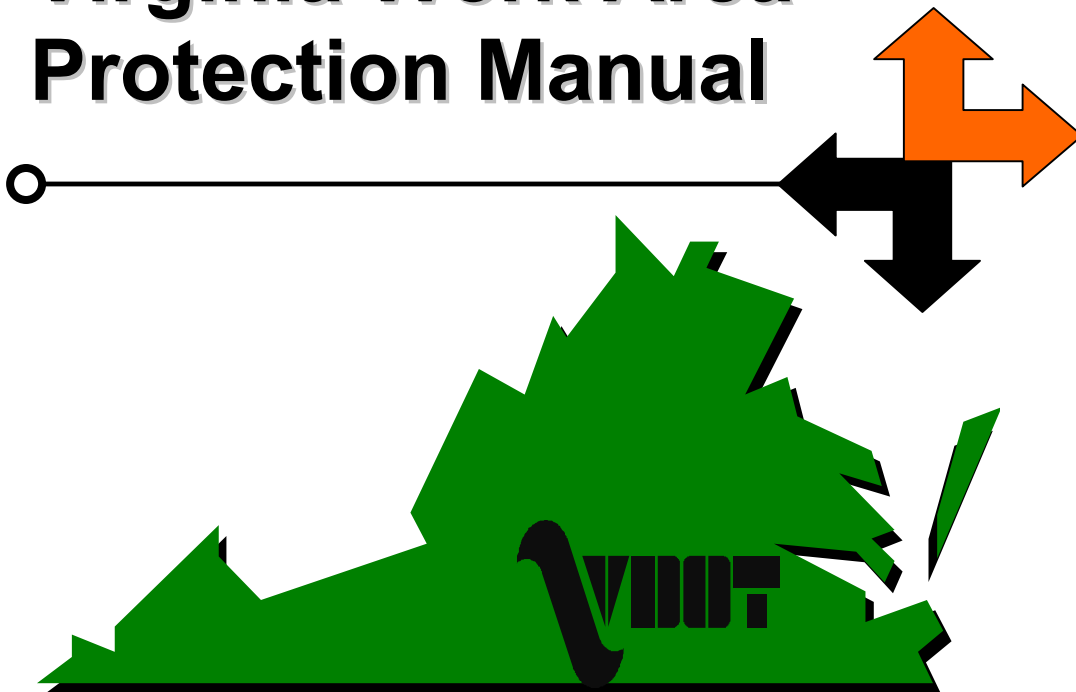


Virginia Work Area Protection Manual



**Standards and Guidelines
for Temporary Traffic Control**

January 2003

(Intentionally Left Blank)

The Virginia Department of Transportation has published a complete revision of the *Virginia Work Area Protection Manual* effective January 2003. This Manual replaces the previous issue of the *Virginia Work Area Protection Manual* dated January 1996.

This Manual is Virginia's version of Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) millennium edition and either meets or exceeds the requirements for temporary traffic control established by the Federal Highway Administration. This Manual may also be accessed on the Virginia Department of Transportation web page at www.VirginiaDOT.org. Future revisions to this manual will be posted on the web site only and it will be the responsibility of the holder of this manual to periodically check the web site and replace revised pages.

When appropriate, please use the Change of Address and/or Ownership form found on the web site to assist us in keeping our records. Please include the name of the previous owner when reporting a change of ownership.

(Intentionally Left Blank)

VIRGINIA WORK AREA PROTECTION MANUAL

**STANDARDS AND
GUIDELINES**

*FOR
TEMPORARY
TRAFFIC CONTROL*

**DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219**

JANUARY 2003

(Intentionally Left Blank)

VIRGINIA WORK AREA PROTECTION MANUAL

INTRODUCTION

Standard:

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, or bikeway by authority of a public agency having jurisdiction.

Part VI of the 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.

The 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 traffic control devices on all public roads open to public travel 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.

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 or copyright, except for the Interstate Shield and any other items owned by the FHWA.

Standard:

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.

Guidance:

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 re-adjustments 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.

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.

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 District Traffic Engineer should be consulted to select or tailor the proper traffic control devices.

Nothing contained herein is intended to abridge or disclaim the Manual on Uniform Traffic Control Devices, but rather to augment and to supplement for the safety of the traveling public.

Support:

23 CFR, Part 655.603 adopts the MUTCD as the national standard for any street, highway, or bicycle trail open to public travel in accordance with 23 U.S.C. 109(d) and 402(a). The “Uniform Vehicle Code (UVC)” is one of the documents referenced in the MUTCD. The UVC contains a model set of motor vehicle codes and traffic laws for use throughout the United States. The States are encouraged to adopt Section 15-117 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.” Section 15-104 of the UVC adopts the MUTCD as the standard for conformance.

The Standard, Guidance, Option, and Support material described in this edition of the MUTCD provide the transportation professional with the information needed to make appropriate decisions regarding the use of traffic control devices on streets and highways. The material in this edition is organized to better differentiate between Standards that must be satisfied for the particular circumstances of a situation, Guidances that should be followed for the particular circumstances of a situation, and Options that may be applicable for the particular circumstances of a situation.

Throughout this Manual the headings Standard, Guidance, Option, and Support are used to classify the nature of the text that follows. Figures, tables, and illustrations 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 illustration.

Standard:

When used in this Manual, the text headings shall be defined as follows:

1. **Standard** — a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. All standards are labeled, and the text appears in bold large type. The verb shall is typically used. Standards are sometimes modified by Options.
2. **Guidance** — a statement of highly recommended 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 large italicized type. The verb should is typically used. Guidance statements are sometimes modified by Options.
3. **Option** — a statement of practice that is a permissive condition and carries no requirement or recommendation. Options may contain allowable modifications to a Standard or Guidance. All Option statements are labeled, and the text is underlined. The verb may is typically used.
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 small font. The verbs shall, should, and may are not used in Support statements.

(Intentionally Left Blank)

VIRGINIA WORK AREA PROTECTION MANUAL

TABLE of CONTENTS

CHAPTER 6A.	GENERAL	Page 6A-1
Section 6A.01	General.....	Page 6A-1
Section 6A.02	Definitions of Words and Phrases in This Manual	Page 6A-2
Section 6A.03	Abbreviations Used on Traffic Control Devices.....	Page 6A-6
<i>Table 6A-1</i>	<i>Acceptable Abbreviations</i>	<i>Page 6A-7</i>
<i>Table 6A-2.</i>	<i>Abbreviations That Are Acceptable Only with a Prompt Word</i>	<i>Page 6A-8</i>
<i>Table 6A-3.</i>	<i>Unacceptable Abbreviations</i>	<i>Page 6A-8</i>
CHAPTER 6B.	FUNDAMENTAL PRINCIPLES	Page 6B-1
Section 6B.01	Fundamental Principles of Temporary Traffic Control.....	Page 6B-1
CHAPTER 6C.	TEMPORARY TRAFFIC CONTROL ELEMENTS	PAGE 6C-1
Section 6C.01	Temporary Traffic Control Plans.....	Page 6C-1
Section 6C.02	Temporary Traffic Control Zones.....	Page 6C-2
Section 6C.03	Components of Temporary Traffic Control Zones	Page 6C-3
Section 6C.04	Advance Warning Area.....	Page 6C-3
Section 6C.05	Transition Area	Page 6C-3
<i>FIGURE 6C-1</i>	<i>COMPONENT PARTS OF A TEMPORARY TRAFFIC CONTROL ZONE</i>	<i>Page 6C-4</i>
Section 6C.06	Buffer Space Area.....	Page 6C-5
Section 6C.07	Activity Area.....	Page 6C-6
Section 6C.08	Termination Area.....	Page 6C-6
<i>FIGURE 6C-2</i>	<i>TYPE OF TAPERS AND BUFFER SPACES</i>	<i>Page 6C-7</i>
<i>Table 6C-1.</i>	<i>Length of the Longitudinal Buffer Space</i>	<i>Page 6C-8</i>
Section 6C.09	Tapers	Page 6C-8
<i>Table 6C-2.</i>	<i>Taper Length Criteria for Temporary Traffic Control Zones</i>	<i>Page 6C-10</i>
Section 6C.10	Detours and Diversions.....	Page 6C-11
<i>FIGURE 6C-3</i>	<i>ONE - LANE, TWO-WAY TRAFFIC TAPER</i>	<i>Page 6C-12</i>
Section 6C.11	One-Lane, Two-Way Traffic Control	Page 6C-13
Section 6C.12	Flagger Method of One-Lane, Two-Way Traffic Control	Page 6C-13
Section 6C.13	Flag Transfer Method of One-Lane, Two-Way Traffic Control	Page 6C-14
Section 6C.14	Pilot Car Method of One-Lane, Two-Way Traffic Control	Page 6C-14
Section 6C.15	Temporary Traffic Control Signal Method of One-Lane,	Page 6C-14
	Two-Way Traffic Control	Page 6C-14
Section 6C.16	Stop or Yield Control Method of One-Lane, Two-Way Traffic Control	Page 6C-14
CHAPTER 6D.	PEDESTRIAN AND WORKER SAFETY	Page 6D-1
Section 6D.01	Pedestrian Considerations.....	Page 6D-1
Section 6D.02	Worker Considerations	Page 6D-4
CHAPTER 6E.	FLAGGER CONTROL	Page 6E-1
Section 6E.01	Qualifications for Flaggers	Page 6E-1
Section 6E.02	High-Visibility Clothing	Page 6E-1
Section 6E.03	Hand-Signaling Devices	Page 6E-2
Section 6E.04	Flagger Procedures	Page 6E-3
Section 6E.05	Flagger Stations	Page 6E-4
<i>FIGURE 6E-1</i>	<i>USE OF HAND SIGNALING DEVICES BY FLAGGER</i>	<i>Page 6E-5</i>
<i>Table 6E-1</i>	<i>Distance of Flagger Station in Advance of the Work Space</i>	<i>Page 6E-6</i>
Section 6E.06	Traffic Spotters	Page 6E-7
CHAPTER 6F.	TEMPORARY TRAFFIC CONTROL ZONE DEVICES	Page 6F-1
Section 6F.01	Types of Devices	Page 6F-1
Section 6F.02	General Characteristics of Signs	Page 6F-1

Section 6F.03	Sign Placement	Page 6F-2
<i>FIGURE 6F-1.</i>	<i>HEIGHT AND LATERAL LOCATION OF SIGNS-TYPICAL INSTALLATIONS</i>	<i>Page 6F-4</i>
Section 6F.04	Sign Maintenance	Page 6F-5
Section 6F.05	Regulatory Sign Authority	Page 6F-5
Section 6F.06	Regulatory Sign Design	Page 6F-6
Section 6F.07	Regulatory Sign Applications	Page 6F-6
Section 6F.08	ROAD (STREET) CLOSED Sign (R11-2).....	Page 6F-6
Section 6F.09	Local Traffic Only Signs (R11-3a, R11-4)	Page 6F-7
Section 6F.10	Weight Limit Signs (R12-1, R12-2, R12-5).....	Page 6F-7
Section 6F.11	STAY IN LANE Sign (R4-9)	Page 6F-8
<i>FIGURE 6F-2a.</i>	<i>COMMONLY USED REGULATORY SIGNS</i>	<i>Page 6F-8</i>
<i>FIGURE 6F-2b.</i>	<i>COMMONLY USED REGULATORY SIGNS</i>	<i>Page 6F-9</i>
Section 6F.12	PEDESTRIAN CROSSWALK Sign (R9-8).....	Page 6F-10
Section 6F.13	SIDEWALK CLOSED Signs (R9-9, R9-10, R9-11, R9-11a)	Page 6F-10
Section 6F.14	Special Regulatory Signs	Page 6F-10
Section 6F.15	Warning Sign Function, Design, and Application	Page 6F-11
Section 6F.16	Position of Advance Warning Signs	Page 6F-12
Section 6F.17	ROAD (STREET) WORK Sign (W21-4).....	Page 6F-12
<i>FIGURE 6F-3a.</i>	<i>WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES</i>	<i>Page 6F-13</i>
<i>FIGURE 6F-3b.</i>	<i>WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES</i>	<i>Page 6F-14</i>
<i>FIGURE 6F-3c.</i>	<i>WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES</i>	<i>Page 6F-15</i>
<i>FIGURE 6F-3d.</i>	<i>WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES</i>	<i>Page 6F-16</i>
<i>FIGURE 6F-3e.</i>	<i>WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES</i>	<i>Page 6F-17</i>
<i>FIGURE 6F-3f.</i>	<i>WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES</i>	<i>Page 6F-18</i>
Section 6F.18	DETOUR Sign (W20-2)	Page 6F-19
Section 6F.19	ROAD (STREET) CLOSED Sign (W20-3)	Page 6F-19
Section 6F.20	ONE LANE ROAD Sign (W20-4)	Page 6F-19
Section 6F.21	LANE(S) CLOSED Signs (W20-5, W20-5a).....	Page 6F-19
Section 6F.22	CENTER LANE CLOSED AHEAD Signs (W9-3, W9-3a).....	Page 6F-19
Section 6F.23	THRU TRAFFIC MERGE RIGHT (LEFT) Sign (W4-1a)	Page 6F-20
Section 6F.24	Lane Ends Sign (W4-2L, W4-2R)	Page 6F-20
Section 6F.25	ON RAMP Plaque (W13-4).....	Page 6F-20
Section 6F.26	RAMP NARROWS Sign (W5-4)	Page 6F-20
Section 6F.27	SLOW TRAFFIC AHEAD Sign (W23-1).....	Page 6F-20
Section 6F.28	EXIT OPEN, EXIT CLOSED Signs (E5-2, E5-2a).....	Page 6F-20
Section 6F.29	Flagger Symbol Sign (W20-7a)	Page 6F-21
Section 6F.30	Two-Way Traffic Sign (W6-3)	Page 6F-21
Section 6F.31	NEW TRAFFIC PATTERN AHEAD Sign (VW-)	Page 6F-21
Section 6F.32	FRESH OIL (TAR) Sign (W21-2).....	Page 6F-22
Section 6F.33	ROAD MACHINERY AHEAD Sign (W21-3)	Page 6F-22
Section 6F.34	SHOULDER WORK Signs (W21-5, W21-5a, W21-5b).....	Page 6F-22
Section 6F.35	SURVEY CREW Sign (W21-6).....	Page 6F-22
Section 6F.36	UTILITY WORK AHEAD Sign (W21-7).....	Page 6F-23
Section 6F.37	Signs for Blasting Areas	Page 6F-23
Section 6F.38	BLASTING ZONE AHEAD Sign (W22-1)	Page 6F-23
Section 6F.39	TURN OFF 2-WAY RADIO AND CELL PHONE Sign (W22-2)	Page 6F-23
Section 6F.40	END BLASTING ZONE Sign (W22-3).....	Page 6F-24
Section 6F.41	SHOULDER DROP-OFF Sign (W8-9a)	Page 6F-24
Section 6F.42	UNEVEN LANES Sign (W8-11)	Page 6F-24
Section 6F.43	NO CENTER STRIPE Sign (W8-12).....	Page 6F-24
Section 6F.44	Other Warning Signs.....	Page 6F-24
Section 6F.45	Advisory Speed Plaque (W13-1)	Page 6F-25
Section 6F.46	Supplementary Distance Plaque (W7-3a)	Page 6F-25
Section 6F.47	Guide Signs.....	Page 6F-25
Section 6F.48	ROAD WORK NEXT XX MILES Sign (G20-1).....	Page 6F-26
Section 6F.49	END ROAD WORK Sign (G20-2a).....	Page 6F-26
Section 6F.50	Detour Signs and Markers (M4-8, M4-8a, M4-8b, M4-9, and M4-10)	Page 6F-27
Section 6F.51	PILOT CAR FOLLOW ME Sign (G20-4)	Page 6F-27
Section 6F.52	Portable Changeable Message Signs.....	Page 6F-28
Section 6F.53	Arrow Panels.....	Page 6F-30

FIGURE 6F-4.	ADVANCE WARNING ARROW DISPLAY SPECIFICATIONS	Page 6F-32
Section 6F.54	High-Level Warning Devices (Flag Trees).....	Page 6F-34
Section 6F.55	Channelizing Devices	Page 6F-35
Section 6F.56	Cones	Page 6F-36
Table 6F-1.	Spacing of Channelizing Devices:	Page 6F-37
FIGURE 6F-5.	CHANNELIZING DEVICES.....	Page 6F-37
Section 6F.57	Tubular Markers	Page 6F-38
Section 6F.58	Vertical Panels	Page 6F-39
Section 6F.59	Drums	Page 6F-39
Section 6F.60	Type III Barricades	Page 6F-40
Section 6F.61	Direction Indicator Barricades.....	Page 6F-42
Section 6F.62	Temporary Traffic Barriers as Channelizing Devices.....	Page 6F-42
Section 6F.63	Other Channelizing Devices	Page 6F-43
Section 6F.64	Temporary Raised Islands.....	Page 6F-43
Section 6F.65	Pavement Markings	Page 6F-44
Section 6F.66	Temporary Pavement Markings.....	Page 6F-45
Section 6F.67	Raised Pavement Markers.....	Page 6F-45
Section 6F.68	Delineators.....	Page 6F-46
Section 6F.69	Lighting Devices.....	Page 6F-46
Section 6F.70	Floodlights	Page 6F-47
Section 6F.71	Flashing Warning Beacons	Page 6F-47
Section 6F.72	Warning Lights	Page 6F-48
Section 6F.73	Steady-Burn Electric Lamps	Page 6F-49
Section 6F.74	Vehicle Warning Lights.....	Page 6F-49
Section 6F.75	Temporary Traffic Control Signals.....	Page 6F-50
Section 6F.76	Temporary Traffic Barriers.....	Page 6F-51
Section 6F.77	Crash Cushions	Page 6F-52
Section 6F.78	Vehicle-Arresting Systems	Page 6F-55
Section 6F.79	Rumble Strips	Page 6F-55
Sections 6F.80	Screens.....	Page 6F-56
Section 6F.81	Future and Experimental Devices.....	Page 6F-56
CHAPTER 6G.	TYPE OF TEMPORARY TRAFFIC CONTROL	
	ZONE ACTIVITIES	Page 6G-1
Section 6G.01	Typical Applications.....	Page 6G-1
Section 6G.02	Work Duration	Page 6G-1
Section 6G.03	Location of Work and Roadway Characteristics.....	Page 6G-4
Section 6G.04	Modifications To Fulfill Special Needs	Page 6G-5
Section 6G.05	Work Outside of Shoulder	Page 6G-6
Section 6G.06	Work on the Shoulder with No Encroachment	Page 6G-7
Section 6G.07	Work on the Shoulder with Minor Encroachment	Page 6G-8
Section 6G.08	Work Within the Median	Page 6G-8
Section 6G.09	Work Within the Traveled Way of Two-Lane Highways.....	Page 6G-9
Section 6G.10	Work Within the Traveled Way of Urban Streets.....	Page 6G-9
Section 6G.11	Work Within the Traveled Way of Multilane, Nonaccess Controlled Highways..	Page 6G-10
Section 6G.12	Work Within the Traveled Way at an Intersection	Page 6G-12
Section 6G.13	Work Within the Traveled Way of Expressways and Freeways.....	Page 6G-14
Section 6G.14	Two-Lane, Two-Way Traffic on One Roadway of a	
	Normally Divided Highway.....	Page 6G-15
Section 6G.15	Crossovers.....	Page 6G-15
Section 6G.16	Interchanges.....	Page 6G-16
Section 6G.17	Movable Barriers	Page 6G-16
Section 6G.18	Work in the Vicinity of Highway-Rail Grade Crossings	Page 6G-16
Section 6G.19	Control of Traffic Through Incident Areas.....	Page 6G-17
Section 6G.20	Work During Inclement Weather.....	Page 6G-18
CHAPTER 6H.	TYPICAL TRAFFIC CONTROL FIGURES	Page 6H-1
Section 6H.01	Typical Traffic Control Figures	Page 6H-1
Table 6H-1	Index to Typical Traffic Control Figures and Notes.....	Page 6H-2

Table 6H-3	Buffer Space Length.....	Page 6H-4
Table 6H-4	Flagger Distance From Work Space	Page 6H-4
FIGURE 6H-1	SYMBOLS USED IN TYPICAL APPLICATION DRAWINGS.....	Page 6H-5
TTC-1.0	WORK BEYOND THE SHOULDER OPERATION.....	Page 6H-6
TTC-2.0	BLASTING ZONE OPERATION	Page 6H-8
TTC-3.0	MOBILE OR SHORT DURATION ON SHOULDER OPERATION.....	Page 6H-10
TTC-4.0	STATIONARY OPERATION ON SHOULDER.....	Page 6H-12
TTC-5.0	SHOULDER CLOSURE WITH BARRIER AND LANE SHIFT OPERATION.....	Page 6H-14
TTC-6.0	SHOULDER CLOSURE WITH BARRIER OPERATION.....	Page 6H-16
TTC-7.0	MOWING OPERATION WITH ENCROACHMENT.....	Page 6H-18
TTC-8.0	MOVING/MOBILE OPERATIONS ON LIMITED ACCESS HIGHWAYS	Page 6H-20
TTC-9.0	MOVING/MOBILE OPERATION ON MULTI-LANE ROADWAY.....	Page 6H-22
TTC-10.0	MOBILE/MOVING OPERATION ON TWO-LANE ROADWAY.....	Page 6H-24
TTC-11.0	SHORT DURATION OPERATION ON MULTI-LANE ROADWAY.....	Page 6H-26
TTC-12.0	OUTSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY	Page 6H-28
TTC-13.0	INSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY	Page 6H-30
TTC-14.0	MULTI-LANE CLOSURE OPERATION	Page 6H-32
TTC-15.0	LANE CLOSURE OPERATION WITH LANE WEAVE	Page 6H-34
TTC-16.0	LANE CLOSURE OPERATION WITH CONCRETE TRAFFIC BARRIER.....	Page 6H-36
TTC-17.0	CENTER TURN LANE CLOSURE OPERATION.....	Page 6H-38
TTC-18.0	FLAGGING OPERATION ON TWO-LANE ROAD.....	Page 6H-40
TTC-19.0	NON-STATIONARY FLAGGING OPERATION ON TWO-LANE ROAD	Page 6H-42
TTC-20.0	LANE CLOSURE OPERATION – NEAR SIDE OF INTERSECTION.....	Page 6H-44
TTC-21.0	LANE CLOSURE OPERATION – FAR SIDE OF INTERSECTION	Page 6H-46
TTC-22.0	CLOSURE OPERATION IN INTERSECTION	Page 6H-48
TTC-23.0	TURN LANE CLOSURE OPERATION	Page 6H-50
TTC-24.0	SIDEWALK CLOSURE AND BYPASS SIDEWALK OPERATION	Page 6H-52
TTC-25.0	CROSSWALK CLOSURE AND PEDESTRIAN DETOUR OPERATION.....	Page 6H-54
TTC-26.0	WORK OPERATION IN THE VICINITY OF EXIT RAMPS.....	Page 6H-56
TTC-27.0	PARTIAL RAMP CLOSURE OPERATION	Page 6H-58
TTC-28.0	WORK OPERATION IN THE VICINITY OF ENTRANCE RAMPS.....	Page 6H-60
TTC-29.0	MULTI-LANE SHIFT OPERATION.....	Page 6H-62
TTC-30.0	HALF ROAD CLOSURE OPERATION ON MULTI-LANE ROADWAY.....	Page 6H-64
TTC-31.0	TOTAL FREEWAY CLOSURE OPERATION.....	Page 6H-66
TTC-32.0	SURVEYING OPERATION	Page 6H-68
TTC-33.0	DISRUPTION OPERATION ON MULTI-LANE ROADWAY.....	Page 6H-70
TTC-34.0	HAUL ROAD CROSSING OPERATION.....	Page 6H-72
TTC-35.0	SIGNING FOR REDUCED SPEEDS IN WORK ZONES.....	Page 6H-74
TTC-36.0	SIGNING FOR PROJECT LIMITS.....	Page 6H-76
TTC-37.0	MOTORIST SURVEY OPERATION ON TWO-LANE ROADWAY.....	Page 6H-78
TTC-38.0	ERADICATION OF PAVEMENT MARKINGS IN WORK ZONES.....	Page 6H-80
TTC-39.0	WORK IN THE VICINITY OF HIGHWAY-RAIL CROSSING.....	Page 6H-82

APPENDIX A	Page A-1
GUIDELINES FOR USE OF BARRIER/CHANNELIZATION DEVICES		Page A-1
FREQUENCY FACTOR CHART		Page A-3
FIXED OBJECT CLEARANCE & SLOPE GUIDES.....		Page A-4
SELECTING BARRIERS, BARRICADES & CHANNELIZING DEVICES.....		Page A-5
CONSTRUCTION ACCESS TECHNIQUES.....		Page A-6
INTRODUCED BARRIER ((FIXED OBJECT).....		Page A-6
INTRODUCED BARRIER (FIXED OBJECT).....		Page A-7
STOPPING SIGHT DISTANCE (S.S.D.)		Page A-8

APPENDIX B	Page B-1
WORK ZONE SAFETY CHECKLIST FORM DOCUMENTATION.....		Page B-1

APPENDIX C	Page C-1
GUIDELINES FOR USE OF VIRGINIA STATE POLICE IN		
CONSTRUCTION / MAINTENANCE WORK ZONES.....		Page C-1

CHAPTER 6A. GENERAL

Section 6A.01 General

Support:

When the normal function of the roadway is suspended, temporary traffic control planning provides for continuity of the movement of motor vehicle, bicycle, and pedestrian traffic; transit operations; and access to property and utilities.

The primary function of temporary traffic control is to provide for the safe and efficient movement of vehicles, bicyclists, and pedestrians through or around temporary traffic control zones while reasonably protecting workers and equipment.

Of equal importance to the public traveling through the temporary traffic control zone is the safety of workers performing the many varied tasks within the work space. Temporary traffic control zones present constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the workers on or near the roadway (see Section 6D.02). At the same time, the temporary traffic control zone provides for the efficient completion of whatever activity interrupted the normal use of the roadway.

Consideration for road user safety, worker safety, and the efficiency of road user flow is an integral element of every temporary traffic control zone, from planning through completion. A concurrent objective of the temporary traffic control is the efficient construction and maintenance of the highway.

No one set of temporary traffic control devices can satisfy all conditions for a given project. At the same time, defining details that would be adequate to cover all applications is not practical. Instead, Part 6 displays typical applications that depict common applications of temporary traffic control devices. The temporary traffic control selected for each situation depends on type of highway, road user conditions, duration of operation, physical constraints, and the nearness of the work space to road users.

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 temporary traffic zone, which reduces the possible number of conflicts.

Standard:

Temporary traffic control 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 incident management. Such statutes shall provide sufficient flexibility in the application of temporary traffic control to meet the needs of changing conditions in the temporary traffic control zone.

Guidance:

The temporary traffic control plan should start in the planning phase and continue through the design, construction, and restoration phases. The temporary traffic control plans and devices should follow the principles set forth in the Virginia Work Area Protection Manual and Part 6 of the Manual on Uniform Traffic Control Devices.

Option:

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

Support:

The criteria of Part 6 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.

Section 6A.02 Definitions of Words and Phrases in This Manual**Standard:**

The following select words and phrases have been incorporated from Section 1A.13 of the 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. 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.**
- 2. Changeable Message Signs - signs that are capable of displaying more than one message, changeable manually, by remote control, or by automatic control. These signs are referred to as Dynamic Message Signs in the National Intelligent Transportation Systems (ITS) Architecture.**
- 3. 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.**
- 4. Clear Zone - the total roadside border area, starting at the edge of the traveled way, that is wide enough to allow 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.**
- 5. Delineators - retroreflective devices 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.**
- 6. Edge Line Markings - white or yellow pavement marking lines that delineate the right or left edge(s) of a traveled way.**
- 7. Engineering Judgment - the evaluation of available pertinent information, and the application of appropriate principles, Standards, Guidance, 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. Documentation of engineering judgment is not required.

- 8. Engineering Study - the comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, Standards, Guidance, 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.**
- 9. Flashing (Flashing Mode) - a mode of operation in which a traffic signal indication is turned on and off repetitively.**
- 10. Guide Sign - a sign that shows route designations, destinations, directions, distances, services, points of interest, or other geographical, recreational, or cultural information.**
- 11. Lane Line Markings - white pavement marking lines that delineate the separation of traffic lanes that have the same direction of travel on a roadway.**
- 12. Limited Access – The regulated limitation of public access rights to and from properties abutting a highway facility. Limited access can be either of the following types:**
 - (a) Full Limited Access – Provides access to selected public roads and prohibits crossings at grade and direct driveway connections.**
 - (b) Partial Limited Access – Provides access to selected public roads, crossings at grade and some private driveway connections.**
- 13. 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.**
- 14. Object Markers - devices used to mark obstructions within or adjacent to the roadway.**
- 15. Pedestrian - a person afoot, in a wheelchair, on skates, or on a skateboard.**
- 16. Raised Pavement Marker - a device with a height of at least 0.4 inch mounted on or in a road surface and intended to supplement pavement markings.**
- 17. Regulatory Signs- -a sign that gives notice to road users of traffic laws or regulations.**

18. **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.
19. **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.
20. **Road User** - a vehicle operator, bicyclist, or pedestrian within the highway, including workers in temporary traffic control zones.
21. **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.
22. **Rural Highway** - a type of roadway normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians.
23. **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.
24. **Shared-Use Path** - a bikeway 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, skaters, wheelchair users, joggers, and other nonmotorized users.
25. **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, intended for use by pedestrians.
26. **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.
27. **Sign Assembly**—a group of signs, located on the same support(s), that supplement one another in conveying information to road users.
28. **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.
29. **Sign Legend** - all word messages, logos, and symbol designs that are intended to convey specific meanings.
30. **Sign Panel** - a separate panel or piece of material containing a word or symbol legend that is affixed to the face of a sign.
31. **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.
 - (g) **Posted Speed** - the speed limit determined by law and shown on Speed Limit signs.
 - (h) **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.
- 32. **Speed Limit** - the maximum (or minimum) speed applicable to a section of highway as established by law.
 - 33. **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.
 - 34. **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.
 - 35. **Truck-Mounted Attenuator** – Energy-absorbing devices attached to the rear of trucks to reduce the severity of rear-end crashes.
 - 36. **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.
 - 37. **Traffic** - pedestrians, bicyclists, ridden or herded animals, vehicles, streetcars, and other conveyances either singularly or together while using any highway for purposes of travel.
 - 38. **Traffic Control Devices** - 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, or bicycle path by authority of a public agency having jurisdiction.

39. **Traffic Control Signal (Traffic Signal) - any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed.**
40. **Traveled Way - the portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.**
41. **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.**
42. **Warning Sign - a sign that gives notice to road users of a situation that might not be readily apparent.**
43. **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.**
44. **Work Zone - A work zone is an area of a highway with construction, maintenance, or utility work activities.**
45. **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.03 Abbreviations Used on Traffic Control Devices

Standard:

When the word messages shown in Table 6A-1 need to be abbreviated in connection with traffic control devices, the abbreviations shown in Table 6A-1 shall be used.

Guidance:

The abbreviations for the words listed in Table 6A-2 should not be used in connection with traffic control devices unless the prompt word shown in Table 6A-2 either precedes or follows the abbreviation.

Table 6A-1. Acceptable Abbreviations

Word Message	Standard Abbreviation	Word Message	Standard Abbreviation
Afternoon / Evening	PM	Liquid Propane Gas	LP-GAS
Alternate	ALT	Maintenance	MAINT
Avenue	AVE	Meter(s)	M
Bicycle	BIKE	Metric Ton	t
Boulevard	BLVD	Mile(s)	MI
Cannot	CANT	Miles Per Hour	MPH or M.P.H.
CB Radio	CB	Minute(s)	MIN
Center	CNTR	Monday	MON
Civil Defense	CD	Morning / Late Night	AM
Compressed Natural Gas	CNG	Normal	NORM
Crossing (other than highway-rail)	XING	North	N
Diesel Fuel	D	Northbound	NB
Do Not	DON'T	Parking	PKING
Drive	DR	Parkway	PKWY
East	E	Pedestrian	PED
Eastbound	EB	Pounds	LBS
Electric Vehicle	EV	Right	RHT
Emergency	EMER	Road	RD
Entrance, Enter	Entrance, Enter	Saturday	SAT
Expressway	EXPWY	Service	SERV
FM Radio	FM	Shoulder	SHLDR
Freeway	FRWY, FWY	Slippery	SLIP
Friday	FRI	South	S
Hazardous Cargo	HC	Speed	SPD
Hazardous Material	HAZMAT	Street	ST
High Occupancy Vehicle	HOV	Sunday	SUN
Highway	HWY	Telephone	PHONE
Highway-Rail Grade Crossing Pavement Marking	RXR	Temporary	TEMP
Hospital	H	Thursday	THURS
Hour(s)	HR	Tires With Lugs	LUGS
Information	INFO	Tons of Weight	T
It Is	ITS	Traffic	TRAF
Junction / Intersection	JCT	Travelers	TRAVLRS
Kilogram	kg	Tuesday	TUES
Kilometer(s)	KM	Two-Way Intersection	-2WAY
Kilometers Per Hour	km/h	Two-Wheeled Vehicles	CYCLES
Lane	LN	US Numbered Route	US
Left	LFT	Vehicles	VEH
		Warning	WARN
		Wednesday	WED
		West	W
		Westbound	WB
		Will Not	WONT

Table 6A-2. Abbreviations That Are Acceptable Only with a Prompt Word

Word	Abbreviation	Prompt Word
Access	ACCS	Road
Ahead	AHD	Fog*
Blocked	BLKD	Lane*
Bridge	BRDG	[Name]*
Condition	COND	Traffic*
Congested	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic*
Eastbound	E-BND	Traffic
Exit	EX, EXT	Next*
Express	EXP	Lane
Frontage	FRNTG	Road
Hazardous	HAZ	Driving
Interstate	I	[Number]
Lower	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Northbound	N- BND	Traffic
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Quality	QLTY	Air*
Roadwork	RDWK	Ahead [Distance]
Route	RT	Best*
Southbound	S- BND	Traffic
Township	TWNSHP	Limits
Turnpike	TRNPK	[Name]*
Upper	UPR	Level
Vehicle	VEH	Stalled*
Westbound	W- BND	Traffic

* These prompt words should precede the abbreviation

Table 6A-3. Unacceptable Abbreviations

Abbreviation	Intended Word	Common Misinterpretations
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

Standard:

The abbreviations shown in Table 6A-3.0 shall not be used in connection with traffic control devices because of their potential to be misinterpreted by road users.

Guidance:

Where multiple abbreviations are permitted in Tables 6A-1. or 6A-2., the same abbreviation should be used throughout a single jurisdiction

CHAPTER 6B. FUNDAMENTAL PRINCIPLES

Section 6B.01 Fundamental Principles of Temporary Traffic Control

Standard:

The control of road users (drivers, bicyclists, and pedestrians) through a temporary traffic control zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.

Support:

Construction, maintenance, utility, and incident zones can all benefit from temporary traffic control to compensate for the unexpected or unusual situations faced by road users. When planning for temporary traffic control 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 temporary traffic control techniques.

Special plans preparation and coordination with transit, other highway agencies, police and other emergency units, utilities, schools, and railroad companies might be needed to reduce unexpected and unusual road user operation situations.

During temporary traffic control 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.46 and 2B.47, respectively.

Experience has shown that following the fundamental principles of Part 6 will assist road users and help protect workers in the vicinity of temporary traffic control zones. While these principles provide guidance for good temporary traffic control for the practitioner, they do not establish standards and warrants.

Guidance:

The needs of pedestrians who have disabilities should be considered in accordance with the Americans with Disabilities Act of 1990 (ADAS), Title II, Paragraph 35.130.

Road user and worker safety in temporary traffic control 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 of drivers, bicyclists, pedestrians (including those with disabilities), and workers being considered at all times. If the temporary traffic control zone includes a highway-rail grade crossing, early coordination with the railroad company should take place.

Support:

Formulating specific plans for temporary traffic control at traffic incidents is difficult because of the variety of situations that can arise.

Guidance:

General plans or guidelines should be developed to provide safety for drivers, 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 temporary traffic control zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and temporary traffic control devices as nearly as possible comparable to those for normal highway situations.*
- B. A temporary traffic control 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 temporary traffic control plan should be approved by an official knowledgeable (for example, trained and/or certified) in proper temporary traffic control practices and documented.*

Road user movement should be inhibited as little as practical, based on the following considerations:

- A. Temporary traffic control 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 for speed control).*
- 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. Provisions should be made for the reasonably safe operation of work, particularly on high-speed, high-volume roadways.*
- D. Road users should be encouraged to use alternative routes that do not include temporary traffic control zones.*
- E. Bicyclists and pedestrians, including those with disabilities, should be provided with access and reasonably safe passage through the temporary traffic control zone.*
- F. Roadway occupancy should be scheduled during off-peak hours and, if necessary, night work should be considered.*
- G. Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur before roadway or ramp closings.*

Drivers, bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing temporary traffic control 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 temporary traffic control 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. Temporary traffic control devices inconsistent with intended travel paths through temporary traffic control zones should be removed or covered. However, in short-duration and mobile operations, where visible permanent devices are inconsistent with intended travel paths, devices that highlight or emphasize the appropriate path should be used.*
- C. Flagging procedures, when used, should provide positive guidance to road users traversing the temporary traffic control zone.*

To provide acceptable levels of operations, routine day and night inspections of temporary traffic control elements should be performed as follows:

Standard:

Temporary traffic control installations shall be reviewed daily to ensure the functionality of the temporary traffic control devices and compliance to this Manual. 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 detail information as warranted for the type of operation.

Guidance:

Review of temporary traffic control on high speed, high traffic volume projects should also be performed during night and non-work periods (weekends), as well on all projects after severe weather conditions.

Standard:

A review of the temporary traffic control shall be performed for compliance immediately after a change in traffic patterns. Deficiencies in the temporary traffic control shall be corrected and documented as soon as possible.

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.

Support:

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

Guidance:

When warranted, an engineering study should be made (in cooperation with law enforcement officials) of reported crashes occurring within the temporary traffic control zone. Crash records

in temporary traffic control zones should be monitored to identify the need for changes in the temporary traffic control zone.

Standard:

All temporary traffic control devices shall be removed as soon as practical when they are no longer needed. When work is suspended for short periods, advance warning signs that are no longer appropriate shall be removed from the roadway, and other inappropriate devices removed from the work area so they are not visible to drivers.

Guidance:

Attention should be given to the maintenance of roadside safety during the life of the temporary traffic control 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 (drivers, bicyclists, and pedestrians) 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.*

Each person whose actions affect temporary traffic control 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:

Only those individuals who are trained in proper temporary 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 temporary traffic control devices used for temporary traffic control zones and for incident management.

Guidance:

Good public relations should be maintained by applying the following principles:

- A. The need of all road users (drivers, bicyclists, and pedestrians) should be assessed such that appropriate advance notice is given and clearly defined alternate paths are provided.*
- B. The cooperation of the various news media should be sought in publicizing the existence of and reasons for temporary traffic control 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 (police, 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 commercial vehicles such as buses and large trucks should be assessed and appropriate accommodations made.*

CHAPTER 6C. TEMPORARY TRAFFIC CONTROL ELEMENTS

Section 6C.01 Temporary Traffic Control Plans

Support:

A temporary traffic control plan describes temporary traffic control measures to be used for facilitating road users through a work zone. Temporary traffic control plans play a vital role in providing continuity of 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 temporary traffic control plan.

Temporary traffic control 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 temporary traffic control plan depends entirely on the nature and complexity of the situation.

Guidance:

Temporary traffic control plans should be prepared by persons knowledgeable (for example, trained and/or certified) about the fundamental principles of temporary traffic control and work activities to be performed. The design, selection and placement of temporary traffic control devices for a temporary traffic control plan should be based on engineering judgment.

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.

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 temporary traffic control zone. Planning for all road users should be included in the process.

Option:

Provisions may be incorporated into the project bid documents that enable contractors to develop an alternate temporary traffic control plan.

Modifications of temporary traffic control plans may be necessary because of changed conditions or a determination of better methods of safely and efficiently handling road users.

Standard:

This alternate or modified plan shall be reviewed and approved by a trained and knowledgeable authority in temporary traffic control practices prior to implementation.

Guidance:

Provisions for effective continuity of transit service should be incorporated into the temporary traffic control 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 temporary traffic control plan should provide for features such as temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, if applicable (see Section 10A.05 of the MUTCD for additional light rail transit issues to consider for temporary traffic control).

Provisions for effective continuity of railroad service and acceptable access to abutting property owners and businesses should also be incorporated into the temporary traffic control planning process.

Reduced speed zoning should be avoided as much as practical. Reduced speed limits should be used only in the specific portion of the temporary traffic control zone where conditions or restrictive features are present. However, frequent changes in the speed limit should be avoided. A temporary traffic control plan should be designed so that vehicles can safely travel through the temporary traffic control zone with a speed limit reduction of no more than 10 mph.

Standard:

Speeds shall only be reduced within construction/maintenance work zones by the District Traffic Engineer upon completion of an engineering and traffic investigation warranting the reduction. Documentation of the change shall be performed.

Guidance:

A reduction of more than 10 mph in the speed limit should be used only when required by restrictive features in the temporary traffic control 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, and additional temporary traffic control warning devices should be used.

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:

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:

A temporary traffic control 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 temporary traffic control devices, police, or other authorized personnel.

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 rotating/strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device.

An incident area is an area of a highway where temporary traffic controls are imposed by authorized officials in response to a traffic incident, natural disaster, or special event. It extends from the first warning sign or rotating/strobe lights on a vehicle to the last temporary traffic control device or to a point where road users return to the original lane alignment and are clear of the incident.

Section 6C.03 Components of Temporary Traffic Control Zones

Support:

Most temporary traffic control 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.07A.

Section 6C.04 Advance Warning Area

Support:

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

Option:

The advance warning area may vary from a single sign or rotating/strobe lights on a vehicle to a series of signs in advance of the temporary traffic control zone activity area.

Guidance:

Typical distances for placement of advance warning signs on expressways and freeways should be longer because drivers are conditioned to uninterrupted flow. Therefore the advance warning sign placement should extend on these facilities as far as 1 mile or more.

Sign spacing distance should be 1000'-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:

Low speed urban streets with speeds of 25 mph or less may reduce the spacing to 200' between signs.

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 District Traffic Engineer.

Section 6C.05 Transition Area

Support:

The transition area is that section of highway where road users are redirected out of their normal path.

Standard:

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

Support:

In mobile operations, the transition area moves with the work space. Transition areas usually involve strategic use of tapers, which because of their importance are discussed separately in detail.

Section 6C.06 Buffer Space Area

Support:

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.

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

Standard:

Neither work activity nor storage of equipment, vehicles, or material shall occur within a buffer space.

Option:

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:

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.

The length of a longitudinal buffer space should be as shown in Table 6C-1 and is based on the posted speed.

Support:

Typically, the buffer space is formed as a traffic island and defined by channelizing devices. When a shadow vehicle is placed in advance of the work space, only the space upstream of the vehicle constitutes the buffer space.

Option:

The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figures 6C-1 and 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.

Guidance:

The width of a lateral buffer space should be determined by engineering judgment.

Option:

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:

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:

The activity area is the section of the highway where the work activity takes place.

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:

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

Guidance:

Since there may 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.

The maximum length of the work space should not exceed two miles unless approved by the District Traffic Engineer.

Support:

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:**

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 END ROAD WORK signs, if posted.

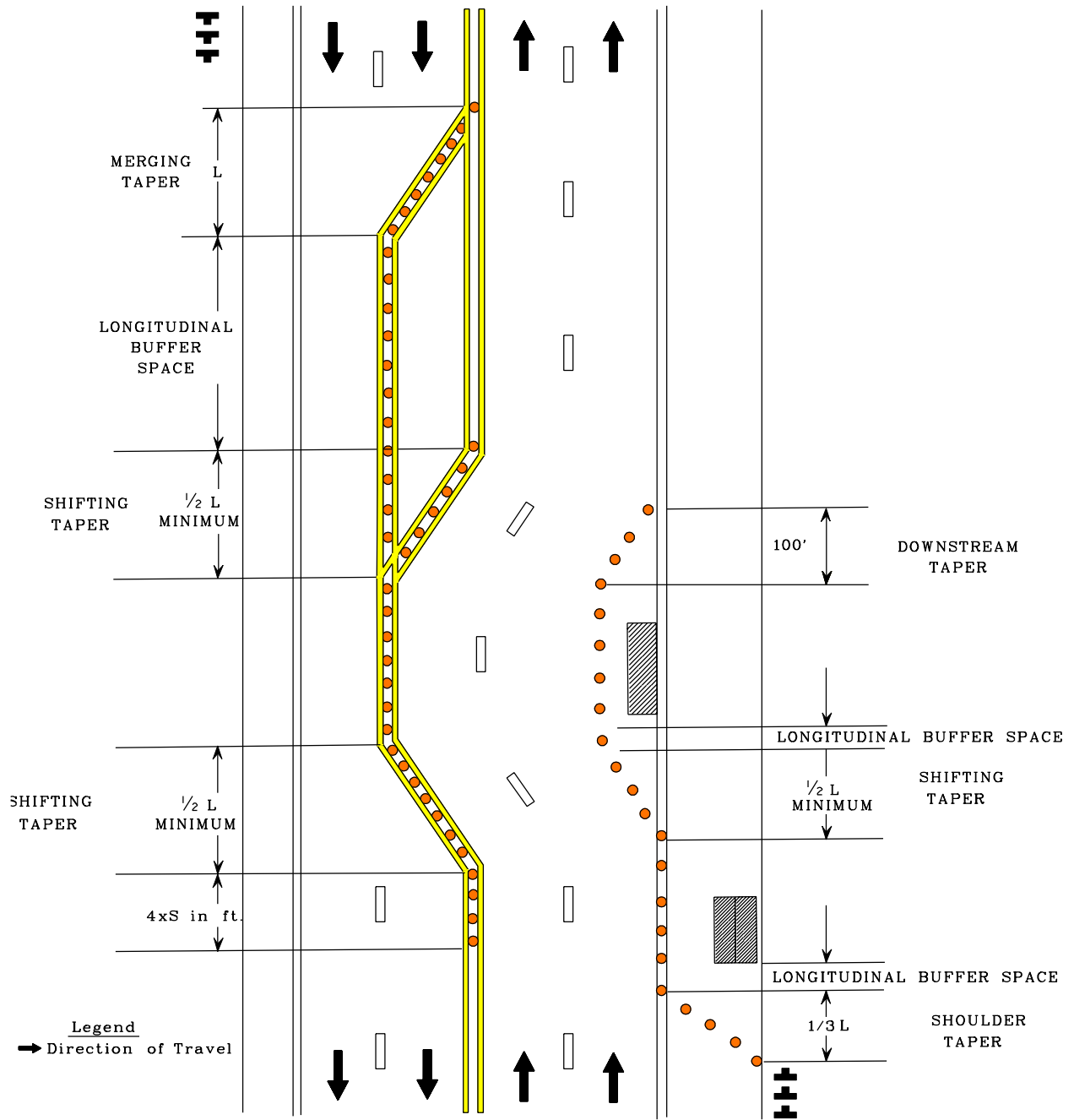


FIGURE 6C-2 TYPE OF TAPERS AND BUFFER SPACES

Table 6C-1. Length of the Longitudinal Buffer Space

Speed* (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

*** posted Speed Limit of the Temporary Traffic Control Zone.**

Option:

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.

Guidance:

Conditions may exist where posting the END ROAD WORK signs may not be helpful. For example, the END ROAD WORK signs should normally not be used if other temporary traffic control zones begin within a mile of the end of the temporary traffic control zone in rural areas, or about a quarter-mile within urban areas.

Section 6C.09 Tapers

Option:

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:

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.

Longer tapers are not necessarily better than shorter tapers (particularly in urban areas characterized by short block lengths, 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 temporary traffic control plans are put into effect.

Guidance:

The criteria for determining the taper length (L) is shown in Table 6C-2 and should be the minimum used.

The maximum distance in feet between devices in a taper should not exceed 20 feet at speeds up to 35 mph, and 40 feet for speeds greater than 35 mph.

Support:

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

Guidance:

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:

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:

A shifting taper should have a minimum length of at least 1/2 L (see Table 6C-2).

Support:

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

Table 6C-2. Taper Length Criteria for Temporary Traffic Control Zones

<u>Type of Taper</u>	<u>Taper Length (L)</u>	
Merging Taper	L minimum	L = Taper Length
Shifting Taper	1/2 L minimum (L desirable)	W = Width of Offset
Shoulder Taper	1/3 L minimum	S = Operating Speed
Two-way Traffic Taper	100 feet maximum	
Downstream Taper	100 feet per lane	

TAPER LENGTH (L)					
SPEED (MPH)	WIDTH OF OFFSET (FT.)				REMARKS
	9	10	11	12	
25 or below	94	105	115	125	$L=S^2W/60$
30	135	150	165	180	"
35	184	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	"
75	675	750	825	900	"
MINIMUM LANE CLOSURE TAPER LENGTH ON ALL LIMITED ACCESS ROADWAYS SHALL BE 1000 FT.					

CONE SPACING:

- 20' FOR TAPERS AND CURVES @ 0-35 M.P.H
- 40' FOR TAPERS AND CURVES @ 36 M.P.H. & ABOVE
- 40' ALONG TRAVELWAY FOR SPEEDS 0-35 M.P.H.
- 80' ALONG TRAVELWAY FOR SPEEDS 35 M.P.H. & ABOVE

Guidance:

Shoulder tapers should have a length of approximately 1/3 L (see Table 6C-2). If a shoulder is used as a travel lane, either through practice or during a temporary traffic control activity, a normal merging or shifting taper should be used.

Option:

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:

When used, a downstream taper should have a minimum length of approximately 100 ft per lane with devices placed at a spacing of approximately 20 ft.

Support:

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:

In a one-lane, two-way operation, traffic should be controlled by a flagger or a STOP or YIELD sign (see Section 6C-11). A short taper having a maximum length of 100 ft with channelizing devices at approximately 20 foot spacings should be used to guide traffic into the one-way section.

Support:

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

Section 6C.10 Detours and Diversions

Support:

A detour is a temporary rerouting of road users onto an existing highway in order to avoid a temporary traffic control zone.

Guidance:

Detours should be clearly signed over their entire length so that road users can easily use existing highways to return to the original highway.

Support:

A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work area.

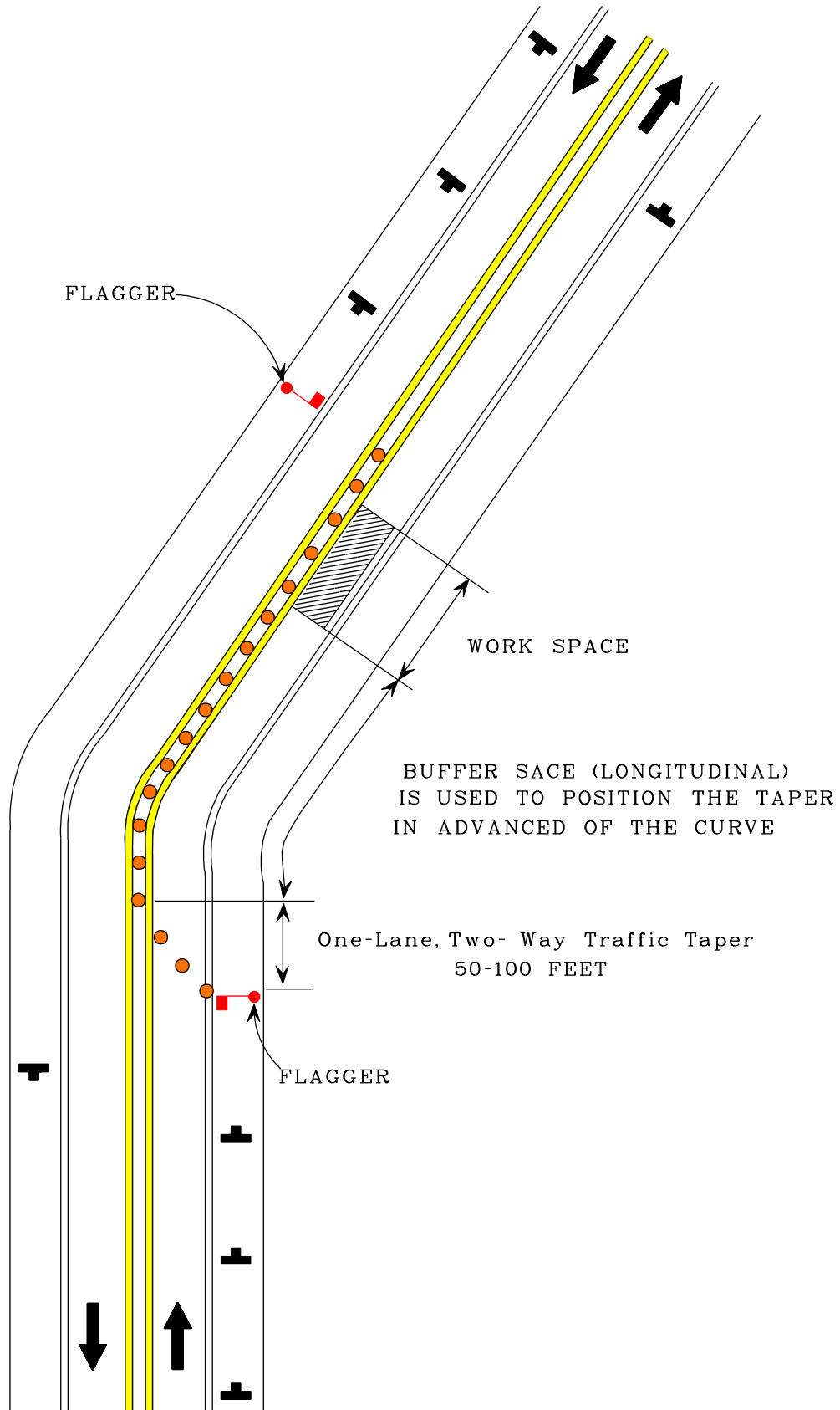


FIGURE 6C-3 ONE - LANE, TWO-WAY TRAFFIC TAPER

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

Standard:

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

Guidance:

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.

Control points at each end should be chosen to permit easy passing of opposing lanes of vehicles.

If traffic on the affected one-lane roadway is not visible from one end to the other, then flagging procedures, a pilot car, or traffic control signal should be used to control opposing traffic flows.

Support:

At a spot constriction, such as an isolated pavement patch on highways with lower speeds and adequate sight distance, the movement of traffic through one-lane, two-way constrictions tends to be self-regulating.

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

Option:

When a one-lane, two-way temporary traffic control 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:

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. 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.

Due to limited room for vehicles to pass activities and equipment occurring on narrow roadways, cones should not be used for channelization on roadways 20 foot or less in width.

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

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 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:

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 Control**Option:**

A pilot car may be used to guide a queue of vehicles through the temporary traffic control zone or detour.

Guidance:

The operation of the pilot vehicle should be coordinated with flagging operations or other controls at each end of the one-lane section. The pilot car should have the name of the contractor or contracting authority prominently displayed.

Option:

On low volume roadways, a "WAIT FOR PILOT VEHICLE" sign may be used with approval of the District Traffic Engineer.

Standard:

The PILOT CAR FOLLOW ME (G20-4) sign shall be mounted at a conspicuous location on the rear of the vehicle.

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

Traffic control signals may be used to control motor vehicle traffic movements in one-lane, two-way temporary traffic control zones as approved by the District Traffic Engineer (see Figure 6H-12 and Chapter 4G of the MUTCD). For bridge reconstruction, see Standard TS-1, VIRGINIA ROAD AND BRIDGE STANDARDS.

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

STOP or YIELD signs may be used to control traffic on low-volume roads at a one-lane, two-way work 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:

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 District Traffic Engineer. See warrants for No-Passing Zones at Curves in Chapter 3B of the MUTCD.

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:

A wide range of pedestrians can be expected at work sites, including the young, old, and disabled (for example, hearing, visual, and mobility). All of these pedestrians need a clearly delineated and usable travel path.

Standard:

The various temporary traffic control provisions for pedestrian and worker safety set forth in this Manual and the MUTCD shall be applied by knowledgeable (for example, trained and/or certified) persons after appropriate evaluation and engineering judgment.

Advance notification of sidewalk closures shall be provided.

Support:

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:

Adequate provisions should be made for persons with disabilities as determined by an engineering study. There are three considerations in planning for pedestrians in temporary traffic control zones:

- A. Pedestrians should not be led into conflicts with work site vehicles, equipment, and operations.*
- B. Pedestrians should not be led into conflicts with vehicles moving through or around the work site.*
- C. Pedestrians should be provided with a safe, convenient path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or a footpath(s).*

A pedestrian route should not be severed and/or moved for nonconstruction activities such as parking for vehicles and equipment.

Consideration should be made to separate pedestrian movements from both work site activity and motor vehicle traffic. 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 motor vehicle traffic volumes, these signs should be placed at intersections so that pedestrians are not confronted with midblock work sites that will induce them to attempt skirting the work site or making a midblock crossing.

Support:

Figure TTC-26.0 shows typical temporary traffic control device usage and techniques for pedestrian movement through work zones.

Guidance:

When pedestrian movement through or around a work site is necessary, a separate usable footpath without abrupt changes in grade or terrain should be provided.

Option:

Whenever it is feasible, closing off the work site from pedestrian intrusion may be preferable to channelizing pedestrian traffic along the site with temporary traffic control devices such as cones, tubular markers, barricades and drums, or other suitable fencing.

Guidance:

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.

Standard:

Temporary traffic control devices used to delineate a temporary traffic control zone pedestrian walkway shall be crashworthy and, when struck by vehicles, present a minimum threat to pedestrians, workers, and occupants of impacting vehicles.

Guidance:

Ballast for temporary traffic control devices should be kept to the minimum amount needed and should be mounted low to prevent penetration of the vehicle windshield.

Movement by work vehicles and equipment across designated pedestrian paths should be minimized and, when necessary, should be controlled by flaggers or temporary traffic control. 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.

Access to work space 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.

Option:

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

Guidance:

Covered walkways should be sturdily constructed and adequately lighted for nighttime use.

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.

If a temporary traffic barrier is used to shield pedestrians, it should be designed to suit site conditions.

Support:

Depending on the possible motor vehicle 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 Appendix A.

Standard:

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.

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

Option:

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 motor vehicle traffic by minimizing the possibility of midblock crossings.

Support:

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:

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

Support:

Standard temporary traffic control devices can satisfactorily delineate a pedestrian path. Although tape, rope, fencing, or plastic chain strung between devices can help discourage pedestrian movements off the designated pathway, they cannot eliminate them entirely.

Guidance:

The extent of pedestrian needs should be determined through engineering judgment for each work zone situation.

The entity in charge of the temporary traffic control should regularly inspect the activity area so that effective pedestrian temporary traffic control is maintained.

Section 6D.02 Worker Considerations*Support:*

Equally as important as the safety of road users traveling through the temporary traffic control zone is the safety of workers. Temporary traffic control 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.

Maintaining temporary traffic control zones with road user flow inhibited as little as possible, and using temporary traffic control devices that get the road user's attention and provide positive direction are of particular importance.

Guidance:

The following are the key elements of temporary traffic control 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 temporary traffic control responsibilities should be trained in temporary traffic control techniques, device usage, and placement. Training should be conducted on a continual basis.*
- B Worker Clothing - all workers should be adequately clothed for the type of operations they will be performing (see standard below for clothing requirement when working near traffic.)*
- C Temporary Traffic Barriers - temporary traffic barriers should be placed along the work space based on an engineering study considering 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.*
- D. Speed Reduction - reducing the speed of motor vehicle traffic, mainly through regulatory speed zoning, funneling, use of law enforcement officials, lane reduction, or flaggers, should be considered.*
- E. Activity Area – planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the inherent risk to workers on foot.*

Standard:

After January 1, 2007, workers shall wear safety apparel meeting the requirements of ISEA “American National Standard for High-Visibility Apparel” (see Section 1A.11) and labeled as meeting the ANSI 107-1999 standard performance for Class 3 risk exposure. The apparel background (outer) material shall be either fluorescent orange-red or fluorescent yellow-green as defined in the standard. The retroreflective material shall be either orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of 1,280 ft. The retroreflective clothing shall be designed to clearly identify the wearer as a person.

Guidance:

Until January 1, 2007, all workers should wear an orange, yellow, or yellow-green (or fluorescent versions of these colors) shirt, vest, or jacket for daytime work.

Standard:

For nighttime work outside garments similar to daytime garments shall be worn and shall be retro-reflective. The retro-reflective material shall be orange, yellow, white, silver, yellow green, or a fluorescent version of one of these colors and shall be visible at a minimum distance of 1,000 feet. The retroreflective clothing shall be designed to clearly identify the wearer as a person.

Option:

The following are additional elements of temporary traffic control management that may be considered to improve worker safety:

- A. 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.
- B. Police Use - in highly vulnerable work situations, particularly those of relatively short duration, police units may be stationed to heighten the awareness of passing vehicular traffic and to improve safety through the temporary traffic control zone.
- C. Lighting - for nighttime work, the temporary traffic control zone and approaches may be lighted.
- D. Special Devices - these include rumble strips, portable 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:

Judicious use of the special devices described in Item D above might be helpful for certain difficult temporary traffic control 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:

A flagger shall be a person who provides temporary traffic control.

A flagger shall be certified in flagging and shall have his/her certification card with them at all time while performing flagging activities.

Guidance:

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 have the following minimum qualifications, skills and abilities:

- A. Sense of responsibility for the safety of the public and the workers;
- B. Adequate training in safe temporary traffic control practices;
- C. Average intelligence;
- D. Good physical condition, including sight, mobility, and hearing;
- E. Mental alertness and the ability to react in an emergency;
- F. Courteous but firm manner;
- G. Skill in communicating specific instructions clearly, firmly, and courteously;
- H. At least 18 years old

Section 6E.02 High-Visibility Clothing

Standard:

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, OSHA approved hardhats and steel toe safety shoes. Prior to July 1, 2007, for daytime work, the flagger's vest, shirt, or jacket shall be either orange, yellow, yellow-green, or a fluorescent version of these colors. For nighttime work, similar outside garments shall be retroreflective. The retroreflective material shall be either orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of 1,000 ft. The retroreflective clothing shall be designed to clearly identify the wearer as a person.

After January 1, 2007, flaggers shall wear safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel" and labeled as meeting the ANSI 107-1999 standard performance for Class 3 risk exposure. The apparel background (outer) material shall be either fluorescent orange-red or fluorescent yellow-green as defined in the standard. The retroreflective material shall be either orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of 1,280 feet. The retroreflective clothing shall be designed to clearly identify the wearer as a person.

Guidance:

When uniformed law enforcement officers are used, high-visibility clothing as described above should be worn by the law enforcement officer.

Section 6E.03 Hand-Signaling Devices

Support:

Hand-signaling devices, such as STOP/SLOW paddles, lights, and red flags, are used to control road users through temporary traffic control zones.

Standard:

The STOP/SLOW paddle shall be the primary hand-signaling device because the STOP/SLOW paddle gives road users more positive guidance than red flags.

Guidance:

Use of red flags should be limited to emergency situations and use by traffic spotters on low volumes, low speed streets.

Standard:

The STOP/SLOW paddle shall have an octagonal shape on a rigid handle. STOP/SLOW paddles shall be at least 24 inch wide with letters at least 8 inch high and should be fabricated from light semirigid material. The background of the STOP face shall be red with white letters and border and made of encapsulated lens sheeting material. The background of the SLOW face shall be fluorescent orange prismatic lens sheeting material with black letters and border.

Option:

The STOP/SLOW paddle may be modified to improve conspicuity by incorporating white flashing lights. The white flashing lights may be arranged in any of the following patterns:

- A. Two white lights centered vertically above and below the STOP and/or SLOW legend;
- B. Two white lights centered horizontally on each side of the STOP and/or SLOW legend;
- C. One white light centered below the STOP and/or SLOW legend; or
- D. A series of eight or more small white 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 side of the paddle, and/or arranged in a diamond pattern along the border of the SLOW side of the panel. More than eight lights may be used only if the arrangement of the lights is such that it clearly conveys the octagonal shape of the STOP side of the paddle and/or the diamond shape of the SLOW side of the paddle.

Standard:

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.

Flags, when used for emergency situations and by traffic spotters, shall be a minimum of 24 inch square, made of a good grade of red material, and securely fastened to a staff that is approximately 36 inch in length.

When used at nighttime, flags shall be retroreflectorized red.

Option:

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.

Section 6E.04 Flagger Procedures**Support:**

The use of paddles and flags by flaggers are illustrated in Figure 6E-1.

Standard:

The following methods of signaling with 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. For added emphasis, the flagger may raise and lower the free hand with the palm down.

Option:

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:

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 the shoulder level toward approaching traffic.**
- B. To direct stopped road users to proceed, the flagger shall stand parallel to the road user movement and with 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.**
- C. The flagger shall face traffic with the flag held in the down position and slowly motion up and down with the free hand, palm down, indicating the vehicle should slow down.**

Section 6E.05 Flagger Stations**Standard:**

Flagger stations shall be located far enough in advance of the work space so that approaching road users will have sufficient distance to stop before entering the work space.

Support:

Guidelines for determining the distance of the flagger station in advance of the work space are shown in Table 6E-1.

Option:

The distances shown in Table 6E-1 may be increased for downgrades and other conditions that affect stopping distance.

Guidance:

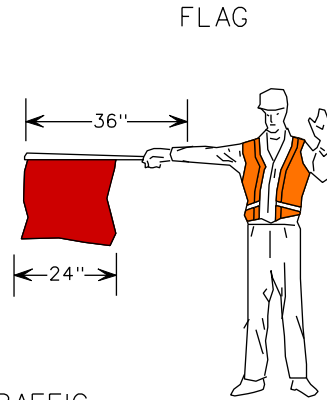
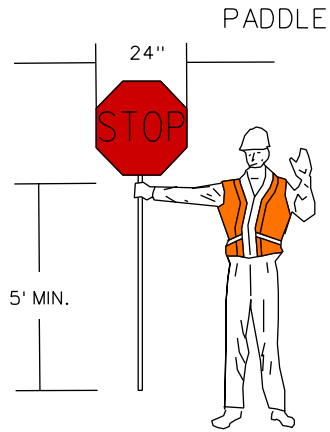
To assure that a fully alert flagger is present at the flagger station, flaggers should be relieved every two hours for a minimum period of fifteen minutes.

Standard:

Flagger stations shall be preceded by proper advance warning signs. At night, flagger stations shall be illuminated.

PREFERRED METHOD
STOP/SLOW Paddle

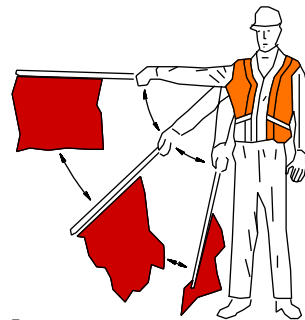
EMERGENCY AND TRAFFIC
SPOTTER SITUATIONS ONLY
Red Flag



TO STOP TRAFFIC



TO LET
TRAFFIC PROCEED



TO ALERT AND
SLOW TRAFFIC

FIGURE 6E-1 USE OF HAND SIGNALING DEVICES BY FLAGGER

Guidance:

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. The flagger should be clearly visible to the first approaching road user at all times. The flagger also should be visible to other road users. The flagger should be stationed sufficiently in advance of the workers to warn them (for example, with audible warning devices such as horns, whistles, etc.) of approaching danger by out-of-control vehicles.

Standard:

The flagger shall stand alone, never permitting a group of workers to congregate around the flagger station. Vehicles and equipment shall not be allowed around the flagger station, which can interfere with the visibility of the flagger to approaching motorist.

When the flagger is no longer at the flagger station performing flagging duties, the advance warning signs advising of flagging operations shall be removed.

Option:

If work and/or equipment is still in the area, the ROAD WORK AHEAD sign may remain.

Table 6E-1. Distance of Flagger Station in Advance of the Work Space

Speed (mph)	Distance (feet)
20	40-50
25	60-70
30	90-100
35	125-135
40	175-185
45	225-235
50	285-295
55	340-350
60	425-450
65	490-500

* Posted speed of the temporary traffic control zone

Option:

At a spot constriction, the flagger may have to take a position on the shoulder opposite the closed section in order to operate effectively.

At spot lane closures where adequate sight distance and a low traffic volume is available for the safe handling of traffic, the use of one flagger may be sufficient.

Section 6E.06 Traffic Spotters**Support:**

A traffic spotter's primary function is to alert and assist motorists through temporary traffic control zones on low volume (under 500 VPD), low speed subdivision streets.

Standard:

Qualifications, clothing requirements and hand signaling procedures for traffic spotters shall be the same as for flaggers. Hand signaling devices for traffic spotters shall be a red flag a minimum of 24 inches square fastened to a staff that is approximately 36 inches in length.

Guidance:

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

Standard:

The ROAD WORK AHEAD sign shall be the minimum sign requirement for traffic spotters.

Option:

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

Blank Page

CHAPTER 6F. TEMPORARY TRAFFIC CONTROL ZONE DEVICES

Section 6F.01 Types of Devices

Guidance:

The design and application of temporary traffic control devices used in temporary traffic control zones should consider the needs of all road users (drivers, pedestrians and bicyclists).

Support:

Crashworthiness and crash testing information on devices described in Part 6 are found in AASHTO's "Roadside Design Guide" (see Section 1A.11).

Standard:

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, or bikeway by authority of a public body or official having jurisdiction.

All traffic control devices used on street and highway construction, maintenance, utility, or incident management operations shall conform to the applicable provisions of this Manual.

Section 6F.02 General Characteristics of Signs

Support:

Temporary traffic control zone signs convey both general and specific messages by means of words or symbols and have the same three categories as all road user signs: regulatory, warning, and guide.

Standard:

The colors for regulatory signs shall follow the Standards for regulatory signs in Table 2A-4 and Chapter 2B of the MUTCD. Warning signs in temporary traffic control zones shall have a black legend on an fluorescent orange background, except for the Railroad Advance Warning (W10-1) sign which shall have a black message and border on a yellow background. Colors for guide signs shall follow the Standards in Table 2A-4 and Chapter 2D, except for guide signs as noted in Section 6F.47 of the MUTCD. Sign material shall conform to the latest Virginia Road and Bridge Specification including all revisions to such.

Option:

Existing warning signs that are still applicable may remain in place.

In order to maintain the systematic use of yellow or fluorescent yellow-green background for pedestrian, bicycle, and school warning signs in a jurisdiction, the yellow or fluorescent yellow-green background for pedestrian, bicycle, and school warning signs may be used in temporary traffic control zones.

Standard orange flags or flashing warning lights for post-mounted signs may be used in conjunction with signs.

Standard:

When standard orange 24"x 24" flags or flashing warning lights are used in conjunction with post mounted signs, they shall not block the sign face.

Option:

The dimensions of signs shown in this Manual are for standard sizes, which may be increased wherever necessary for greater legibility or emphasis.

Standard:

Deviations from standard sizes as prescribed herein shall be in 6 inch increments.

Support:

Sign design details are contained in the "Standard Highway Signs" book (see Section 1A.11).

Standard:

All signs used at night shall be either retroreflective with a material that has a smooth, sealed outer surface or illuminated to show the same shape and similar color both day and night.

Option:

Sign illumination may be either internal or external.

Support:

Street, highway, or strobe lighting does not constitute external sign illumination.

Option:

Signs may be made of rigid or flexible material.

Section 6F.03 Sign Placement

Guidance:

Signs should be located on the right side of the roadway unless otherwise specified in this Manual.

Standard:

On roadways having a median wider than 8 foot, left and right sign assemblies shall be used.

Option:

Crashworthy signs may be mounted on or above Type III barricades.

Support:

Guidelines for height and lateral clearance of temporary post-mounted signs are shown in Figure 6F-1.

Standard:

Post-mounted signs installed at the side of the road in rural and urban areas shall be mounted at a height at least 7 feet measured from the bottom of the sign to the near edge of the pavement. For crashworthy purposes, the top of the sign shall be a minimum of 9 feet above the ground elevation at the base of the sign. The height to the bottom of a secondary sign mounted below another sign may be 1 foot less than the 7-foot requirement. Signs mounted on barricades and barricade/sign combinations shall be crashworthy.

Guidance:

Neither portable nor permanent sign supports should be located on sidewalks, bicycle lanes, or areas designated for pedestrian or bicycle traffic. Signs mounted lower than 7 feet should not project more than 4 inches into pedestrian facilities

Standard:

Except as noted in the Option above, signs mounted on portable supports shall not be used for a duration of more than 3 consecutive days (72 hours).

Guidance:

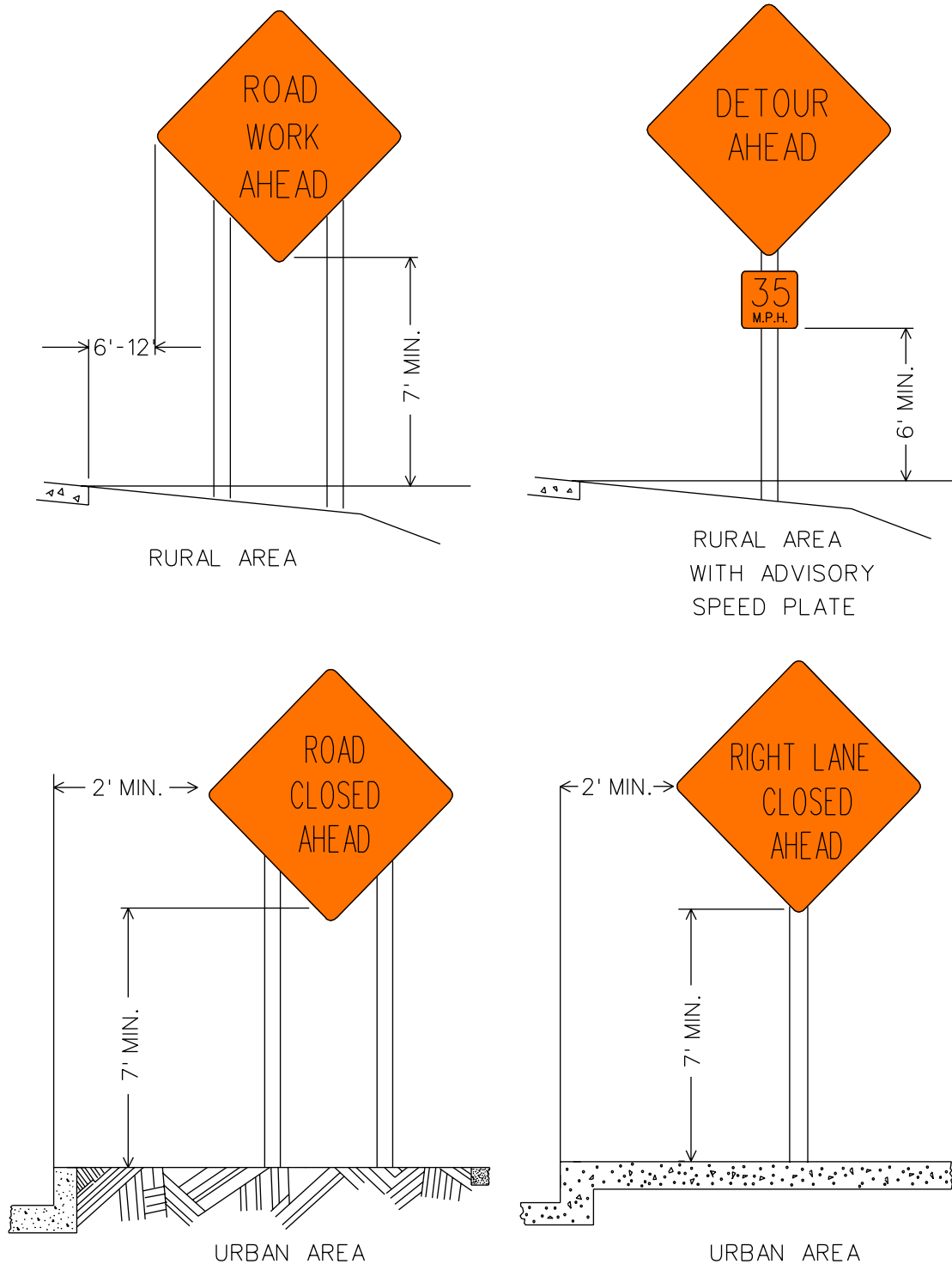
Signs mounted on Type III barricades should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails.

Standard:

Sign supports shall be crashworthy. Large signs having an area exceeding 50 square feet that are installed on multiple breakaway posts shall be mounted a minimum of 7 feet above the ground.

Portable stands shall meet the following conditions: accommodate signs of all standard shapes, including octagonal and triangular, have a flag holder which will accommodate two flags as an integral part of the unit, have adjustable legs capable of adjusting to uneven surfaces, and while supporting a 16 square foot rigid sign panel, the stand shall withstand 50 MPH winds without tipping over or rotating more than + 5 degrees about its vertical axis without the use of tie downs or ballast of any kind. The complete unit shall not exceed 40 pounds. The unit shall meet NCHRP 350 crashworthy standards.

Signs mounted on portable supports, shall be no less than 1 foot above the traveled way from the bottom of the sign.



NOTE: FOR POST SIZE AND NUMBER OF POSTS SEE EITHER PLAN INSERTABLE SHEET OR ROAD AND BRIDGE STANDARDS. FOR POST INSTALLATION SEE ROAD AND BRIDGE STANDARDS WPS-1.

FIGURE 6F-1. HEIGHT AND LATERAL LOCATION OF SIGNS-TYPICAL INSTALLATIONS

Guidance:

For mobile operations, a sign should be mounted on a work vehicle, a shadow vehicle, or on the shoulder stationed in advance of the temporary traffic control zone or moving along with it.

Support:

The design and placement of work zone signs is described elsewhere in Chapter 6F of this Manual.

Guidance:

Sign posts placed in the clear zone should yield or breakaway upon impact to minimize obstructions to road users and to not present an undue risk to workers.

Support:

Depending upon the crash tested design, slight variations to the support might not be considered crashworthy.

Option:

Although work zone signs may be mounted on fixed, temporary, or portable supports, fixed supports are preferable for long-term (over 72 consecutive hours) projects.

Guidance:

These supports should meet the breakaway requirements for permanent installations discussed in AASHTO's "Roadside Design Guide" (See Section 1A.11 of the MUTCD).

Section 6F.04 Sign Maintenance

Support:

Signs used in temporary traffic control zones are moved frequently, loaded and unloaded from trucks, and in general receive much harsher treatment than permanent signs. For this reason, particular attention must be given to maintaining signs properly for cleanliness, visibility, and correct positioning.

Standard:

Signs shall be properly maintained for cleanliness, visibility, and correct positioning.

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.

Section 6F.05 Regulatory Sign Authority

Support:

Regulatory signs such as those shown in Figures 6F-2a through 6F-3f inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.

Standard:

Regulatory signs impose legal obligations on all drivers, and they shall be authorized by the District Traffic Engineer or an official having jurisdiction and conform to Chapter 2B of the MUTCD.

Section 6F.06 Regulatory Sign Design

Standard:

Temporary traffic control regulatory signs shall conform to the Standards for regulatory signs presented in Part 2 on the MUTCD and in the FHWA's "Standard Highway Signs" book.

Support:

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:

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

Section 6F.07 Regulatory Sign Applications

Standard:

If a temporary traffic control 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 conformance with applicable ordinances or statutes of the jurisdiction as well as comply with the sign design standards of the MUTCD.

Section 6F.08 ROAD (STREET) CLOSED Sign (R11-2)

Guidance:

The ROAD (STREET) CLOSED (R11-2) sign 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:

The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for ROAD (STREET) CLOSED where applicable.

Guidance:

The ROAD (STREET) CLOSED sign should be installed at or near the center of the roadway on or above a Type III barricade that closes the roadway (see Section 6F.60).

Standard:

The ROAD (STREET) CLOSED sign shall not be used where road user flow is maintained or where the actual closure is some distance beyond the sign.

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

The Local Traffic Only signs 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. Appropriate warning and detour signing should accompany these signs.

In rural applications, the Local Traffic Only sign should have the legend ROAD CLOSED XX MILES AHEAD, LOCAL TRAFFIC ONLY (R11-3a).

Option:

In urban areas, the legend ROAD (STREET) CLOSED TO THRU TRAFFIC (R11-4) or ROAD CLOSED, LOCAL TRAFFIC ONLY may be used.

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.

Standard:

The sign shall carry the legend ROAD CLOSED [XX] MILES AHEAD—LOCAL TRAFFIC ONLY or, optionally for urban use, ROAD (STREET) CLOSED TO THRU TRAFFIC.

Section 6F.10 Weight Limit Signs (R12-1, R12-2, R12-5)**Standard:**

A Weight Limit sign, 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.

When weight restrictions are imposed, a marked detour shall be provided for vehicles weighing more than the posted limit.

Section 6F.11 STAY IN LANE Sign (R4-9)

Option:

A STAY IN LANE (R4-9) sign may be used where a multilane shift has been incorporated as part of the temporary traffic control on a highway to direct road users around road work that occupies part of the roadway on a multilane highway.

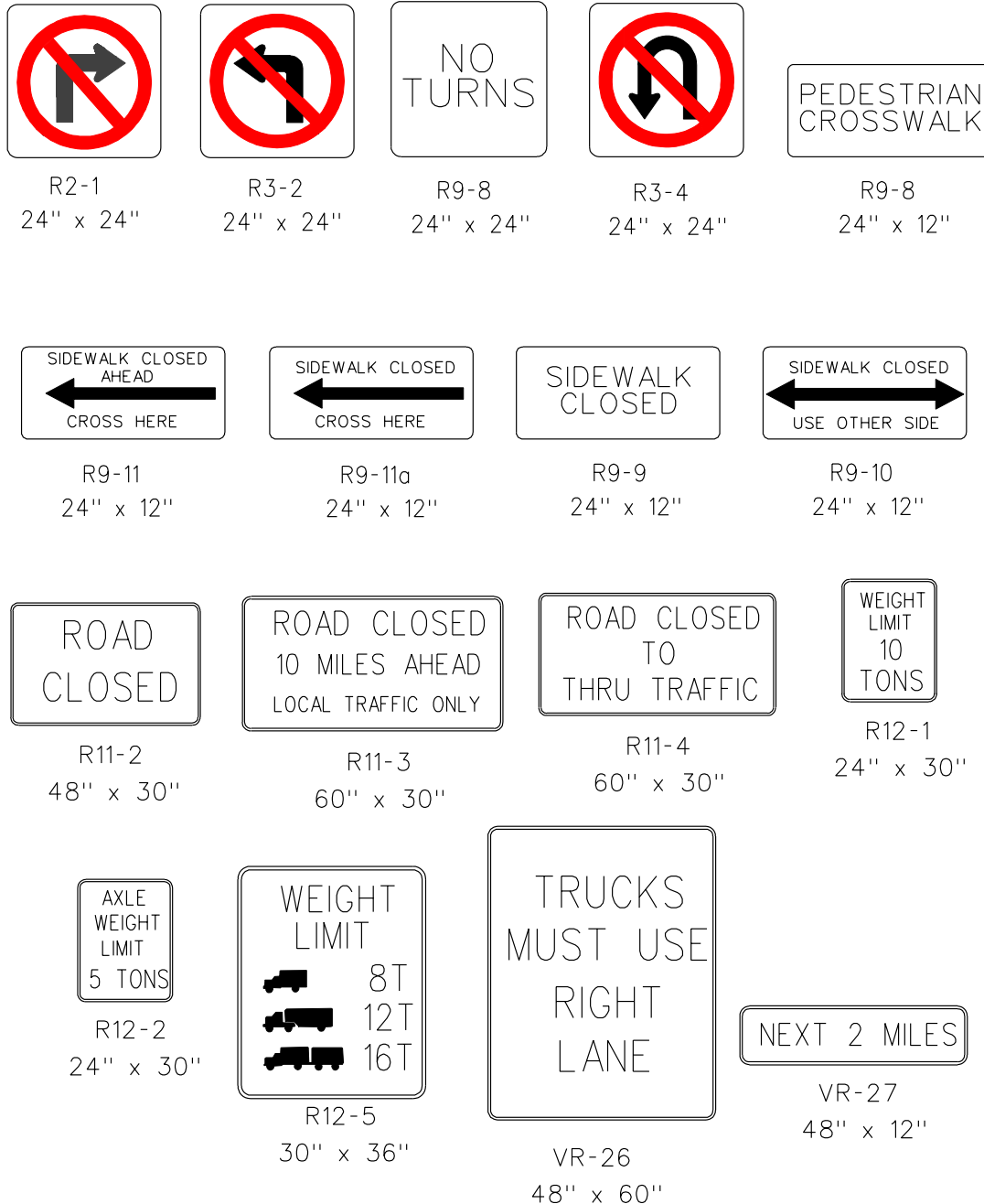
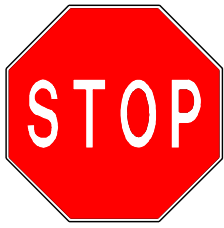


FIGURE 6F-2a. COMMONLY USED REGULATORY SIGNS



R1-1
30" x 30"



R1-2
36" x 36" x 36"



R5-1
30" x 30"



R5-1A
36" x 24"



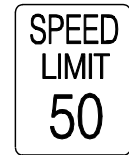
R2-5a
24" x 30"



R2-5b
24" x 30"



R2-5c
24" x 30"



R2-1
24" x 30"



R8-3a
24" x 24"



VR-9L
48" x 48"



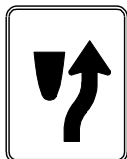
VR-9R
48" x 48"



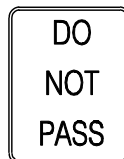
R6-1
36" x 12"



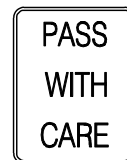
R6-2
18" x 24"



R4-7
24" x 30"



R4-1
24" x 30"



R4-2
24" x 30"

FIGURE 6F-2b. COMMONLY USED REGULATORY SIGNS

Section 6F.12 PEDESTRIAN CROSSWALK Sign (R9-8)**Option:**

The PEDESTRIAN CROSSWALK (R9-8) sign may be used to indicate where a temporary crosswalk has been established.

Section 6F.13 SIDEWALK CLOSED Signs (R9-9, R9-10, R9-11, R9-11a)***Guidance:***

SIDEWALK CLOSED signs should be used where pedestrian flow is restricted or rerouted by work activities.

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.

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.

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.

The SIDEWALK CLOSED, (ARROW) CROSS HERE (R9-11a) sign should be installed just beyond the point to which pedestrians are being redirected.

Support:

These signs are typically mounted on a 4 foot wide barricade to encourage compliance.

Section 6F.14 Special Regulatory Signs**Option:**

Special regulatory signs may be used based on engineering judgment consistent with regulatory requirements.

Guidance:

Special regulatory signs should conform to the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.

Section 6F.15 Warning Sign Function, Design, and Application

Support:

Temporary traffic control zone warning signs notify road users of specific situations or conditions on or adjacent to a roadway that might not otherwise be apparent.

Standard:

Temporary traffic control warning signs shall conform to the Standards for warning signs presented in Part 2 and in FHWA's "Standard Highway Signs" book. Except as noted in the Option below, temporary traffic control warning signs shall be diamond-shaped with a black symbol or message and border on an fluorescent orange prismatic lens sheeting background, except for the W10-1 sign, which shall have a black message and border on a yellow background, and except for signs that are permitted in Part 2 to have yellow or fluorescent yellow-green backgrounds. The District Traffic Engineer shall approve the use of reduced regulatory speed limits in temporary traffic control zones. Sign material shall conform to latest Virginia Road and Bridge specifications and all revisions to such.

Option:

Mounting or space considerations may justify a change from the standard diamond shape.

In emergencies, available warning signs having yellow backgrounds may be used if orange signs are not at hand.

Guidance:

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.

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.

Option:

Advance warning signs may be used singly or in combination.

Standard:

Because of their importance, advance-warning signs shall have a size of 48 x 48 inch (see Part 2) of the MUTCD. The determination of the sign or signs to be used shall be based on an engineering study using the following sections as guidelines.

Option:

Advance warning signs larger than the minimum standards may be used for additional emphasis of the temporary traffic control zone (see Part 2) of the MUTCD.

Section 6F.16 Position of Advance Warning Signs*Guidance:*

Where highway conditions permit, warning signs should be placed in advance of the temporary traffic control zone at varying distances depending on roadway type, condition, 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 is used, the closest sign to the temporary traffic control zone should be placed approximately 100 feet for low-speed urban streets to 1000 feet or more for expressways and freeways.

Support:

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.

Option:

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

Support:

At temporary traffic control zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.

Option:

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

Guidance:

Utility, maintenance, and minor construction signing and temporary traffic control should be coordinated with appropriate authorities so that road users are not confused or misled by the additional temporary traffic control devices.

Section 6F.17 ROAD (STREET) WORK Sign (W21-4)*Guidance:*

The ROAD (STREET) WORK (W20-1) sign, 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, and on all intersecting roadways.

Standard:

The ROAD (STREET) WORK (W20-1) sign shall have the legend ROAD (STREET) WORK, XX FT, XX MILES, or AHEAD.

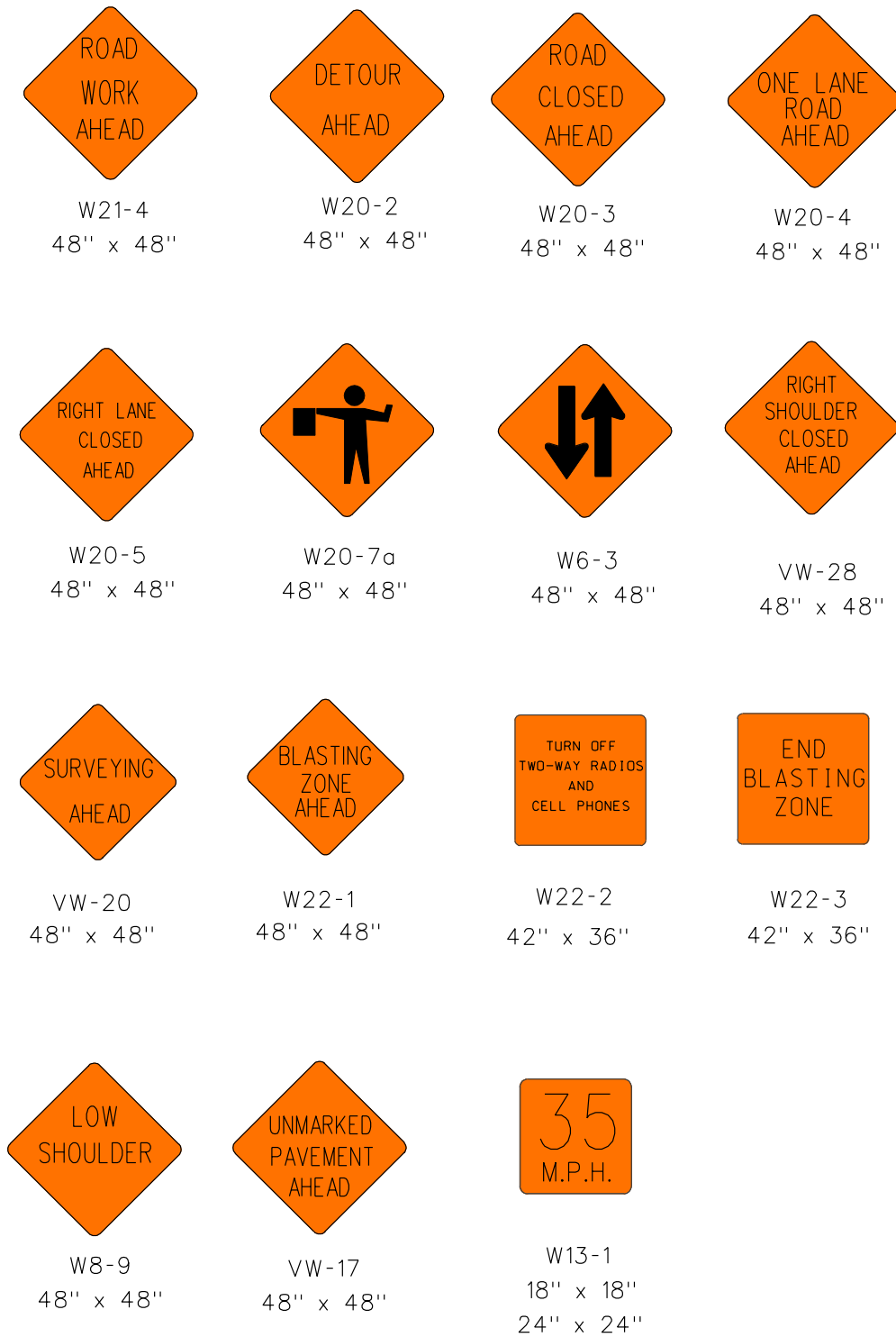


FIGURE 6F-3a. WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

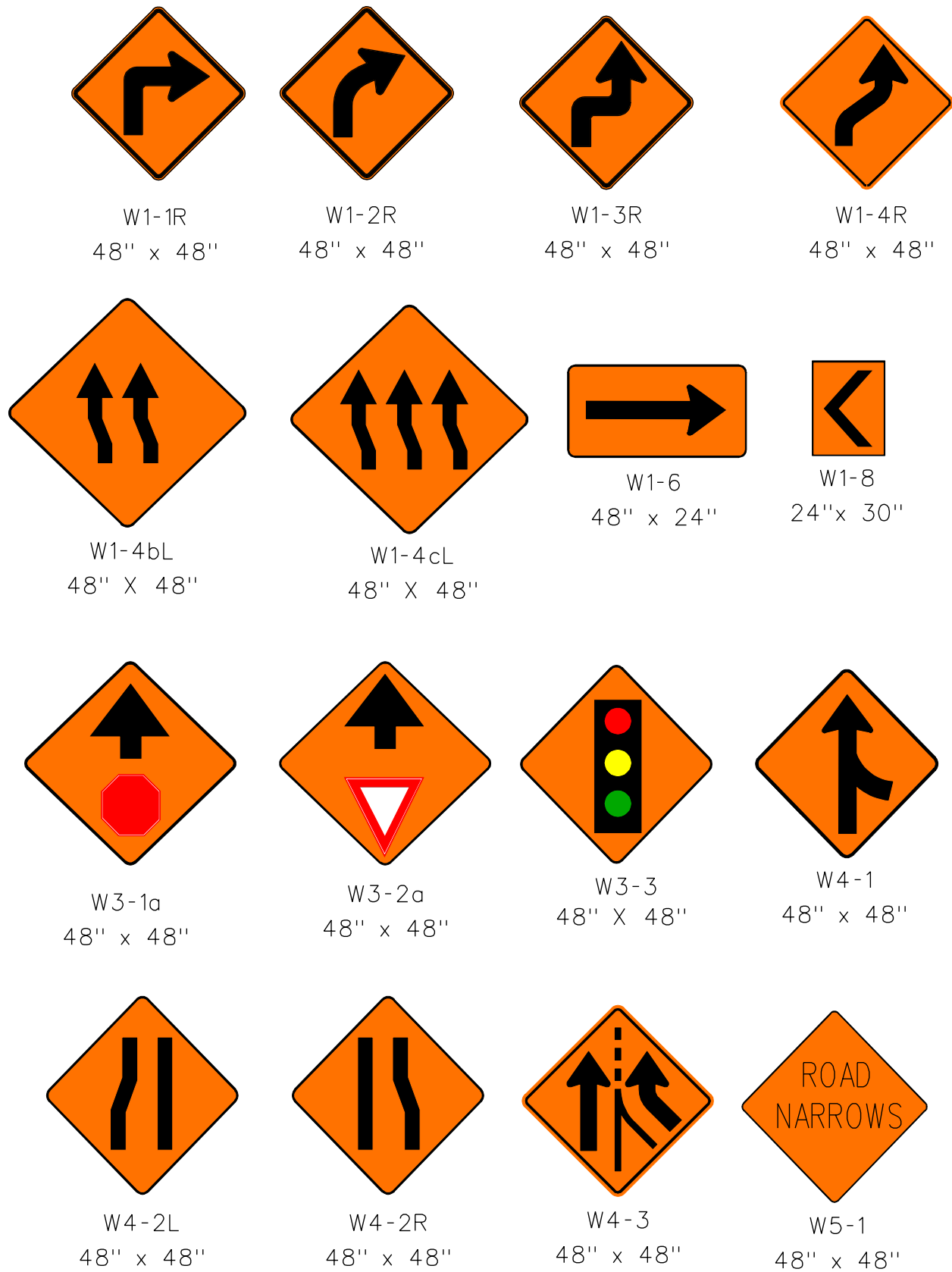
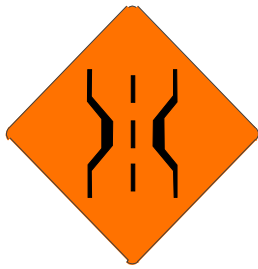


FIGURE 6F-3b. WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES



W5-2a
48" x 48"



W5-3
48" x 48"



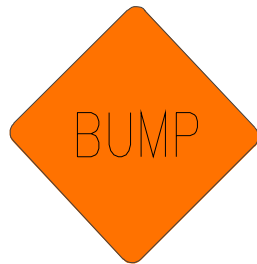
W6-1
48" x 48"



W6-2
48" x 48"



W7-1
30" x 30"



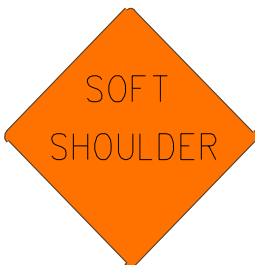
W8-1
30" x 30"



W8-2
30" x 30"



W8-3
30" x 30"



W8-4
48" x 48"



W8-5
48" x 48"



W8-6
48" x 48"



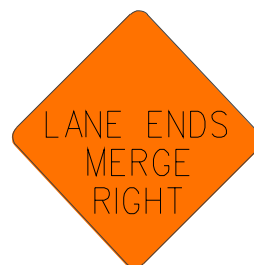
W8-7
48" x 48"



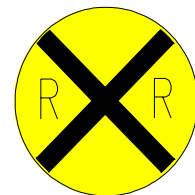
W8-8
48" x 48"



VW-
48" x 48"

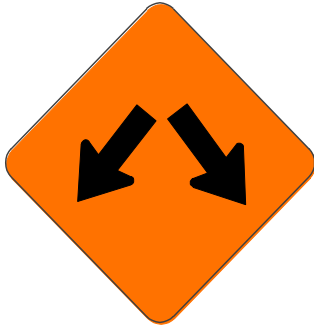


W9-2R
48" x 48"



W10-1
36" Diameter

FIGURE 6F-3c. WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES



W12-1
24" x 24"



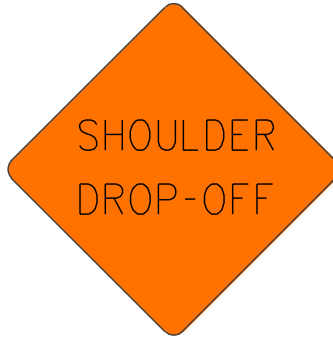
W12-2
36" x 36"



VW-27
48" x 48"



W20-5a
48" x 48"



W8-9a
48" x 48"



W14-3
36" x 48" x 48"

FIGURE 6F-3d. WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

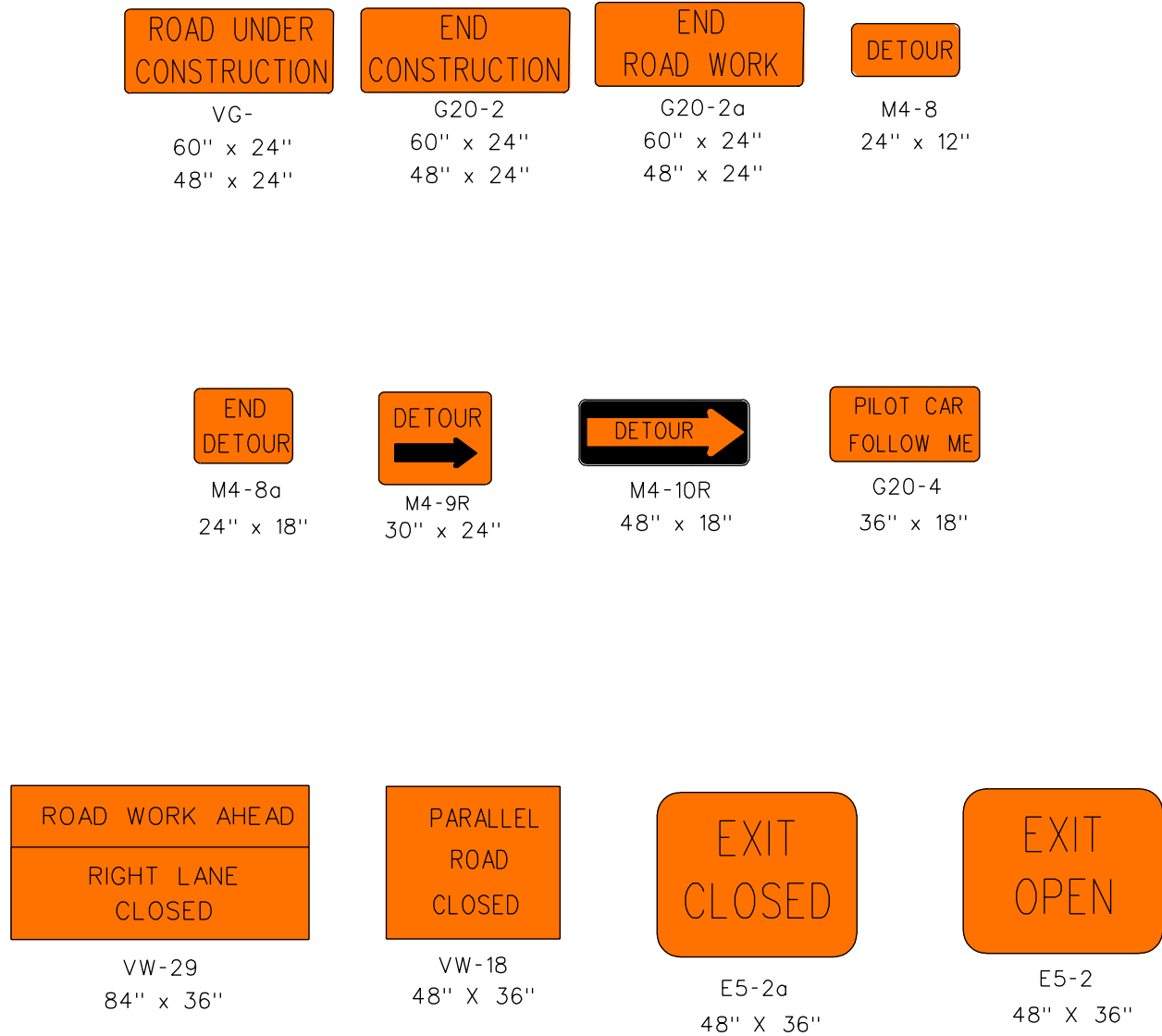


FIGURE 6F-3e. WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

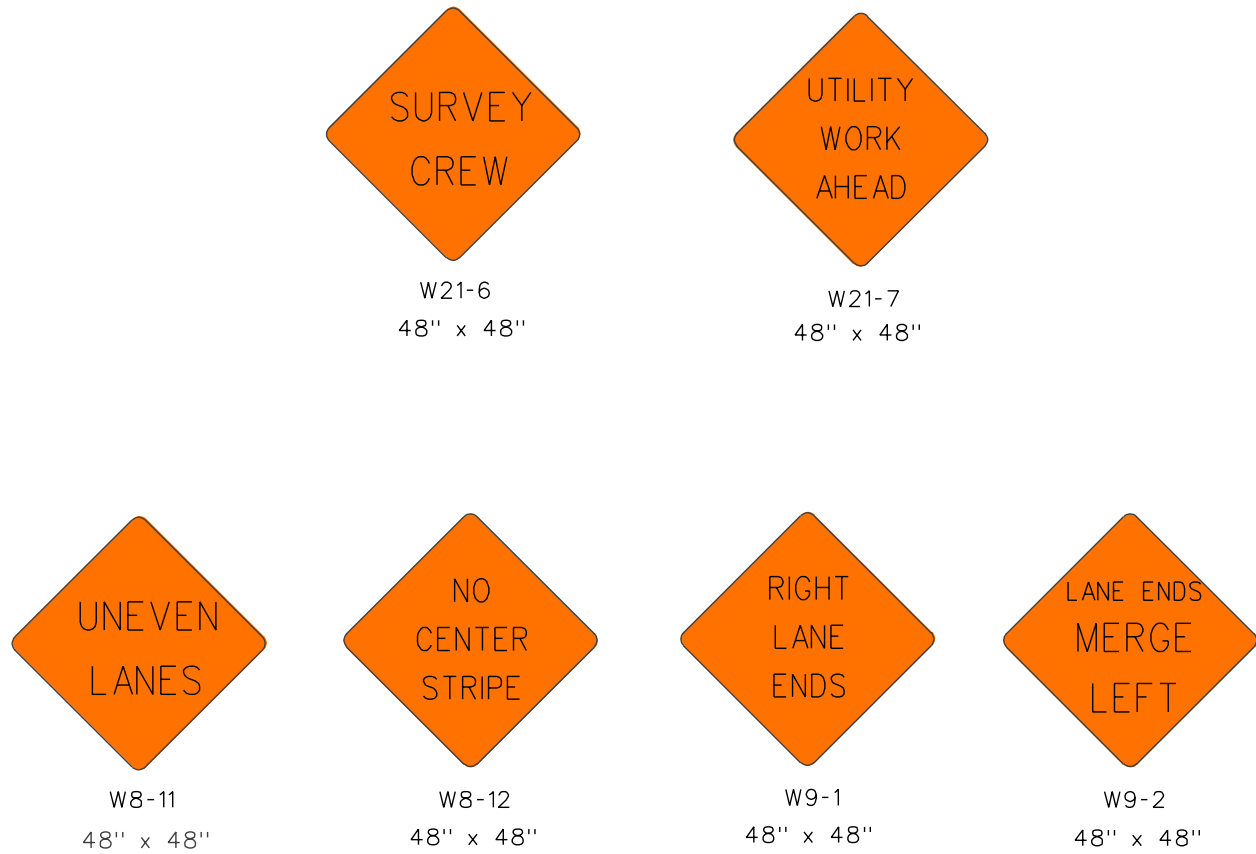


FIGURE 6F-3f. WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

Section 6F.18 DETOUR Sign (W20-2)*Guidance:*

The DETOUR (W20-2) sign should be used in advance of a road user detour over a different roadway or route.

Standard:

The DETOUR sign shall have the legend DETOUR, XX FT, XX MILES, or AHEAD.

Section 6F.19 ROAD (STREET) CLOSED Sign (W20-3)*Guidance:*

The ROAD (STREET) CLOSED (W20-3) sign 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:

The ROAD (STREET) CLOSED sign shall have the legend ROAD (STREET) CLOSED, XXFT, XX MILES, or AHEAD.

Section 6F.20 ONE LANE ROAD Sign (W20-4)**Standard:**

The ONE LANE ROAD AHEAD (W20-4) sign 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.10).

Section 6F.21 LANE(S) CLOSED Signs (W20-5, W20-5a)**Standard:**

The LANE(S) CLOSED sign shall be used in advance of that point where one or more through lanes of a multiple-lane roadway are closed.

For a single lane closure, the LANE CLOSED (W20-5) sign shall have the legend RIGHT (LEFT) LANE CLOSED, AHEAD. Where two adjacent lanes are closed, the sign shall have the legend RIGHT (LEFT) TWO LANES CLOSED, AHEAD.

Section 6F.22 CENTER LANE CLOSED AHEAD Signs (W9-3, W9-3a)*Guidance:*

The CENTER LANE CLOSED AHEAD (W9-3) sign should be used in advance of that point where work occupies the center lane(s) and approaching motor vehicle traffic is directed to the right or left of the work zone in the center lane.

Option:

The Center Lane Closed Ahead (W9-3a) symbol sign may be substituted for the CENTER LANE CLOSED AHEAD (W9-3) word message sign.

Section 6F.23 THRU TRAFFIC MERGE RIGHT (LEFT) Sign (W4-1a)*Guidance:*

The THRU TRAFFIC MERGE RIGHT (LEFT) (W4-1a) sign should be used in advance of an intersection where one or more lane closures on the far side of a multilane intersection require through motor vehicle traffic on the approach to the intersection to use the right (left) lane to proceed through the intersection.

Section 6F.24 Lane Ends Sign (W4-2L, W4-2R)**Standard:**

The Lane Ends (W4-2L or R) symbol sign shall be used to warn drivers of the reduction in the number of motor vehicle traffic lanes in the direction of travel on a multilane roadway.

Section 6F.25 ON RAMP Plaque (W13-4)*Guidance:*

When work is being done on a ramp, but the ramp remains open, the ON RAMP (W13-4) plaque should be used to supplement the advance ROAD WORK sign.

Section 6F.26 RAMP NARROWS Sign (W5-4)*Guidance:*

The RAMP NARROWS (W5-4) sign should be used in advance of the point where work on a ramp reduces the normal width of the ramp along a part or all of the ramp.

Section 6F.27 SLOW TRAFFIC AHEAD Sign (W23-1)Option:

The SLOW TRAFFIC AHEAD (W23-1) sign 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 vehicles. A ROAD WORK AHEAD (W20-1) sign may also be used with the SLOW TRAFFIC AHEAD sign.

Section 6F.28 EXIT OPEN, EXIT CLOSED Signs (E5-2, E5-2a)

Option:

An EXIT OPEN (E5-2) or EXIT CLOSED (E5-2a) sign 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 motor vehicle traffic using the ramp is different from the normal condition.

Guidance:

When an exit ramp is closed, an EXIT CLOSED panel with a black legend and border on an orange background should be placed diagonally across the interchange/intersection guide signs.

Section 6F.29 Flagger Symbol Sign (W20-7a)***Guidance:***

The Flagger (W20-7a) symbol sign should be used in advance of any point where a flagger is stationed to control road users.

Option:

A distance legend may be displayed on a supplemental plaque below the Flagger symbol sign. The sign may be used with appropriate legends or in conjunction with other warning signs, such as the BE PREPARED TO STOP (W20-7b) sign.

Standard:

The Flagger sign shall be removed, or covered if sign is post mounted, from display to road users when the flagging operations are not occurring.

Section 6F.30 Two-Way Traffic Sign (W6-3)***Guidance:***

When one roadway of a normally divided highway is closed, with two-way motor vehicle traffic maintained on the other roadway, the Two-Way Traffic (W6-3) sign should be used at the beginning of the two-way motor vehicle traffic section and at intervals of at least one sign every two miles to remind road users of opposing motor vehicle traffic.

Section 6F.31 NEW TRAFFIC PATTERN AHEAD Sign (VW-)**Option:**

The NEW TRAFFIC PATTERN AHEAD sign may be used to indicate a change from the normal traffic pattern. The sign may be used with other warning signs, placed in advance of the changed condition.

Guidance:

To retain its effectiveness, the sign should be displayed for up to two weeks, then covered or removed.

Section 6F.32 FRESH OIL (TAR) Sign (W21-2)

Guidance:

The FRESH OIL (TAR) (W21-2) sign should be used to warn road users of the surface treatment.

Section 6F.33 ROAD MACHINERY AHEAD Sign (W21-3)

Option:

The ROAD MACHINERY AHEAD (W21-3) sign may be used to warn of machinery operation in or adjacent to the roadway.

Section 6F.34 SHOULDER WORK Signs (W21-5, W21-5a, W21-5b)

Support:

Shoulder Work signs warn of maintenance, reconstruction, or utility operations on the highway shoulder where the roadway is unobstructed.

Standard:

The Shoulder Work sign shall have the legend SHOULDER WORK (W21-5), RIGHT (LEFT) SHOULDER CLOSED (W21-5a), or RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5b).

Option:

The Shoulder Work sign may be used in advance of the point on a nonlimited access highway where there is shoulder work. It may be used singly or in combination with a ROAD WORK NEXT X MILES or ROAD WORK AHEAD sign.

Guidance:

On expressways and freeways, the RIGHT (LEFT) SHOULDER CLOSED sign followed by RIGHT (LEFT) SHOULDER CLOSED sign should be used in advance of the point where the shoulder work occurs and should be preceded by a ROAD WORK AHEAD sign.

Section 6F.35 SURVEY CREW Sign (W21-6)

Guidance:

The SURVEY CREW (W21-6) sign should be used to warn of surveying crews working in or adjacent to the roadway.

Section 6F.36 UTILITY WORK AHEAD Sign (W21-7)Option:

The UTILITY WORK AHEAD (W21-7) sign may be used as an alternate to the ROAD (STREET) WORK AHEAD (W20-1) sign for utility operations on or adjacent to a highway.

Section 6F.37 Signs for Blasting Areas

Support:

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

Standard:

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.

Guidance:

A minimum safe distance of 1,000 feet should be used for warning sign placement.

Section 6F.38 BLASTING ZONE AHEAD Sign (W22-1)**Standard:**

The BLASTING ZONE AHEAD (W22-1) sign shall be used in advance of any temporary traffic control 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.

Section 6F.39 TURN OFF 2-WAY RADIO AND CELL PHONE Sign (W22-2)**Standard:**

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

Section 6F.40 END BLASTING ZONE Sign (W22-3)**Standard:**

The END BLASTING ZONE (W22-3) sign shall be placed a minimum of 1,000 feet past the blasting zone.

Option:

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

Section 6F.41 SHOULDER DROP-OFF Sign (W8-9a)**Standard:**

The SHOULDER DROP-OFF (W8-9a) sign shall be used when a shoulder drop-off, adjacent to the travel lane, exceeds 3 inches in depth and is not protected by portable barriers.

Section 6F.42 UNEVEN LANES Sign (W8-11)***Guidance:***

The UNEVEN LANES (W8-11) sign should be used during operations that create a difference in elevation between adjacent lanes.

Section 6F.43 NO CENTER STRIPE Sign (W8-12)***Guidance:***

The NO CENTER STRIPE (W8-12) sign should be used when the work obliterates the centerline pavement markings. This sign should be placed at the beginning of the temporary traffic control zone and repeated at 2 mile intervals in long temporary traffic control zones.

Section 6F.44 Other Warning Signs**Option:**

Advance warning signs may be used by themselves or with other advance warning signs.

Besides the warning signs specifically related to temporary traffic control zones, several other warning signs in Part 2 may apply in temporary traffic control zones.

Standard:

When used in temporary traffic control zones, these other warning signs shall have black legends and borders on an orange background, except for the Railroad Advance Warning (W10-1) sign, and school, pedestrian, and bicycle signs (see Section 6F.02).

Section 6F.45 Advisory Speed Plaque (W13-1)**Option:**

In combination with a warning sign, an Advisory Speed (W13-1) plaque may be used to indicate a recommended safe speed through the temporary traffic control zone.

Standard:

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 orange temporary traffic control zone signs, this plaque shall have a black legend and border on an orange background. The sign shall be at least 24 x 24 inch in size when used with a sign that is 36 x 36 inch or larger. Except in emergencies, an Advisory Speed plaque shall not be mounted until the recommended speed is determined by the District Traffic Engineer or official having jurisdiction.

Section 6F.46 Supplementary Distance Plaque (W7-3a)**Option:**

In combination with a warning sign, a Supplementary Distance (W7-3a) plaque with the legend NEXT XX MILE 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 temporary traffic control zone.

In long temporary traffic control 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 temporary traffic control work activity or condition exists.

Standard:

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 orange temporary traffic control zone signs, this plaque shall have a black legend and border on an orange background. The sign shall be at least 30 x 24 inch in size when used with a sign that is 36 x 36 inch or larger.

Guidance:

When used in temporary traffic control 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.47 Guide Signs

Support:

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

Guidance:

The following guide signs should be used in temporary traffic control 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:

If additional guide signs are used in temporary traffic control zones, they shall have a black legend on an orange background.

Option:

When directional signs and street name signs are used in conjunction with detour routing, these signs may have a black legend on an orange background.

Section 6F.48 ROAD WORK NEXT XX MILES Sign (G20-1)**Guidance:**

The ROAD WORK NEXT XX MILES (G20-1) sign should be installed in advance of temporary traffic control zones that are more than 2 mile in length.

Option:

The ROAD WORK NEXT XX MILES sign may be mounted on a Type III barricade. The sign may also be used for work zones of shorter length.

Standard:

The distance shown on the ROAD WORK NEXT XX MILES sign shall be stated to the nearest whole mile.

Section 6F.49 END ROAD WORK Sign (G20-2a)**Guidance:**

The END ROAD WORK (G20-2a) sign should be placed about 500 feet beyond the end of the temporary traffic control zone or termination area.

Option:

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 III barricade.

Section 6F.50 Detour Signs and Markers (M4-8, M4-8a, M4-8b, M4-9, and M4-10)**Standard:**

Each detour shall be adequately marked with standard temporary route markers and destination signs.

Option:

The Detour Arrow (M4-10) sign may be used where a detour route has been established.

The DETOUR (M4-8) or (M4-9) marker may be mounted at the top of a route marker assembly to mark a temporary route that detours from a highway, bypasses a section closed by a temporary traffic control zone, and rejoins the highway beyond the temporary traffic control zone.

Guidance:

The Detour Arrow (M4-10) sign should normally be mounted just below the ROAD CLOSED (R11-2, R11-3a, or R11-4) sign. The Detour Arrow sign should include a horizontal arrow pointed to the right or left as required.

The DETOUR (M4-9) sign 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 markers.

A Street Name sign should be placed above, or the street name should be incorporated into, a DETOUR (M4-9) sign to indicate the name of the street being detoured.

Option:

The END DETOUR (M4-8a or M4-8b) sign may be used to indicate that the detour has ended.

Guidance:

When the END DETOUR sign is used on a numbered highway, the sign should be mounted above a marker after the end of the detour.

Section 6F.51 PILOT CAR FOLLOW ME Sign (G20-4)

Standard:

The PILOT CAR FOLLOW ME (G20-4) sign shall be mounted in a conspicuous position on the rear of a vehicle used for guiding one-way motor vehicle traffic through or around a temporary traffic control zone. A flagger shall be stationed on the approach to the activity area to stop motor vehicle traffic until the pilot vehicle is available.

Section 6F.52 Portable Changeable Message Signs**Standard:**

Portable Changeable Message signs (PCMS) shall be temporary traffic control devices with the flexibility to display a variety of messages. Each message shall consist of either one or two phases. A phase shall consist of up to three lines of eight characters per line. Each character module shall use at least a five wide and seven high pixel matrix.

Support:

Portable Changeable Message signs are 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.

Guidance:

The components of a Portable Changeable Message sign should include: a message sign panel, control systems, a power source, and mounting and transporting equipment.

Portable Changeable Message signs should subscribe to the principles established in this Manual and, to the extent practical, with the design (that is, color, letter size and shape, and borders) and applications prescribed in this Manual, except that the reverse colors for the letters and the background are considered acceptable.

The front face of the sign should be covered with a protective material. The color of the elements should be yellow or orange on a black background.

Portable Changeable Message signs should be visible from 0.5 mile under both day and night conditions. For a trailer or large truck mounted sign, the letter height should be a minimum of 18 inches. For Changeable Message Signs mounted on the back of service patrol trucks or work trucks, the letter height should be a minimum of 10 inches. The message should be legible from a minimum distance of 650 feet for Portable Message Signs mounted on a trailer or large truck, and 330 feet for PMS's mounted on service patrol or work trucks.

The message panel should have adjustable display rates, so that the entire message can be read at least twice at the posted speed, the off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed.

Messages should be designed taking into account the following factors:

- A. *Each Phase should convey a single thought.*

- B. *If the message can be displayed in one phase, the top line should present the problem, the center line should present the location or distance ahead, and the bottom line should present the recommended driver action.*
- C. *The message should be brief as possible.*
- D. *When a message is longer than two phases, additional Portable Changeable Message signs should be used.*
- E. *When abbreviations are used, they should be easily understood (see Table 6A-1. Acceptable Abbreviations)*

Option:

The message sign panel may vary in size.

Standard:

Portable Changeable Message signs shall automatically adjust their brightness under varying light conditions, to maintain legibility.

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.

Portable Changeable Message signs shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs.

The mounting of Portable Changeable Message signs shall be such that the bottom of the message sign panel shall be a minimum of 7 feet above the roadway when it is in the operating mode.

The text of the messages shall not scroll or travel horizontally or vertically across the face of the sign.

Support:

Portable Changeable Message signs have a wide variety of applications in temporary traffic control zones including: roadway, lane, or ramp closures, crash or emergency incident management, width restriction information, speed reductions, advisories on work scheduling, road user management and diversion, warning of adverse conditions, and operation control.

Guidance:

Portable Changeable Message signs should be used as a supplement to and not as a substitute for conventional signs and pavement markings.

Support:

The primary purpose of Portable Changeable Message signs in temporary traffic control zones is to advise the road user of unexpected situations. Some typical applications include the following:

- A. Where the speed of motor vehicle 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:

When Portable Changeable Message signs are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to exit the affected highway. The PCMS should be sited and aligned to ensure legibility. Multiple PCMS's should be placed on the same side of the roadway, separated from each other a minimum distance of 1,000 feet.

Portable Changeable Message signs should be placed on the shoulder of the roadway or, if practical, further from the traveled lane. They should be delineated with retroreflective temporary traffic control devices or when within the clear zone, shielded with a barrier or crash cushion. When Portable Changeable Message signs are not being used, they should be removed or placed out of the clear zone; if not removed, they should be shielded; or if the previous two options are not feasible, they should be delineated with retroreflective temporary traffic control devices.

Standard:

When used in unmanned work zones, group 2 channelizing devices shall be used to delineate Portable Changeable Message signs.

Portable Changeable Message sign trailers shall be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.

Section 6F.53 Arrow Panels

Standard:

An arrow panel 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 temporary traffic control zone.

Guidance:

An arrow panel should be used in combination with appropriate signs, channelizing devices, or other temporary traffic control devices.

An arrow panel should be placed on the shoulder of the roadway or, if practical, further from the traveled lane. It should be delineated with retroreflective temporary traffic control devices, or when within the clear zone, shielded with a barrier or crash cushion. When an arrow panel 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 retroreflective temporary traffic control devices.

Standard:

When used in unmanned work zones, Group 2 channelizing devices shall be used to delineate arrow panels.

Arrow panel trailers shall be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.

Arrow panels shall meet the minimum size, legibility distance, number of elements, and other specifications shown on Figure 6F-4.

Support:

Type A arrow panels are appropriate for use on low-speed (below 35 mph) urban streets. Type B arrow panels are appropriate for intermediate-speed (35 mph to 44 mph) facilities and for maintenance or mobile operations on high-speed (45 mph and greater) roadways. Type C arrow panels are intended to be used on high-speed, high-volume motor vehicle traffic control projects.

Standard:

Type A, B, and C arrow panels shall have solid rectangular appearances.




All arrow panels shall be finished in nonreflective black. The arrow panel shall be mounted on a vehicle, a trailer, or other suitable support.

Guidance:

The minimum mounting height of an arrow panel should be 7 feet from the roadway to the bottom of the panel, except on vehicle-mounted panels, which should be as high as practical. A vehicle-mounted arrow panel should be provided with remote controls.

Standard:

Arrow panel 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 panels.

Operating Mode	Panel Display (Type C Panel Illustrated)
The following modes shall be provided:	(Right arrow shown; left is similar)
I. Flashing Arrow	 Move/Merge Right
II. Flashing Double Arrow	 Move/Merge Right or Left
III. Flashing Caution	 Caution

Panel 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

Standard:

Arrow panels 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 taken when there is more than one lamp out in the stem. Immediate corrective shall be taken when there are any lamps out in the arrow head(s).

FIGURE 6F-4. ADVANCE WARNING ARROW DISPLAY SPECIFICATIONS

Guidance:

Full brilliance should be used for daytime operation of arrow panels.

Standard:

The arrow panel shall have suitable elements capable of the various operating modes. The color presented by the elements shall be yellow.

Guidance:

If an arrow panel 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:

The minimum element on-time shall be 50 percent for the flashing mode. The flashing rate shall be not less than 25 nor more than 40 flashes per minute.

An arrow panel shall have the following three mode selections:

- A. A Flashing Arrow; and**
- B. A Flashing Double Arrow mode; and**
- C. A Flashing Caution mode.**

An arrow panel in the arrow mode shall be used only for stationary or moving lane closures on multilane roadways.

For shoulder work, blocking the shoulder, for roadside work near the shoulder, within an already closed lane on a multi-lane roadway, or for temporarily closing one lane on a two-lane, two-way roadway, an arrow panel shall be used only in the four-corner caution mode.

Guidance:

For a stationary lane closure, the arrow panel should be located on the shoulder at the beginning of the shifting or merging taper. Where the shoulder is narrow, the arrow panel should be located completely in the closed lane behind the channelizing devices.

To maintain respect for the arrow panel device, one arrow display should be used for each lane closed except where noted in the following option.

Option:

In locations with restricted sight distance due to roadway geometrics and/or heavy truck volumes, an additional arrow panel or static arrow sign (96 " by 48") on the shoulder may be used approximately 1000 feet in advance of the lane closure taper. In this situation, all of the advance warning signs must be placed in advance of this extra arrow panel device.

In certain situations on Primary and Secondary roadways with long term lane closure operations, upon approval from the District Traffic Engineer, a 96" by 48" static arrow sign may replace an electronic arrow panel which has been displayed for two weeks.

Standard:

When arrow panels are used to close multiple lanes, a separate arrow panel shall be used for each closed lane.

Guidance:

When arrow panels are used to close multiple lanes, if the first arrow panel is placed on the shoulder, the second arrow panel should be placed in the first closed lane at the beginning of the second merging taper (see Figure TTC-14.0). When the first arrow panel is placed in the first closed lane, the second arrow panel should be placed in the second closed lane at the downstream end of the second merging taper.

For mobile operations where a lane is closed, the arrow panel should be located to provide adequate separation from the work operation to allow for appropriate reaction by approaching drivers.

Standard:

A vehicle displaying an arrow panel shall be equipped with rotating lights or strobe lights.

A single arrow panel shall not be used to shift traffic laterally more than one lane.

Option:

A vehicle mounted portable changeable message sign may be used to simulate an arrow panel display.

Section 6F.54 High-Level Warning Devices (Flag Trees)Option:

A high-level warning device (flag tree) may supplement other temporary traffic control devices in temporary traffic control zones.

Support:

A high-level warning device is designed to be seen over the top of typical passenger cars.

Standard:

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 inch square or larger and shall be orange or fluorescent red-orange in color.

Option:

An appropriate warning sign may be mounted below the flags.

Support:

High-level warning devices are most commonly used in high-density road user situations to warn road users of short-term operations.

Section 6F.55 Channelizing Devices**Standard:**

Designs of various channelizing devices shall be as shown in Figure 6F-5.

Support:

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, plastic drums, barricades, and temporary raised islands.

Channelizing devices provide for smooth and gradual motor vehicle traffic flow from one lane to another, onto a bypass or detour, or into a narrower traveled way. They are also used to separate motor vehicle traffic from the work space, pavement drop-offs, pedestrian or bicycle paths, or opposing directions of motor vehicle traffic.

Guidance:

Channelizing devices should be constructed and ballasted to perform in a predictable manner when inadvertently struck by a vehicle. Channelizing devices should be crashworthy. Fragments or other debris from the device or the ballast should not pose a significant hazard to road users or workers in the immediate area.

The spacing of channelizing devices should be as shown in Table 6F-1. The spacing of channelizing devices in tangent sections of the work zone is normally twice the distance for devices used in the taper and around curves of 6 degrees and greater.

When channelizing devices have the potential of leading motor vehicle traffic out of the intended motor vehicle traffic space as shown in Figure TTC-30.0, the channelizing devices should be extended a distance in feet of 2.0 times the speed limit in mph beyond the end of the transition area.

Channelizing devices are elements in a total system of traffic control devices for use in temporary traffic control zones. These elements shall be preceded by a subsystem of warning devices that are adequate in size, number, and placement for the type of highway on which the work is to take place. Standard designs of channelizing devices are shown in Figure 6F-5.

Option:

Warning lights may be added to channelizing devices in areas with frequent fog, snow, or severe roadway curvature, or where visual distractions are present.

Standard:

Warning lights shall flash when placed on channelizing devices used alone or in a cluster to warn of a condition. Warning lights placed on channelizing devices used in a series to channelize road users shall be steady-burn. Barrier vertical panels shall not be installed on Group 1 or 2 channelizing devices.

The retroreflective material used on channelizing devices shall have a smooth, sealed outer surface that will display approximately the same color day or night. In addition to conforming to the requirements stated herein, channelizing devices, including retroreflective material, shall conform to the requirements of the Virginia Department of Transportation's Road and Bridge Specifications.

Option:

The name and telephone number of the highway agency, contractor, or supplier may be shown on the nonretroreflective surface of all types of channelizing devices.

Standard:

The letters and numbers of the name and telephone number shall be nonretroreflective and not over 2 inch in height.

Guidance:

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

Standard:

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 American Traffic Safety Service Association's (ATSSA) "Quality Standards For Work Zone Traffic Control Devices" publication.

Section 6F.56 Cones**Standard:**

Cones shall be predominantly orange and shall be made of a material that can be struck without causing damage to the impacting vehicle. The height of cones for use on all roadways shall be 36 inch.

For nighttime use, cones shall be retroreflectorized or equipped with lighting devices for maximum visibility. Retroreflectorization of cones shall be provided by a minimum 13 inch white band placed a maximum of 3 inches from the top, or by a white band 6 inches wide located 3 to 4 inches from the top of the cone and an additional 4 inch wide white band approximately 2 inches below the 6 inch band.

Table 6F-1. Spacing of Channelizing Devices:

Spacing of Channelizing Devices		
Work Zone Locations	Posted Speed Limit	Spacing in Feet
In Transitions and Curves	35 mph or less	20'
Parallel to the Travelway	35 mph or less	40'
Spot Construction Access *	35 mph or less	80'
In Transitions and Curves	Greater than 35 mph	40'
Parallel to the Travelway	Greater than 35 mph	80'
Spot Construction Access *	Greater than 35 mph	120'

* For easier access by construction vehicles into the work area, spacings may be increased to this distance, but shall not exceed one access per quarter mile.

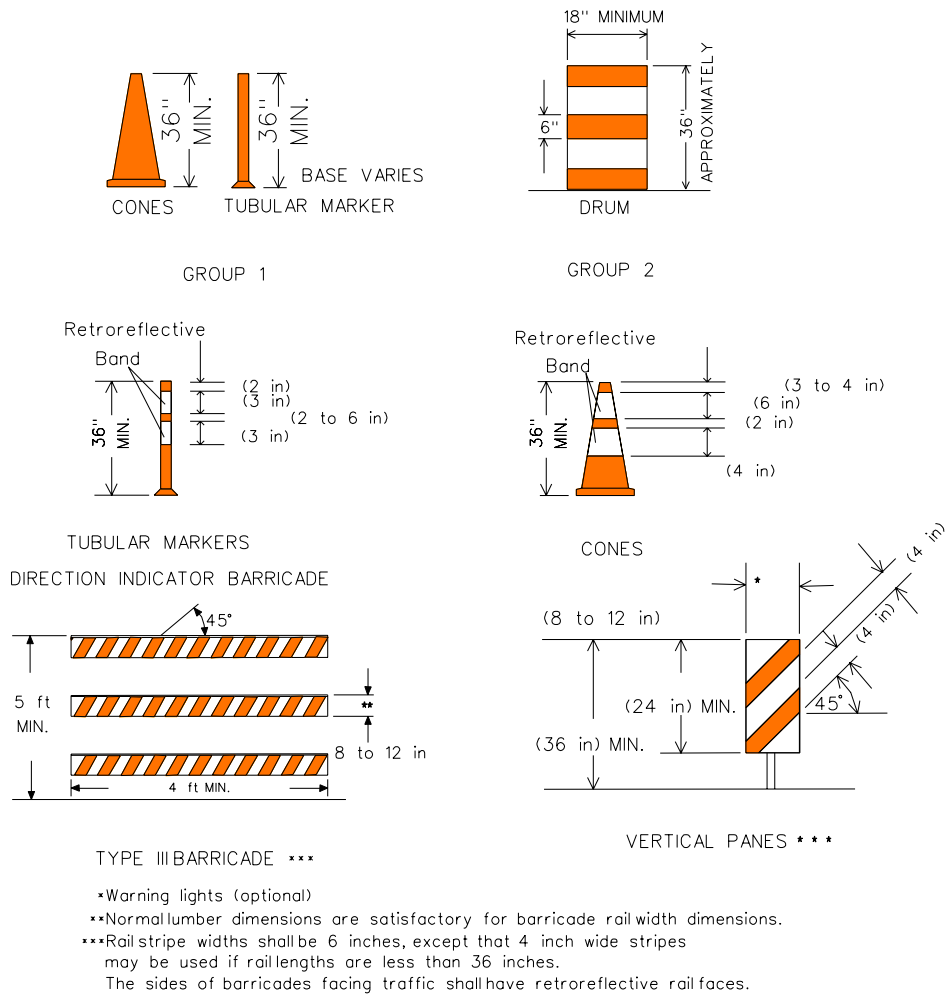


FIGURE 6F-5. CHANNELIZING DEVICES

Option:

When workers are present to maintain them, traffic cones may be used to channelize road users, divide opposing motor vehicle 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:

Steps should be taken to ensure that cones will not be blown over or displaced by wind or moving motor vehicle traffic.

Option:

Cones may be doubled up to increase their weight.

Support:

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:

Ballast should be kept to the minimum amount needed.

Standard:

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

Section 6F.57 Tubular Markers**Standard:**

Tubular markers (see Figure 6F-5.) shall be predominantly orange and shall be not less than 36 inch high and 2 inch wide facing road users. They shall be made of a material that can be struck without causing damage to the impacting vehicle.

For nighttime use, tubular markers shall be retroreflectorized. Retroreflectorization of 36 inch or larger tubular markers shall be provided by two 3 inch wide white bands placed a maximum of 2 inch from the top with a maximum of 6 inch between the bands.

Guidance:

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.

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. Ballast should be kept to the minimum amount needed.

Option:

Tubular markers may be used effectively to divide opposing lanes of road users, divide motor vehicle traffic lanes when two or more lanes 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:

When a non-cylindrical tubular marker is used, it shall be attached to the pavement to ensure that the width facing road users meets the minimum requirements.

A tubular marker shall be attached to the pavement to display the minimum 2 inch width to the approaching road users.

Section 6F.58 Vertical Panels**Standard:**

Vertical panels shall be 8 to 12 inch in width and at least 36 inch in height. They shall have orange and white diagonal stripes and be retroreflectorized.

Vertical panels shall be mounted with the top a minimum of 36 inch above the roadway, and a minimum of 42 inch above the pedestrian travel way. Vertical panels shall be mounted with the bottom no greater than 12 inch above the ground.

Where the height of the vertical panel itself is 36 inch or greater, a panel stripe width of 6 inch shall be used.

Markings for vertical panels shall be alternating orange and white retroreflective stripes, sloping downward at an angle of 45 degrees in the direction motor vehicle traffic is to pass. Vertical panels used on expressways, freeways, and other high-speed roadways shall have a minimum of 270 inch² retroreflective area facing motor vehicle traffic.

Option:

Where space is limited, vertical panels may be used to channelize motor vehicle traffic, divide opposing lanes, or replace barricades when approved by the District Traffic Engineer.

Section 6F.59 Drums**Standard:**

Drums 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. Any nonretroreflectorized 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:

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 temporary traffic control 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:

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:

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:

Ballast shall not be placed on the top of a drum.

Drums shall be used in all unmanned work zone locations, and in all lane closure tapers on limited access highways for nighttime operations.

Section 6F.60 Type III Barricades**Support:**

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.

Standard:

Stripes on barricade rails shall be alternating orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction road users are to pass.

The minimum length for Type III Barricades shall be 48 inch. Each barricade rail shall be 8 to 12 inch wide. Barricades used on expressways, freeways and other high-speed roadways shall have a minimum of 270 inch² of retroreflective area facing road users.

Guidance:

Where barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which road users must turn.

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 (inverted V-shape).

Where no turns are intended, the stripes should be positioned to slope downward toward the center of the barricade or barricades (V-shape).

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.

Standard:

Barricades shall be crashworthy as they are located adjacent to motor vehicle traffic flow and are subject to impact by errant vehicles from both the front and side directions.

Guidance:

On high-speed expressways or in other situations where barricades may be susceptible to overturning in the wind, ballasting should be used.

Option:

Sandbags may be placed on the lower parts of the frame or the stays of barricades to provide the required ballast.

Standard:

Ballast shall not be placed on top of any striped rail. Barricades shall not be ballasted by non-deformable objects such as rocks or chunks of concrete.

Guidance:

Type III Barricades should be used to close or partially close a road.

Option:

Type III Barricades used at a road closure may be placed completely across a roadway or from curb to curb.

Standard:

Where provision is made for access of authorized equipment and vehicles, the responsibility for Type III Barricades shall be assigned to a person to ensure proper closure at the end of each work day.

Support:

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:

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

Option:

Crashworthy signs may be installed on barricades (see Section 6F.03).

Section 6F.61 Direction Indicator Barricades**Standard:**

Due to their proximity in appearance to a type II barricade, the Direction Indicator Barricade shall not be used as a channelizing device.

Section 6F.62 Temporary Traffic Barriers as Channelizing Devices

Support:

Temporary traffic barriers are not temporary traffic control 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 temporary traffic control devices.

Standard:

Temporary traffic barriers serving as temporary traffic control devices shall conform to requirements for such devices as set forth throughout this manual.

Temporary traffic barriers shall not be used solely to channelize road users, but also to protect the work space (see Section 6F.77). For nighttime use, the temporary traffic barrier shall be supplemented with delineation.

Guidance:

Temporary traffic barriers should not be used for a merging taper except in low-speed urban areas. Temporary traffic barriers should not be used for a constricted/restricted temporary traffic control zone.

When it is necessary to use a temporary traffic barrier for a merging taper in low-speed urban areas or for a constricted/restricted temporary traffic control zone, the taper shall be delineated and the taper length should be designed to optimize road user operations considering the available geometric conditions. (See Appendix A for barrier use guidelines).

When used for channelization, temporary traffic barriers should be of a light color for increased visibility.

Section 6F.63 Other Channelizing Devices**Standard:**

Channelizing devices other than those described in this Chapter shall require approval from the Director of Mobility Management of the Department of Transportation based on a review and/or engineering study prior to their use.

Guidance:

Other channelizing devices should conform to the general size, color, stripe pattern, retroreflection, and placement characteristics established for the devices described in this Chapter.

Section 6F.64 Temporary Raised Islands**Standard:**

Temporary raised islands shall be used only in combination with pavement striping and other suitable channelizing devices.

Option:

A temporary raised island may be used to separate motor vehicle traffic flows in two-lane, two-way operations on roadways having a motor vehicle traffic volume range of 4,000 to 15,000 average daily traffic (ADT) and on freeways having a motor vehicle traffic volume range of 22,000 ADT to 60,000 ADT.

Temporary raised islands also may be used in other than two-lane, two-way operations where physical separation of motor vehicle traffic from the temporary traffic control zone is not required.

Guidance:

Temporary raised islands should have the basic dimensions of 4 inches in height by 15 to- 18 inches in width and have rounded or chamfered corners.

The temporary raised islands should not be designed in such a manner that they would cause a driver 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.

Orange flexible post delineators 36 inch in height and 2.25 to 4 inch in should be placed on top of the raised island for delineation.

Standard:

Flexible post delineators shall be spaced every 80 feet, with a temporary pavement marker spaced in-between each delineator on top of the temporary raised median. Retro-

reflective sheeting shall be placed 3 inches from the top of each flexible post delineator (see L&D special design drawing for Temporary Asphalt Median).

Section 6F.65 Pavement Markings

Standard:

The provisions of this Section shall not be considered applicable for short-term, mobile, or incident management temporary traffic control zones.

Pavement markings shall be maintained along paved streets and highways in all long- and intermediate-term stationary (see Section 6G.02) temporary traffic control zones. All pavement markings shall be in accordance with Chapters 3A and 3B of the MUTCD, except as indicated in Section 6F.65. Pavement markings shall match the markings in place at both ends of the temporary traffic control zone. Pavement markings shall be placed along the entire length of any surfaced detour or temporary roadway prior to the detour or roadway being opened to road users.

Warning signs, channelizing devices, and delineation shall be used to indicate required road user paths in temporary traffic control zones where it is not possible to provide a clear path by pavement markings. All pavement markings and devices used to delineate road user paths shall be carefully reviewed during daytime and nighttime periods.

For long-term stationary operations, pavement markings in the temporary traveled way that are no longer applicable shall be removed or obliterated as soon as practical. Pavement marking obliteration shall leave a minimum of pavement scars and shall remove old marking material. Painting over existing pavement markings with black paint or spraying with asphalt shall not be accepted as a substitute for removal or obliteration. Obliteration of pavement markings shall be in accordance to Typical Traffic Control Figure TTC-38.0.

Guidance:

Road users should be provided pavement markings within a temporary traffic control zone comparable to the pavement markings normally maintained along such roadways, particularly at either end of the temporary traffic control zone.

The intended vehicle path should be defined in day, night, and twilight periods under both wet and dry pavement conditions.

The work should be planned and staged to provide for the placement and removal of the pavement markings.

Markings should be provided in intermediate-term, stationary work zones.

Option:

Removable, nonreflective, preformed tape may be used where markings need to be covered temporarily.

Section 6F.66 Temporary Pavement Markings

Support:

Temporary pavement markings are those that are allowed to remain in place until the earliest date when it is practical and possible to install pavement markings that meet the MUTCD Part 3 standards for pavement markings.

Guidance:

Temporary pavement markings should not be in place for more than 2 weeks unless justified by an engineering study.

Standard:

All temporary pavement markings, including pavement markings for no-passing zones, shall conform to the requirements of Chapters 3A and 3B of the MUTCD. All temporary broken-line pavement markings shall use the same cycle length as permanent markings and be at least 2 feet long.

Option:

Half-cycle lengths with a minimum of 2 foot stripes may be used on roadways with severe curvature (see Section 3A.06 of the MUTCD). This applies to centerlines in passing zones and lane lines.

For temporary situations of 3 calendar days or less, for a two- or three-lane road, no-passing zones may be identified by using “NO PASSING ZONE” (W14-3) signs (see Section 2C.32) rather than pavement markings. Also, “NO PASSING ZONE” signs may be used instead of pavement markings on low-volume roads (as defined in Section 5A.01 of the MUTCD) for longer periods in accordance with the State's or highway agency's policy.

Guidance:

The NO PASSING ZONE signs should be placed in accordance with Sections 2B.24, 2B.25, and 2C.32 of the MUTCD.

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 or symbols) should be in accordance with the State's or highway agency's policy.

Section 6F.67 Raised Pavement Markers

Standard:

Temporary pavement markers shall be installed with construction pavement markings, except non-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.

Section 6F.68 Delineators

Standard:

When used, delineators shall combine with or supplement other temporary traffic control 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 side of one-way roadways shall be white. Delineators used along the left side of one-way roadways shall be yellow.

Guidance:

Spacing along roadway curves should be as set forth in the MUTCD and should be such that several delineators are always visible to the driver.

Option:

Delineators may be used in temporary traffic control zones to indicate the alignment of the roadway and to outline the required vehicle path through the temporary traffic control zone.

Section 6F.69 Lighting Devices

Guidance:

Lighting devices should be provided in temporary traffic control zones based on engineering judgment.

Support:

Four types of lighting devices are commonly used in temporary traffic control zones. They are floodlights, flashing warning beacons, warning lights, and steady-burn electric lamps.

Option:

Lighting devices may be used to supplement retroreflectorized signs, barriers, and - channelizing devices.

Support:

During normal daytime maintenance operations, the functions of flashing warning beacons are adequately provided by rotating lights or strobe lights on a maintenance vehicle.

Standard:

Although vehicle hazard warning lights are permitted to be used to supplement rotating or strobe lights, they shall not be used instead of rotating or strobe lights.

Section 6F.70 Floodlights

Support:

Utility, maintenance, or construction activities on highways are frequently conducted during nighttime periods when motor vehicle traffic volumes are lower. Large construction projects are sometimes operated on a double-shift basis requiring night work.

Guidance:

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

Standard:

Floodlighting shall not produce a disabling glare condition for approaching road users. 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.

Support:

Research indicates that 5 foot candles is a desirable nighttime illumination level where workers are active

Section 6F.71 Flashing Warning Beacons

Support:

Flashing warning beacons are often used to supplement a temporary control device.

Standard:

Flashing warning beacons shall comply with the provisions of Chapter 4K of the MUTCD. A flashing warning beacon shall be a flashing yellow light with a minimum nominal diameter of 8 inch.

Guidance:

Flashing warning beacons should be operated 24 hours per day.

Support:

The temporary terminus of a freeway is an example of a location where flashing warning beacons alert drivers to the changing roadway conditions and the need to reduce speed in transitioning from the freeway to another roadway type.

Section 6F.72 Warning Lights

Standard:

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

Warning lights shall be in accordance with the current ITE "Purchase Specification for Flashing and Steady-Burn Warning Lights".

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:

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

Support:

The lightweight 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:

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

Standard:

Flashing warning lights shall not be used for delineation, as a series of flashers fails to identify the desired vehicle path.

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.

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

Support:

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:

Type A warning lights may be mounted on channelizing devices.

Support:

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:

Type B warning lights are designed to operate 24 hours per day and may be mounted on advance warning signs or on independent supports.

Type C Steady-Burn warning lights may be used during nighttime hours to delineate the edge of the traveled way.

Guidance:

When used to delineate a curve, Type C and Type D 360-degree Steady-Burn warning lights should only be used on devices on the outside of the curve, and not on the inside of the curve.

Section 6F.73 Steady-Burn Electric Lamps

Support:

Steady-Burn electric lamps are a series of low-wattage, yellow, electric lamps, generally hard-wired to a 110-volt external power source.

Option:

Steady-Burn electric lamps may be used in place of Type C Steady-Burn warning lights (see Section 6F.71).

Section 6F.74 Vehicle Warning Lights*Guidance:*

Warning lights on vehicles should be mounted as to be viewed 360 degrees on vehicles without arrow panels, and 180 degrees on vehicles with arrow panels.

Standard:

Vehicle warning lights shall be either a rotating amber light or a high intensity amber strobe light and meet the following conditions:

- 1. Rotating amber lights shall consist of a minimum of two halogen sealed beams enclosed within an amber colored dome. Sealed beams shall be at least 60,000 Candlepower and shall have a flash rate of 80 to 100 flashes per minute. Rotating lights shall be approximately 8½ inches or greater in diameter and height (6 inches**

in height for multi-light bars). Rotating lights shall be mounted as to be viewed 360 degrees; double lights may be used to achieve 360 degree viewing.

- 2. High intensity amber strobe lights shall consist of a double flash unit enclosed within an amber colored lens. Flash rate shall be 80±10 flashes per minute. Strobe lights shall be approximately 6 inches in diameter and 7½ inches in height or greater. Strobe lights shall be mounted as to be viewed 360 degrees; double lights may be used to achieve 360 degree viewing.**

Guidance:

During night operations, vehicles entering and exiting the work area should be equipped with and have operating at least one rotating amber light or high intensity amber strobe light.

Section 6F.75 Temporary Traffic Control Signals

Standard:

Temporary traffic control signals used to control road user movements through temporary traffic control zones and in other temporary traffic control situations shall meet the applicable provisions of Part 4 of the MUTCD.

Support:

Temporary traffic control signals are typically used in work 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:

One-lane, two-way motor vehicle traffic flow (see Chapter 4G of the MUTCD) requires all-red interval of sufficient duration for road users to clear the portion of the temporary traffic control zone controlled by the traffic control signals. Safeguards shall be incorporated to avoid the possibility of conflicting signal indications at each end of the temporary traffic control zone. All equipment shall be in compliance with the current national standard and in excellent working condition.

Guidance:

When temporary traffic control signals are used, conflict monitors typical of traditional traffic control signal operations should be used.

Standard:

The District Traffic Engineer shall determine which traffic control signal will be used - portable or temporarily mounted on fixed supports.

Option:

Temporary traffic control signals may be portable or temporarily mounted on fixed supports.

Guidance:

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 motor vehicle traffic movements, using flaggers to control one-way or crossing movements, using STOP or YIELD signs, and using warning devices alone.

Temporary traffic control signals not in use should be covered or removed.

Section 6F.76 Temporary Traffic Barriers**Support:**

Temporary traffic barriers are devices designed to help prevent penetration by vehicles while minimizing injuries to vehicle occupants, and designed to protect workers, bicyclists, and pedestrians.

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 vehicular 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:

Temporary traffic barriers, including shifting portable or movable barrier installations to accommodate varying directional motor vehicle traffic demands, may be used to separate two-way motor vehicle traffic.

Guidance:

Because the protective requirements of a temporary traffic control 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 motor vehicle traffic, temporary traffic barriers should be a light color for increased visibility.

Standard:

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 motor vehicle traffic. The delineation or pavement marking color shall match the applicable pavement marking color.

When serving the additional function of channelizing traffic, portable barriers should be of a light color for increased visibility. More specific information on the use and design of portable barriers and impact attenuators can be obtained from chapters 8 and 9

respectively, of the AASHTO Roadside Design Guide. For nighttime visibility, barriers shall be supplemented with delineators, barrier vertical panels and a flashing light.

Barrier vertical panels 8 inches in width and 12 inches in height shall be installed on top of the barrier. Panels shall be installed on 48 foot centers in the transition or taper sections and on 96 foot centers in the tangent sections. A Type A flashing light shall be installed on the barrier at the breakpoint where the transition or taper ends and the barrier becomes parallel to the roadway. Barrier vertical panels shall have a fluorescent orange retroreflective surface in the direction of oncoming traffic.

The effect of striking the ends of barriers shall be mitigated by 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 a cut slope exists, the barrier shall be buried into the cut slope. Drainage shall be provided as needed.
3. Extend end of barrier until it is beyond the established Clear Zone.
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 Special Design Section for type and quantity needed for each location.

Support:

A movable barrier is a linear system of connected barrier segments that can rapidly be shifted laterally by using a specially designed transfer vehicle. The transfer is accomplished in a manner that does not interfere with motor vehicle traffic in adjacent lanes. Applications of movable barriers 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 motor vehicle traffic flow; and
- C. Creating a temporary reversible lane, thus providing unbalanced capacity favoring the major direction of motor vehicle traffic flow.

More specific information on the use of temporary traffic barriers is contained in Chapters 8 and 9 of AASHTO's "Roadside Design Guide".

Section 6F.77 Crash Cushions

Support:

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 temporary traffic control zones are stationary crash cushions and truck-mounted attenuators. Crash cushions in temporary traffic control 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".

Standard:

Crash cushions shall be crashworthy conforming to the requirements of National Cooperative Highway Research Program Report (NCHRP) 350, except as otherwise indicated herein. 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:

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:

Stationary crash cushions shall be designed for the specific application intended.

Truck-mounted attenuators (TMA's) shall be energy-absorbing devices attached to the rear of shadow trucks when conditions warrant.

Support:

Trucks 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 rotating/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. The most effective placement of the shadow vehicle is in advance of the first work crew, equipment, or hazard the traveling motorist would encounter.

Standard:

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 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 District Traffic Engineer feels such protection is warranted.**

TMA units used on all Limited Access highways, as well as on all four or more lane primary roadways with posted speeds of 55 mph or greater, shall ne NCHRP 350, Test Level 3 units. On July 1, 2005, all TMA units shall conform to the requirements of NCHRP 350, Test Level 3 regardless of where the units will be used.

Option:

NCHRP 230 and NCHRP 350, Test Level 2 units may be used on all roadways except Limited Access Highways and four or more lane Primary roadways with posted speeds of 55 mph or greater until July 1, 2005.

Standard:

The shadow truck with a TMA shall be positioned a sufficient distance (50-100 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.

When all work crews, equipment, or hazards have been sufficiently removed from the lane closure, the shadow truck shall be removed.

Support:

Shadow trucks should be used when installing and removing lane closures from the roadway. In mobile operations, the shadow truck with a truck-mounted attenuator should be 1000 feet ± in advance of the work vehicle.

Option:

Shadow trucks with TMA's may be eliminated when their use would destroy or damage uncured asphalt.

For additional operations or hazards located further downstream from the taper, a shadow vehicle without a truck-mounted attenuator may be used for protection, placed a sufficient distance (50-100 feet) in advance of the hazard.

Support:

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 applications (except pavement marking tape being inlaid into the new asphalt surface), and other similar type operations.

Standard:

During operation as a shadow vehicle with a TMA, the truck shall not be used as a work operations vehicle. All material and/or equipment on the shadow vehicle TMA shall be properly secured to prevent spillage if struck by an errant vehicle.

Guidance:

The attenuator should be in the full down-and-locked position when in use. For stationary operations, the truck's parking brake should be set and the front wheels positioned straight ahead.

Support:

Chapter 9 of AASHTO's "Roadside Design Guide" contains additional information regarding the use of shadow vehicles with TMA's.

Standard:

The TMA shall be used in accordance with the manufacturer's specifications.

Section 6F.78 Vehicle-Arresting Systems**Support:**

Vehicle-arresting systems are designed to prevent penetration into activity areas while providing for smooth, safe deceleration for the errant vehicles. They can consist of portable netting, cables, and energy-absorbing anchors.

Guidance:

When used, a vehicle-arresting system should be used in accordance with the manufacturer's specifications, and should be located so that vehicles are not likely to penetrate the location that the system is designed to protect.

Section 6F.79 Rumble Strips**Support:**

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.

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.

Option:

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 rumble strip installation.

Guidance:

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.

In urban areas, even though a closer spacing might be warranted, transverse rumble strips should be designed in a manner that does not promote panic braking or erratic steering maneuvers by road users.

Transverse rumble strips should not be placed on sharp horizontal or vertical curves.

Rumble strips should not be placed through pedestrian crossings or bicycle routes

Sections 6F.80 Screens

Support:

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:

Screens should not be mounted where they could adversely restrict motorist visibility and sight distance and adversely affect the safe operation of vehicles.

Screens should be mounted on the top of temporary traffic barriers that separate two-way motor vehicle traffic, especially in crossover areas.

Design of screens should be in accordance with Chapter 9 of AASHTO's "Roadside Design Guide".

Section 6F.81 Future and Experimental Devices

Support:

Virginia, as well as other States, FHWA, AASHTO, the Transportation Research Board, and other organizations conduct research and experimentation on new traffic control and safety devices. Users of this Manual are encouraged to stay abreast of these current efforts and to use such devices with care so as to avoid presenting road users with unusual or confusing situations that might be abnormal or unexpected.

Standard:

New traffic control devices shall conform to the provisions for design, use, and application set forth in this Manual. New traffic control devices that do not conform with the provisions in this Manual shall be subject to experimentation, documentation, and adoption following the provisions of Section 1A.10 of the MUTCD.

Approval shall be obtained from the Mobility Management Division Administrator of the Virginia Department of Transportation for new traffic control devices prior to their use and/or implementation.

CHAPTER 6G. TYPE OF TEMPORARY TRAFFIC CONTROL ZONE ACTIVITIES

Section 6G.01 Typical Applications

Support:

Each temporary traffic control zone is different. Many variables, such as location of work, road type, geometrics, vertical and horizontal alignment, intersections, interchanges, road user volumes, road vehicle mix (buses, trucks, and cars), and road user speeds affect the needs of each zone. The goal of temporary traffic control in work zones is safety with minimum disruption to road users. The key factor in promoting temporary traffic control zone safety is proper judgment.

Typical figures of temporary traffic control zones are organized according to duration, location, type of work, and highway type. Table 6H-1 is an index of these Typical Traffic Control (TTC) figures. These typical figures include the use of various temporary traffic control methods, but do not include a layout for every conceivable work situation.

Guidance:

Typical traffic control figures should be altered, when necessary, to fit the conditions of a particular temporary traffic control zone. The alteration should be documented.

Option:

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:

Decisions regarding the selection of the most appropriate typical traffic control figure to use as a guide for a specific temporary traffic control zone require an understanding of each situation. Although there are many ways of categorizing work 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:

Work duration is a major factor in determining the number and types of devices used in temporary traffic control zones. The duration of a temporary traffic control zone is defined relative to the length of time a work operation occupies a spot location.

Standard:

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, but less than 12 hours.**
- D. Short duration is work that occupies a location from 15 minutes up to 1 hour.**
- E. Mobile is work that moves intermittently (0 – 15 minutes) or continuously.**

Support:

At long-term stationary temporary traffic control zones, there is ample time to install and realize benefits from the full range of temporary traffic control procedures and devices that are available for use. Generally, increased number of channelizing devices, temporary roadways, and temporary traffic barriers are used.

Standard:

Since long-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in long-term stationary temporary traffic control zones. Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned devices.

Guidance:

Inappropriate pavement markings in long-term stationary temporary traffic control zones should be removed and replaced with temporary markings.

Support:

In intermediate-term stationary temporary traffic control zones, it may not be feasible or practical to use procedures or devices that would be desirable for long-term stationary temporary traffic control 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. In other instances, there might be insufficient pay-back time to economically justify more elaborate temporary traffic control measures.

Standard:

Since intermediate-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in intermediate-term stationary temporary traffic control zones. Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned devices.

Support:

Most maintenance and utility operations are short-term stationary work.

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 and use of portable changeable message signs. Devices that are larger, more imposing, or more

visible can be used effectively and economically. The mobility of the temporary traffic control zone is important.

Maintaining safe work and road user conditions is a paramount goal in carrying out mobile operations.

Guidance:

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:

Appropriately colored or marked vehicles with rotating/strobe lights, and augmented with signs or arrow panels, may be used in place of static signs and channelizing devices for short duration or mobile operations.

Support:

During short-duration work, it often takes longer to set up and remove the temporary traffic control zone than to perform the work. Workers face hazards in setting up and taking down the temporary traffic control zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed.

Option:

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 rotating lights or strobe lights on work vehicles.

Support:

Mobile operations often involve frequent short stops, each less than 15 minutes, for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations.

Guidance:

Warning signs, rotating/strobe lights on a vehicle, and/or channelizing devices should be used and moved periodically to keep them near the mobile work area.

Option:

Flaggers may also be used for mobile operations.

Support:

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:

When mobile operations are being performed, a shadow vehicle equipped with an arrow panel or a sign should follow the work vehicle, especially when motor vehicle traffic speeds or volumes are high. Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.

Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.

Standard:

If there are mobile operations on a high-speed travel lane of a multilane divided highway, arrow panels 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).

Option:

For mobile operations that move at speeds less than 3 mph, mobile signs or stationary signing that is periodically retrieved and repositioned in the advance warning area may be used.

At higher speeds, vehicles may be used as components of temporary traffic control zones for mobile operations. Appropriately colored and marked vehicles with signs, rotating/strobe lights, truck-mounted attenuators, and arrow panels or portable changeable message signs may follow a train of moving work vehicles.

For some continuously moving operations, such as street cleaning and snow removal, a single work vehicle with appropriate warning devices on the vehicle may be used to provide warning to approaching road users.

Standard:

Mobile operations that move at speeds greater than 20 mph, such as pavement marking operations, shall have appropriate devices on the equipment (that is, rotating lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.

Section 6G.03 Location of Work and Roadway Characteristics

Support:

The choice of temporary traffic control needed for a temporary traffic control zone depends upon where the work is located and the roadway characteristics. As a general rule, the closer the work is to road users, the greater the number of temporary traffic control devices that are needed. Procedures are described later in this Chapter for establishing temporary traffic control 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:

When the work space is within the traveled way, except for mobile operations, advance warning shall provide a general message that work is taking place, shall supply information about highway conditions, and shall indicate how motor vehicle traffic can move through the temporary traffic control zone.

Section 6G.04 Modifications To Fulfill Special Needs

Support:

The typical traffic control figures in Chapter 6H illustrate commonly encountered situations in which temporary traffic control 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:

Other devices may be added to supplement the devices indicated in the typical traffic control figures, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical traffic control figures, fewer devices may be needed.

Guidance:

When conditions are more complex, typical traffic control figures should be modified by incorporating appropriate devices and practices from the following list:

A. Additional devices:

- 1. Signs*
- 2. Arrow panels*
- 3. More channelizing devices at closer spacing*
- 4. Temporary raised pavement markers*
- 5. High-level warning devices*
- 6. Portable changeable message signs*
- 7. Temporary traffic 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*

Support:

Uniformity of devices and their application is always of paramount importance.

As noted earlier, temporary traffic barriers are not temporary traffic control devices in themselves; however, when placed in a position identical to a line of channelizing devices and marked and equipped with appropriate channelization features to provide guidance and warning both day and night, they serve as temporary traffic control devices.

Standard:

Temporary traffic barriers serving as temporary traffic control devices shall conform to requirements for such devices as set forth throughout this manual.

Section 6G.05 Work Outside of Shoulder

Support:

When work is being performed off the roadway (beyond the shoulders, but within the right-of-way), little temporary traffic control may be needed. Temporary traffic control 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, temporary traffic control is appropriate where distracting situations exist, such as vehicles parked on the shoulder, vehicles accessing the work site 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 TTC-1.0 and TTC-2.0.

Guidance:

Where the above situations exist, a single warning sign, such as "ROAD WORK AHEAD", should be used. If the equipment travels on the roadway, the equipment should be equipped with appropriate flags, rotating/strobe lights, and/or a SLOW MOVING VEHICLE symbol.

If work vehicles or equipment are on the shoulder, a "SHOULDER WORK AHEAD" sign should be used. For mowing operations, the sign "MOWING AHEAD" and "WATCH FOR SLOW MOVING VEHICLES" should be used.

Option:

Where the activity is spread out over a distance of more than 2 miles, the “SHOULDER WORK AHEAD” sign may be repeated every 1 mile.

A supplementary plaque with the message “NEXT X MILES” may be used.

Guidance:

A general warning sign like “ROAD MACHINERY AHEAD” should be used if workers and equipment must occasionally move closer to the traveled way.

Section 6G.06 Work on the Shoulder with No Encroachment**Support:**

The provisions of this Section apply to short-term through long-term stationary operations.

Standard:

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:

When a highway shoulder is occupied, a “SHOULDER WORK AHEAD” sign, except for short duration and mobile operations, should be placed in advance of the activity area. When work is performed on a paved shoulder 8 foot or more in width, channelizing devices should be placed on a taper having a length that conforms to the requirements of a shoulder taper.

When paved shoulders having a width of 8 foot or more are closed on expressways and freeways, 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”) should be used, followed by a “RIGHT” or “LEFT SHOULDER CLOSED AHEAD” sign. Where the end of the shoulder closure extends beyond the distance which can be perceived by road users, a supplementary plaque bearing the message “NEXT XX FEET” or “MILES” should be placed below the “SHOULDER CLOSED AHEAD” sign. On multilane, divided highways, signs advising of shoulder work or the condition of the shoulder should be placed only on the side of the affected shoulder.

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 temporary traffic control zone. The sign(s) should read “SHOULDER CLOSED AHEAD” with distances indicated. The work space on the shoulder should be closed off by a taper or channelizing devices with a length of $0.33 L$ using the formulas in Table 6C-2.

When the shoulder is not occupied but work has adversely affected its condition, the “LOW SHOULDER” or “SOFT SHOULDER” sign should be used, as appropriate.

Where the condition extends over a distance in excess of 1 mile, the sign should be repeated at one (1) mile intervals.

Option:

In addition, a supplementary plaque bearing the message “NEXT X MILES” may be used. Temporary traffic barriers may be needed to inhibit encroachment of errant vehicles into the work space and to protect workers.

Standard:

When used for shoulder work, arrow panels shall operate in the four-corner caution mode only.

Support:

A typical traffic control figure for stationary work operations on shoulders is shown in Figure TTC-4.0. Short duration or mobile work on shoulders is shown in Figure TTC-3.0. Work on freeway shoulders is shown in Figure TTC-6.0.

Section 6G.07 Work on the Shoulder with Minor Encroachment

Guidance:

When work takes up part of a lane, motor vehicle traffic volumes, vehicle mix (buses, trucks, and cars), 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.

Truck off-tracking should be considered when determining whether the minimum lane width of 10 feet is adequate when working on Exit ramps (See TTC- 27.0).

Option:

A lane width of 10 feet may be used for short-term stationary work on low-volume (less than 500 vehicles per day), low-speed (under 45 mph) roadways when motor vehicle traffic does not include longer and wider heavy commercial vehicles.

Support:

Figure TTC-5.0 illustrates a method for handling motor vehicle traffic where the stationary or short duration work space encroaches slightly into the traveled way.

Section 6G.08 Work Within the Median

Guidance:

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, temporary traffic control should be used through the use of advance warning signs and channelizing devices.

Section 6G.09 Work Within the Traveled Way of Two-Lane Highways

Support:

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. Examples of typical applications for detouring or diverting road users on two-lane highways can be found in Figures 6H-7, 6H-8, and 6H-9 of the MUTCD.

Standard:

Detours and diversions shall be reviewed and approved by the District Traffic Engineer prior to implementation.

Guidance:

When a detour is long, Detour Marker (M4-8) or Detour (M4-9) signs should be installed to remind and reassure road users periodically that they are still successfully following the detour.

When an entire roadway is closed, a detour should be provided and road users should be warned in advance of the closure. If local road users are allowed to use the roadway up to the closure, the "ROAD CLOSED TO THRU TRAFFIC" sign should be used. The portion of the road open to local road users should have adequate signing, marking, and delineation.

Detours should be signed so that road users will be able to traverse the entire detour route and back to the original roadway.

Support:

Techniques for controlling motor vehicle traffic under one-lane, two-way conditions are described in Section 6C.10.

Option:

Flagger may be used as shown in Figure TTC-18.0.

Section 6G.10 Work Within the Traveled Way of Urban Streets

Support:

In urban temporary traffic control zones, decisions are needed on how to control motor vehicle traffic, such as how many lanes are required, whether any turns should be prohibited at intersections, and how to maintain access to business, industrial, and residential areas. Pedestrian traffic needs separate attention. Chapter 6D contains information regarding controlling pedestrian movements near work zones.

Standard:

If the temporary traffic control zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided.

If the temporary traffic control zone affects the movement of bicyclists, adequate access to the roadway, bicycle paths, or shared-use paths shall be provided (see Part 9 of the MUTCD for additional guidance).

Guidance:

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.

Support:

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 temporary traffic control devices placed in the temporary traffic control zone is usually minimal.

Standard:

All temporary traffic control devices shall be retroreflective or illuminated if utility work is performed during nighttime hours.

Guidance:

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 rotating lights or strobe lights on work vehicles.

Support:

Figures TTC-17.0, TTC-18.0, TTC-20.0, TTC-21.0, TTC-22.0, and TTC-23.0 are examples of typical applications for utility operations. Other typical applications might apply as well.

Section 6G.11 Work Within the Traveled Way of Multilane, Nonaccess Controlled Highways

Support:

Work on multilane (two or more lanes 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:

When a lane is closed on a multilane road, a transition area containing a merging taper and an arrow panel display shall be used.

Guidance:

When justified by an engineering study, temporary traffic barriers should be used to prevent incursions of errant vehicles into hazardous areas or work space.

Standard:

When temporary traffic barriers are placed immediately adjacent to the traveled way, they shall be equipped with appropriate channelizing devices, delineation, and/or other temporary traffic control devices. For lane closures, the merging taper shall use channelizing devices and the temporary traffic barrier shall be placed beyond the transition area.

Support:

It must be recognized that although temporary traffic barriers are shown in several of the typical applications of Chapter 6H, they are not considered to be temporary traffic control devices in themselves.

Figure TTC-16.0 illustrates a lane closure in which temporary traffic barriers are used.

There are four primary functions of temporary traffic barriers:

- A. To keep motor vehicle 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 motor vehicle traffic; and
- D. To separate motor vehicle traffic, bicyclists, and pedestrians from the work area such as false work for bridges and other exposed objects.

Option:

When the right lane is closed, temporary traffic control similar to that shown in Figure TTC-16.0 may be used for undivided or divided four-lane roads.

Guidance:

If morning and evening peak hourly motor vehicle 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 lane, consideration should be given to closing the inside lane for opposing motor vehicle traffic and making the lane available to the side with heavier motor vehicle traffic.

If morning and evening peak hourly motor vehicle 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 lane, consideration should be given to closing the inside lane for opposing motor vehicle traffic and making the lane available to the side with heavier motor vehicle traffic.

If the larger motor vehicle traffic volume changes to the opposite direction at a different time of the day, the temporary traffic control should be changed to allow two lanes for opposing motor vehicle traffic by moving the devices from the opposing lane back to the centerline. When it is necessary to create a temporary centerline that is not consistent with the pavement markings, channelizing devices should be used and closely spaced.

Option:

When closing a left lane on a multilane undivided road, as motor vehicle traffic flow permits, the two interior lanes may be closed to provide drivers and workers additional lateral clearance and to provide access to the work space.

Standard:

When only the left lane is closed on undivided roads, channelizing devices shall be placed along the centerline as well as along the adjacent lane.

Guidance:

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.

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. Motor vehicle traffic should be moved over one lane at a time. As shown in Figure TTC-14.0, the tapers should be separated by a distance of $2L$, with L being determined by the formulas in Table 6C-2.

Standard:

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:

When half the road is closed on an undivided highway, both directions of motor vehicle traffic may be accommodated as shown in Figure TTC-30.0. When both interior lanes are closed, temporary traffic controls may be used as indicated in Figure TTC 14.0 for both directions of travel. When a roadway must be closed on a divided highway, a median crossover may be used (see Section 6G.15).

Support:

Temporary traffic control for lane closures on five-lane roads is similar to other multilane undivided roads. Figure TTC-30.0 can be adapted for use on five-lane roads. Figure TTC9.0 can be used on a five-lane road for short duration and mobile operations.

Section 6G.12 Work Within the Traveled Way at an Intersection

Support:

The typical traffic control 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

temporary traffic control plan is obtained by combining features shown in two or more of the intersection and pedestrian typical applications.

Temporary traffic control 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, and signal detectors for actuated control.

Guidance:

The effect of the work upon signal operation should be considered, such as signal phasing for ensuring adequate capacity, maintaining or adjusting signal detectors, and ensuring the appropriate visibility of signal heads.

Standard:

When work will occur near signalized intersections where operational and capacity problems are anticipated, VDOT or the agency having jurisdiction shall be contacted.

Guidance:

When work will occur near non-signalized intersections where operational and capacity problems are anticipated, the highway agency having jurisdiction should be contacted.

For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical traffic control figures depict urban intersections on arterial streets. Where the posted speed limit, the off-peak 85th- percentile speed prior to the work starting, or the anticipated speed exceeds 40 mph, additional warning signs should be used in the advance warning area.

Support:

Near-side work spaces, as depicted in FigureTTC-20.0, 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:

When near-side work spaces are used, an exclusive turn lane may be used for through motor vehicle traffic.

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 regulatory sign (such as “KEEP LEFT”) may be placed within the transition area.

Support:

Far-side work spaces, as depicted in Figure TTC-21.0, involve additional treatment because road users typically enter the activity area by straight-through and left- or right-turning movements.

Guidance:

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.

Option:

If, however, 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:

Figure TTC-22.0 provides guidance on applicable procedures for work performed within the intersection.

Option:

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 Fig. TTC-22.0;
- B. Flaggers to assign the right-of-way to each leg entering the intersection;
- C. Work in stages so the work space is kept small; and
- D. Road closures or upstream diversions to reduce road user volumes.

Guidance:

Depending on road user conditions, flaggers and/or a uniformed law enforcement officer(s) should be used to control road users.

Section 6G.13 Work Within the Traveled Way of Expressways and Freeways

Support:

Problems of temporary traffic control might occur under the special conditions encountered where motor vehicle traffic must be moved through or around temporary traffic control 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 safely and efficiently accommodate motor vehicle traffic while also protecting work forces. The road user volumes, road vehicle mix (buses, trucks, and cars), and speed of vehicles on these facilities require that careful temporary traffic control 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 motor vehicle 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.

Work under high-speed, high-volume motor vehicle 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 motor vehicle traffic flow might prohibit the closing of one of the roadways or the diverting of motor vehicle traffic to the other roadway. Lack of access to and from adjacent roadways prohibits rerouting of motor vehicle 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.

Temporary traffic control for a typical lane closure on a divided highway is shown in Figures TTC 12.0 and TTC 13.0. Temporary traffic controls for short duration and mobile operations on freeways are shown in Figure TTC-8.0. A typical application for shifting motor vehicle traffic lanes around a work space is shown in Figure TTC-15.0. Temporary traffic control for multiple and interior lane closures on a freeway is shown in Figure TTC-14.0.

Guidance:

The method for closing an interior lane when the open lanes have the capacity to carry motor vehicle traffic should be as shown in Figure TTC-14.0.

Section 6G.14 Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway

Support:

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:

When two-lane, two-way traffic control must be maintained on one roadway of a normally divided highway, opposing motor vehicle traffic shall be separated with either temporary traffic barriers (concrete safety-shape or approved alternate) or with channelizing devices throughout the length of the two-way operation. The use of markings and complementary signing, by themselves, shall not be used.

Support:

Figure 6H-39 of the MUTCD 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 MUTCD. Modifications to any of these layouts must first be reviewed and approved by the District Traffic Engineer prior to their use.

Section 6G.15 Crossovers

Guidance:

The following are considered good guiding principles for the design of crossovers:

- A. Tapers for lane drops should be separated from the crossovers.*
- 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, glare screens along the crossover, and full-length, properly placed pavement markings should be used to provide drivers with a clearly defined travel path.*
- D. *The design of the crossover should accommodate all motor vehicle traffic, including trucks and buses.*

Support:

Temporary traffic barriers and the excessive use of temporary traffic control devices cannot compensate for poor geometric and roadway cross-section design of crossovers.

Section 6G.16 Interchanges

Guidance:

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:

If access is not possible, ramps may be closed by using signs and Type III barricades. As the work space changes, the access area may be changed, as shown in Figure TTC-26.0. A temporary traffic control zone in the exit ramp may be handled as shown in Figure TTC-27.0.

When a work space interferes with an entrance ramp, a lane may need to be closed on the freeway. A temporary traffic control zone in the entrance ramp may require shifting ramp motor vehicle traffic. Temporary traffic control for both operations is shown in Figure TTC-28.0.

Section 6G.17 Movable Barriers

Support:

Figure 6H-45 of the MUTCD shows a temporary reversible lane using movable barriers.

Standard:

Modifications to Figure 6H-45 of the MUTCD shall be reviewed and approved by the District Traffic Engineer prior to its use.

Option:

If the work activity in Figure TTC-16.0 permits, a movable barrier may be used and relocated to the shoulder during nonwork periods or peak-period motor vehicle traffic conditions.

Section 6G.18 Work in the Vicinity of Highway-Rail Grade Crossings

Standard:

When highway-rail grade crossings exist either within or in the vicinity of a temporary traffic control zone, lane restrictions, flagging, or other operations shall not create conditions where vehicles can be stopped on the railroad tracks with no means of escape.

If the queuing of vehicles across the tracks cannot be avoided, a law enforcement officer or 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:

Figure 6H-46 of the MUTCD shows work in the vicinity of a highway-rail grade crossing.

Guidance:

Early coordination with the railroad company should occur before work starts.

Section 6G.19 Control of Traffic Through Incident Areas

Support:

An incident is an emergency road user occurrence, a natural disaster, or a special event. The primary functions of temporary traffic control at an incident area are to move road users safely and expeditiously through or around the incident, and to reduce the likelihood of secondary crashes. Examples include a stalled vehicle blocking a lane, a road user crash blocking the traveled way, a chemical spill along a highway, floods and severe storm damage, a planned visit by a dignitary, or a major sporting event.

Guidance:

In order to reduce response time for incident management, highway agencies municipalities should preplan for occurrences of incidents along the major and heavily traveled highway and street system. Special events should be planned for and coordinated in advance.

Support:

While some incidents might be anticipated and planned for, emergencies and disasters might pose more severe and unpredictable problems. The ability to install proper temporary traffic control might greatly reduce the effects of an emergency. An essential part of fire, rescue, spill clean-up, and enforcement activities is the proper control of road users through the incident area.

These operations 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 temporary traffic control to respond to the needs of changing conditions found in incident areas.

Option:

For unexpected incidents, particularly those of an emergency nature, temporary traffic control devices on hand may be used for the initial response as long as they do not themselves create unnecessary additional hazards.

Standard:

If the incident is anticipated to last more than 3 days, applicable procedures and devices set forth in this manual shall be used.

Support:

A short-term road closure can be caused by an incident such as a road user crash that blocks the traveled way. Road users are usually detoured around the incident and back to the original roadway. A combination of traffic engineering and enforcement preparations is needed to determine the detour route and install the necessary devices. Large trucks are a significant concern in such a detour.

During 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 cargo might need to follow a different route from other vehicles.

Some incidents such as hazardous spills might require closure of an entire highway. Through road users must have adequate guidance around the incident.

Maintaining good public relations is desirable. The cooperation of the news media in publicizing the existence of and reasons for incident areas and their temporary traffic control can be of great assistance in keeping road users and the general public well informed.

Guidance:

The channelizing devices discussed in Section 6F.55 should be used whenever possible.

When flares are used to initiate temporary traffic control at incidents or for short-term temporary traffic control, they should be replaced by more permanent devices as soon as practical. Both the flare and its supporting device should be removed from the roadway.

Section 6G.20 Work During Inclement Weather

Support:

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 to slow and stop a motor vehicle; An increase in the difficulty of controlling a motor vehicle; and An increase in distraction and anxiety for road users while traveling on the roadway

Guidance:

Therefore, planned work activities should be avoided, if possible, during inclement weather conditions.

Option:

Emergency operations, however, may be performed where inaction would be worst than allowing the condition to remain unattended.

CHAPTER 6H. TYPICAL TRAFFIC CONTROL FIGURES

Section 6H.01 Typical Traffic Control Figures

Support:

Chapter 6G contains discussions of typical temporary traffic control activities. Chapter 6H presents typical traffic control figures 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 temporary traffic control 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 traffic control figures, while a third typical traffic control figure shows how to handle pedestrian crosswalk closures.

Procedures for establishing temporary traffic control 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, and cars), and road user speeds. Examples presented in this Chapter are guides 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:

Other devices may be added to supplement the devices and device spacing may be adjusted to provide additional reaction time or delineation as long as they don't add confusion or cause unnecessary lane changing maneuvers. Fewer devices may be used based on field conditions.

Support:

Figures and tables found throughout Part 6 provide information for the development of temporary traffic control plans. Table 6C-2 is used for the determination of taper lengths, while Table 6C-1 can be used for sign spacing for various area and roadway types.

Table 6H-1 is an index of the 38 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 Table 6H-2. In many of the TTC figures, sign spacing and other dimensions are indicated in the notes to the left of the figure.

Some of the TTC figures show temporary traffic control devices for only one direction.

Table 6H-1 Index to Typical Traffic Control Figures and Notes

Type Of Operation	<i>Figure Number</i>	<i>Page Numbers</i>
Work Outside of Shoulder		
WORK BEYOND THE SHOULDER OPERATION	TTC-1.0	6H-6, 6H-7
BLASTING ZONE OPERATION	TTC-2.0	6H-8, 6H-9
Work on the Shoulder		
MOBILE OR SHORT DURATION ON SHOULDER OPERATION	TTC-3.0	6H-10,6H-11
STATIONARY OPERATION ON SHOULDER	TTC-4.0	6H-12,6H-13
SHOULDER CLOSURE WITH BARRIER AND LANE SHIFT OPERATION	TTC-5.0	6H-14,6H-15
SHOULDER CLOSURE WITH BARRIER OPERATION	TTC-6.0	6H-16,6H-17
MOWING OPERATION WITH ENCROACHMENT	TTC-7.0	6H-18,6H-19
Work Within the Travelway		
MOVING/MOBILE OPERATIONS ON LIMITED ACCESS HIGHWAYS	TTC-8.0	6H-20,6H-21
MOVING/MOBILE OPERATION ON MULTI-LANE ROADWAY	TTC-9.0	6H-22,6H-23
MOBILE/MOVING OPERATION ON TWO-LANE ROADWAY	TTC-10.0	6H-24,6H-25
SHORT DURATION OPERATION ON MULTI-LANE ROADWAY	TTC-11.0	6H-26,6H-27
OUTSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY	TTC-12.0	6H-28,6H-29
INSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY	TTC-13.0	6H-30,6H-31
MULTI-LANE CLOSURE OPERATION	TTC-14.0	6H-32,6H-33
LANE CLOSURE OPERATION WITH LANE WEAVE	TTC-15.0	6H-34,6H-35
LANE CLOSURE OPERATION WITH TRAFFIC BARRIER	TTC-16.0	6H-36,6H-37
CENTER TURN LANE CLOSURE OPERATION	TTC-17.0	6H-38,6H-39
FLAGGING OPERATION ON TWO-LANE ROAD	TTC-18.0	6H-40,6H-41
NON-STATIONARY FLAGGING OPERATION ON TWO-LANE ROAD	TTC-19.0	6H-42,6H-43

Table 6H-1 Index to Typical Traffic Control Figures and Notes

Type Of Operation	Figure Number	Page Numbers
Work Within the Travelway at an Intersection and Sidewalks		
LANE CLOSURE OPERATION – NEAR SIDE OF INTERSECTION	TTC-20.0	6H-44, 6H-45
LANE CLOSURE OPERATION – FAR SIDE OF INTERSECTION	TTC-21.0	6H-46, 6H-47
CLOSURE OPERATION IN INTERSECTION	TTC-22.0	6H-48, 6H-49
TURN LANE CLOSURE OPERATION	TTC-23.0	6H-50, 6H-51
SIDEWALK CLOSURE AND BYPASS SIDEWALK OPERATION	TTC-24.0	6H-52, 6H-53
CROSSWALK CLOSURE AND PEDESTRIAN DETOUR OPERATION	TTC-25.0	6H-54, 6H-55
Work Within the Travelway of Multi-Lane Highways		
WORK OPERATION IN THE VICINITY OF EXIT RAMPS	TTC-26.0	6H-56, 6H-57
PARTIAL RAMP CLOSURE OPERATION	TTC-27.0	6H-58, 6H-59
WORK OPERATION IN THE VICINITY OF ENTRANCE RAMPS	TTC-28.0	6H-60, 6H-61
MULTI-LANE SHIFT OPERATION	TTC-29.0	6H-62, 6H-63
HALF ROAD CLOSURE OPERATION ON MULTI-LANE ROADWAY	TTC-30.0	6H-64, 6H-65
TOTAL FREEWAY CLOSURE OPERATION	TTC-31.0	6H-66, 6H-67
Specialty Operations Within the Travelway		
SURVEYING OPERATIONS	TTC-32.0	6H-68, 6H-69
TEMPORARY DISRUPTION OPERATION ON MULTI-LANE ROADWAY	TTC-33.0	6H-70, 6H-71
HAUL ROAD CROSSING OPERATION	TTC-34.0	6H-72, 6H-73
SIGNING FOR REDUCED SPEEDS IN WORK ZONES	TTC-35.0	6H-74, 6H-75
SIGNING FOR PROJECT LIMITS	TTC-36.0	6H-76, 6H-77
MOTORIST SURVEY OPERATION ON TWO-LANE ROADWAY	TTC-37.0	6H-78, 6H-79
ERADICATION OF PAVEMENT MARKINGS IN WORK ZONES	TTC-38.0	6H-80, 6H-81
WORK IN THE VICINITY OF HIGHWAY-RAIL CROSSING	TTC-39.0	6H-82, 6H-83

Table 6H-3 Buffer Space Length

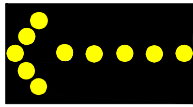
Speed* (mph)	Distance (feet)
20	120
25	160
30	200
35	250
40	310
45	360
50	425
55	500
60	570
65	650

*** Note: Posted Speed of the
Temporary Traffic Control Zone.**

**Table 6H-4 Flagger Distance From Work
Space**

Speed* (mph)	Distance (feet)
20	120
25	160
30	200
35	250
40	310
45	360
50	425
55	500
60	570
65	650

**Values May be Increased for Down
Grades for Either Table.**



ARROW PANEL



CHANGEABLE MESSAGE SIGN SUPPORT OR TRAILER



ARROW PANEL ON TRAILER



ARROW PANEL ON VEHICLE



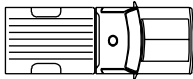
CHANNELIZING DEVICE



DIRECTION OF TRAFFIC



FLAGGER



WORK VEHICLE



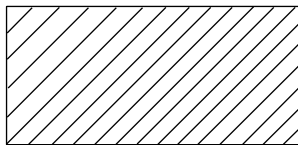
SIGN



TRUCK MOUNTED ATTENUATOR



FLASHERS



WORK SPACE

FIGURE 6H-1 SYMBOLS USED IN TYPICAL APPLICATION DRAWINGS

**TYPICAL TRAFFIC CONTROL
WORK BEYOND THE SHOULDER OPERATION
(FIGURE TTC-1.0)**

NOTES

Guidance:

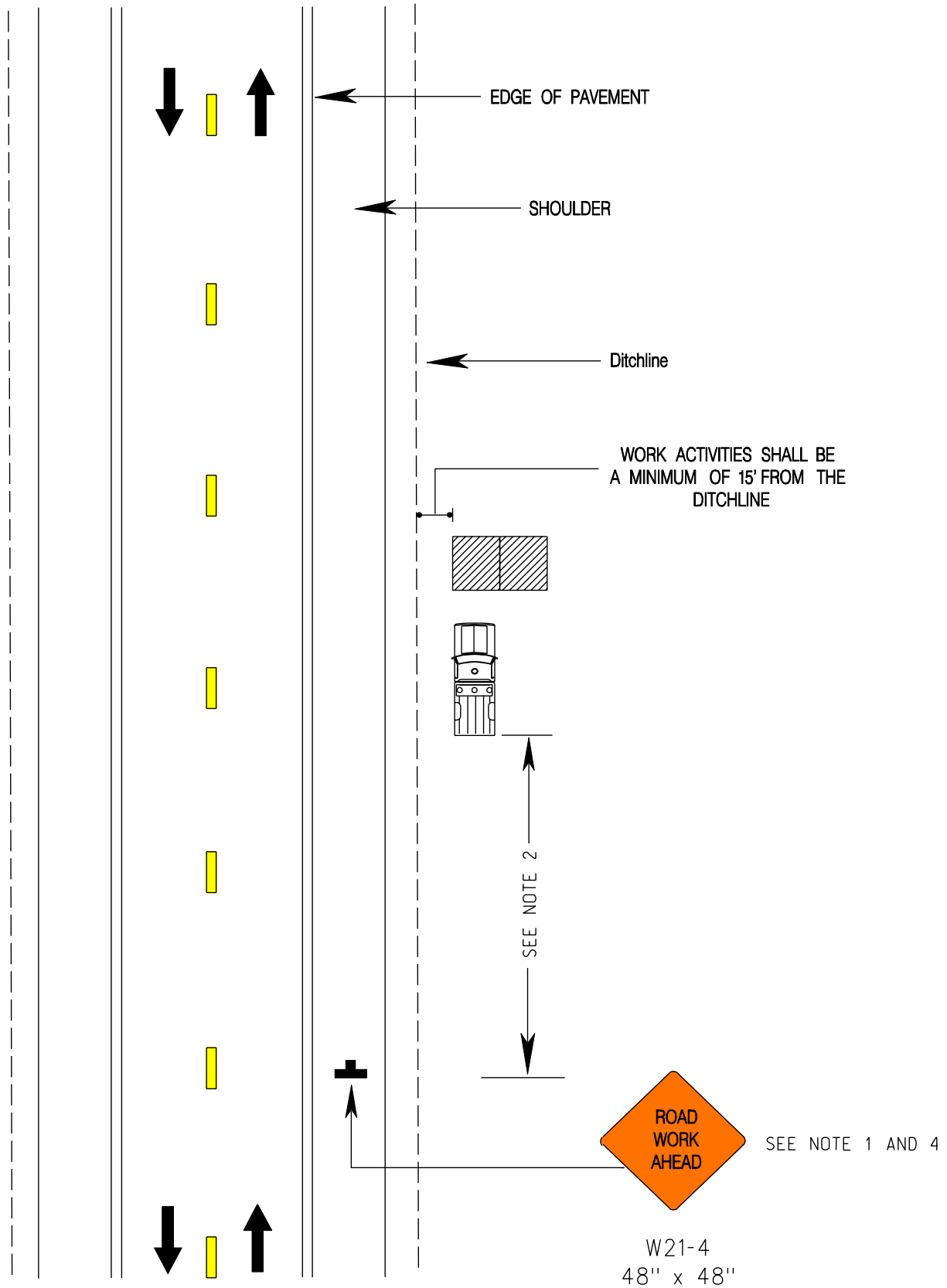
1. *An advance warning sign should be used if the work will be performed immediately adjacent to the shoulder, if equipment will cross or move along the roadway, or if the activity may distract motorists.*
2. *The minimum distance between sign and work vehicle should be 1000'-1500' on limited access highways, and on all other roadways 500'-800' where posted speed limit is greater than 45 mph, and 350'-500' where posted speed limit is 45 mph or less.*

Option:

3. The "ROAD WORK AHEAD" sign may be replaced with other appropriate signs such as "SHOULDER WORK AHEAD" or "UTILITY WORK AHEAD".
4. If the vehicle and/or work activity are both outside the right-of-way, behind the ditchline, behind the guardrail, more than 2' behind the curb, or 15' or more from the edge of any non-limited access roadway, then only an activated rotating amber light or high intensity amber strobe light is needed.
5. For short-duration or mobile operations, all signs and channelizing devices may be eliminated if a vehicle with activated rotating amber light or high intensity amber strobe light is used.

Standard:

6. **If the workspace is in the median of a divided highway, an advance warning sign shall also be placed on the left side of the directional roadway.**
7. **Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.**



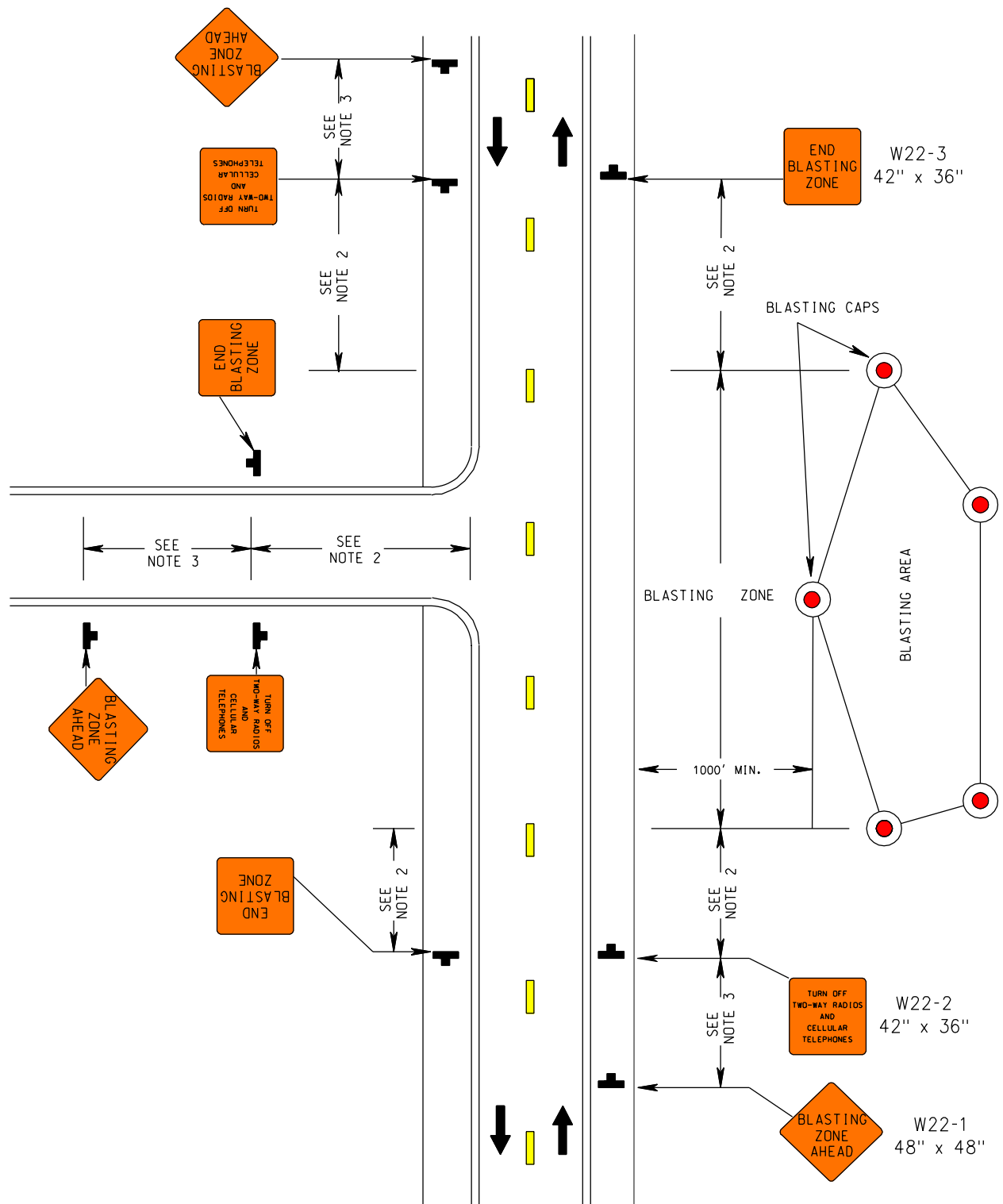
WORK BEYOND THE SHOULDER
FIGURE TTC-1.0

**TYPICAL TRAFFIC CONTROL
BLASTING ZONE OPERATION
(FIGURE TTC-2.0)**

NOTES

Standard:

- 1. Whenever blasting caps are used within 1000' of a roadway, the signing shown shall be required. On a divided highway with a median wider than 8', left and right sign assemblies shall be required.**
- 2. Sign spacing distance shall be a minimum of 1000' from the blasting area.**
- 3. Sign spacing shall be 1000'-1500' for limited access highways. For all other roadways, the sign spacing shall be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted limit is 45 mph or less.**
- 4. The signs shall be covered or removed when there are no explosives in the area or when the area is otherwise secure.**
- 5. Whenever a side road intersects the roadway between the "BLASTING ZONE AHEAD" signs and the "END BLASTING ZONE" sign, or a side road is within 1000' of any blasting cap, similar signing, as on the mainline, shall be erected on the side road.**
- 6. Before blasting, the blaster in charge shall determine whether highway traffic in the blasting zone shall be endangered by the blasting operation. If there is danger, highway traffic shall not be permitted to pass through the blasting zone during blasting operations.**



BLASTING ZONE OPERATIONS
FIGURE TTC-2.0

**TYPICAL TRAFFIC CONTROL
MOBILE OR SHORT DURATION ON SHOULDER OPERATION
(FIGURE TTC-3.0)**

NOTES

Options:

1. The first advance warning vehicle may be replaced by a 48" x 48" ROAD WORK AHEAD", "UTILITY WORK AHEAD" or "SHOULDER WORK AHEAD" signs.
2. This layout may be used for two or more lane roadways.
3. Warning signs may be omitted if the distance between work locations is 1 mile or more, and if the work vehicle travels at motor vehicle traffic speeds between locations.

Guidance:

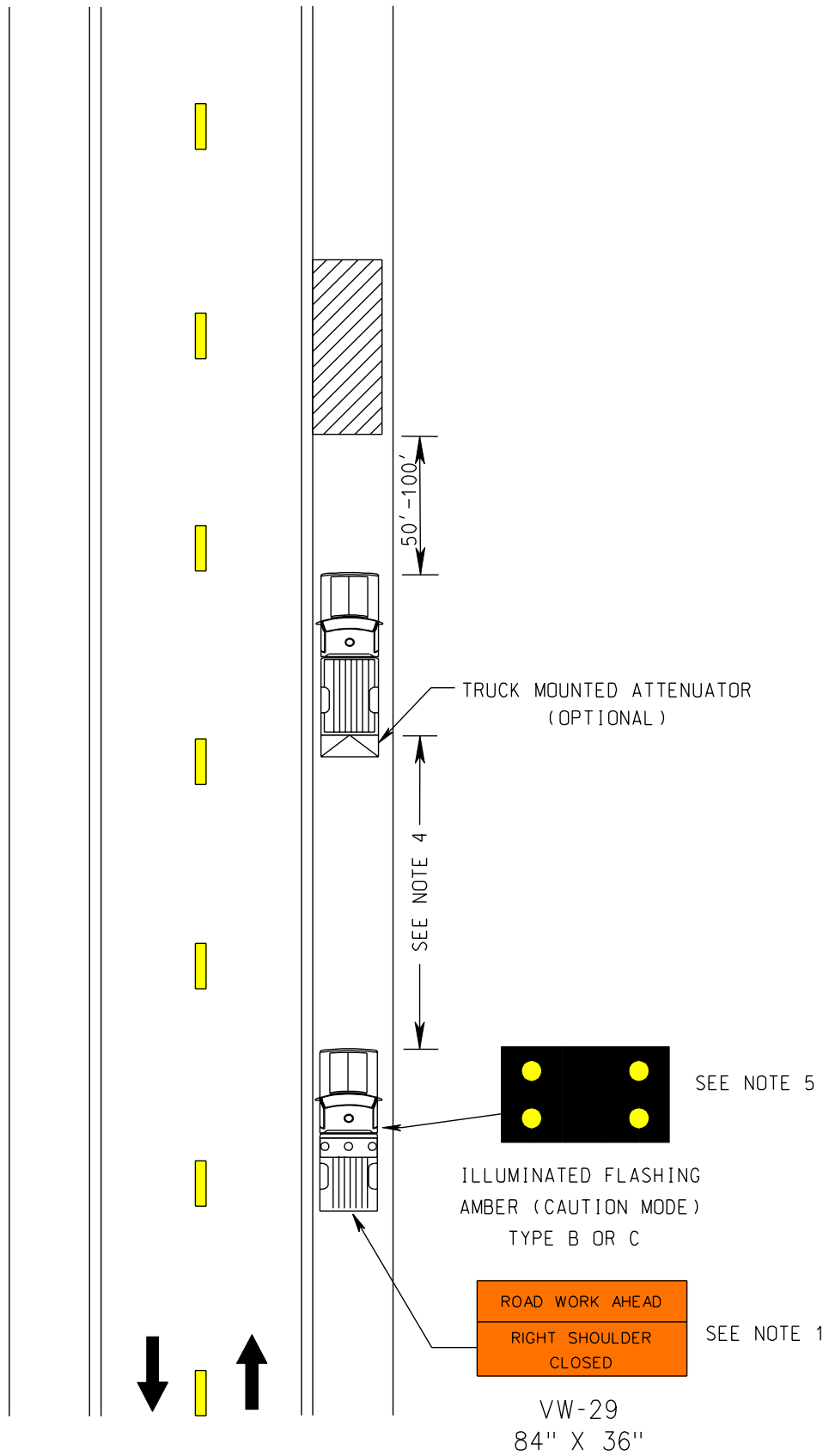
4. *The minimum spacing distance should be 1000'-1500' for limited access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph and 350'-500' where posted speed limit is 45 mph or less. The maximum distance between sign and work vehicle should be 2 miles.*

Standard:

5. **Each vehicle involved in the operation shall have either an arrow board operating in the caution mode, or at least one rotating amber light or high intensity amber strobe light.**
6. **Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.**

Support:

7. 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' + linear distance.) A mobile operation is defined as an operation that moves intermittently and will not occupy the immediate area.



MOBILE OR SHORT DURATION ON SHOULDER OPERATION
FIGURE TTC-3.0

**TYPICAL TRAFFIC CONTROL
STATIONARY OPERATION ON SHOULDER
(FIGURE TTC-4.0)**

NOTES

Guidance:

1. A "SHOULDER WORK" sign should be placed on the left side of the roadway for a divided or one-way street only if the left shoulder is affected.
2. Sign spacing distance should be 1000'-1500' for limited access highways, and on all 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. Channelizing Device spacing shall be at the following:

<i>Location</i>	<i>Speed (mph)</i>	
	<i>0-35</i>	<i>36+</i>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

4. The buffer space length shall be as shown in Table 6H-3 for the posted speed limit.

5. Cone Taper Length (L):

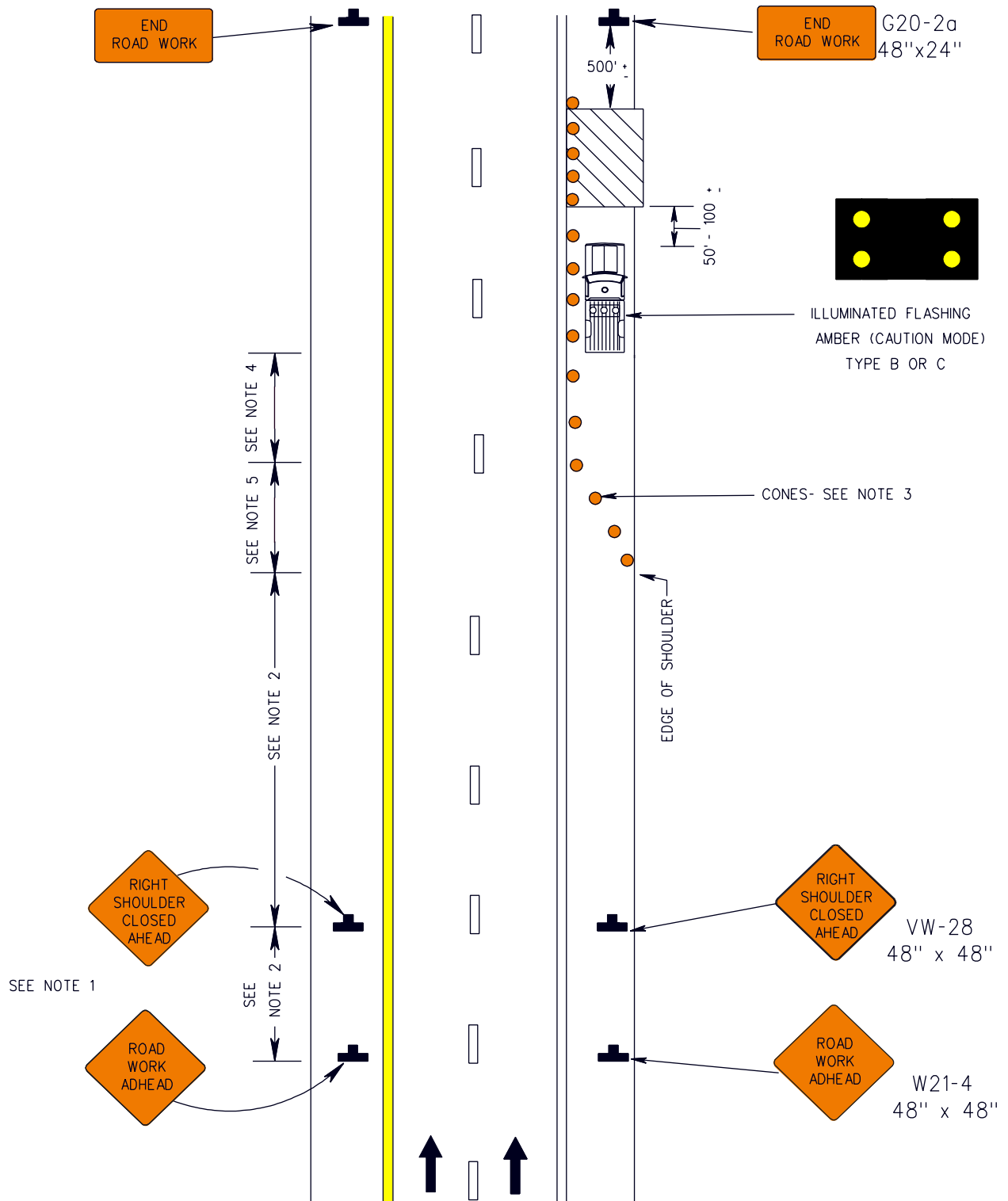
Speed Limit <u>M.P.H</u>	Taper Length Lane Width In Feet		
	10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

(Shoulder Taper = 1/3 L Minimum)

6. A shadow vehicle with either an arrow board operating in the caution mode, or at least one rotating amber light or alternating high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.
7. Although vehicle hazard signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.

Option:

8. For short-duration operations of 60 minutes or less, all signs and channelizing devices may be eliminated if the distance between work locations is 1 mile or more, and if the work vehicle travels at motor vehicle traffic speeds between locations.



STATIONARY OPERATION ON SHOULDER
FIGURE TTC-4.0

TYPICAL TRAFFIC CONTROL
SHOULDER CLOSURE WITH BARRIER AND LANE SHIFT OPERATION
(FIGURE TTC-5.0)

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 only the "ROAD WORK AHEAD" and "RIGHT SHOULDER CLOSED AHEAD" advance warning signs are required.*
3. *Sign spacing distance should be 1000'-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.*
4. *Double Lane Shift signs may be used in place of the Reverse Curve signs.*

Standard:

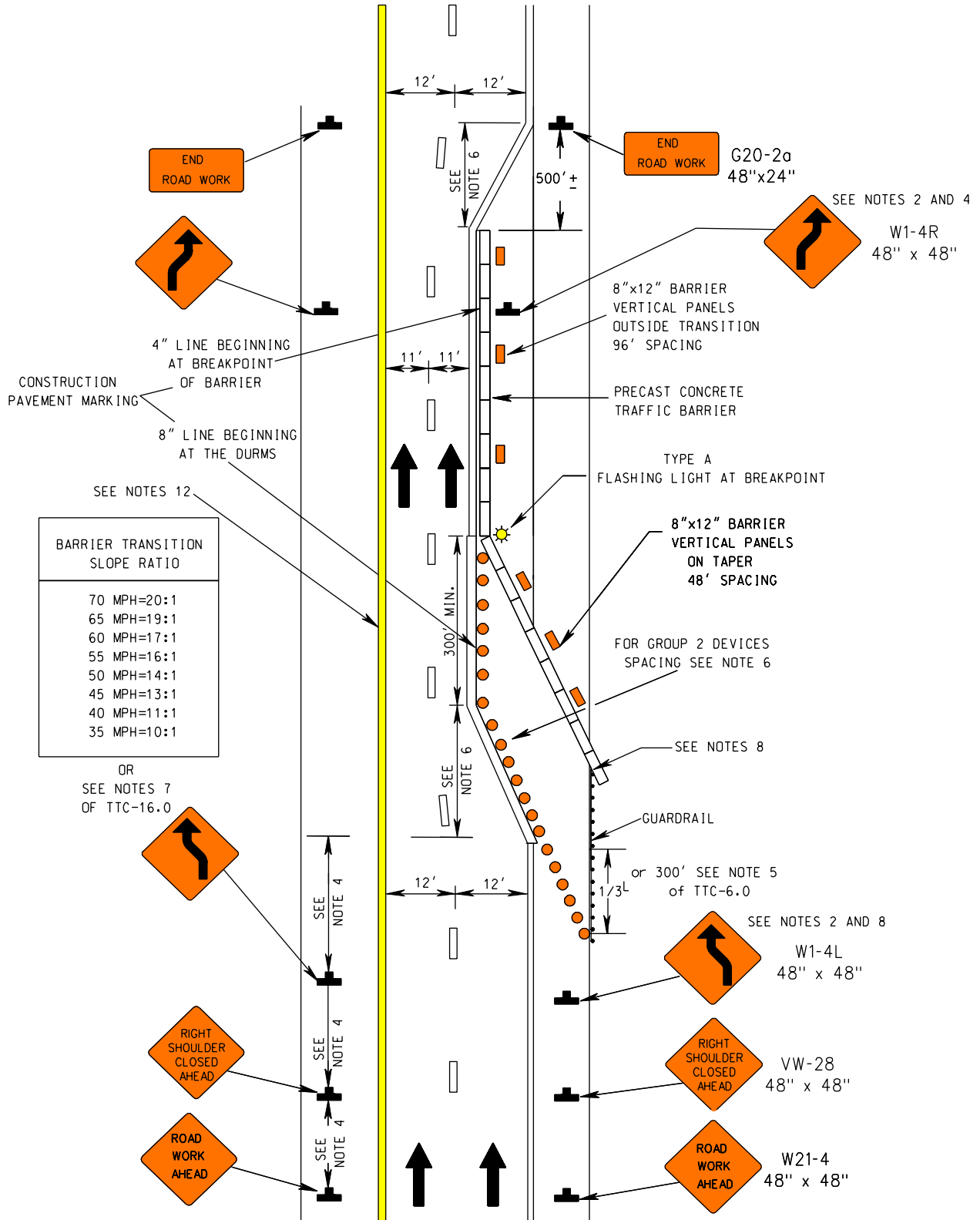
5. **On divided highways having a median wider than 8', left and right sign assemblies shall be required.**
6. **Length of pavement marking transition (L) = posted speed (S) x width of transition (W). (Example: 55 x 2 = 110)**
7. **Group 2 channelizing device spacing shall be at the following:**

<i>Location</i>	<i>Speed (mph)</i>	
	<i>0-35</i>	<i>36+</i>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

8. **For end treatment of the barrier in order of preference see Note 7 of TTC-6.0.**
9. **Barrier vertical panel 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. ReflectORIZED surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be Type A flashing.**
10. **Unless approved by the District Traffic Engineer, the minimum width of the travel lanes shall be 11 ft.**
11. **For long-term stationary work, existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Option:

12. Temporary pavement may be needed to maintain traffic with 11' minimum width lanes.



SHOULDER CLOSURE WITH BARRIER & LANE SHIFT OPERATIONS
FIGURE TTC-5.0

**TYPICAL TRAFFIC CONTROL
SHOULDER CLOSURE WITH BARRIER OPERATION
(FIGURE TTC-6.0)**

NOTES

Guidance:

1. Sign spacing distance should be 1000'-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. 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.

Standard:

3. On divided highways having a median wider than 8', left and right sign assemblies shall be required.
4. Group 2 channelizing device spacing shall be at the following:

<i>Location</i>	<i>Speed (mph)</i>	
	<i>0-35</i>	<i>36+</i>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

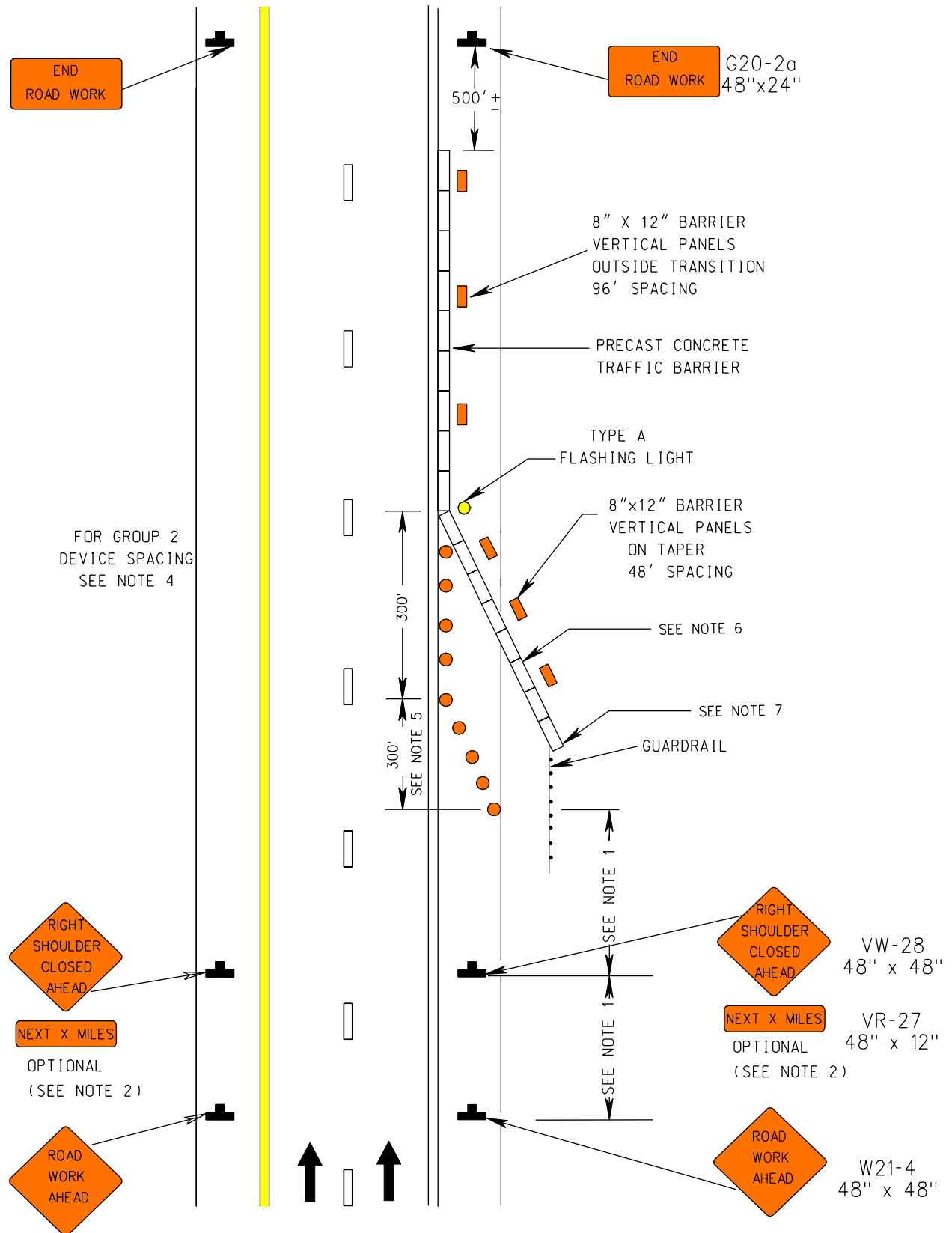
5. The minimum length for a shoulder taper should be 300' on limited access highways, and 1/3 L for all other roadways. (See note 5, TTC-4.0 for values of L).

6. Barrier transition slope ratio shall be as follows:

70 mph=20:1	60 mph=17:1	50 mph=14:1	40 mph=11:1	30 > mph=8:1
65 mph=19:1	55 mph=16:1	45 mph=13:1	35 mph=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.

7. End treatment of 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 Appendix A, Page A-4 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.
8. Barrier vertical panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be a Type A flashing light.



SHOULDER CLOSURE WITH BARRIER OPERATION
FIGURE TTC-6.0

**TYPICAL TRAFFIC CONTROL
MOWING OPERATION WITH ENCROACHMENT
(FIGURE TTC-7.0)**

NOTES

Standard:

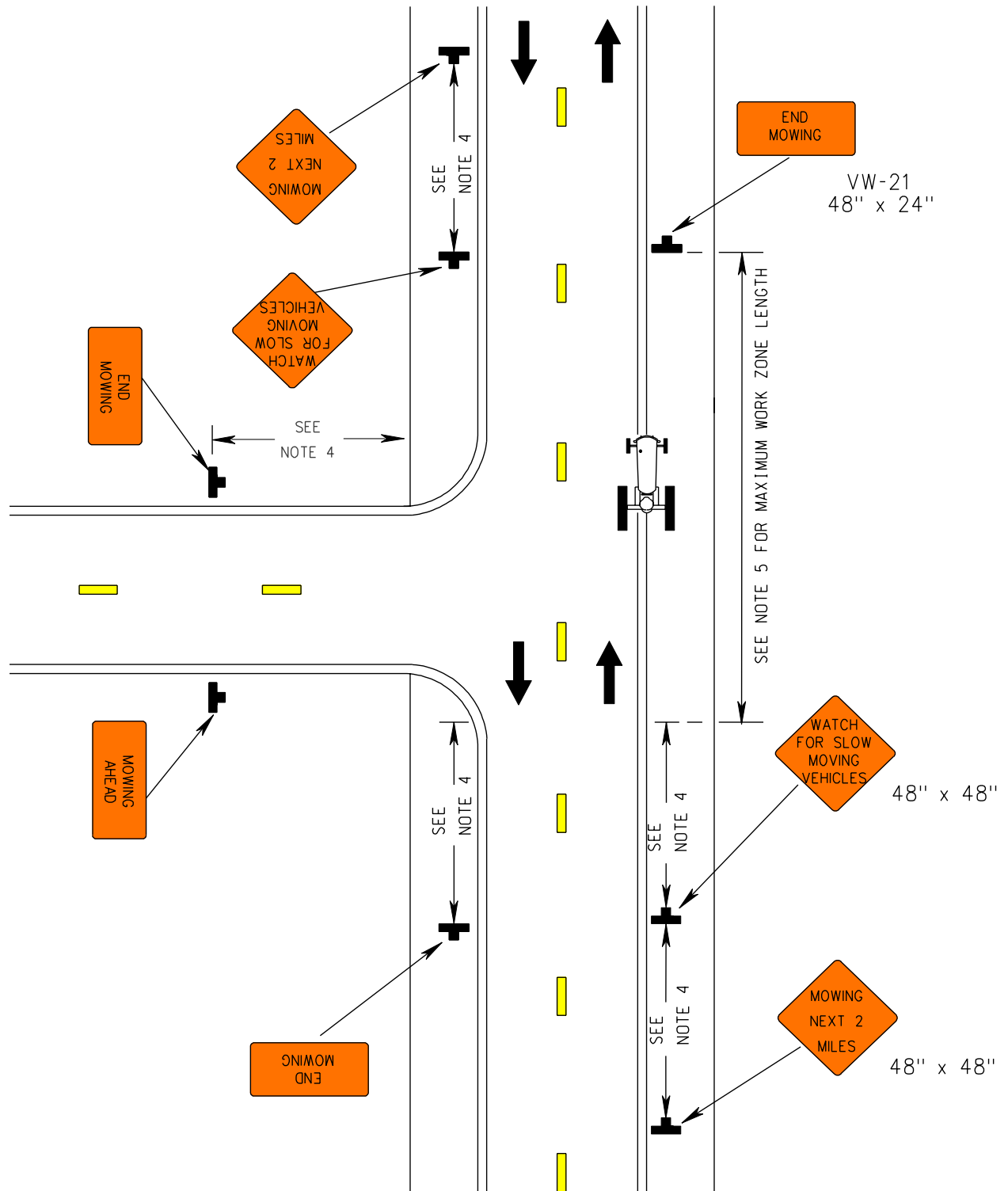
- 1. Each vehicle involved in the operation shall be equipped with at least one rotating amber light or high intensity amber strobe light visible from 360°.**
- 2. On divided highways having a median wider than 8', left and right sign assemblies shall be required.**
- 3. Connecting roads entering into the work area shall be signed as shown.**

Guidance:

- 4. Sign spacing distance should be 1000'-1500' for limited access highway, 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.*
- 5. No more than 2 complete setups (2 miles each) should be exposed to motorist at any one time.*
- 6. 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:

- 7. If the operation is completely off the travelway, the 'WATCH FOR SLOW MOVING VEHICLES' sign may be omitted.**



MOWING OPERATION WITH ENCROACHMENT
FIGURE TTC-7.0

**TYPICAL TRAFFIC CONTROL
MOVING/MOBILE OPERATIONS ON LIMITED ACCESS HIGHWAYS
(FIGURE TTC-8.0)**

NOTES

Standard:

1. Each vehicle involved in the moving/mobile operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. Illuminated flashing arrows on the advance warning vehicles shall be type C, and on the work operations vehicle a type B or C. Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.

Option:

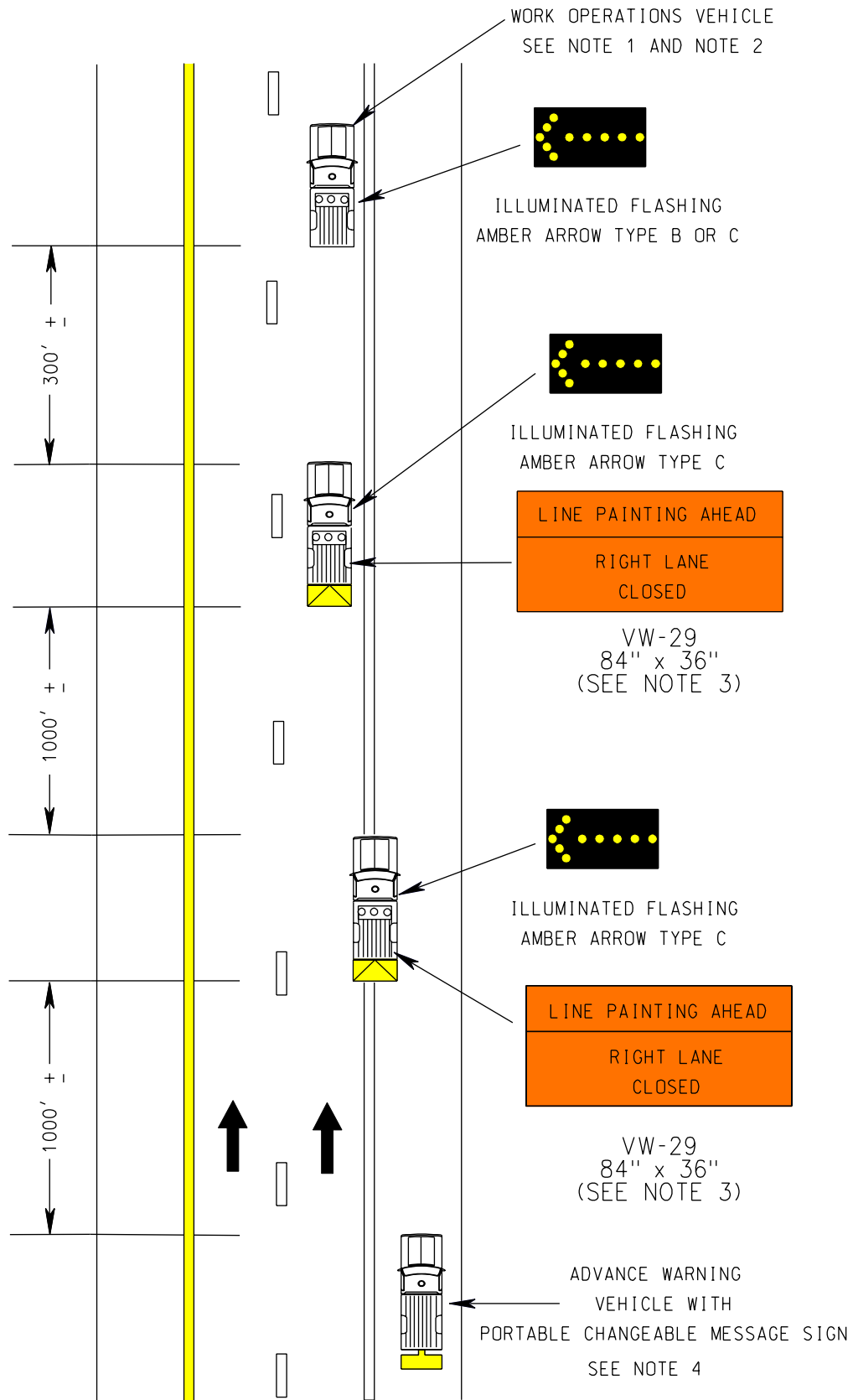
2. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow will not be required.
3. The static warning sign and arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters. The arrow display using a CMS may be a type B. Arrow direction and lane designation may change as needed.

Standard:

4. The first advance warning vehicle shall travel along the paved shoulder with either a flashing arrow, or a portable changeable message sign with 18" height characters advising of the operation ahead ("LINE PAINTING AHEAD"), and lane closure information ("RIGHT LANE CLOSED", "MERGE LEFT"). The second advance warning vehicle, with a truck mounted attenuator (TMA), shall straddle the edgeline, partially on the shoulder and partially in the lane. The third advance warning vehicle, with a TMA, shall be in the travel lane.
5. If the first advance warning vehicle cannot run completely on the shoulder and is partially in the travel lane, it shall be equipped with a truck mounted attenuator.
6. When the work operations vehicle is stationary, the advance warning vehicle following the operations vehicle shall be in a position 50'-100' in advance of the operations vehicle to provide protection. When the work operations vehicle is moving, the advance warning vehicle following the operations vehicle shall follow at a distance of 300'±.
7. Each vehicle involved in the moving operation shall have radio communication between vehicles.

Guidance:

8. *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 protection vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The protection vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
9. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*



**MOVING/MOBILE OPERATIONS ON LIMITED ACCESS HIGHWAYS
FIGURE TTC-8.0**

**TYPICAL TRAFFIC CONTROL
MOVING/MOBILE OPERATION ON MULTI-LANE ROADWAY
(FIGURE TTC-9.0)**

NOTES

Standard:

1. **Each vehicle involved in the moving/mobile operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. 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 panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters.
4. Arrow direction and designation may change as needed.

Guidance:

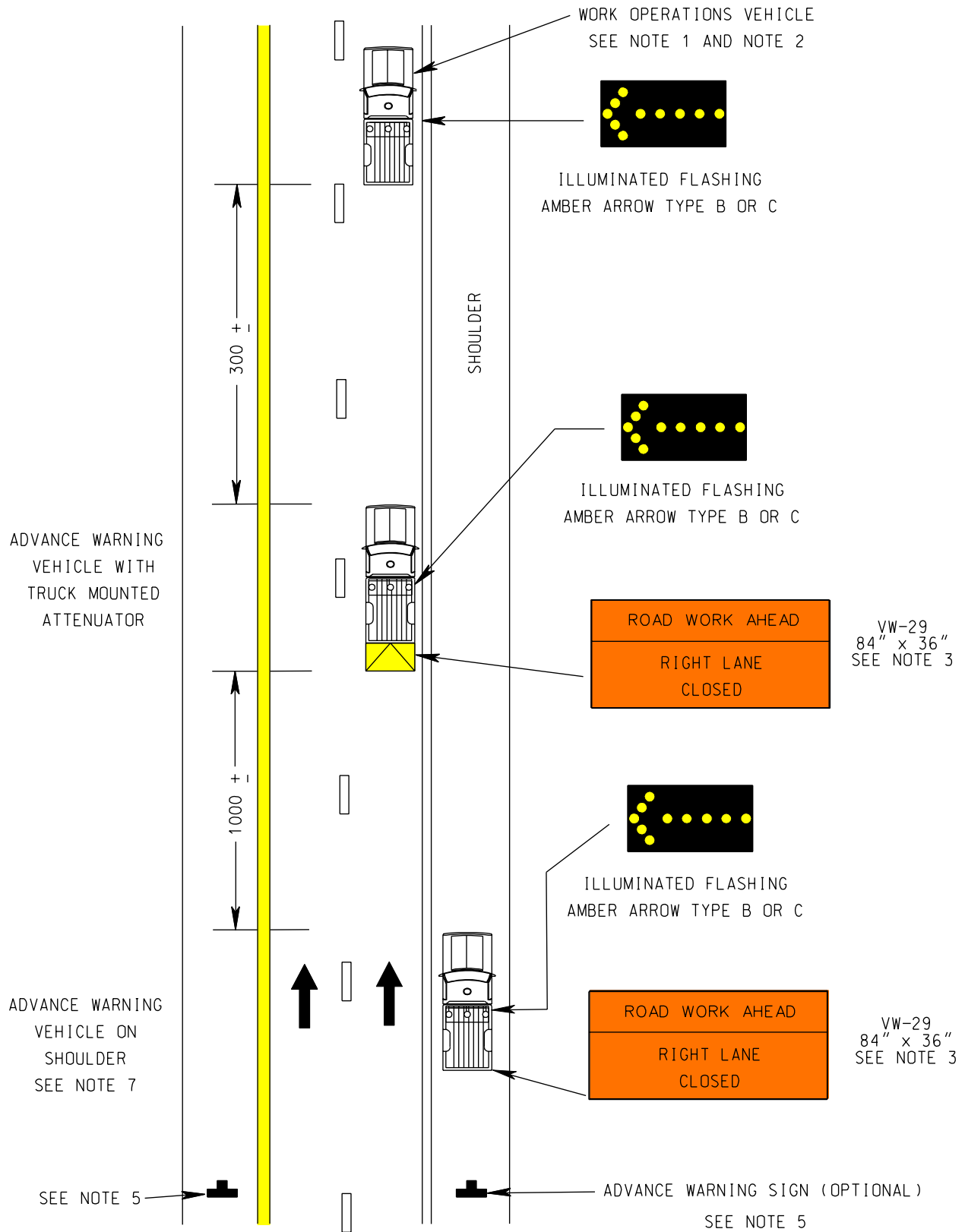
5. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of moving operation. Whenever adequate stopping sight distance exists to the rear, the protection vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The protection 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, an advance warning vehicle on the shoulder with an arrow board and sign should be used. Also, in certain situations, appropriate stationary signing ("SPRAYING NEXT 2 MILES") may be used to further enhance safety.*

Standard:

7. **When the work operations vehicle is stationary, the advance warning vehicle following the operations vehicle shall be in a position 50'-100' in advance of the operations vehicle to provide protection. When the work operations vehicle is moving, the advance warning vehicle following the operations vehicle shall follow at a distance of 300'±.**
8. **If the first advance warning vehicle cannot run completely on the shoulder and is partially in the travel lane, it shall be equipped with a truck mounted attenuator (TMA).**
9. **When the operation is completely off the travelway, only one advance warning 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:

10. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*



TYPICAL TRAFFIC CONTROL MOVING/MOBILE OPERATION ON MULTI-LANE ROADWAY (FIGURE TTC-9.0)

**TYPICAL TRAFFIC CONTROL
MOBILE/MOVING OPERATION ON TWO-LANE ROADWAY
(FIGURE TTC-10.0)**

NOTES

Standard:

1. Each vehicle involved in the moving/mobile operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.
2. Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inch above the pavement. Sign legends shall be covered or turned from view when work is not in progress.

Guidance:

3. *Where practical and when needed, the work and shadow vehicles should pull over periodically to allow motor vehicle traffic to pass.*
4. *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.*
5. *A truck-mounted attenuator should be used on the shadow vehicle.*

Standard:

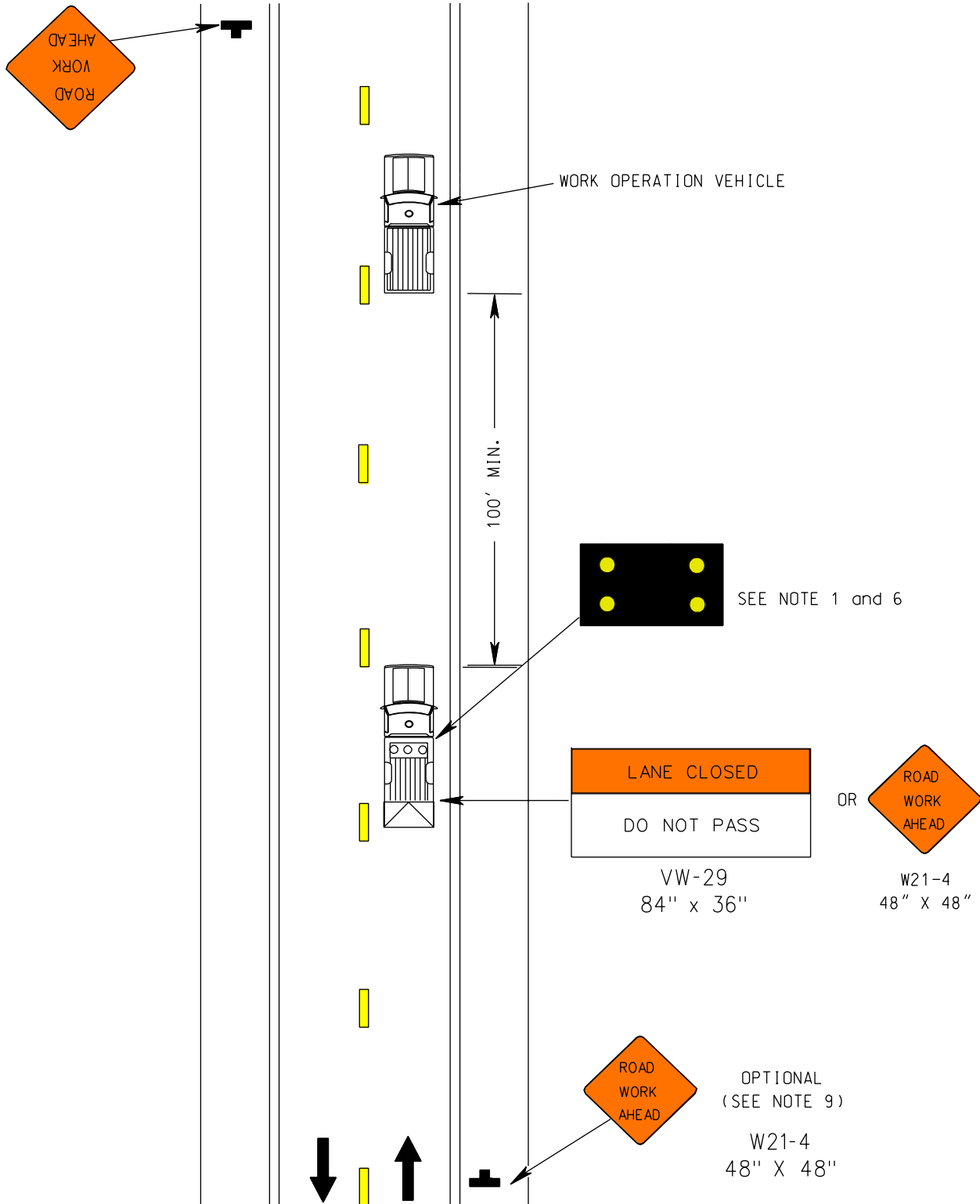
6. **If using an arrow board on the shadow vehicle, it shall operate in the four corner caution mode.**

Option:

7. The distance between the work and shadow vehicles may vary according to speed, terrain, paint drying time, and other factors.
8. If the work and shadow vehicles cannot pull over to allow motor vehicle traffic to pass frequently, a “DO NOT PASS” sign may be placed on the rear of the vehicle blocking the lane.
9. Stationary signing may be used on high volume, high speed roadways. Signs may be fabricated to permit change of the message in the field to identify the type of moving operation (“SPRAYING NEXT XX MILES”). The maximum distance between the sign and protection vehicle is 5 miles for limited access highways, and 2 miles for all other roads.
10. The static warning sign and caution mode arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10” height characters.

Guidance:

11. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*



MOVING/MOBILE OPERATION ON TWO-LANE ROADWAY
FIGURE TTC-10.0

**TYPICAL TRAFFIC CONTROL
SHORT DURATION OPERATION ON MULTI-LANE ROADWAY
(FIGURE TTC-11.0)**

NOTES

Standard:

1. This typical traffic control layout shall not be used for Limited Access Highway or Two-lane roadways.
2. Each vehicle involved in the short duration operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.
3. Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inch 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 first advance warning shadow vehicle on the shoulder side where the operation is occurring may be replaced with a "ROAD WORK AHEAD" sign on low speed (less than 45 mph), low volume (less than 500 vehicles per day) roadways.
6. The static warning sign and arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters.

Standard:

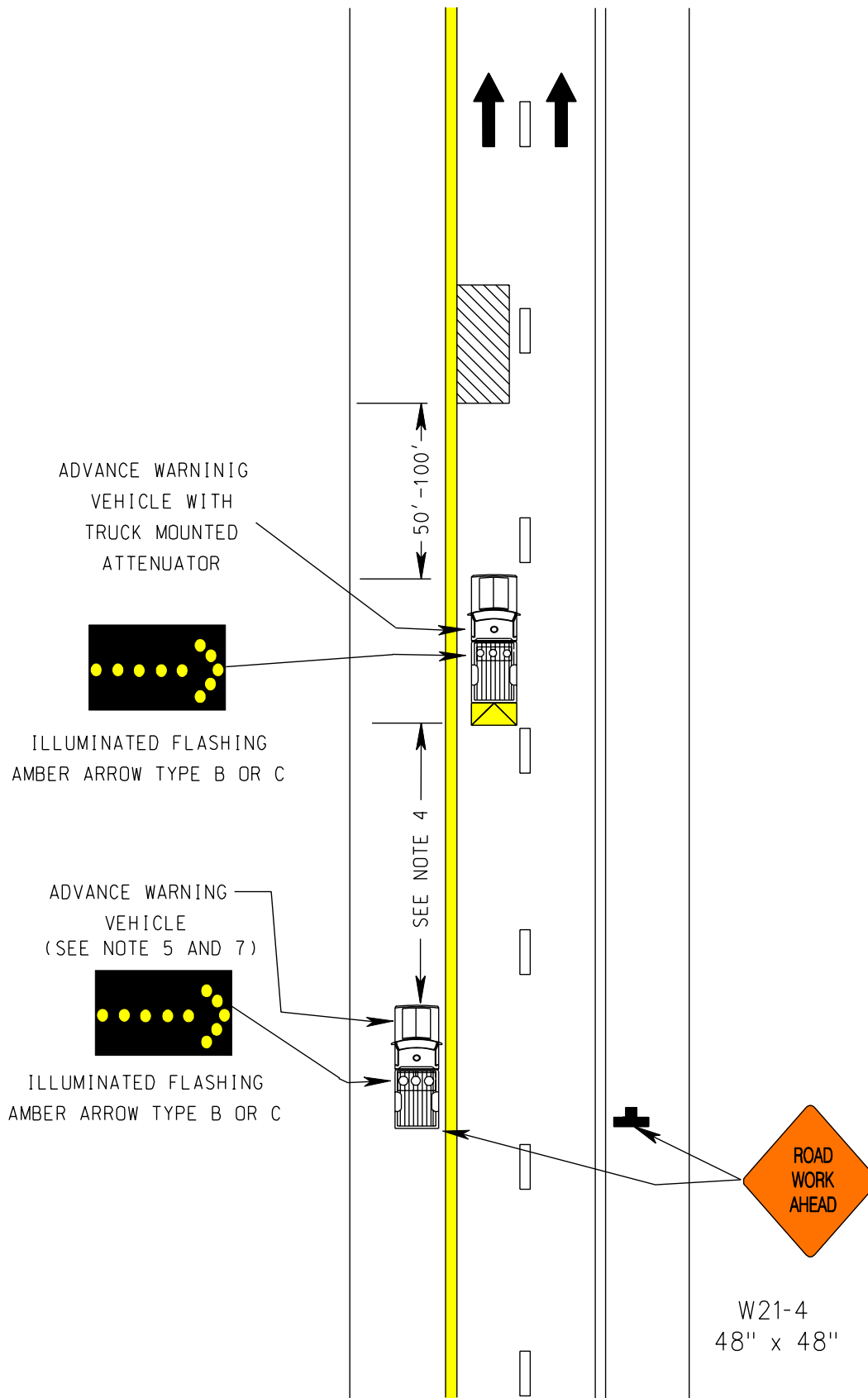
7. **A truck mounted attenuator (TMA) shall be used on the second shadow vehicle in the travelway regardless of the posted speed limit. If the first shadow vehicle occupies any part of the travel lane, it shall be equipped with a TMA, or replaced with the "ROAD WORK AHEAD" sign.**

Guidance:

8. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*

Support:

9. 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 MULTI-LANE ROADWAY
FIGURE TTC-11.0

**TYPICAL TRAFFIC CONTROL
OUTSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
(FIGURE TTC-12.0)**

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1000'-1500' for limited access highway, 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. *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 Appendix A, Page A-8. 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:

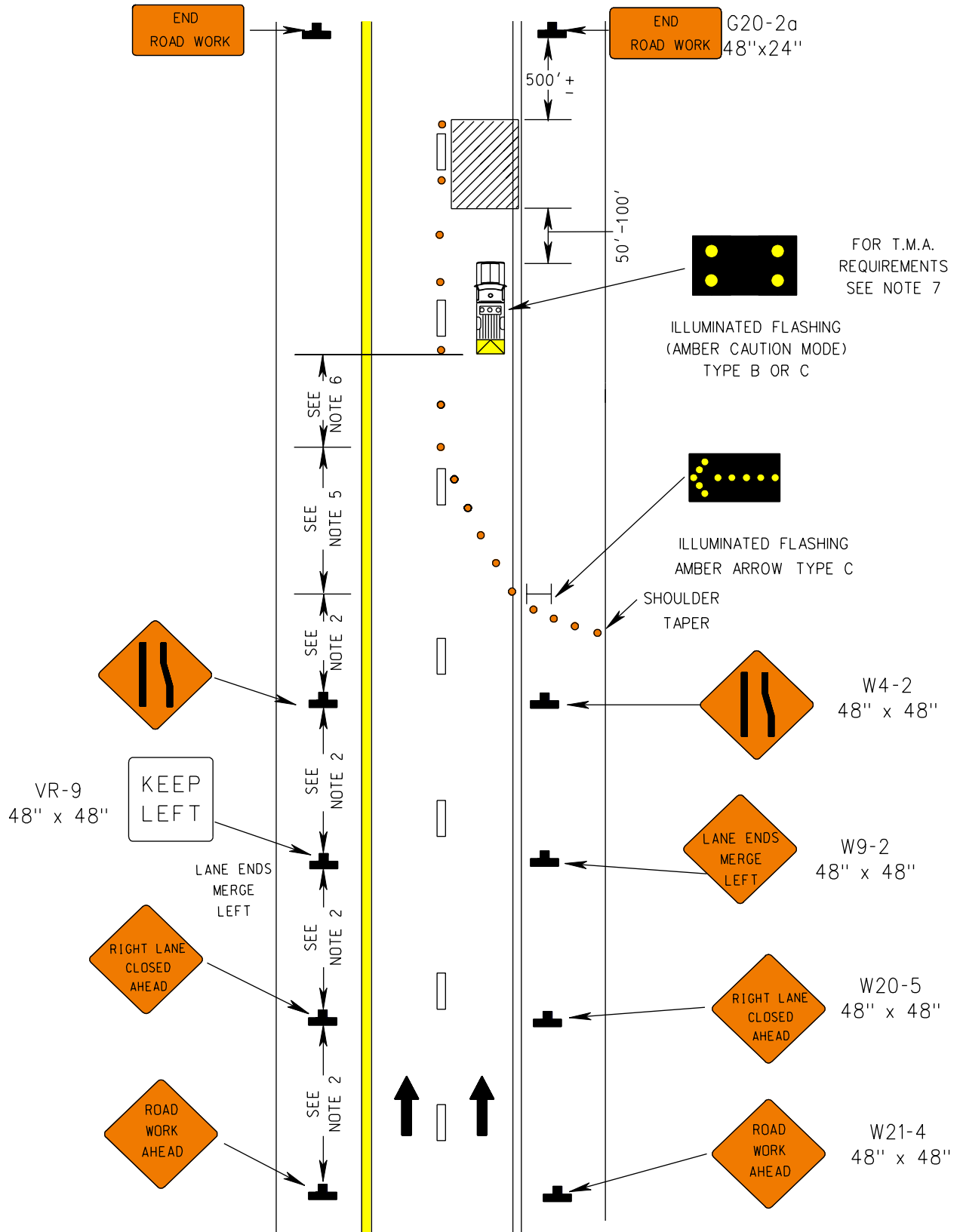
5. **Taper Length and Channelizing Device Spacing shall be:**

Speed Limit M.P.H	Taper Length Lane Width In Feet			Channelizing Device Spacing		
	10	11	12	Location	Speed (mph)	
25	105	115	125	Transition Spacing	0-35	36+
30	150	165	180	Travelway Spacing	20'	40'
35	205	225	245		40'	80'
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5 for the posted speed limit.**
7. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



OUTSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
FIGURE TTC-12.0

**TYPICAL TRAFFIC CONTROL
INSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
(FIGURE TTC-13.0)**

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1000'-1500' for limited access highway, 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. *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 Appendix A, Page A-8. 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:

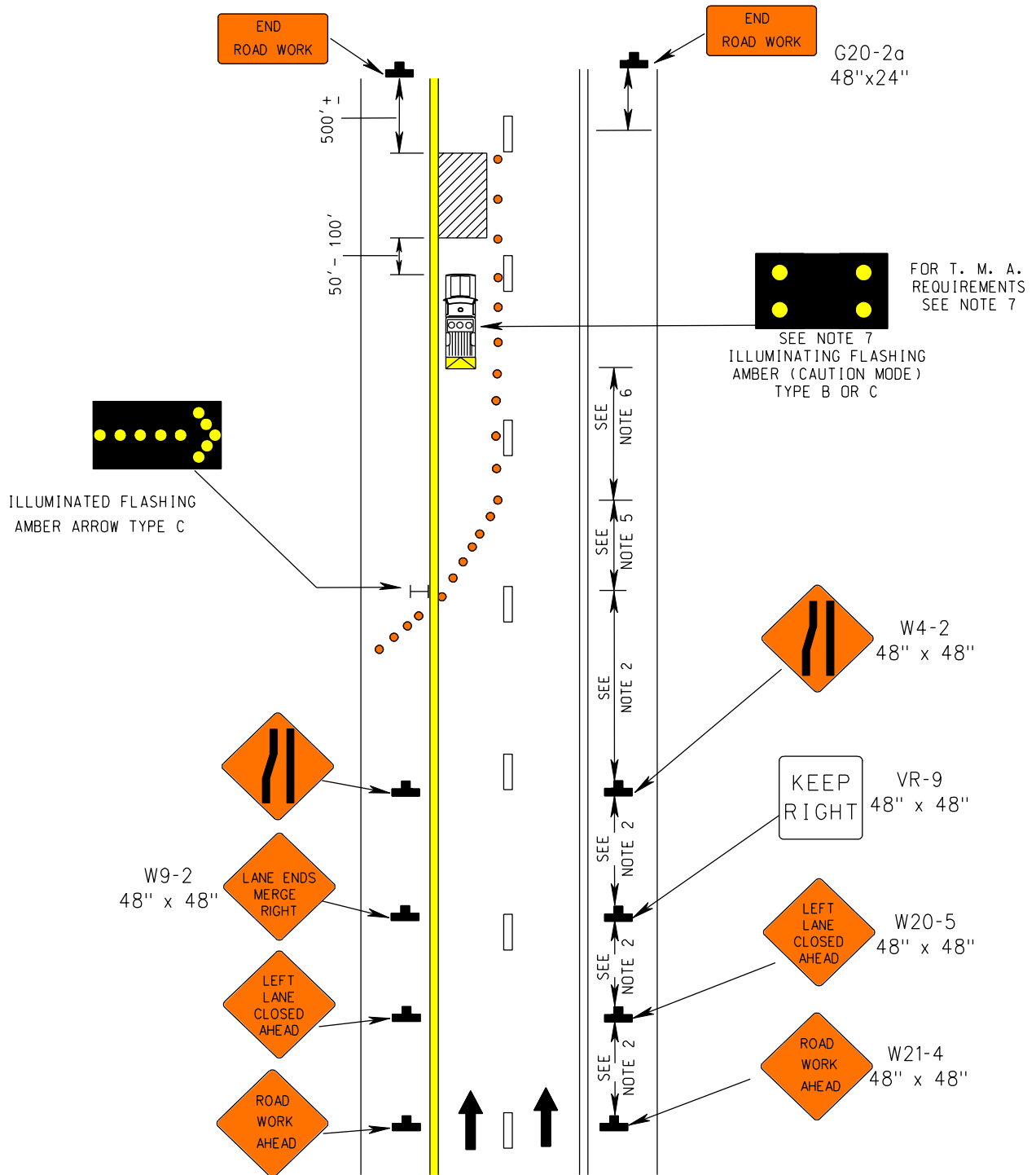
5. **Taper Length and Channelizing Device Spacing shall be:**

Speed Limit M.P.H	Taper Length			Channelizing Device Spacing		
	Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5 for the posted speed limit.**
7. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



INSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
FIGURE TTC-13.0

**TYPICAL TRAFFIC CONTROL
MULTI-LANE CLOSURE OPERATION
(FIGURE TTC-14.0)**

NOTES

Standard:

- 1. On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

- 2. Sign spacing distance should be 1000'-1500' for limited access highway, 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. 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 Appendix A, Page A-8. 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:

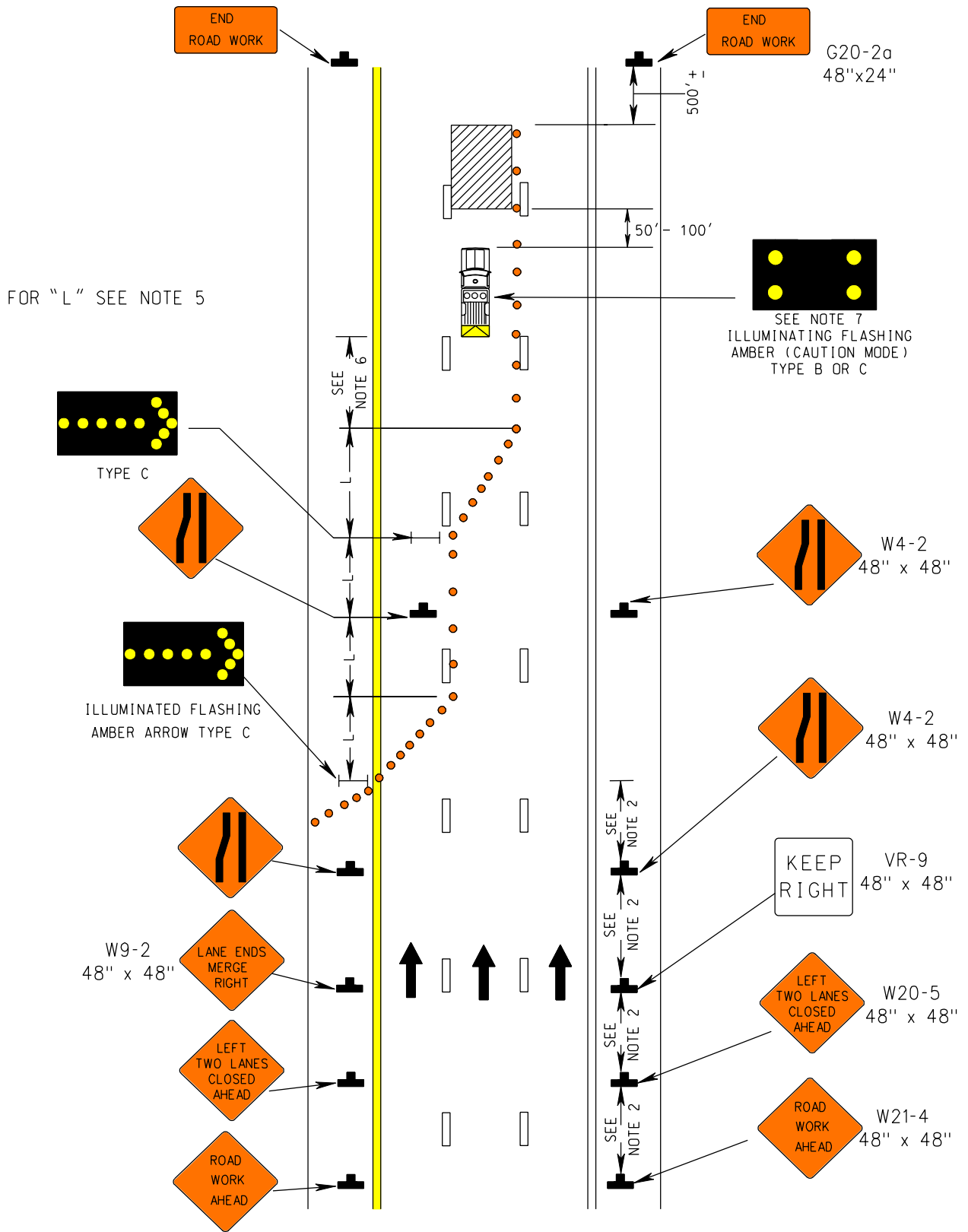
- 5. Taper Length and Channelizing Device Spacing shall be:**

Speed Limit M.P.H	Taper Length			Channelizing Device Spacing		
	Taper Length Lane Width In Feet			Location	Speed (mph)	
	10	11	12	Transition Spacing	0-35	36+
25	105	115	125	Travelway Spacing	20'	40'
30	150	165	180		40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

- 6. The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5.0 for the posted speed limit.**
- 7. A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



MULTI-LANE CLOSURE OPERATION
FIGURE TTC-14.0

**TYPICAL TRAFFIC CONTROL
LANE CLOSURE OPERATION WITH LANE WEAVE
(FIGURE TTC-15.0)**

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1000'-1500' for limited access highway, 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. *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 Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

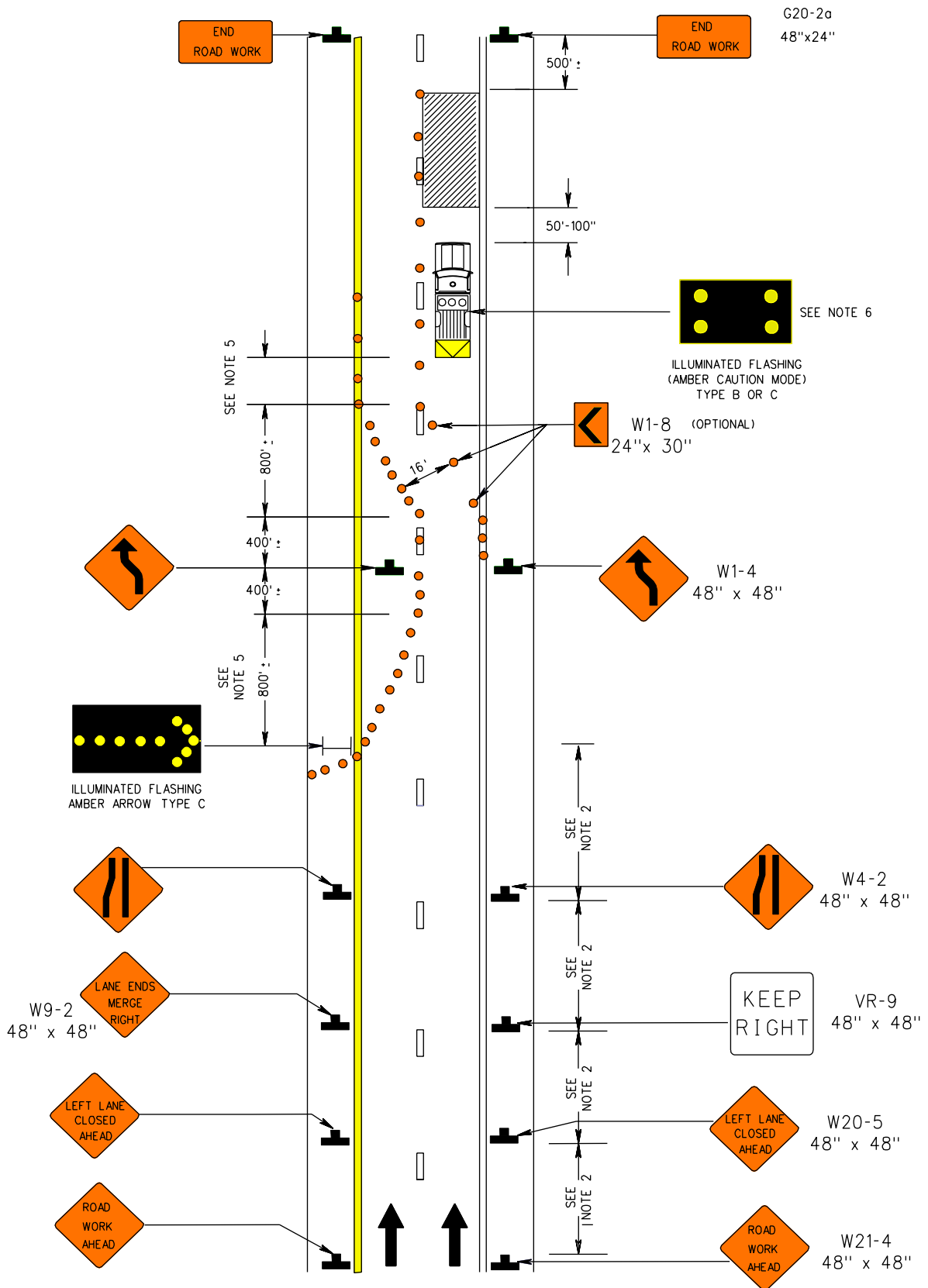
4. **Taper Length and Channelizing Device Spacing shall be:**

<u>Taper Length</u>				<u>Channelizing Device Spacing</u>		
Speed Limit M.P.H	Taper Length Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

5. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5.0 for the posted speed limit.**
6. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



LANE CLOSURE WITH LANE WEAVE
FIGURE TTC-15.0

**TYPICAL TRAFFIC CONTROL
LANE CLOSURE OPERATION WITH CONCRETE TRAFFIC BARRIER
(FIGURE TTC-16.0)**

NOTES

Standard:

- 1. On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

- 2. Sign spacing distance should be 1000'-1500' for limited access highway, 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. 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 Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

- 4. Group 2 Channelizing device spacing shall be at the following:**

<i>Location</i>	<i>Speed (mph)</i>	
	<i>0-35</i>	<i>36+</i>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

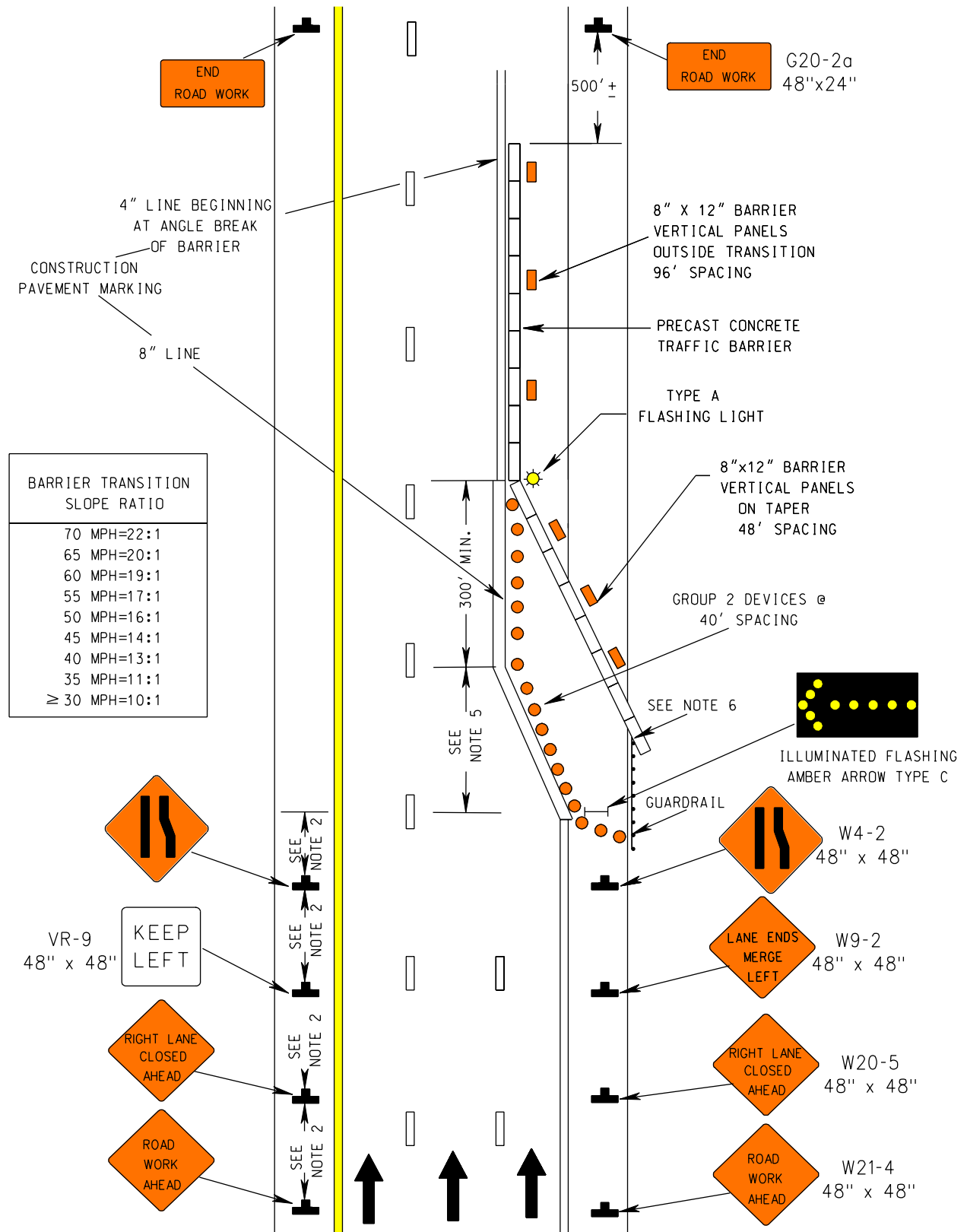
- 5. Length of pavement marking transition (L) = Posted Speed (S) x Width of Transition (W). (Example: 55 x 12' = 660')**
- 6. End treatment of barrier in order of preference shall be:**
 - a. Where guardrail exists, attach to barrier with appropriate fixed object attachment.
 - b. Where cut slope exists, 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 Appendix A, page 4 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.

- 7. Barrier transition slope ratio shall be as follows:**

70 mph=20:1	60 mph=17:1	50 mph=14:1	40 mph=11:1	30 > mph=8:1
65 mph=19:1	55 mph=16:1	45 mph=13:1	35 mph=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.

- 8. Barrier vertical panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be a Type A flashing light.**



LANE CLOSURE OPERATION WITH CONCRETE TRAFFIC BARRIER
FIGURE TTC-16.0

**TYPICAL TRAFFIC CONTROL
CENTER TURN LANE CLOSURE OPERATION
(FIGURE TTC-17.0)**

NOTES

Guidance:

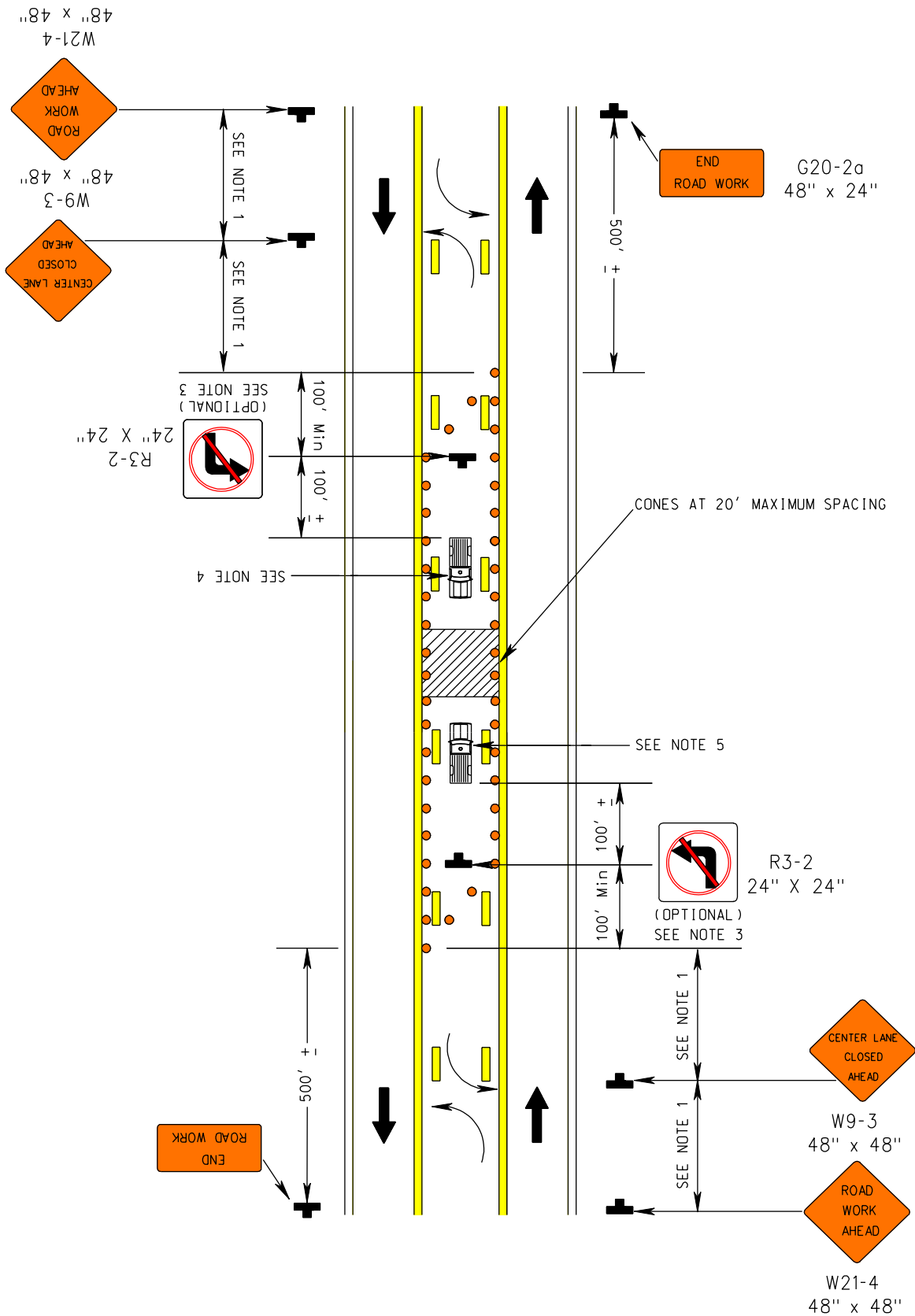
1. *The distance between signs and beginning of cone transition should be a minimum of 500' and a maximum of 800'.*

Option:

2. Where Right-of-Way or geometric conditions prevent use of 48" x 48" signs, 36" x 36" signs may be used.
3. For locations with a high volume of left turning movements, R3-2 graphic "NO LEFT TURN" signs may be used within the closed lane.

Standard:

4. **To prevent vehicles from entering into the work zone, channelizing device spacing shall be a maximum of 20' on centers.**
5. **A shadow vehicle shall be parked 50'-100' in advance of the work crew. 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 vehicle(s) shall be equipped with a truck mounted attenuator (TMA).**



CENTER TURN LANE CLOSURE OPERATION
FIGURE TTC-17.0

**TYPICAL TRAFFIC CONTROL
FLAGGING OPERATION ON TWO-LANE ROAD
(FIGURE TTC-18.0)**

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 flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*

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 zone to permit approaching traffic to reduce speed and/or stop before passing the work zone and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-4. 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:**

<u>Location</u>	<u>Speed (mph)</u>	
	<u>0-35</u>	<u>36+</u>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

7. **A shadow vehicle with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.**

Option:

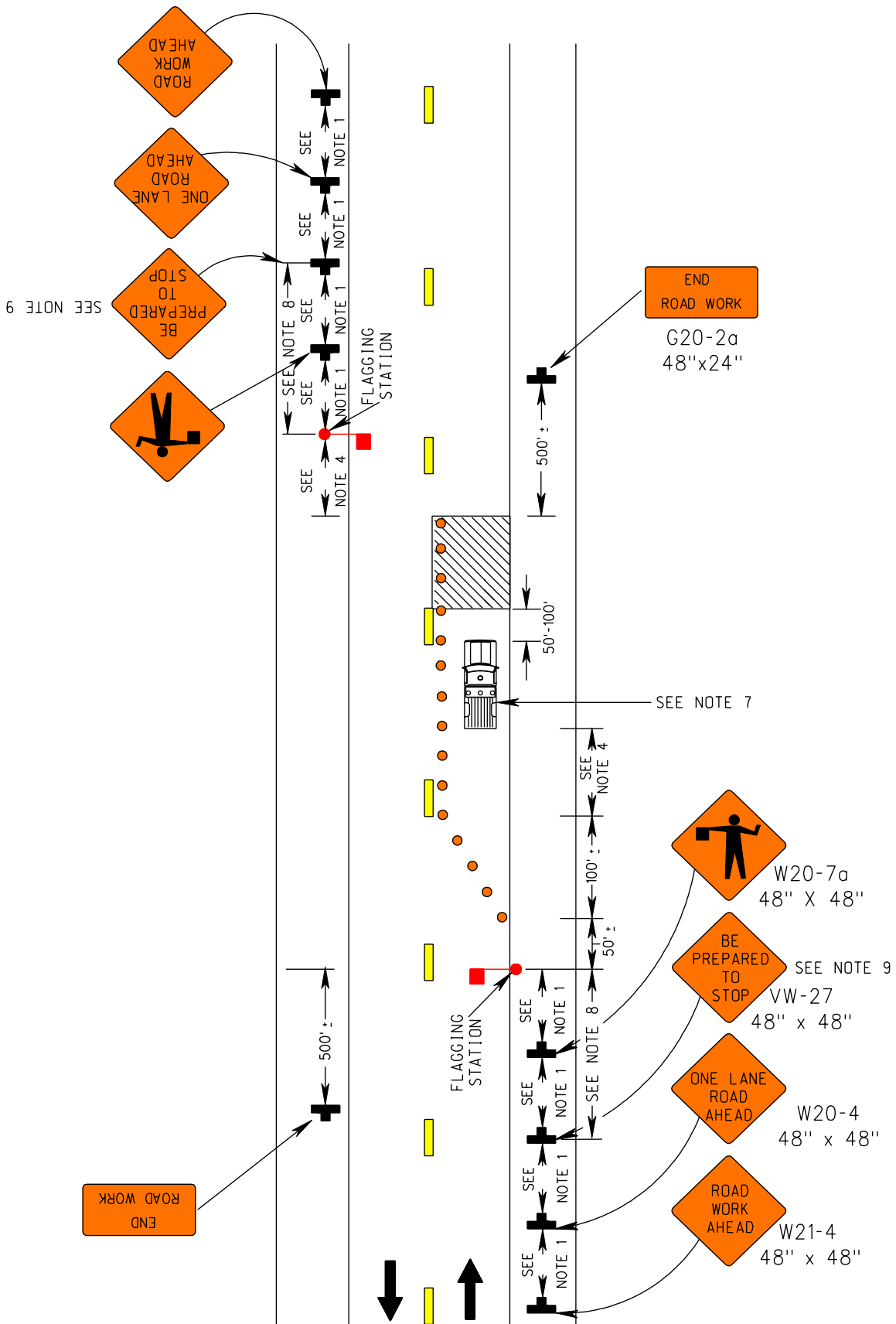
8. A supplemental flagger may be required in this area to give advance warning of the operation ahead by slowing approaching traffic prior to reaching the flagger station or queued traffic.

Guidance:

9. *If the queue of traffic reaches the "BE PREPARED TO STOP" sign, then the signs should be readjusted at greater distances.*

Option:

10. Cones may be eliminated when using a pilot vehicle operation.



FLAGGING OPERATION ON TWO-LANE ROAD
FIGURE TTC-18.0

**TYPICAL TRAFFIC CONTROL
NON-STATIONARY FLAGGING OPERATION ON TWO-LANE ROAD
(FIGURE TTC-19.0)**

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 flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*

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:

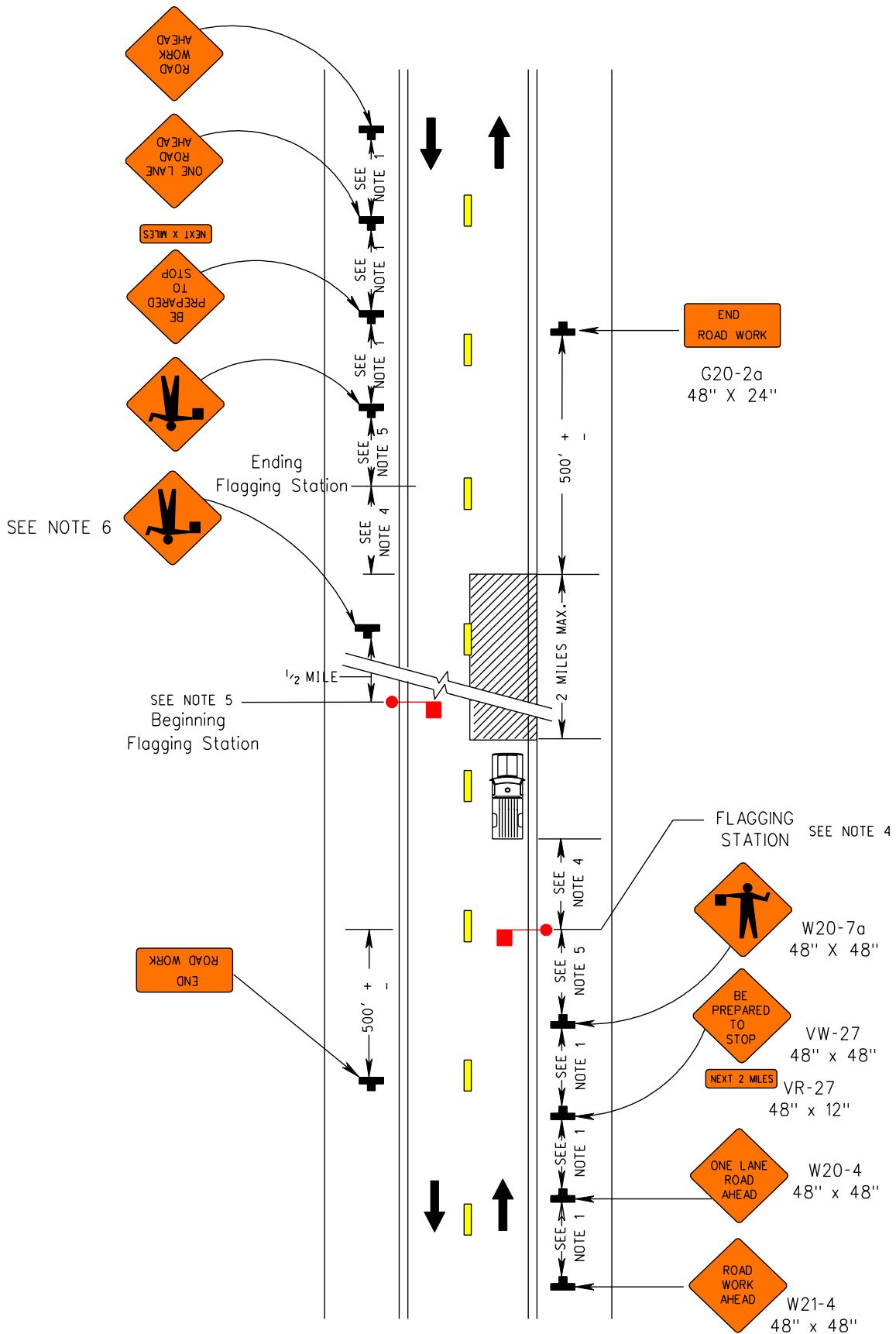
4. **Flagging stations shall be located far enough in advance of the work zone to permit approaching traffic to reduce speed and/or stop before passing the work zone and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-4. on page 6H-5).**
5. **The GRAPHIC FLAGGER AHEAD sign (W20-7A) shall stay within ½ mile of each flagger.**

Guidance:

6. *Additional GRAPHIC FLAGGER AHEAD 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.*

Standard:

7. **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)**
8. **A shadow vehicle with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.**
9. **The maximum length of the work area shall be two miles.**



NON-STATIONARY FLAGGING OPERATION
FIGURE TTC-19.0

**TYPICAL TRAFFIC CONTROL
LANE CLOSURE OPERATION – NEAR SIDE OF INTERSECTION
(FIGURE TTC-20.0)**

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.

Standard:

2. On roadways having a median wider than 8', left and right sign assemblies shall be used.
3. Taper Length and Channelizing Device Spacing shall be:

Taper Length				Channelizing Device Spacing		
Speed Limit M.P.H	Taper Length Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

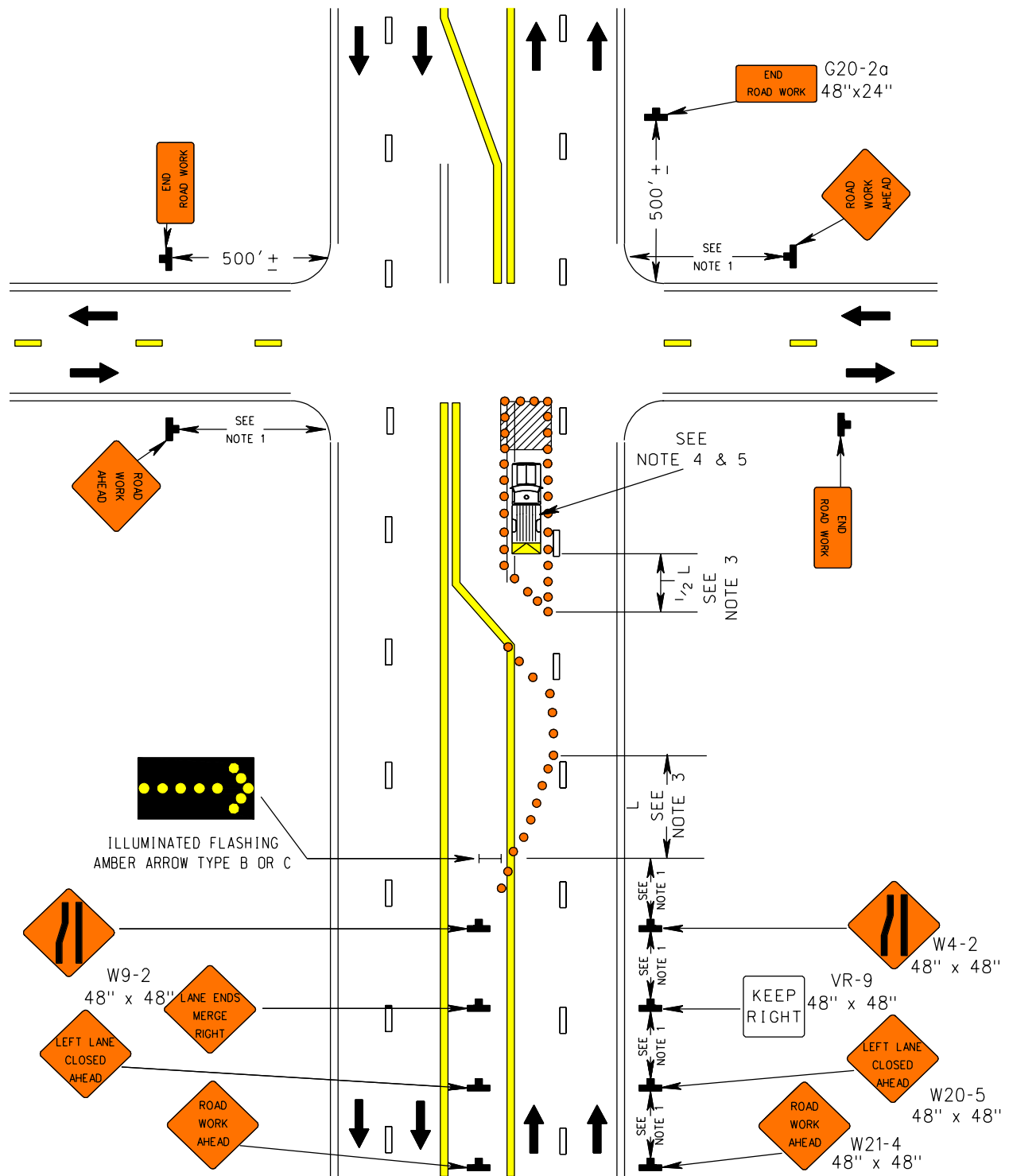
(Shoulder Taper = 1/3 L Minimum)

Guidance:

4. If room permits, a shadow vehicle with at least one rotating amber light or high intensity amber strobe light should be parked 50'-100' 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.
7. Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.



**LANE CLOSURE OPERATION NEAR SIDE OF INTERSECTION
FIGURE TTC-20.0**

**TYPICAL TRAFFIC CONTROL
LANE CLOSURE OPERATION – FAR SIDE OF INTERSECTION
(FIGURE TTC-21.0)**

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.

Standard:

2. On roadways having a median wider than 8', left and right sign assemblies shall be used.
3. Taper Length and Channelizing Device Spacing shall be:

Taper Length				Channelizing Device Spacing		
Speed Limit M.P.H	Taper Length Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

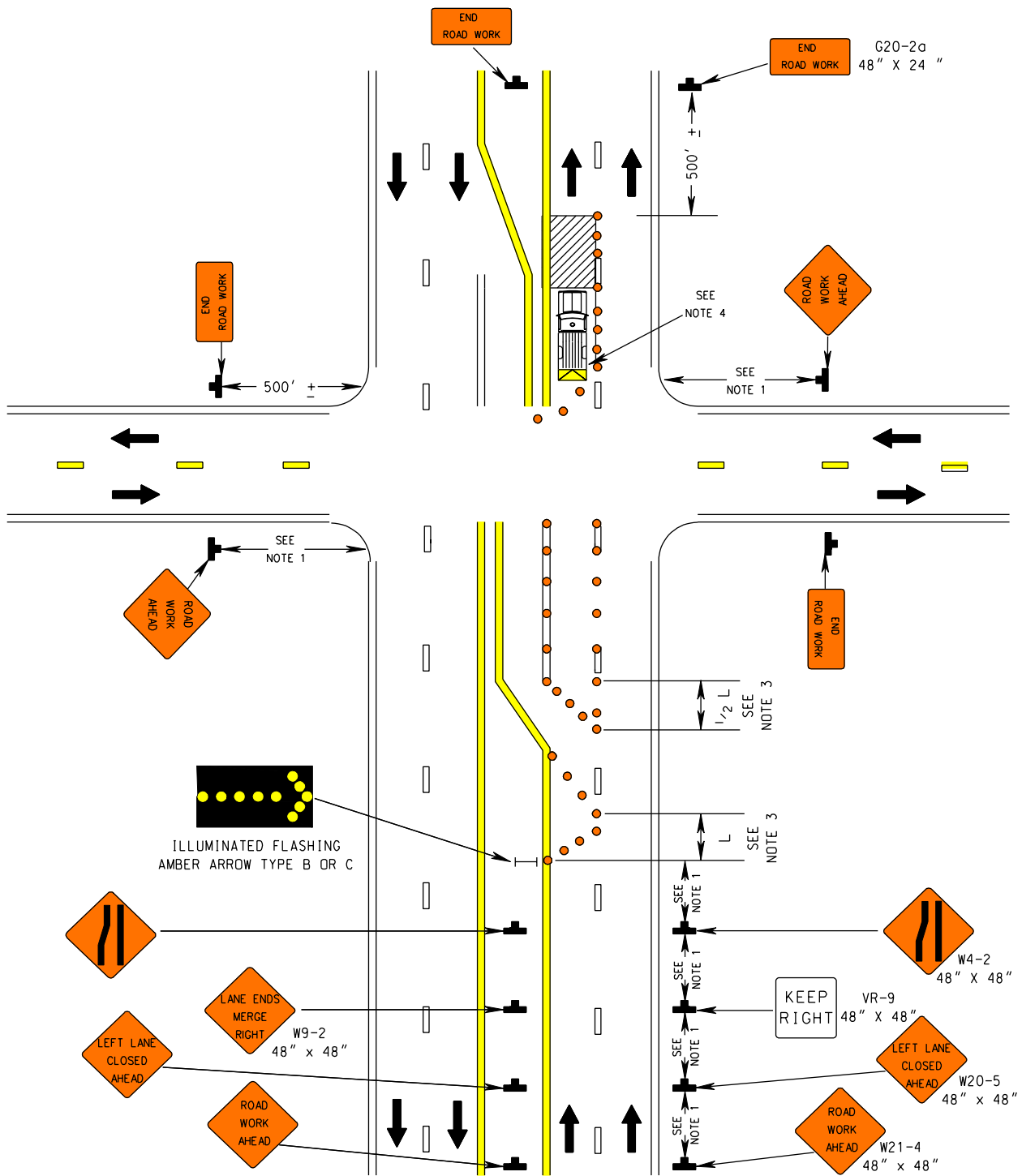
(Shoulder Taper = 1/3 L Minimum)

Guidance:

4. If room permits, a shadow vehicle with at least one rotating amber light or high intensity amber strobe light should be parked 50'-100' 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.
7. Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.



LANE CLOSURE OPERATION - FAR SIDE OF INTERSECTION
FIGURE TTC-21.0

**TYPICAL TRAFFIC CONTROL
CLOSURE OPERATION IN INTERSECTION
(FIGURE TTC-22.0)**

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 District Traffic Engineer.*
 - c) *Place a state certified flagger on each leg of the intersection with the appropriate signing as shown.*
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.*

Standard:

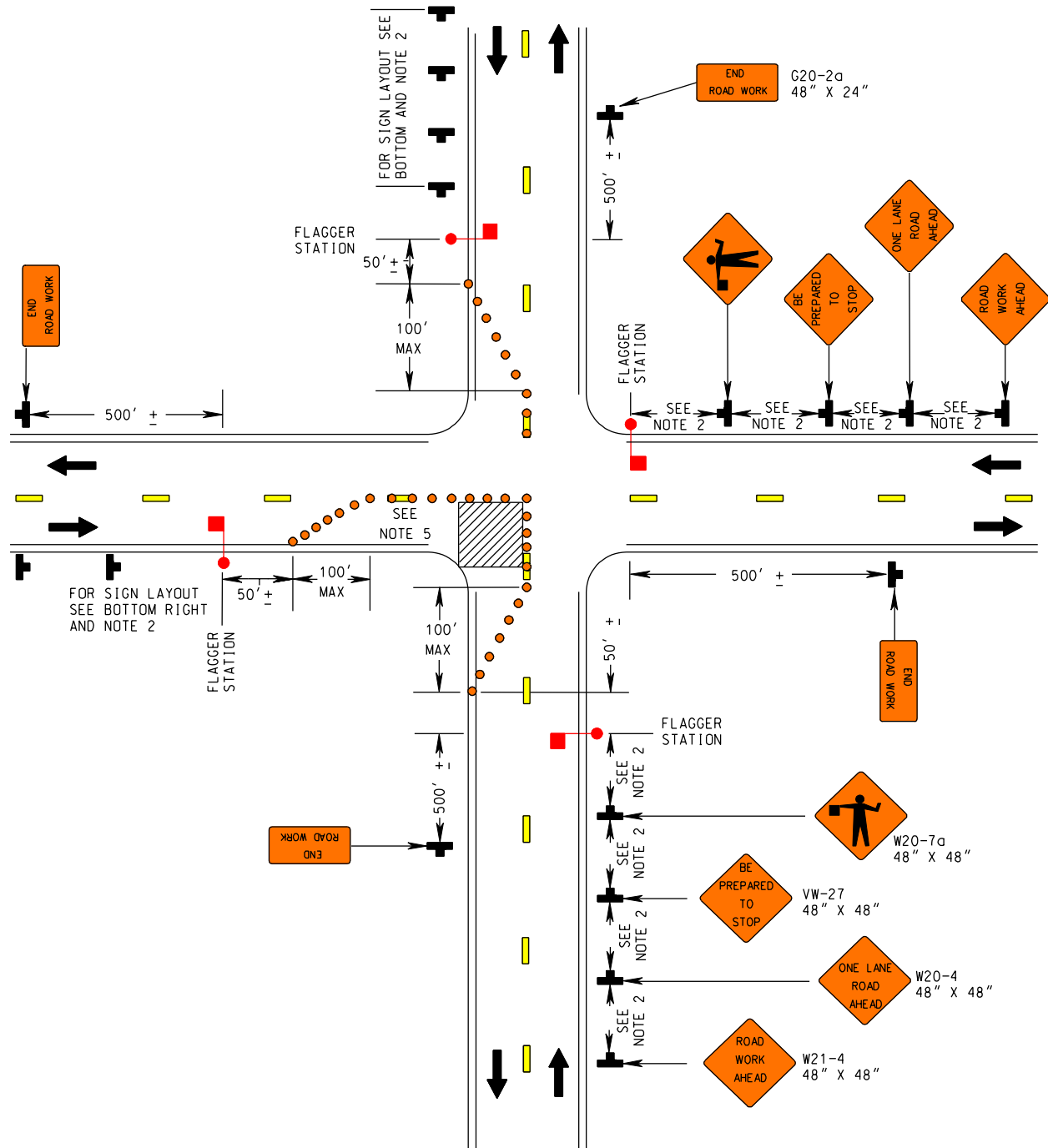
3. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
4. **Cone spacing shall be on 20' centers or less.**

Guidance:

5. *If room permits, a shadow vehicle with at least one rotating amber light or high intensity amber strobe light should be parked 50'-100' in advance of the first work crew.*

Standard:

6. **If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck mounted attenuator.**
7. **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.**
8. **Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.**



LANE CLOSURE OPERATION IN INTERSECTION
FIGURE TTC-22.0

**TYPICAL TRAFFIC CONTROL
TURN LANE CLOSURE OPERATION
(FIGURE TTC-23.0)**

NOTES

Guidance:

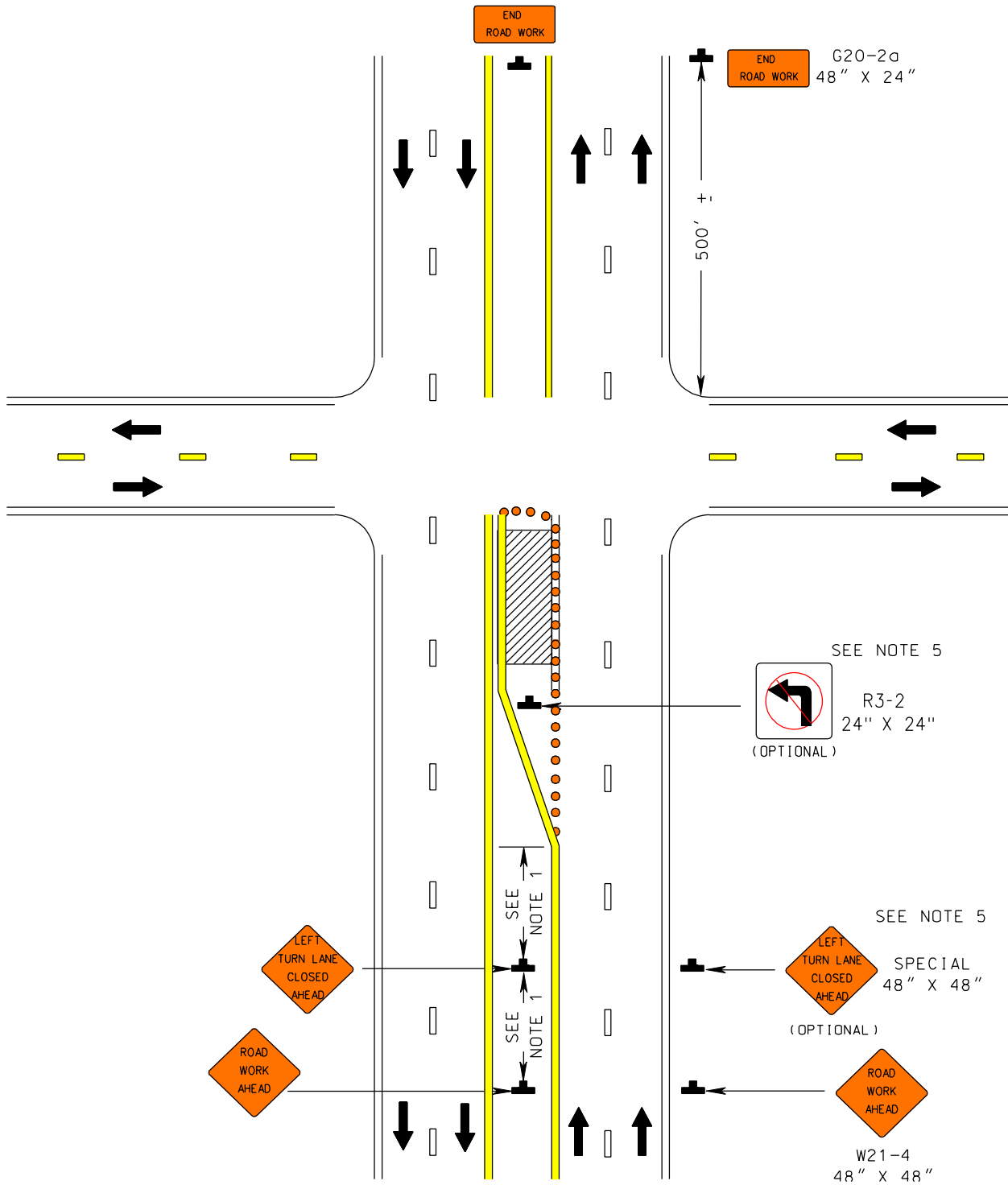
1. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
3. **To prevent accidental intrusion into the work area, cone 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", "LEFT LANE MUST TURN LEFT" or "LEFT TURN CLOSED AHEAD"), cones and vehicles may be used



TURN LANE CLOSURE OPERATION
FIGURE TTC-23.0

**TYPICAL TRAFFIC CONTROL
SIDEWALK CLOSURE AND BYPASS SIDEWALK OPERATION
(FIGURE TTC-24.0)**

NOTES

Standard:

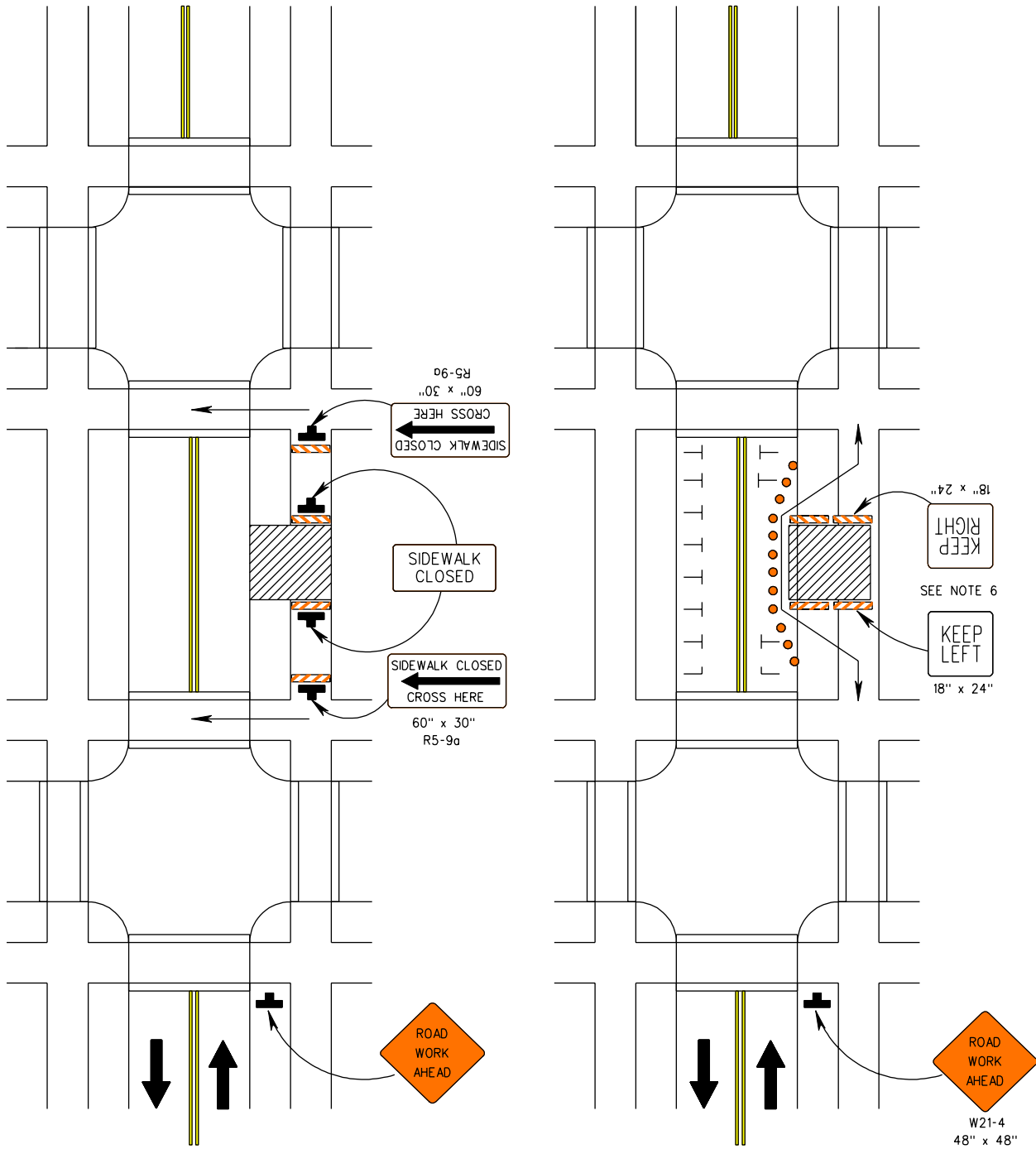
- 1. Where sidewalks exist, provisions shall be made for disabled persons.**

Guidance:

- 2. Where high speeds are anticipated, a temporary traffic barrier and crash cushion device should be used to separate the temporary sidewalks from motor vehicle traffic.*

Option:

3. Only traffic control devices controlling pedestrian flows are shown. Other devices, such as lane closure signing or "ROAD NARROWS" signs, may be used to control motor vehicle traffic.
4. For nighttime closures, Type A flashing warning lights may be used on barricades supporting signs and closing walkways.
5. Type C Steady-Burn warning lights may be used on channelizing devices separating the work area from motor vehicle traffic.
6. Signs, such as "KEEP RIGHT" and "KEEP LEFT" may be placed along a temporary sidewalk to guide or direct pedestrians.



**SIDEWALK CLOSURE AND BYPASS SIDEWALK OPERATION
FIGURE TTC-24.0**

**TYPICAL TRAFFIC CONTROL
CROSSWALK CLOSURE AND PEDESTRIAN DETOUR OPERATION
(FIGURE TTC-25.0)**

NOTES

Standard:

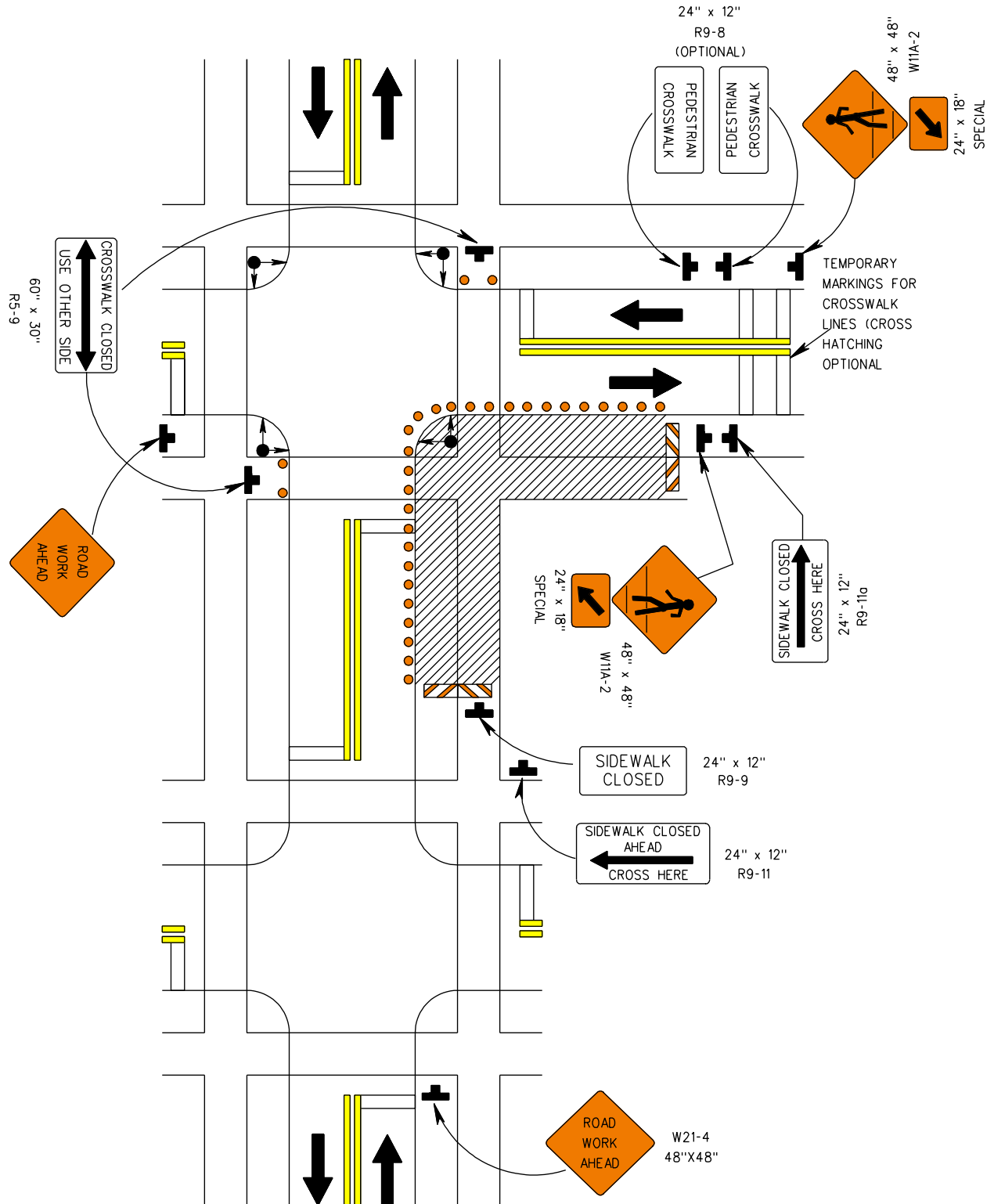
1. Where sidewalks exist, provisions shall be made for disabled persons.
2. Curb parking shall be prohibited for at least 50 feet in advanced of the mid-block crosswalk.
3. Pedestrian traffic signal displays controlling closed crosswalks shall be covered or deactivated.

Option:

4. Only traffic control devices controlling pedestrian flows are shown. Other devices, such as lane closure signing or "ROAD NARROWS" signs, may be used to control motor vehicle traffic.
5. For nighttime closures, Type A flashing warning lights may be used on barricades supporting signs and closing walkways.
6. Type C Steady-Burn warning lights may be used on channelizing devices separating the work area from motor vehicle traffic.

Guidance:

7. *Temporary markings should be considered for operations exceeding three days in duration.*



SIDEWALK CLOSURE AND PEDESTRIAN DETOUR OPERATION
FIGURE TTC-25.0

**TYPICAL TRAFFIC CONTROL
WORK OPERATION IN THE VICINITY OF EXIT RAMPS
(FIGURE TTC-26.0)**

NOTES

Guidance:

1. *Sign spacing distance should be 1000'-1500' for limited access highway, 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 flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*

Standard:

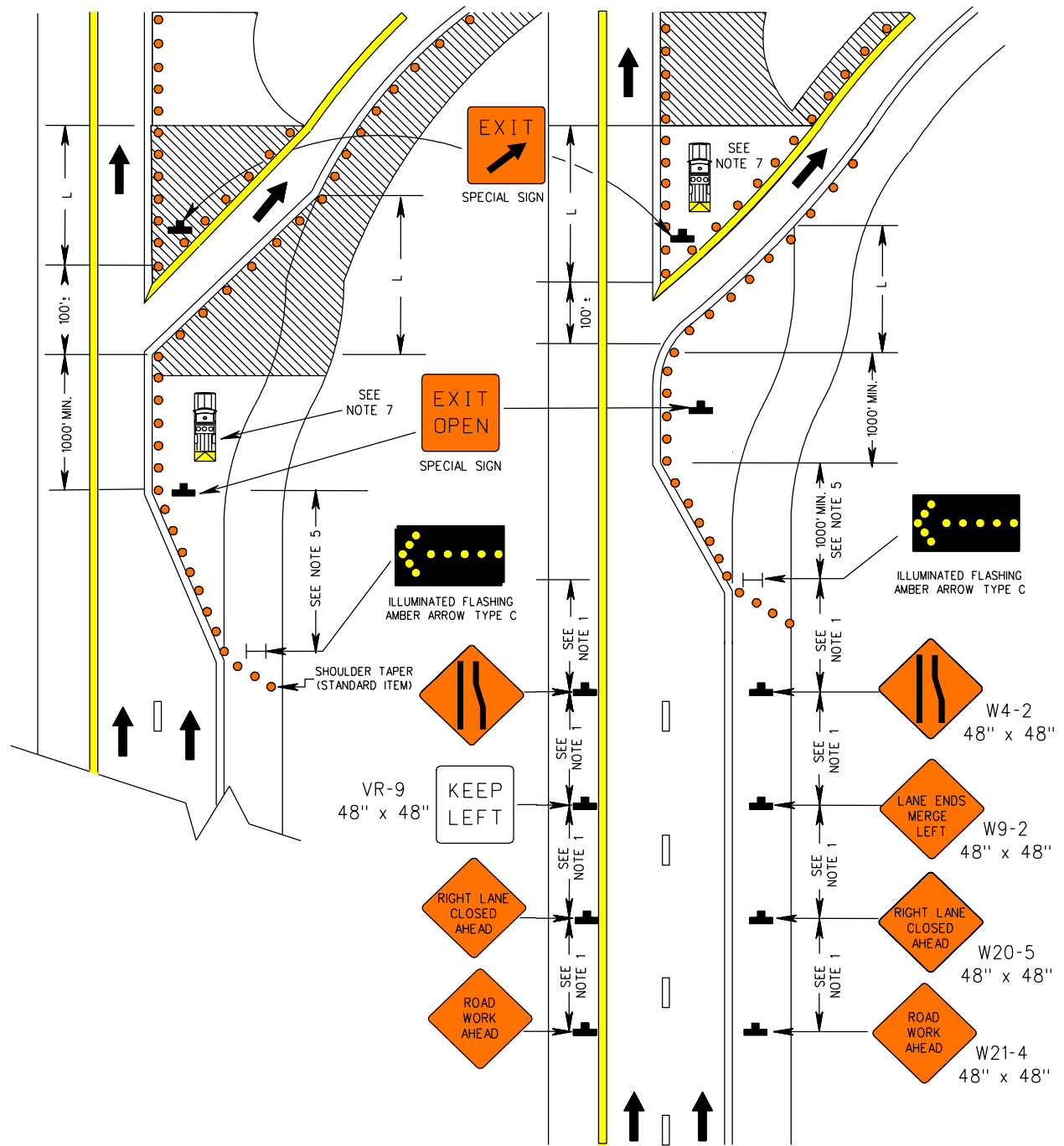
3. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
4. **A temporary "EXIT" sign shall be located in the temporary gore. For better visibility, it shall be mounted a minimum of 7 feet from the pavement surface to the bottom of the sign.**
5. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length				Channelizing Device Spacing		
Speed Limit M.P.H	Taper Length Lane Width In Feet			Location	Speed (mph)	
	10	11	12	Transition Spacing	0-35	36+
25	105	115	125	Travelway Spacing	20'	40'
30	150	165	180		40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. **A 1000' buffer located from the end of the taper to the beginning of the off ramp shall be used.**
7. **A shadow vehicle with either a Type B or C arrow panel operating in the caution mode, or equipped with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**



WORK OPERATIONS IN VICINITY OF EXIT RAMP
FIGURE TTC-26.0

**TYPICAL TRAFFIC CONTROL
PARTIAL RAMP CLOSURE OPERATION
(FIGURE TTC-27.0)**

NOTES

Guidance:

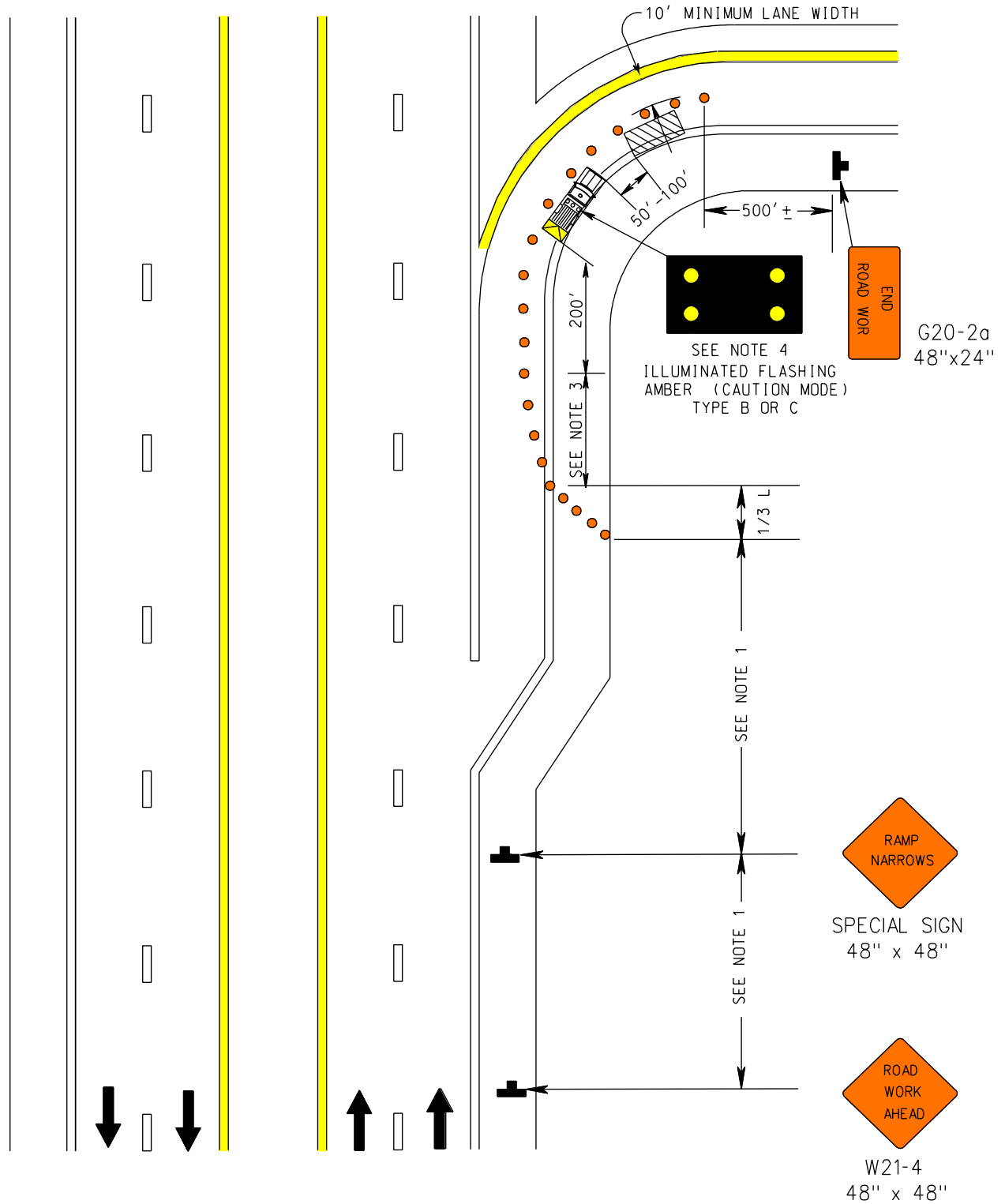
1. *Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **To prevent accidental intrusion into the work area, cone spacing shall not exceed 20' on centers.**
3. **Cone Taper Length (L) = Posted Speed Limit (S) x Width of actual ramp closure (W).
(Example: 55 x 6' = 330')**
4. **A shadow vehicle with either a Type B or C arrow panel operating in the caution mode, or equipped with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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 District Traffic Engineer shall determine the advisory speed limit.**

Guidance:

6. *A minimum 200' buffer space should be provided, when possible.*
7. *Truck off-tracking should be considered when determining whether the 10 foot minimum lane width is adequate.*



PARTIAL RAMP CLOSURE OPERATION
FIGURE TTC-27.0

**TYPICAL TRAFFIC CONTROL
WORK OPERATION IN THE VICINITY OF ENTRANCE RAMPS
(FIGURE TTC-28.0)**

NOTES

Guidance:

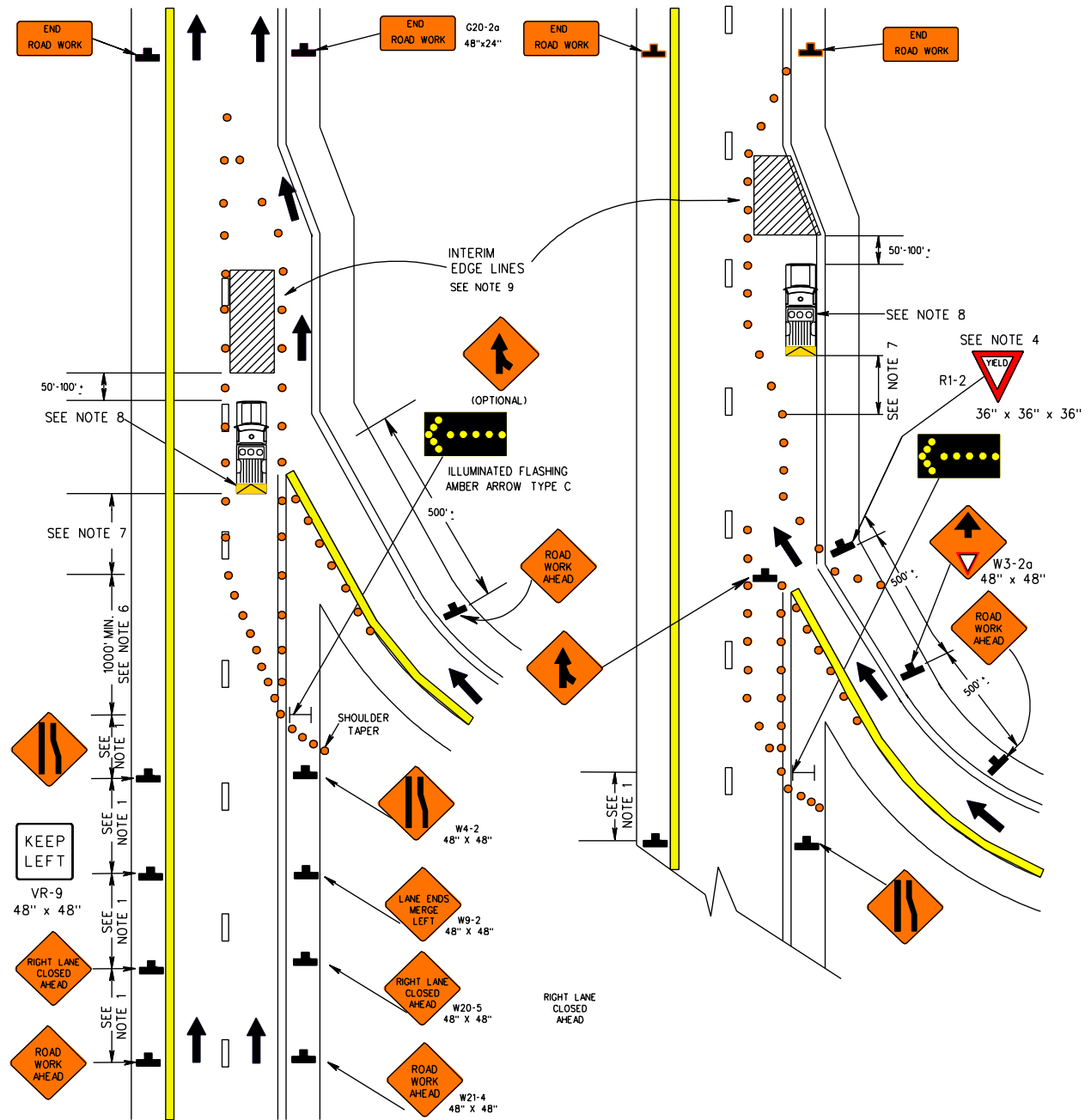
1. *Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*
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 right diagram of the typical application, where inadequate acceleration distance exists, for the temporary entrance, the "YIELD" sign shall be replaced with "STOP" signs (one on each side of the approach).**
5. **On highways having a median wider than 8', left and right sign assemblies shall be used.**
6. **For taper lengths and channelizing device spacing, Note 5 of TTC 26.0 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-3.0 on page 6H-5.0 for the posted speed limit.**
8. **A shadow vehicle with either a Type B or C arrow panel operating in the caution mode, or equipped with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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. **Existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Option:

10. When operations are 3 days or less in duration, lanes may be delineated by channelizing devices in lieu of temporary markings.
11. A Type B High-Intensity warning flasher with a red lens may be placed above the "STOP" signs.



WORK OPERATIONS IN THE VICINITY OF ENTRANCE RAMPS
FIGURE TTS-28.0

**TYPICAL TRAFFIC CONTROL
MULTI-LANE SHIFT OPERATION
(FIGURE TTC-29.0)**

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 1000'-1500' for limited access highway, 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" sign is used, then solid 4 inch wide minimum white lanes should be used.*
4. *For shifting taper lengths and channelizing device spacing, Note 5 of TTC 26.0 should be used. The minimum length of a lane shifting taper should be $\frac{1}{2} L$.*

Option:

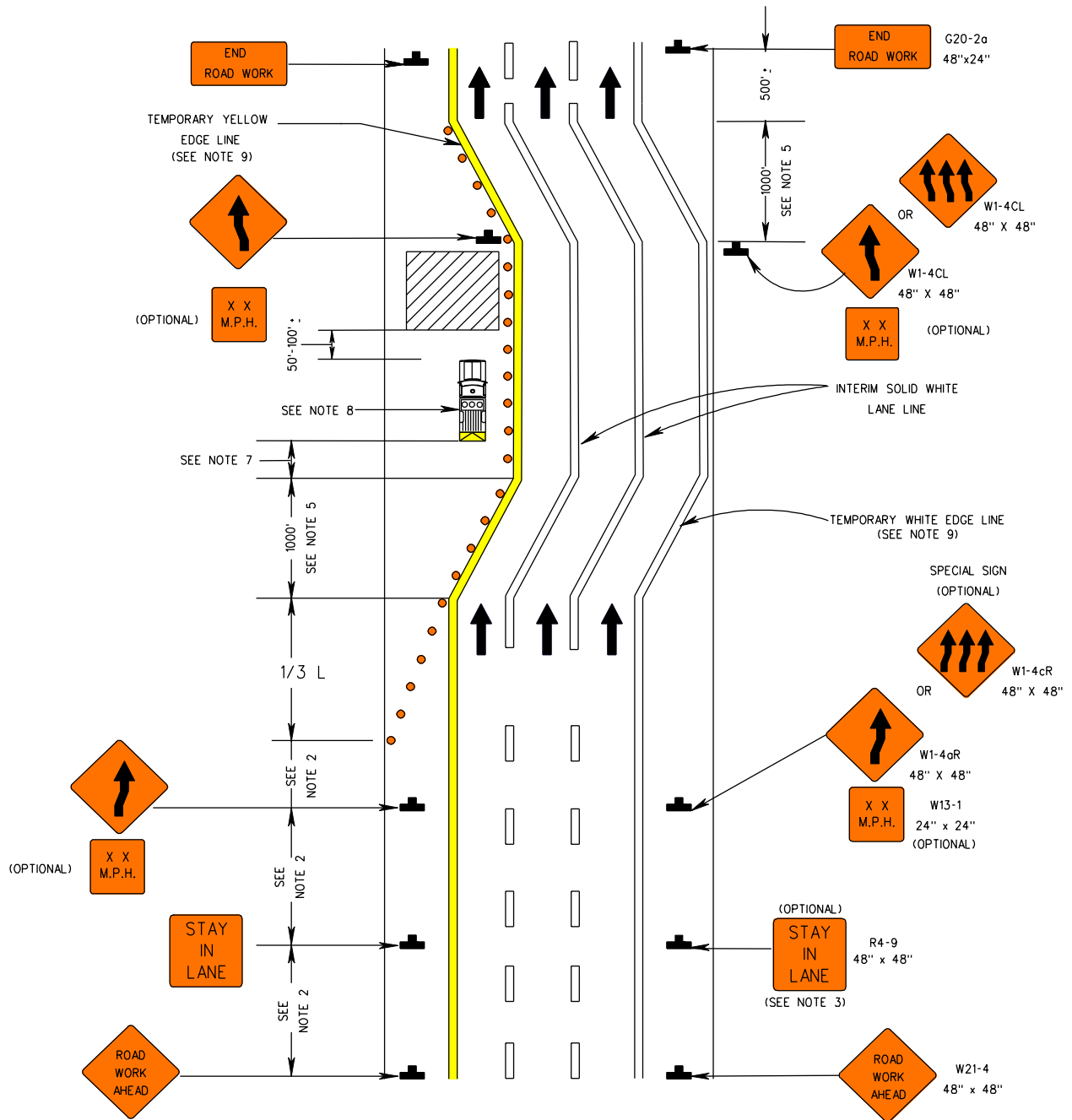
5. For all limited access highways, the desired shifting transition length is 1000', but lesser values, not to exceed $\frac{1}{2} L$, may be used.

Standard:

6. **The minimum width of the shoulder lane shall be 10'.**
7. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5 for the posted speed limit.**
8. **A shadow vehicle with either a type B or C arrow panel operating in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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 (over 3 days duration) stationary work, existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Option:

10. For short-term (less than 3 days duration) stationary work, lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.



MULTI-LANE SHIFT OPERATION
FIGURE TTC-29.0

**TYPICAL TRAFFIC CONTROL
HALF ROAD CLOSURE OPERATION ON MULTI-LANE ROADWAY
(FIGURE TTC-30.0)**

NOTES

Guidance:

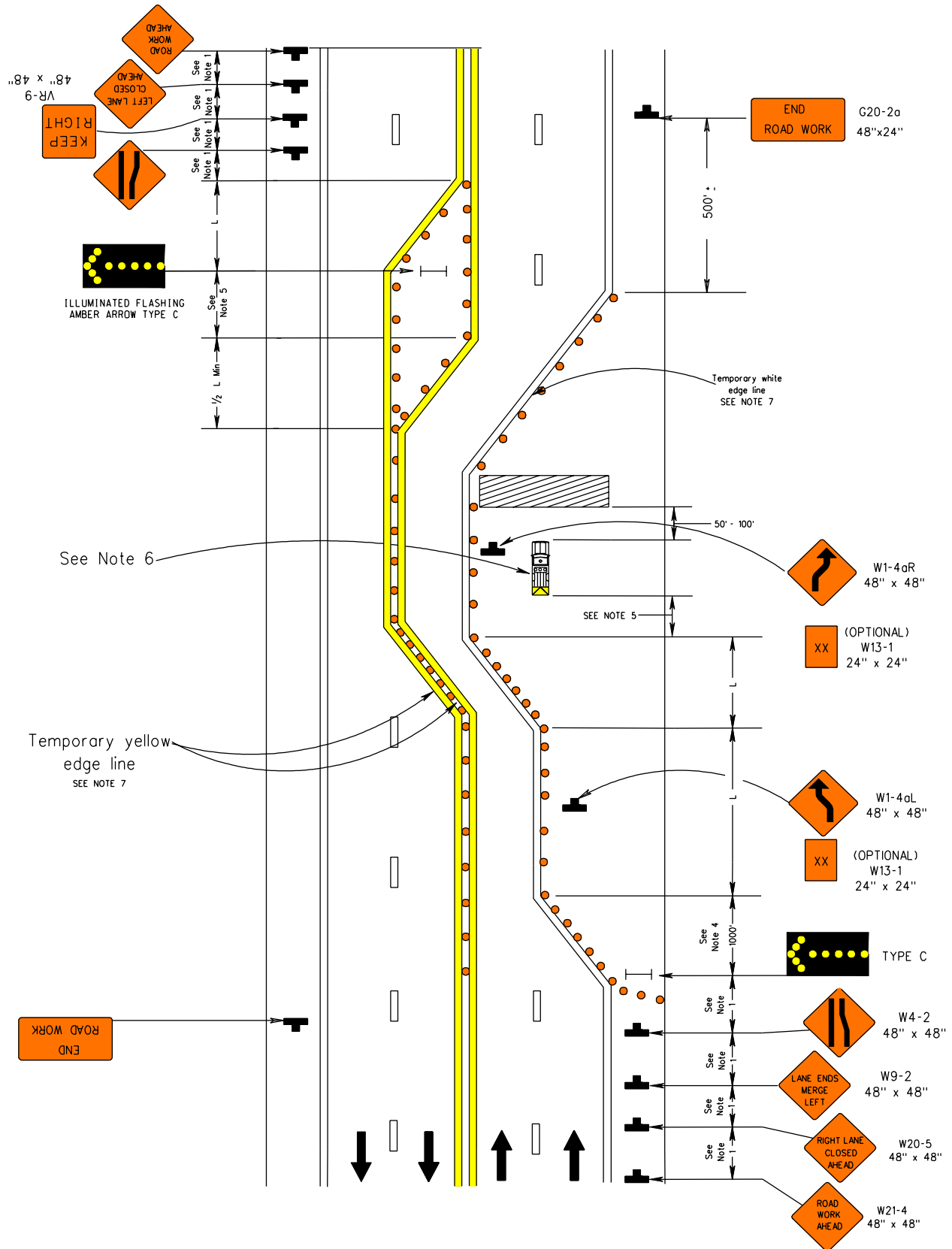
1. *Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone 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 Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

3. **On highways having a median wider than 8', left and right sign assemblies shall be used.**
4. **For taper lengths and channelizing device spacing, Note 5 of TTC 26.0 shall be used. The minimum length of a lane closure taper on a limited access highway shall be 1000'.**
5. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5 for the posted speed limit.**
6. **A shadow vehicle with either a type B or C arrow panel operating in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' 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 (less than 3 days duration) stationary work, existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Option:

8. For short-term stationary work (under 3 days duration), lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.



HALF ROAD CLOSURE OPERATION ON MULTI-LANE ROADWAY
FIGURE TTC-30.0

**TYPICAL TRAFFIC CONTROL
TOTAL FREEWAY CLOSURE OPERATION
(FIGURE TTC-31.0)**

NOTES

Guidance:

1. *A Portable Changeable Message Sign (PCMS) should be placed 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".*
2. *Sign spacing distance should be 1000'-1500' for limited access highways.*

Standard:

3. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

4. *GRAPHIC LANE REDUCTION signs, W4-2, should be placed within the closed lanes only as shown to allow access to the shoulder for emergency vehicles.*

Standard:

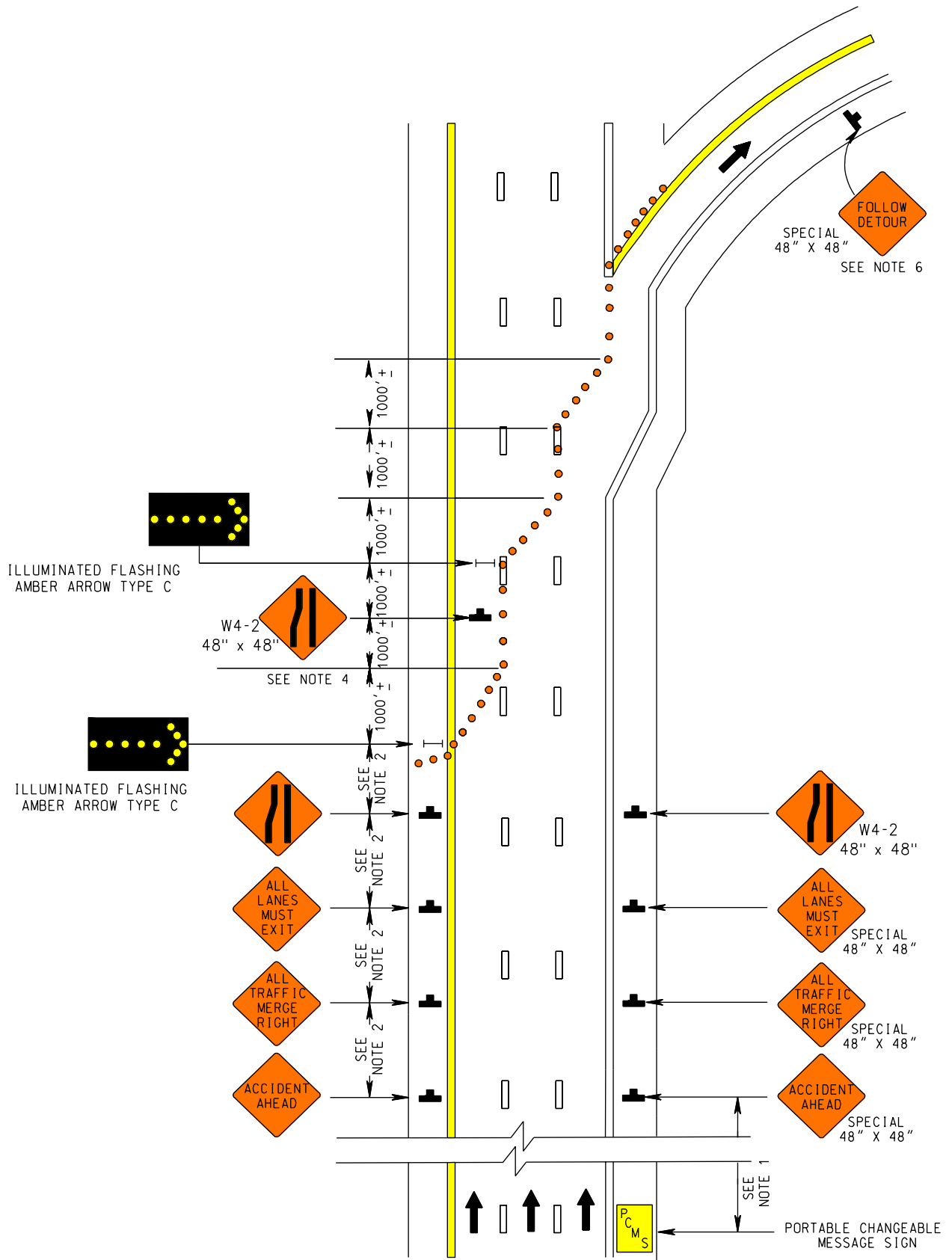
5. **Cone spacing shall be a maximum of 40' in transitions, and 80' along the travelway. Transitions shall be a minimum of 1000' in length.**

Guidance:

6. *If detour signing has been installed along the detour route, a "FOLLOW DETOUR" 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 "FOLLOW DETOUR".*

Option:

7. Other sign layouts for "Total Freeway Closure" may be substituted as directed by the District Traffic Engineer.



TOTAL FREEWAY CLOSURE OPERATION
FIGURE TTC-31.0

**TYPICAL TRAFFIC CONTROL
SURVEYING OPERATION
(FIGURE TTC-32.0)**

NOTES

OFF TRAVELWAY -

Guidance:

1. *Sign spacing distance should be 1000'-1500' for limited access highway, 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 roadways having a median wider than 8', left and right 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. **Although vehicle hazard warning signals can be used to supplement the rotating light or strobe light, they shall not be used instead of rotating lights 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.
7. "ROAD WORK AHEAD" or SURVEYING AHEAD" SIGNS MAY BE USED IN PLACE OF THE "SURVEY CREW AHEAD" sign

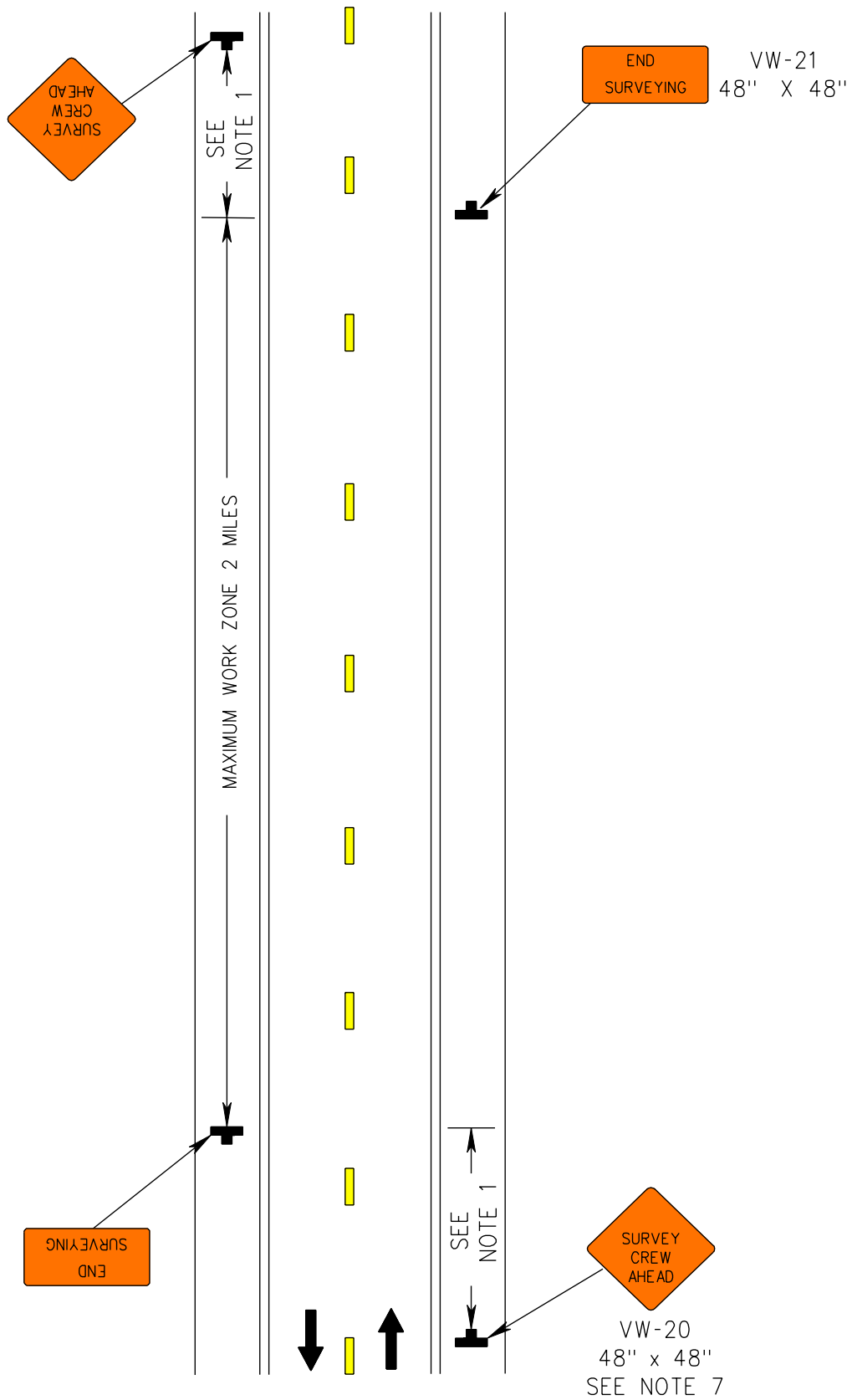
Standard:

8. **All workers near the roadway shall wear high visibility clothing.**

OFF TRAVELWAY -

Guidance:

9. *For surveying operations on the travelway, Typical Traffic Control Figure TTC-19.0, Flagging Operation on Two Lane Roadway, or Typical Traffic Control Figure TTC-12.0 or 13.0, Right or Left Lane Closure Operation on Four-Lane Roadway, should be used.*



SURVEYING OPERATIONS
FIGURE TTC-32.0

**TYPICAL TRAFFIC CONTROL
DISRUPTION OPERATION ON MULTI-LANE ROADWAY
(FIGURE TTC-33.0)**

NOTES

Support:

1. Conditions represented are a planned closure not exceeding 20 minutes during the daytime.

Guidance:

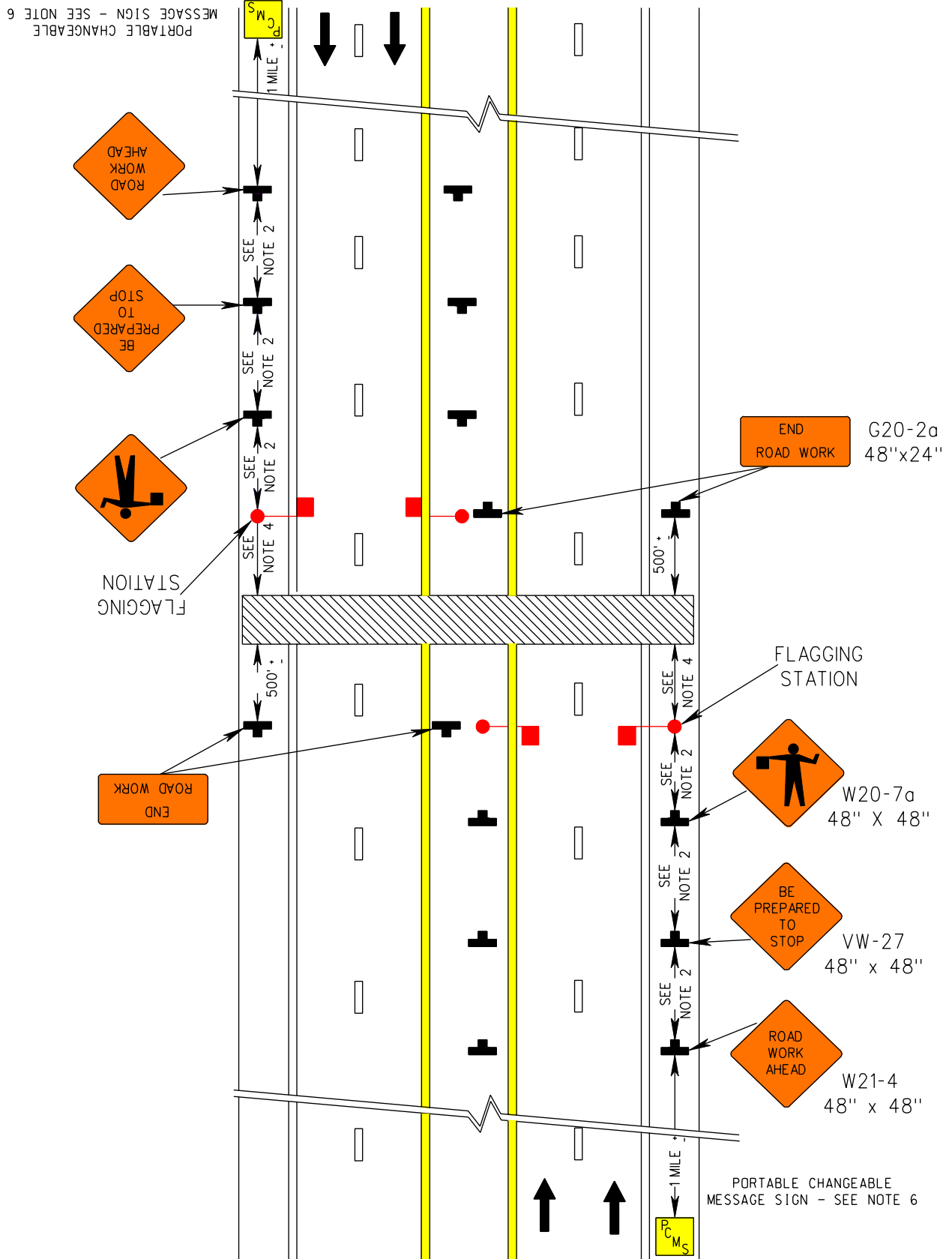
2. *On limited access highways, the sign spacing distance and flagger distance should be 1000'-1500'. For all other roadways, the distance between the advance warning signs and between the flagger should be 500'-800' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing 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 Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

4. **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.**
5. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**

Guidance:

6. *A Portable Changeable Message Sign (PCMS) should be used on limited access highways and placed 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").*
7. *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.*



TEMPORARY DISRUPTION ON MULTI-LANE ROADWAY
FIGURE TTC-33.0

**TYPICAL TRAFFIC CONTROL
HAUL ROAD CROSSING OPERATION
(FIGURE TTC-34.0)**

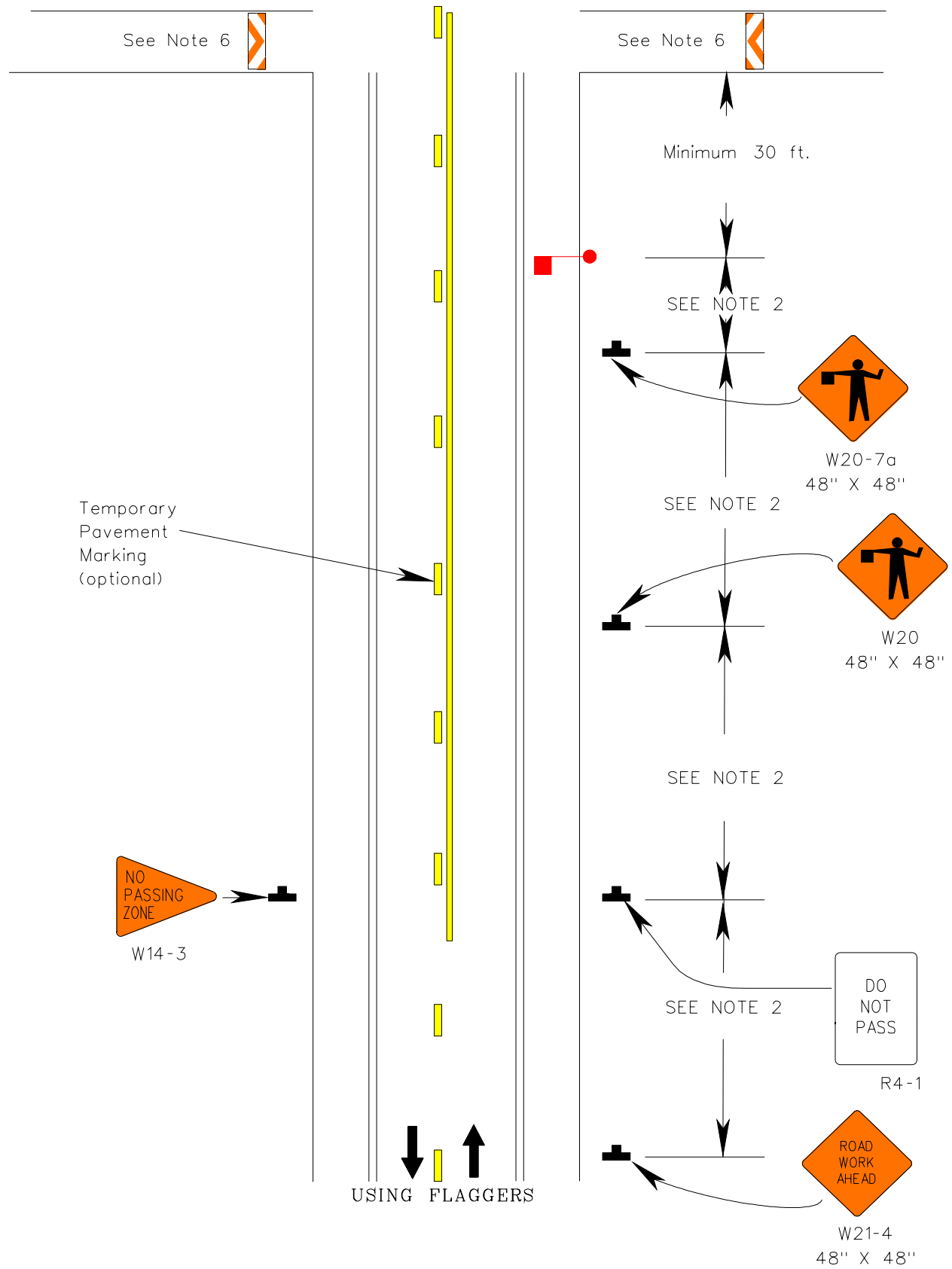
NOTES

Guidance:

1. *Floodlights should be used to illuminate haul road crossings where existing light is inadequate.*
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.*
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” sign (W14-3) shall be used directly across from the “DO NOT PASS” sign (R4-1).**
6. **When a road used exclusively as a haul road is not in use, Type III barricades shall be in place and the “Flagger” symbol and “BE PREPARED TO STOP” signs covered or removed.**
7. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**



**HAUL ROAD CROSSING OPERATION
FIGURE TTC-34.0**

**TYPICAL TRAFFIC CONTROL
SIGNING FOR REDUCED SPEEDS IN WORK ZONES
(FIGURE TTC-35.0)**

NOTES

Standard:

1. **The District Traffic Engineer must approve reducing the speed in a work zone after performing a Traffic Engineering study prior to the use of this layout.**

Option:

2. This layout depicts signing requirements for reducing speeds 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 1000'-1500' for limited access highway, 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 roadways having a median wider than 8', left and right sign assemblies shall be required.**
5. **The use of the "NOTICE \$250 MAXIMUM FINE FOR EXCEEDING SPEED LIMIT IN WORK ZONE" sign is optional and shall be approved by the District Traffic Engineer prior to installation. The size shown shall be used on Major Primary and Interstate highway systems.**

Option:

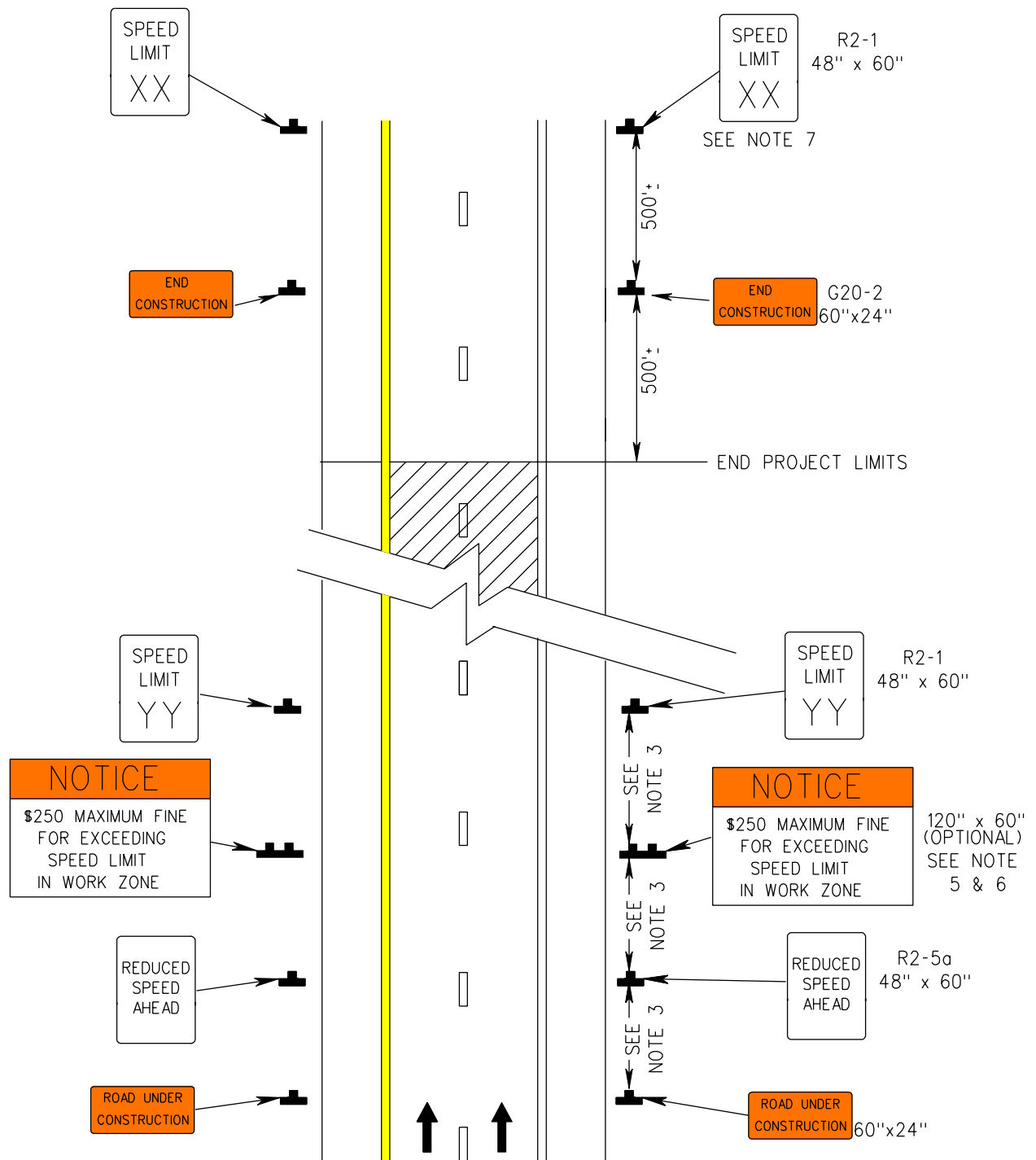
6. For Secondary and Minor Primary road systems, a 60" x 48" sign may be used.

Standard:

7. **If the entire project is signed for a reduced speed, and an original speed limit sign is not within 1000 linear feet of the "END CONSTRUCTION" sign, signs depicting the original speed limit shall be erected 500' ± past the "END CONSTRUCTION" sign. On secondaries with unposted speed limits, an "END XX SPEED LIMIT" (VR-5) 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 end point of reduced speed.**

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.).



SIGNING FOR REDUCED SPEEDS IN WORK ZONES
FIGURE TTC-35.0

**TYPICAL TRAFFIC CONTROL
SIGNING FOR PROJECT LIMITS
(FIGURE TTC-36.0)**

NOTES

Support:

1. This layout depicts signing requirements for designating the beginning and ending termini of construction projects. The purpose of the signs is to inform motorists when they are entering and exiting a potential construction area.

Standard:

2. **The “ROAD UNDER CONSTRUCTION” sign shall be placed 2000’ ± from the project limit, or prior to any other construction warning sign.**

Option:

3. On projects where there is a one time set up of construction signs and the length of the actual work zone is unchanged during the project, the “ROAD UNDER CONSTRUCTION” sign may be eliminated as directed by the District Traffic Engineer.

Standard:

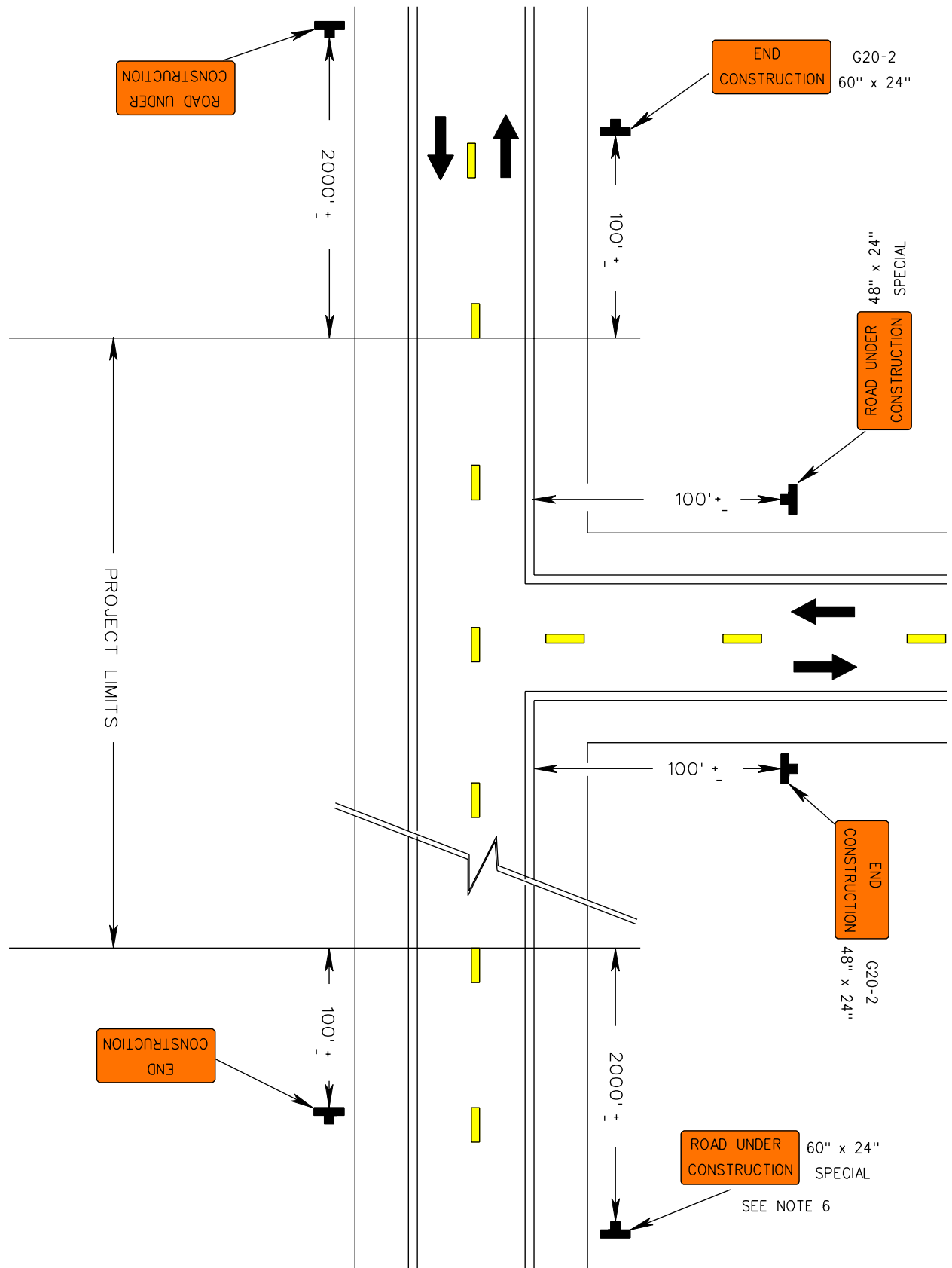
4. **On roadways having a median wider than 8’, left and right sign assemblies shall be required.**

Guidance:

5. *All connections within the project limits should be identified with project termini signs.*

Option:

6. The signing shown (60” x 24”) is for Primary and Limited Access highway systems. For Secondary road systems, 48” x 24” may be used.



SIGNING FOR PROJECT LIMITS
FIGURE TTC-36.0

**TYPICAL TRAFFIC CONTROL
MOTORIST SURVEY OPERATION ON TWO-LANE ROADWAY
(FIGURE TTC-37.0)**

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 Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*
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.*

Standard:

3. **Where Right-of-way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.**
4. **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:

5. 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:

6. *If the queue of traffic reaches the "BE PREPARED TO STOP" sign, the flaggers controlling the traffic in both directions should turn their paddles to "SLOW" to allow the traffic to clear. Also, the advance warning signs should be readjusted at greater distances.*

Standard:

7. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**
8. **Cones spaced a maximum of 20' on center shall be used to delineate the survey area.**
9. **All workers in or near the roadway shall wear high-visibility clothing.**

Option:

10. Additional traffic control devices may be needed as determined by the District Traffic Engineer.

**TYPICAL TRAFFIC CONTROL
ERADICATION OF PAVEMENT MARKINGS IN WORK ZONES
(FIGURE TTC-38.0)**

NOTES

Support:

1. This figure depicts requirements for pavement marking removal for long-term (over 3 days 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:

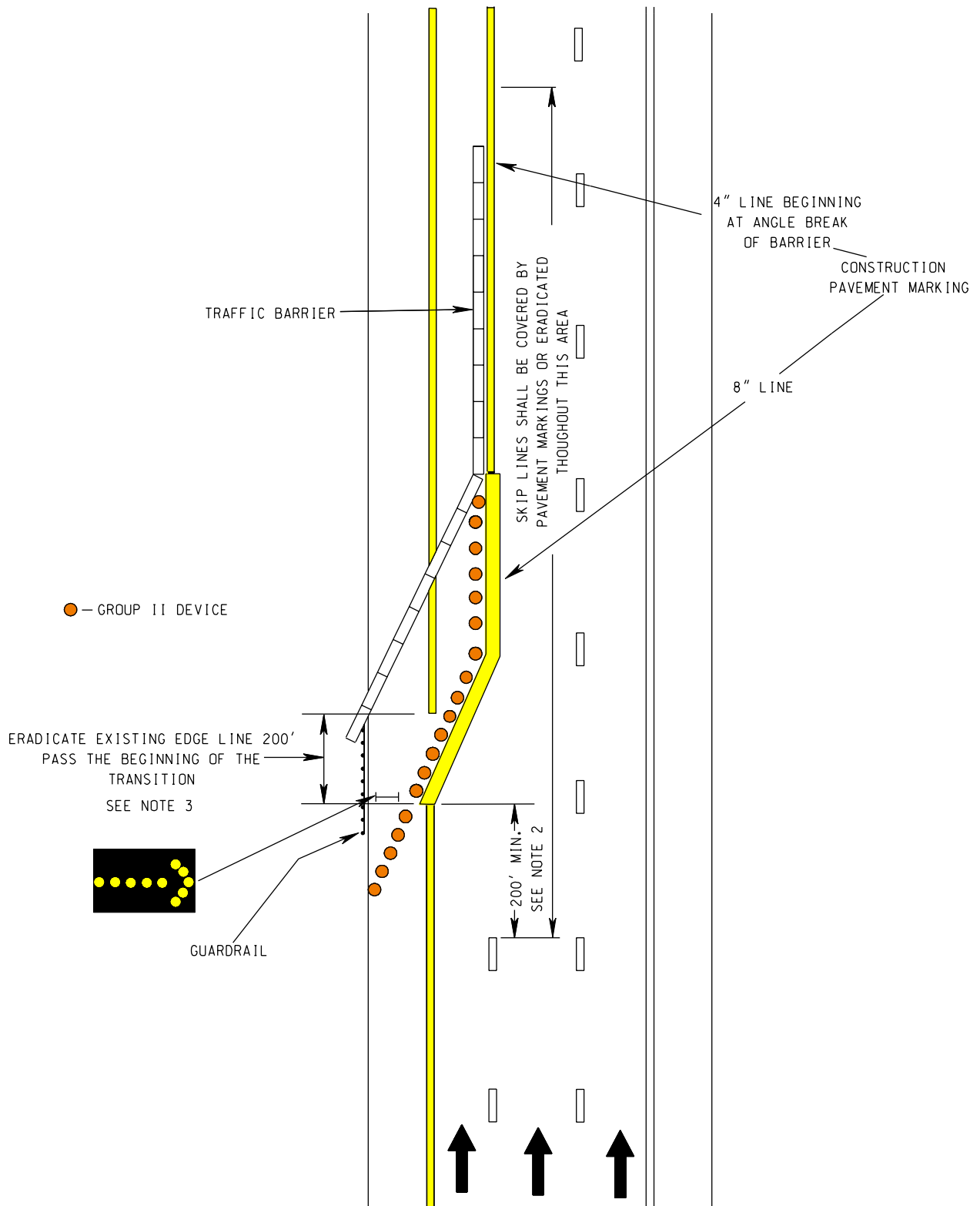
5. In lane shift situations, if Group 2 channelizing devices are placed between the barrier service or work area and the travel lanes, removal of skip lines in excess of 6' away from the new edge line is not required and may remain.

Standard:

6. **All existing pavement markers in conflict with the new construction pavement markings shall have the reflective element remove.**
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 WORK ZONES
FIGURE TTC-38.0

**TYPICAL TRAFFIC CONTROL
WORK IN THE VICINITY OF HIGHWAY-RAIL CROSSING
(FIGURE TTC-39.0)**

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:

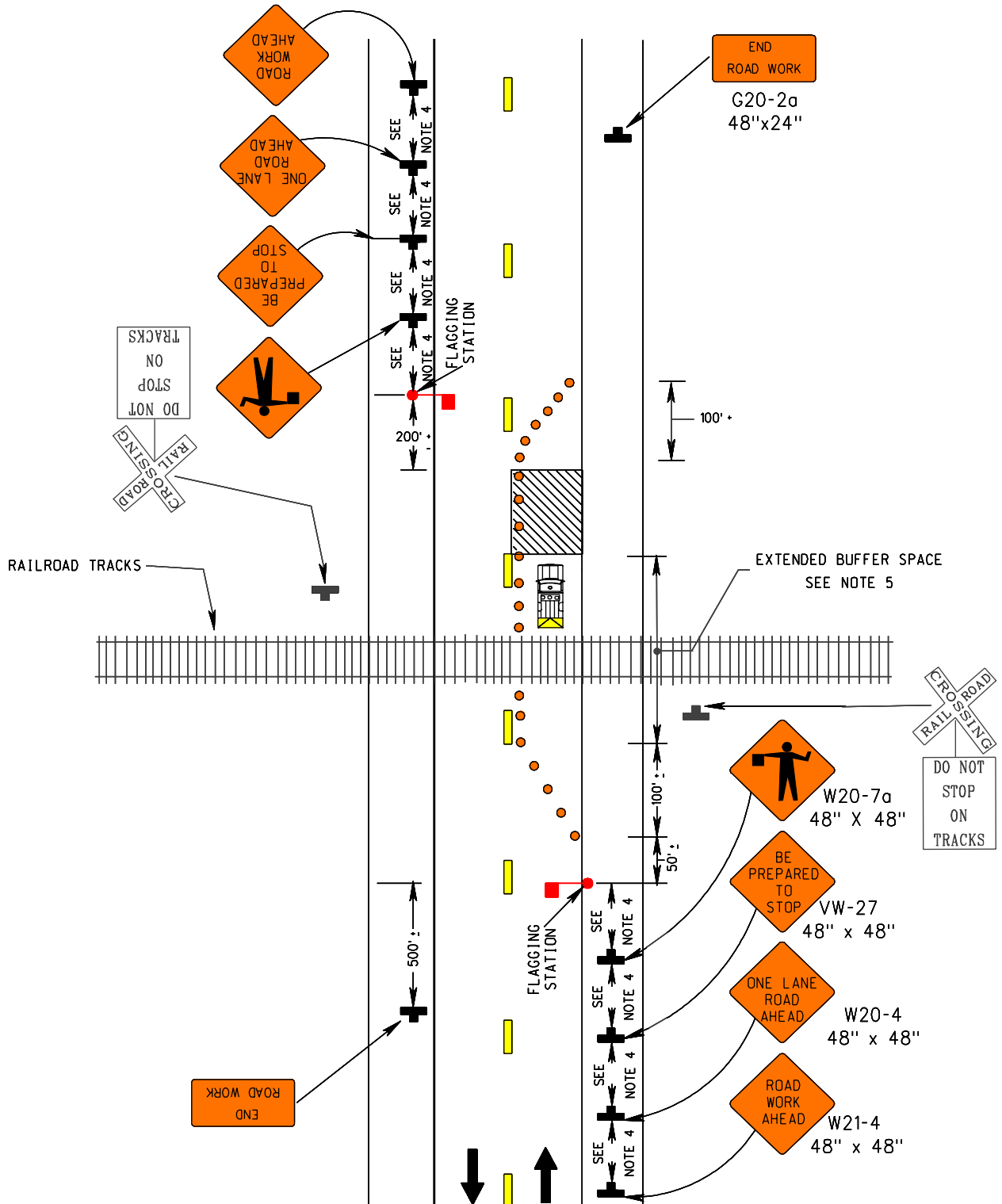
3. *Early coordination with the railroad company should occur before work starts.*
4. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
5. *In the example depicted in TTC-39.0, the buffer space 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" 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. **Lighting shall be provided as needed to adequately illuminate the flagger stations at night.**
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:**

<i>Location</i>	<i>Speed (mph)</i>	
	<i>0-35</i>	<i>36+</i>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

10. **A shadow vehicle with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.**



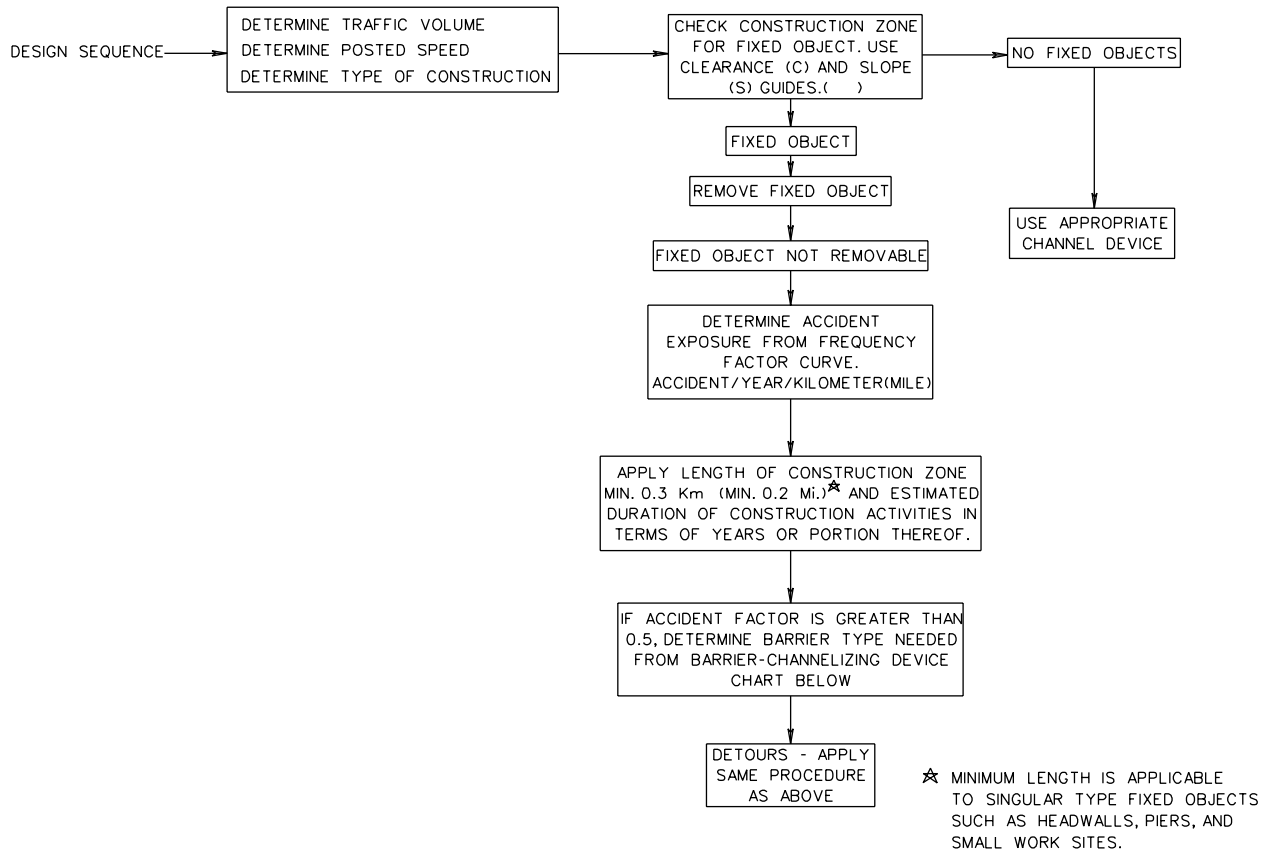
**WORK IN THE VICINITY OF HIGHWAY-RAIL CROSSING
(FIGURE TTC-39.0)**

APPENDIX A

GUIDELINES FOR USE OF BARRIER/CHANNELIZATION DEVICES

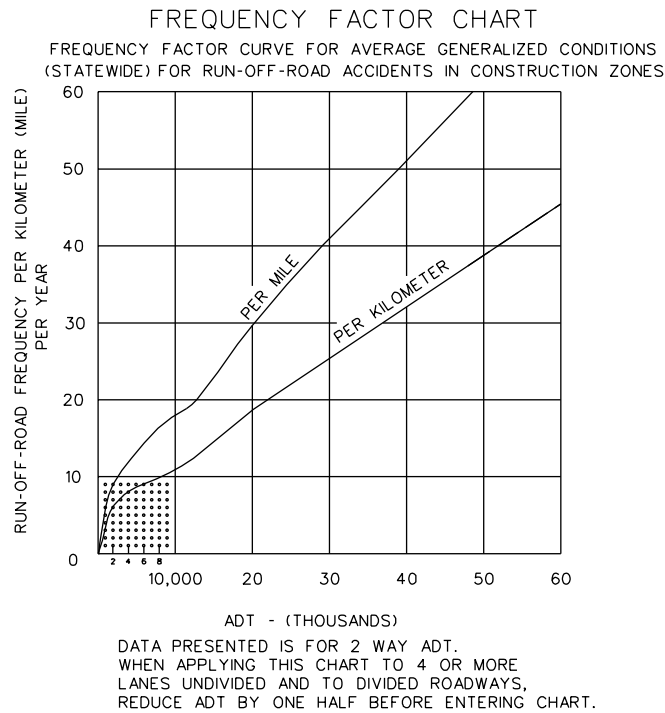
The following Safety Guidelines for Construction Zones have been developed to provide a methodical framework from which to assess every project as to the needs for appropriate techniques and devices to be employed during the construction phase. This covers a broad range of traffic conditions, vehicle speed and duration of construction, to insure that motorist and worker safety are addressed in a uniform manner throughout the State. Of particular note is the step in the design sequence that asks the question, "Can the fixed object be removed?" 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. The "Guidelines" are to be used as a supplement to the Millennium edition of the Manual on Uniform Traffic Control Devices (MUTCD) and the Virginia Work Area Protection Manual.

DETERMINATION OF BARRIER / CHANNELIZATION DEVICES
IN CONSTRUCTION ZONES



* A FIXED OBJECT IS ANY CONDITION RESULTING FROM THE CONSTRUCTION ACTIVITIES OR ANY OBJECT CONSIDERED DAMAGING TO A MOVING VEHICLE AS WOULD BE THE FOLLOWING:

HEADWALL	BARRIER ENDS	OPEN EXCAVATION
PARAPET	DROP INLET	SIGN POLES & BASES
MANHOLE	PIPE	BRIDGE PIER
GUARDRAIL END	SLOPE	BOX CULVERT
STORED MAT'L.	EQUIPMENT	



- Having determined a fixed object, excavation or hazardous slope exists within the clear zone and cannot be removed, proceed with the following.
- Determine accident exposure from Frequency Factor Curve [Accidents/Kilometer (Mile)/Year].
- Apply Length of Construction Zone and Estimated Duration of Construction Activities in terms of years or portion thereof.

For singular type fixed objects such as headwalls, piers, and small work sites use minimum of 0.3 km (0.2 mi.) for Length of Construction Zone.

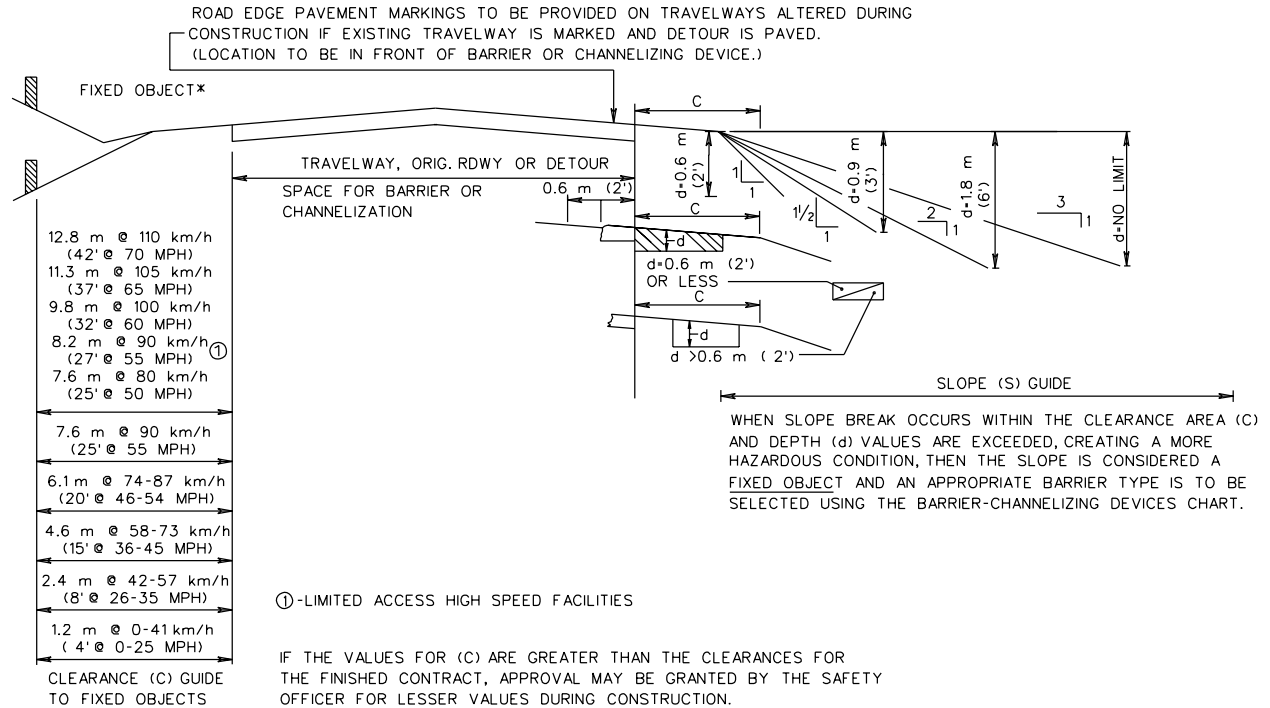
- Example: (2 lane - 2 way)
 ADT = 20,000
 Length of Construction Zone = 2.5 km (1.6 mi.)
 Construction Time = 0.5 yr.

(1) From Frequency Factor Chart, ADT of 20,000 would indicate 19 (30) Run-off-Road Accidents/Kilometer(Mile)/Year.

(2) Accident Factor is 19 (30) x 2.5 km (1.6 mi.) x 0.5 yr = 23.75 (22.5)

- If Accident Factor is greater than 0.5, go to Barrier Channelization Device Chart to determine type needed.

FIXED OBJECT CLEARANCE & SLOPE GUIDES



Example

ADT = 15,000 (2 - lane, 2 - way) Fixed Object @ 5.5 m (18')

1/2:1 Slope d = 1.5 m (5') Length of Construction Zone = 2.5 km (1.6 mi.)

Construction Time = 0.5 yr. 0.3 m (1') excavation at 3 m (10')

90 km/h (55 MPH) Accident Frequency Factor = 15 (17)

- (1) From Clear Zone Guide, clear zone (c) for 90 km/h (55MPH) = 6.9 m (20')
- (2) Fixed object @ 5.5 m (18') is within 6.9 m (20') (c); go to Barrier Channelization Device Chart
For 15,000 ADT and 90 km/h (55MPH), Type A Barrier required.
- (3) Since 1.5 m (5') for 1/2:1 slope exceeds 0.9 m (3') in Slope (s) Guide, Type A Barrier required.
- (4) Since 0.3 m (1') excavation occurs within 6.9 m (20') (c), use lesser value from upper left segment of Barrier-Channelization Device Chart, Type B Barrier required.

SELECTING BARRIERS, BARRICADES AND CHANNELIZING DEVICES

BARRIER-CHANNELIZING DEVICE CHART					
POSTED SPEED LIMIT - MPH					
EXISTING TRAFFIC ADT	0-25	26-35	36-45	46-54	55+
0-750	1, 2 1, 2	1, 2 1, 2	1, 2 1, 2	1, 2 1, 2	1, 2 B
751-5500	1, 2 1, 2	1, 2 1, 2	1, 2 B	B B	B A
5500-15000	1, 2 1, 2	1, 2 B	B B	B A	A A
ABOVE 15000	1, 2 1, 2	1, 2 B	A A	A A	A A

A MORE POSITIVE TYPE OF BARRIER CAN BE SUBSTITUTED FOR VALUES SHOWN.

BARRIER BEGINNINGS ARE TO BE PLACED AS FAR AS POSSIBLE FROM TRAVELWAY.

WHEN AN EXCAVATION OCCURS WITHIN THE CLEARANCE (C) AREA WITH A DEPTH (d) BETWEEN 150 mm (6") AND 0.6 m (2') USE THE LESSER VALUE FROM THE UPPER LEFT SEGMENT OF THE BARRIER - CHANNELIZATION DEVICE CHART. ALL OTHER CONDITIONS REQUIRING A BARRIER OR CHANNELIZATION DEVICE SHOULD USE THE TYPE DEPICTED IN THE LOWER RIGHT SEGMENT.




DRUMS SHALL BE USED TO DELINEATE ALL UNMANNED WORK AREAS

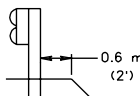
TYPES OF BARRIERS
(Fixed Object Class)

FOR DETAILS - SEE PLANS

ALPHABETICAL LISTING OF BARRIERS IS IN ORDER OF POSITIVE REDIRECTION CAPACITY. INSTALLATION IS TO BE IN ACCORDANCE WITH THE ROAD AND BRIDGE STANDARDS.




A
POSITIVE



B
LESS POSITIVE


BRIDGES

TEMPORARY CONCRETE PARAPET




BR. ENGR. APPROVAL

TEMPORARY CONCRETE TRAFFIC BARRIER




BOLTED DOWN CHANNEL SECTION
SUBJ. TO BR. ENGR. APPROVAL

BARRICADES & CHANNELIZING DEVICES
(FOR DETAILS AND METHOD OF PLACEMENT SEE MUTCD AND PLANS)



CONES

GROUP 1



DRUM

GROUP 2

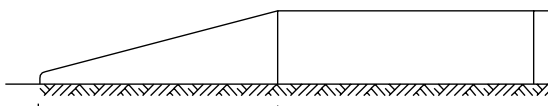
SPACING GUIDE

SPEED	0-57 (0-35)	58+ (36+)
SPACING	12(40)	24(80)

CHANNELIZATION DEVICE SPACING ALONG TRAVELWAY - METERS (FEET) - SPACING ON CURVES 280 m (6°) OR GREATER, ON TRANSITIONS OR LOCATIONS DETERMINED BY DISTRICT TRAFFIC ENGINEER TO BE 1/2 OF TRAVELWAY SPACING.

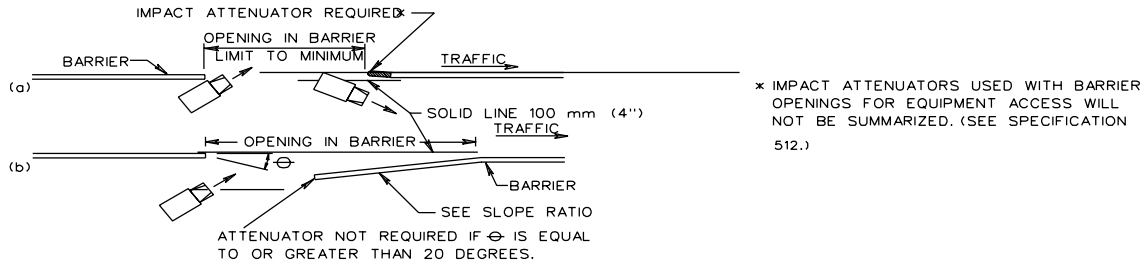
PC BARRIER END TREATMENT

To be USED ONLY when "Clear Zone" distance requirements are met

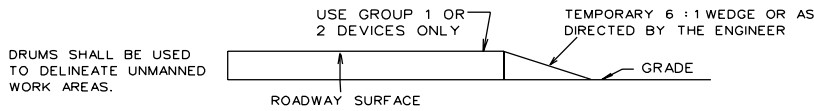


← 3.6 m (12') MINIMUM →

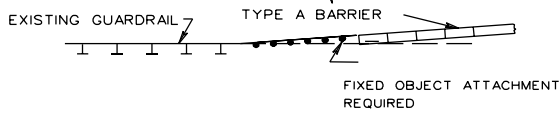
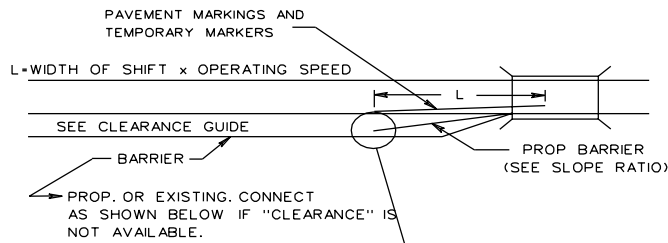
CONSTRUCTION ACCESS TECHNIQUES



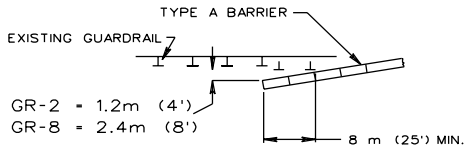
PAVEMENT PLACEMENT GUIDE



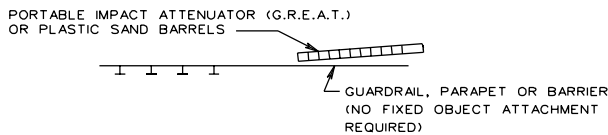
INTRODUCED BARRIER (FIXED OBJECT)



OR



OR

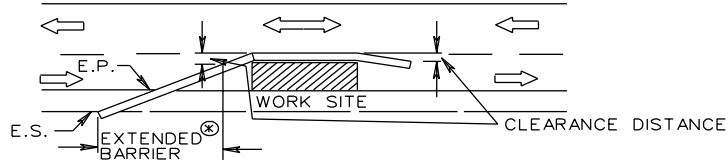


BARRIER TRANSITION SLOPE RATIO

110 km/h (70 MPH)	=	22:1
105 km/h (65 MPH)	=	20:1
100 km/h (60 MPH)	=	19:1
90 km/h (55 MPH)	=	17:1
80 km/h (50 MPH)	=	16:1
70 km/h (45 MPH)	=	14:1
60 km/h (40 MPH)	=	13:1
52 km/h (35 MPH)	=	11:1
45 km/h (30 MPH)	=	10:1
Below 30 MPH	=	10:1

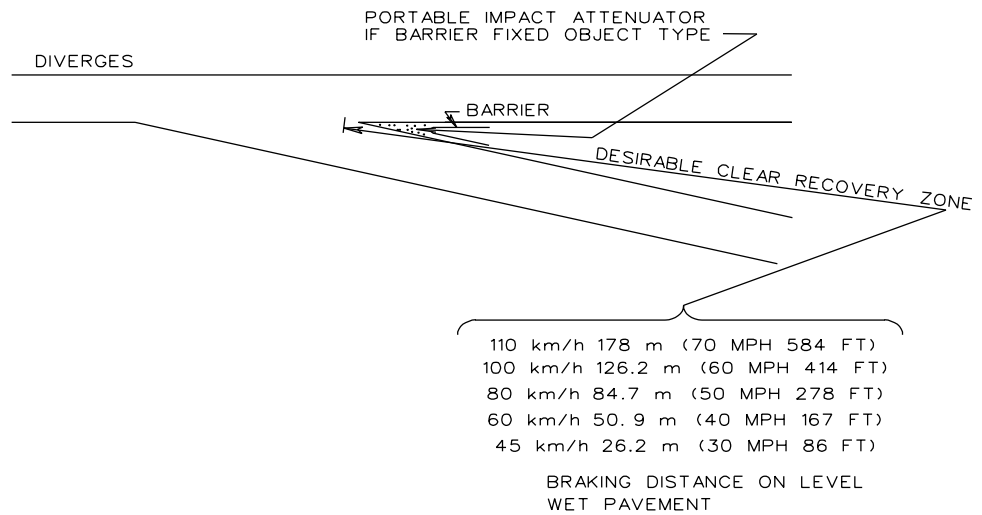
WHEN THE BARRIER TRANSITION SLOPE IS ON HORIZONTAL ALIGNMENT THE TOTAL OFFSET SHALL BE PRORATED AROUND THE CURVE IN LIEU OF A STRAIGHT LINE SLOPE.

INTRODUCED BARRIER (FIXED OBJECT)

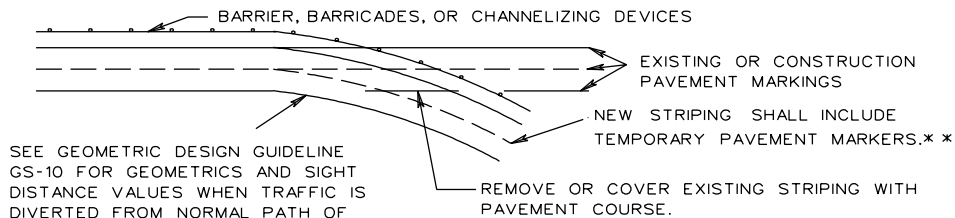


SEE TYPICAL TRAFFIC CONTROL FIGURE TTC-16.0 FOR DETAIL INFORMATION ON BARRIER INSTALLATION AND REQUIRED TRAFFIC CONTROL

⊗ WHENEVER A TRAVEL LANE IS DIVERTED WITH THE USE OF CONCRETE BARRIERS AND THE CLEARANCE DISTANCE DOES NOT PLACE THE BARRIER OR ITS END TO THE OUTSIDE OF THE SHOULDER OF THE ONCOMING LANE, THEN THE BARRIER IS TO BE EXTENDED TO THE SHOULDER, OR AN IMPACT ATTENUATOR SHALL BE UTILIZED.



DETOURS



SEE GEOMETRIC DESIGN GUIDELINE GS-10 FOR GEOMETRICS AND SIGHT DISTANCE VALUES WHEN TRAFFIC IS DIVERTED FROM NORMAL PATH OF LANE OR LANES. USE CLEARANCE GUIDE FOR FIXED OBJECTS.

* * TEMPORARY PAVEMENT MARKERS TO BE SPACED ON 6 m (20') CENTERS IN TRANSITIONS. WHEN TEMPORARY MARKERS ARE REQUIRED IN OTHER AREAS, THEY SHALL BE INSTALLED ON 12 m (40') CENTERS, OR LOCATIONS DETERMINED BY THE DISTRICT TRAFFIC ENGINEER.

STOPPING SIGHT DISTANCE (S.S.D.) - Feet

Height of Eye 3.5'

Height of Object 0.5'

Use "Desirable" values as minimum on Interstate system, and the Arterial system where feasible.

<i>Posted Speed</i>	<i>20</i>	<i>25</i>	<i>30</i>	<i>35</i>	<i>40</i>	<i>45</i>	<i>50</i>	<i>55</i>	<i>60</i>	<i>65</i>	<i>70</i>
Minimum S.S.D.	125	150	200	225	275	325	400	450	525	550	625
Desirable S.S.D.	125	150	200	250	325	400	475	550	650	725	850

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.

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. 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 detail information as warranted for the type of operation.” Additional methods of documentation may also be used with this form, including written notes and sketches, project diary entries, photographs, and video recordings.

An explanation form to explain the fields found on the work zone safety checklist form follows on pages B-5 through B-11.

Blank Page

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)
- TO MUCH INFORMATION ON P.C.M.S.
- NOT DELINEATED, NO CONES / BARRELS

COMMENTS: _____

D. ARROW PANEL:

- ADEQUATE INADEQUATE
- MALFUNCTION (BULB OUT, ETC.)
- INCORRECT PLACEMENT
- MISALIGNED BULBS
- NOT DIMMED AT NIGHT

COMMENTS: _____

E. DRUMS = D / CONES = C

D C

- ADEQUATE INADEQUATE
- INAPPROPRIATE TAPER LENGTH
- SPACING INADEQUATE (TO LONG / TOO SHORT
- (REPAIR / CLEAN / REPLACEMENT)
- REFLECTIVE BANDS (DAMAGED / MISSING) ON (CONES / TUBULAR MARKERS)
- 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: _____

G. FLAGGING OPERATION:

ADEQUATE INADEQUATE

NEED ADDITIONAL ADVANCE SIGNING

ARE FLAGPERSONS

CERTIFIED? YES NO
POSITIONED CORRECTLY? YES NO
HIGHLY VISIBLE? YES NO
PROPERLY CLOTHED? YES NO
FLAGGING 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 INADEQUATE

REPLACE MISSING
REMOVE
NEED ADDITIONAL

COMMENTS:

J. TRUCK MOUNTED ATTENUATOR:

PROPERLY POSITIONED? YES NO
PROPERLY MAINTAINED /
DELINEATED? YES NO

COMMENTS:

K. MISCELLANEOUS:

YES NO
ADEQUATE BUFFER SPACE? YES NO
IS THE WORK AREA PROTECTED? YES NO
MATERIALS PROPERLY STORED? YES NO
ARE LANE CLOSURES IN ACCORD
WITH ALLOWED HOURS" YES NO

ACCIDENTS:

EVIDENCE OF AN ACCIDENT | YES NO
DAMAGED 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. <i>DRIVE THRU:</i> 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 panels, 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 of the Virginia Work Area Protection Manual (VWAPM)

“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 VWAPM (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: See Section 6F-52 of the VWAPM

“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 CONES / BARRELS:” - 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 PANEL: See Section 6F-53 of the VWAPM

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 panel. 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 Section 6F-55 of the VWAPM

DRUMS = D: Circle the letter **D** when drums are checked.

CONES = C: Circle the letter **C** when cones are checked.

(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-76 and Appendix A of the VWAPM

“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” VERTICAL 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 Section 6E of the VWAPM

“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 VWAPM.

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?” - Flagpersons shall be dressed in accordance with the VWAPM. 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-65 of the VWAPM

“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-67 of the VWAPM

“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 VWAPM.

“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-77 of the VWAPM

“PROPERLY POSITIONED?” - Mark the appropriate box according to the requirements of the VWAPM.

“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 VWAPM 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.

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) and contractor's superintendent should meet and discuss when and where the trooper will give the best benefit in reducing excessive speeds through the work zone. The following suggestions 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 in the lane closure 500 - 1000 feet in advance of the first work crew. If a Truck Mounted Attenuator (TMA) is used within the lane closure, the trooper's vehicle should not block the TMA cushion.
 - B. If traffic is backing-up within the transition area or within the advance warning area, the trooper should position his vehicle on the shoulder in advance of the back-up to slowed/stopped traffic, which should increase driver attention and prevent potential crashes. This may require repositioning of the vehicle from time to time to stay in advance of the back up.
 - C. Mobile lane closure operations on multilane roadways are one of the most dangerous operations performed. If possible, the use of a trooper, placed on the shoulder 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 and where 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. VDOT contact information, including name and cell phone or pager number, shall be given to the trooper 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 designate shall relay any changes to the placement of the trooper.
3. VDOT personnel should request that the trooper's vehicle be a marked vehicle and equipped with a radar unit.
4. Once on the project at the designated location, the state police vehicle should operate with its lights flashing. If equipped with radar, the trooper should operate the radar 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 obtain a project charge. If the trooper must leave the site due to an emergency or other related situation, the VDOT contact person shall be notified.
6. 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.