 6F.69

Note: Desired placement is on the shoulder at the beginning of the transition. The four- corner display shall be used for the caution mode.

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the arrow board. When “ADEQUATE” is checked, continue to the next section. If “INADEQUATE” is checked, one of the conditions below will be checked or other types of problems listed on the comments line.

“MALFUNCTION (BULB OUT, ETC.):” - Circle one of the statements that describes the condition: “MALFUNCTION” if the entire panel is out or “BULB” if one or more bulbs are out.

“MISALIGNED BULBS:” - Mark if bulbs appear dimmer than others due to being out of alignment.

“NOT DIMMED AT NIGHT:” - Mark if the panel is too bright at night.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

E. DRUMS & CONES: See Sections 6F.72 and 6F.75

DRUMS = D: Circle the letter **D** when drums are checked.

CONES = C: Circle the letter **C** when cones are checked.

OTHER = O: If devices other than cones or drums are in use, write O in this section and describe what was used in the comments section.

(Both **D** and **C** can be used at the same time. The boxes that are under the heading letters can be checked based on the deficiency found with these devices.)

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the drums or cones. When “ADEQUATE” is checked continue to the next section. If “INADEQUATE” is checked, one of the conditions below will be checked or other types of problems listed on the comments line.

“INAPPROPRIATE TAPER LENGTH:” - Mark if the taper does not meet the length requirements found in the WAPM and check the box under the letter heading for that device.

“SPACING INADEQUATE (TOO LONG / TOO SHORT):” - Mark if the space between the devices is not in accordance with the WAPM and check the box under the letter heading for that device.

“(REPAIR / CLEAN / REPLACE):” - Circle the statements that describes the condition of the devices and check the box under the letter heading for that device.

“REFLECTIVE SLEEVES OR BANDS MISSING ON (CONES / TUBULAR MARKERS):” Circle the statement that describes the condition and check the box under the letter heading for that device. (Reflective sheeting is required on cones and tubular markers at night)

“ADDITIONAL DEVICES NEEDED:” - Mark if spacing is not within WAPM requirements or if hazards are not adequately protected and check the box under the letter heading for that device.

“MISALIGNED:” - Mark when the drums or cones are out of alignment in either the transition or tangent area and check the box under the letter heading for that device.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

F. TRAFFIC BARRIER: See Section 6F.94 and Appendix A

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the traffic barrier. When “ADEQUATE” is checked continue to the next section. If “INADEQUATE” is checked, one of the conditions below will be checked or other types of problems listed on the comment line.

“IMPROPER BARRIER WALL FLARE:” - Mark if the concrete barrier flare does not meet the requirements of the barrier transition slope ratio table in Appendix A of the *Virginia Work Area Protection Manual*.

“BARRIER NEEDS TO BE (REALIGNED / REMOVED):” - Circle statements that describes the condition: “REALIGNED” when gaps greater than one inch are found between barrier joints or needs straightening or “REMOVED” when the barrier is no longer needed to protect the work area.

“WARNING LIGHT (SERVICE / CLEAN):” - Circle the statements that describes the condition: “SERVICE” when the type “A” warning light is not working; “CLEAN” when the light is dirty with reduced visibility.

DELINEATORS (CLEAN / ADDITIONAL): Circle the statements that describe the condition: “CLEAN” when the delineators on the side of the barrier are dirty; “ADDITIONAL” when they are missing from the barrier.

“8” X 12” BARRIER PANELS (CLEAN / ADDITIONAL):” - Circle the statements that describes the condition: “CLEAN” when the retroreflectivity of the vertical panels is reduced due to dirt; “ADDITIONAL” when vertical panels are missing from the concrete barrier wall.

“ATTENUATOR (REPAIR / REPLACE):” - Circle the statement that describes the condition: “REPAIR” when damage has occurred to the attenuator; “REPLACE” when the device cannot be repaired.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

G. FLAGGING OPERATION: See Chapter 6E

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the flagging operation. When “ADEQUATE” is checked continue to the next section. If “INADEQUATE” is checked, one of the conditions below will be checked or other types of problems listed on the comment line.

“NEED ADDITIONAL ADVANCE SIGNING:” - Mark if signs are missing in the flagger sign series as required in the 2011 WAPM.

ARE FLAGPERSONS:

“CERTIFIED?” - Check to see if flag persons have their certification card on their possession and mark the appropriate box.

“POSITIONED CORRECTLY?” - Check position of flag persons for compliance to WAPM requirements and mark the appropriate box.

“HIGHLY VISIBLE?” - Check the approaching visibility of the flagger and mark the appropriate box.

“PROPERLY CLOTHED?” – Flag persons shall be dressed in accordance with the 2011 WAPM. Mark the appropriate box.

“FLAGGING CORRECTLY?” - Observe the flag person for proper flagging procedures and mark the appropriate box.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

H. PAVEMENT MARKING: See Section 6F.86

“PERMANENT or CONSTRUCTION:” - Mark the type of pavement marking being reviewed.

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the pavement marking: When “ADEQUATE” is checked, continue to the next section. If “INADEQUATE” is checked one of the conditions below will be checked or other types of problems listed on the comments line.

“REMOVE:” - Mark when inappropriate or conflicting pavement marking is found on the roadway.

“REPAIR:” - Mark when existing pavement marking needs to be remarked in spot locations.

“NEED ADDITIONAL:” - Mark when additional pavement marking is needed on the roadway.

“UNNECESSARY (MARKINGS / NOT ERADICATED COMPLETELY):” - Circle the statement that describes the condition: “MARKINGS” when the markings on the roadway are misguiding or confusing to motorists; “NOT ERADICATED COMPLETELY” when the existing markings are still visible and misleading to motorists.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

I. PAVEMENT MARKERS: See Section 6F.87

“PERMANENT or CONSTRUCTION:” - Mark the type of pavement markers being reviewed.

“ADEQUATE or INADEQUATE:” - Used to describe the condition of the pavement markers. When “ADEQUATE” is checked, continue to the next section. If “INADEQUATE” is checked,

one of the conditions below will be checked or other types of problems listed on the comments line.

“REPLACE MISSING:” - Mark when pavement markers are missing from the roadway as defined by the 2011 WAPM.

“REMOVE:” - Mark when either existing or temporary markers are misleading to traffic.

“NEED ADDITIONAL:” - Mark when the markers are missing from the roadway and are needed for more positive guidance with the pavement markings.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

J. TRUCK-MOUNTED ATTENUATOR: See Section 6F.95

“PROPERLY POSITIONED?” - Mark the appropriate box according to the requirements of the 2011 WAPM.

“PROPERLY MAINTAINED / DELINEATED?” - Circle the statements that describes the condition: “PROPERLY MAINTAINED” describing the condition of the attenuator, not in need of repair; “DELINEATED” describing required marking and activated warning lights on vehicle.

“COMMENTS:” - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

K. MISCELLANEOUS:

“ADEQUATE BUFFER SPACE?” - Is this area installed according to 2011 WAPM requirements: See Buffer length Table on page 6H-5

“IS THE WORK AREA PROTECTED?” - Is the work area protected by cones, barrels or positive barrier?

“MATERIALS PROPERLY STORED?” - Are materials stored in the work zone protected or out of the clear zone (See Appendix A for clear zone values)?

“EQUIPMENT PROPERLY STORED?” - Is equipment in or stored at the work zone behind a positive barrier or outside the clear zone (See Appendix A for clear zone values)?

“ARE LANE CLOSURES IN ACCORD WITH ALLOWED HOURS?” - Are time restrictions being followed?

ACCIDENTS: Are there indications of accidents in the work zone?

“EVIDENCE OF AN ACCIDENT?” - Are there skid marks, vehicle debris, or damaged traffic control devices present?

“DAMAGED TRAFFIC CONTROL DEVICES?” - Are damaged traffic control devices present? Are they in need of repair?

“SKID MARKS?” - Are skid marks present which may indicate a problem with the work zone layout?

“DEBRIS?” - Are debris present in the work zone?

“COMMENTS / RECOMMENDATION:” - This area may be used to give additional information on a section listed above or to give a location of the problem. Positive comments should be given under this heading as well. “RECOMMENDATION” is for remarks concerning suggestions to problems addressed in other sections above. Additional sheets may be attached to this report if necessary.

“REVIEWED BY:” - Signed and dated by the person conducting the review.

“REVIEWED WITH:” - Signed and dated by the person supervising the work zone.

“COPY: CONTRACTOR, INSPECTOR, RESIDENT ENGINEER, OR OTHER:” - Suggested distribution of this project review: one copy to person overseeing the work for the state, one copy retained by the reviewer, one copy to the contractor, and one copy forwarded to the resident engineer. However, the district should determine the final distribution.

NOTE: When a work zone temporary traffic control review has been performed and deficiencies have been found and documented, a follow-up review should be performed within a reasonable amount of time to ensure the items have been corrected. The follow-up review should also be documented and placed with the project files.

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APPENDIX C

GUIDELINES FOR USE OF VIRGINIA STATE POLICE IN CONSTRUCTION/MAINTENANCE WORK ZONES

The following Guidelines for use of Virginia State Police in construction and maintenance work zones have been developed by the Virginia State Police and VDOT to ensure the maximum effectiveness of law enforcement in work zone operations. These guidelines are not intended to be all-inclusive, as each work zone presents its own unique situations and ever-changing conditions. Situations will occur which dictate deviations from these guidelines as stated and/or are not covered by the guidelines. In those situations, the project inspector and the trooper should confer on the best way to address the traffic safety problems presented.

Guidelines for Use of Virginia State Police In Construction/Maintenance Work Zones

To ensure the maximum effectiveness of the use of the Virginia State Police in work zones, the following guidelines have been developed for standard lane closure operations:

1. Prior to placing a request for state police on a particular project or work zone operation, the project inspector (or VDOT maintenance personnel) contractor's superintendent and State Police area supervisor should meet and discuss when, where, and how State Police assistance would benefit in reducing excessive speeds and moving violations through the work zone. When it has been determined and approved to assign State Police assistance to the work zone, the following guidelines are offered:
 - A. If traffic is expected to be free flowing through the work zone with little to no back-ups, the trooper should be located at a reasonable and safe distance in advance of the first work crew in the lane closure. If a Truck-Mounted Attenuator (TMA) vehicle is used within the lane closure, the trooper's vehicle should not be stationed in advanced of the TMA as traffic would approach. The TMA vehicle should always be the first vehicle motorist encounter in the work zone.
 - B. If traffic is slowing and backing up within the transition area or within the advance warning area of the work zone, the trooper should position his/her vehicle on the shoulder in advance of the queue to slow traffic, which should increase awareness and prevent potential crashes. This may require repositioning of the law enforcement vehicle periodically to stay in a proper advance position of the traffic queue.
 - C. Mobile lane closure operations on multi-lane roadways are one of the most hazardous operations performed in work zone operations. If possible, the use of a trooper, placed on the shoulder at a reasonable and safe distance (approximately 500 to 800 feet in advance of the vehicles performing the lane closure operations), is recommended to increase motorists' awareness and slow approaching traffic. The trooper's vehicle should not block an open lane unless protected by a TMA.
2. After determining when, where, and how the state police are to be used, the project inspector (or VDOT maintenance personnel) should contact the state police and arrange for a meeting on the project to discuss that day's operations and placement of the trooper(s). VDOT contact information, including name and cell phone or pager number, shall be given to the trooper(s) so that communication may be maintained throughout the shift for that operation. During the course of the day/night, the project inspector, VDOT maintenance supervisor, or his/her designate shall relay any recommended changes to the placement of the trooper(s).
3. VDOT personnel should request that the trooper's vehicle be equipped with a speed detection unit.
4. Once on the project at the designated location, at the discretion of the trooper the state police vehicle should operate with its emergency lights flashing. If equipped with a speed detection unit, the trooper should operate the speed detection unit, periodically stopping vehicles exceeding the safe speed established for that work zone. To retain credibility with motorists, the trooper may travel out of the work zone to stop speeding motorists. Otherwise, motorists

will believe that the trooper is there for “show” only and not for “enforcement”. Due to the activities occurring in the work zone at any given time, the trooper should stop motorists outside of the closed lane or work zone area, then return when possible.

5. Upon completion of the state trooper’s shift, the trooper and the project inspector, maintenance supervisor or his designate should meet to review that shifts operation and to agree upon the time worked and sign the appropriate log. If the trooper must leave the site due to an emergency or other related situation, the VDOT contact person shall be notified.
6. Any condition or situation a state trooper observes within a work zone which needs to be corrected shall be brought to the attention of VDOT project personnel
7. These guidelines are not intended to be all-inclusive. Situations will occur which dictate deviations from the guidelines as stated and/or are not covered by the guidelines. In those situations, the project inspector and the trooper should confer on the best way to address the traffic safety problems presented.

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APPENDIX D

PORTABLE CHANGEABLE MESSAGE SIGN (PCMS) DISPLAYS

A Portable Changeable Message Sign (PCMS) is a valuable resource which provides a direct link to the traveling public regarding information that could affect traffic flow. Ultimately, the success of the PCMS depends upon the motorists' belief in information being displayed. Improper sign usage or incorrect information will erode motorist confidence and reduce the sign's effectiveness.

This Appendix is intended to create uniformity in PCMS messages displayed across the Commonwealth. PCMS messages must quickly relay concise and meaningful information to motorist. The basic message content of the PCMS should include the "what" (situation the motorist will encounter), "where" it is located, and an "action" the motorist should take. Messages on a PCMS should consist of no more than two phases (screen displays), and a phase should consist of no more than three lines of text.

PCMS information shall be followed as shown in Section 6F.68. The VDOT Operations and Security Division shall make any updates, exceptions, or revisions to this guidance. Acceptable abbreviations shall be used and unacceptable messages shall be avoided as shown in Tables D-1 through D-3.

All messages shall be preapproved by the project's Engineer, or by VDOT personnel or the owner having jurisdiction. The PCMS messages shall be programmed by project personnel, or by VDOT personnel or jurisdiction personnel.

Table D-1, Abbreviations That Shall be Used Only on Portable Changeable Messages Signs

Work Message	Standard Abbreviation	Prompt Word That Should Precede the Abbreviation	Prompt Word That Should Follow the Abbreviation
Access	ACCS	—	Road
Ahead	AHD	Fog	—
Blocked	BLKD	Lane	—
Bridge	BR*	(Name)	—
Cannot	CANT	—	—
Center	CNTR	—	LANE
Chemical	CHEM	—	SPILL
Condition	COND	Traffic	—
Congestion	CONG	Traffic	—
Construction	CONST	—	Ahead
Crossing	XING	—	—
Do Not	DON'T	—	—
Downtown	DWNTN	—	Traffic
Eastbound	E-BND	—	—
Emergency	EMER	—	—
Entrance, Enter	ENT	—	—
Exit	EX	Next	—
Express	EXP	—	Lane
Frontage	FRNTG	—	Road
Hazardous	HAZ	—	Driving
Highway-Rail Grade Crossing	RR XING	—	—
Interstate	I-*	—	Number
It Is	ITS	—	—
Lane	LN	[Roadway Name]*, Right, Left Center	—
Left	LFT	—	—
Local	LOC	—	Traffic
Maintenance	MAINT	—	—
Major	MAJ	—	Accident
Minor	MNR	—	Accident
Normal	NORM	—	—
Northbound	N-BND	—	—
Oversized	OVRSZ	—	Load
Parking	PKING	—	—
Pavement	PVMT	Wet	—
Prepare	PREP	—	To Stop
Quality	QLTY	Air	—
Right	RT	Keep, Next	—
Roadwork	RDWK	—	Ahead, [Distance]
Route	RT, RTE	Best	—
Service	SERV	—	—
Shoulder	SHLDR	—	—
Slippery	SLIP	—	—
Southbound	S-BND	—	—
Speed	SPD	—	—
Tire With Lugs	LUGS	—	—
Traffic	TRAF	—	—
Travelers	TRVLRS	—	—
Two-Wheeled Vehicles	Cycles	—	—
Vehicles(s)	VEH, VEHS	—	—
Warning	WARN	—	—
Westbound	W-BND	—	—
Will Not	WONT	—	—

* This abbreviation shall not be used for any application other than the name of a roadway.

** A space and no dash shall be placed between the abbreviation and the number of the route.

Table D-2, Acceptable Abbreviations

Word Message	Standard Abbreviation
Afternoon / Evening	PM
Alternate	ALT
AM Radio	AM
Avenue AVE	AV
Bicycle	BIKE
Boulevard	BLVD
Bridge	BR*
CB Radio	CB
Center (as part of a place name)	CTR
Circle	CIR*
Civil Defense	CD
Compressed Natural Gas	CNG
Court	CT*
Crossing (other than highway-rail)	X-ING
Drive	DR*
East	E
Expressway	EXPWY
Feet	FT
FM Radio	FM
Friday	FRI
Hazardous Material	HAZMAT
High Occupancy Vehicle	HOV
Highway	HWY*
Hospital	HOSP
Hour(s)	HR, HRS
Information	INFO
Interstate	I-**
Junction / Intersection	JCT
Lane	LN
Liquid Propane Gas	LP-GAS

Word Message	Standard Abbreviation
Maximum	MAX
Mile(s)	MI
Miles Per Hour	MPH
Minimum	MIN
Minute(s)	MIN
Monday	MON
Morning / Late Night	AM
Mount	MT
Mountain	MTN
National	NATL
North	N
Parkway	PKWY
Pedestrian	PED
Place	PL*
Road	RD*
Saint	ST
Saturday	SAT
South	S
Street	ST*
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Terrace	TER*
Tons of Weight	T
Trail	TR*
Tuesday	TUES
Two-Way Intersection	2-WAY
US Numbered Route	US
Wednesday	WED
West	W

*This abbreviation shall not be used for any application other than the name of a roadway.

Table D-3, Unacceptable Abbreviations

Abbreviation	Intended Work	Common Misinterpretation
ACC	Accident	Access (Road)
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	Lane (Merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong

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