



Kentucky Transportation Center

Guidelines for Traffic Control in Short Duration / Mobile Work Zones

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The contents of the guide do not reflect the official views or policies of the Kentucky Transportation Cabinet, the Kentucky Transportation Center, or the Federal Highway Administration. This document does not constitute a standard, specification, or regulation.

Introduction

The Technology Transfer Program of the Kentucky Transportation Center is pleased to bring you this handbook as part of our ongoing effort to meet the training needs and demands of transportation agencies and employees in Kentucky.

The Technology Transfer Program offers a wide variety of training including the Work Zone Employee Qualification Program, brought to you in conjunction with the Kentucky Transportation Cabinet. In late 2007, the Cabinet issued a policy and procedure for safe mobility through work zones with a primary goal of reducing crashes and injuries in and around highway work zones, as well as providing a safe and efficient environment for workers. The Technology Transfer Program has developed a series of courses aimed at qualifying workers under the Cabinet's new policy. The Work Zone Traffic Control Employee Qualification Program provides training in Basic Work Zone and Flagger, Work Zone Traffic Control Technician and Work Zone Traffic Control Supervisor. Call 800-432-0719 to register, or visit www.kyt2.com for more information.

About this handbook

This handbook is printed in cooperation with the Kentucky Transportation Cabinet. It summarizes guidelines listed in the MUTCD, adopted as the standard for traffic control devices on public highways in Kentucky (KRS 189.337 and 603 KAR 5.050), with specific focus on temporary traffic control (TTC) in short duration and mobile work zones. It contains basic principles, a description of standard traffic control devices used in work areas, guidelines for the application of the devices, and typical application diagrams. They are not intended as substitutes for engineering judgment and should be altered to fit the conditions of a particular site.

Work Duration

Work duration is a major factor in determining the number and types of devices used in TTC zones. The duration of a TTC zone is defined relative to the length of time a work operation occupies a spot location. The five categories of work duration and time at a location (as defined in the MUTCD) shall be:

- Long-term stationary - Work that occupies a location more than three days.
- Intermediate-term stationary - Work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.
- Short-term stationary - Daytime work that occupies a location for more than one hour and within a single daylight period.
- Short duration - Work that occupies a location up to one hour.
- Mobile - Work that moves intermittently or continuously.

This handbook focuses on short duration and mobile activities with additional examples given for short-term maintenance on two-lane and multi-lane roads.

Major Traffic Control Considerations

The TTC needed at a specific location varies relative to the characteristics of that location and the work being conducted. Following is a list of some questions that should be considered when determining the TTC needed.

1. Where is the work zone located (on the roadway, on the shoulder, or off the roadway)?
2. What type of road is involved?
3. What is the speed of the traffic?
4. What is the traffic volume on the roadway? Should the work be rescheduled to avoid heavy volume conditions?
5. Will the nature of traffic change while work is underway?
6. Do the local law enforcement agencies need to be notified?
7. What kind of signing will be required?
8. Are cones, drums, barricades, or an arrow panel needed for traffic channelization?
9. Will a flagger be required?
10. What will be the duration of the work?
11. What type of work is being performed?
12. What are the weather conditions?

Fundamental Principles

The control of road users through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and incident management. The following principles provide guidance to assist road users and help protect workers in the vicinity of temporary traffic control zones.

1. 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.
2. General plans or guidelines should be developed to provide safety for drivers, bicyclists, pedestrians, workers, enforcement/emergency officials, and equipment.
3. Road user movement should be inhibited as little as practical.
4. Drivers, bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing temporary traffic control zones and incident sites.
5. Routine day and night inspections of temporary traffic control elements should be performed.
6. Attention should be given to the maintenance of roadside safety during the life of the temporary traffic control zone.
7. Each person whose actions affect temporary traffic control zone safety should receive training appropriate to the job decisions each individual is required to make.
8. Good public relations should be maintained.
9. All temporary traffic control devices shall be removed as soon as practical when they are no longer needed.

Guidance, Options, and Support for Short Duration or Mobile Operations in Work Zones

The following standard, support, guidance, and option information is given in Part 6 of the MUTCD relative to short duration or mobile operations.

STANDARD

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

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

A mobile operation involving a lane closure on a multi-lane road does not require a transition area containing a merging taper.

Vehicle mounted signs shall be mounted in a manner such that they are not obscured by equipment or supplies. Sign legends on vehicle-mounted signs shall be covered or turned from view when work is not in progress.

SUPPORT

Mobile operations include work activities where workers and equipment move along the road (usually at slow speeds) without stopping and with the advance warning area moving with the work area.

Devices having greater mobility than for stationary operations (such as signs mounted on trucks) might be necessary.

In mobile operations, the transition area moves with the work space.

Maintaining reasonably safe work and road user conditions is a paramount goal.

During short duration work, it often takes longer to set up and remove traffic control devices than to perform the work.

Work in an intersection usually involves a small work force with only a few vehicles and a minimal number of traffic control devices.

Except for short duration and mobile operations, when a highway shoulder is occupied, a shoulder work sign should be placed in advance of the activity area.

Type B arrow panels, (minimum size 60 x 30 inches) are appropriate for mobile operations on high-speed, multi-lane roadways.

GUIDANCE

Fewer devices should not be used just because the operation will frequently change its location.

In mobile operations a shadow vehicle (equipped with an arrow panel or sign) should follow the work vehicle.

Where feasible, in mobile operations, warning signs should be placed along the roadway and moved periodically as work progresses. The distance between warning signs and the work should not exceed two miles.

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

If there are mobile operations on a high-speed travel lane of a multi-lane divided highway, arrow panels should be used.

When practical and when needed, the work and shadow vehicles should pull over periodically to allow vehicular traffic to pass.

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.

OPTION

Appropriately marked vehicles with high intensity lights may be used in place of signs and channelizing devices. The high intensity lights may be rotating, flashing, oscillating, or strobe lights (typically LED).

Simplified control procedures may be warranted with a reduction in the number of devices offset by use of more dominant devices such as high-intensity lights on work vehicles.

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 the traffic control zone for mobile operations. Appropriately marked vehicles may follow a train of moving work vehicles.

For some continuously moving operations a single work vehicle with appropriate warning devices may be used to provide warning.

For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, or a trailer stationed in advance of the TTC zone or moving along with it. The work vehicle, the shadow vehicle, or the trailer may or may not have an impact attenuator.

For mobile and constantly moving operations, such as pothole patching and striping operations, a shadow vehicle, equipped with appropriate lights and warning signs, may be used to protect the workers from impacts by errant vehicles. The shadow vehicle may be equipped with a rear-mounted impact attenuator.

Flaggers may be used for mobile operations that often involve frequent short stops.

The distance between the work and shadow vehicles may vary according to terrain, paint drying time, and other factors.

Component Parts of a Temporary Traffic Control Zone

Following is a description of the general sections of a work zone (specifically related to short duration/mobile work zones).

Advance Warning Area: In this section of highway road users are informed about the upcoming work zone or incident area. In short duration or mobile operations advance warning signs could be placed along the roadway and moved periodically as work progresses or placed on work vehicles which move with the work area.

Transition Area: Road users are redirected out of their normal path. Stationary areas usually involve use of tapers while the transition area moves with the work space in mobile operations.

Activity Area: This is the section of highway where the work activity takes place and includes the work space, traffic space, and buffer space. In short duration and mobile operations the work space moves as work progresses.

Work Space: Area for workers, equipment, and materials storage.

Buffer Space: Lateral and longitudinal area providing protection for traffic and workers.

Termination Area: This area returns road users to their normal path. It is not typically used in short duration and mobile operations.

TAPERS

Tapers are used as the transition area in stationary operations. Taper lengths are given in the following table. Typical channelizing devices include cones (28" minimum), vertical panels, and barricades. In short duration and mobile operations other methods are used to provide advance warning and transition around and past the work area. This may typically include a shadow vehicle (equipped with an arrow panel or sign) following the work vehicle.

Taper Length (L)*

Speed Limit (MPH)	Lane Width (feet)			Spacing Between Devices (feet)
	10	11	12	
25	105	115	125	25
35	205	225	245	35
45	450	495	540	45
55	550	605	660	55
65	650	715	780	65
70	700	770	840	70

*Following are the formulas used to calculate taper length:

Posted Speed	Formula
40 mph or under	$L = WS^2/60$
45 mph or over	$L = WS$

where: L = taper length; W = width of lane or offset, and S = posted speed, or off-peak 85th percentile speed
Note that the spacing for a one-lane, two-way taper shall be 20 feet for all conditions.

Flaggers

Flaggers are typically used in stationary operations, and may be used for mobile operations that often involve frequent short stops. Guidelines for the minimum qualifications, devices to use, flagger stations, flagging procedures, and communications are given in the MUTCD (Chapter 6E). The following guidelines for high visibility clothing apply to all workers in a work area.

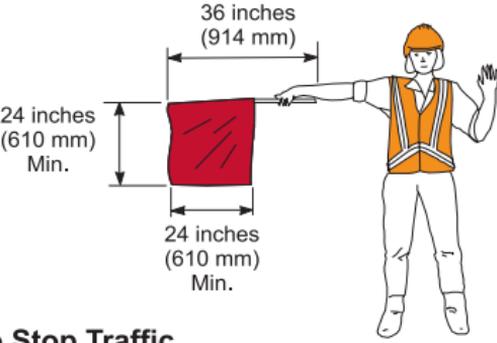
The use of the flag and sign paddle are displayed in the following illustration.

PREFERRED METHOD
STOP/SLOW PADDLE

EMERGENCY SITUATIONS ONLY
RED FLAG

PREFERRED METHOD
Paddle

EMERGENCY USE ONLY
Red Flag



To Stop Traffic



Traffic Proceed



To Alert and Slow Traffic

High Visibility Clothing

High visibility retroreflective safety apparel shall be worn at all times. 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 feet. The retroreflective clothing shall be designed to clearly identify the wearer as a person. All clothing shall meet ANSI 107-2004 standards.

Arrow Panels

Arrow panels are effective day and night, for moving traffic out of a lane to the left or right, and may be used for tapered lane closures and mobile operations. The minimum size (for any roadway) must be 48" x 24" with at least 12 panel lamps to provide a minimum legibility distance of 1/2 mile. The minimum size on high-speed, multi-lane highways is 60" x 30". Arrow panels should be equipped with a dimming device capable of 50 percent dimming for use at night along with circular hoods. The only permissible use of an arrow board on a two-lane, two-way street or road is the flashing caution mode.

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. The arrow panel shall be mounted on a vehicle, a trailer, or other suitable support.

An arrow panel should be used in combination with appropriate signs and other temporary traffic control devices. A vehicle displaying an arrow panel shall be equipped with high-intensity rotating, flashing, oscillating, or strobe light. When arrow panels are used to close multiple lanes, a separate arrow panel shall be used for each closed lane.

Warning Lights

If used, warning lights 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. Flashing warning lights shall not be used for delineation, as a series of flashers fails to identify the desired vehicle path. Warning lights shall have a minimum mounting height of 30 inches to the bottom of the lens.

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

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. Type B warning lights 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. When used to delineate a curve, Type C warning lights should only be used on devices on the outside of the curve, and not on the inside of the curve.

Nighttime Operations

All traffic control devices shall be retroreflectorized when used at night. Workers shall wear ANSI approved retroreflective apparel. Cones shall be equipped with a reflective collar when used at night. When barricades are used, it is desirable to add flashing lights when the barricades are used singly and steady burn lights when they are used in a series for channelization. If a flagger is used, the flagger stations should be adequately illuminated.

Signs

Types

1. **Regulatory signs** inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent. Regulatory signs shall be authorized by the public agency or official having jurisdiction. They are generally rectangular with a black legend and border on a white background.
2. **Warning signs** in temporary traffic control zones notify road users of specific situations or conditions on or adjacent to a roadway that might not otherwise be apparent. Temporary traffic control warning signs shall be diamond-shaped with a black symbol or message and border on an orange background.
3. **Guide signs** 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.

Size

Advance warning signs for higher-speed locations shall have a size of 48 x 48 inches. Where speeds and volumes are moderately low or, where there is a lack of shoulder width, a minimum size of 36 x 36 inches, may be used for advance warning signs. Deviations from standard sizes shall be in 6-inch increments. The bottom of the sign shall be a minimum of 12 inches from the ground.

Sign Placement

Signs should normally be located on the right side of the roadway. Where special emphasis is needed, signs may be placed on both the left and right sides of the roadway. Signs mounted on barricades and barricade/sign combinations shall be crashworthy. For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, or a trailer stationed in advance of the TTC zone or moving along with the work.

Advance Warning Area

The distance from the first sign to the start of the transition area should be long enough to give motorists adequate time to respond to the conditions. The first warning sign may have a flag or cone. Guidelines are presented in the summary of layout dimensions as referenced in Table A (with A, B, and C distances indicated in the typical application diagrams.)

Table A

Summary of Layout Dimensions Sign Spacing

Road Type	Distance Between Signs (feet)		
	A	B	C
Urban (<40 mph)	100	100	100
Urban (Eq. or >45 mph)	350	350	350
Rural	500	500	500
Expressway/Freeway	1,000	1,500	2,640

Buffer Space

When a longitudinal buffer space is used, the values shown in the following table may be used.

Table B

Longitudinal Buffer Space Dimension

Speed (mph)	Distance (feet)
25	155
35	250
45	360
55	495
65	645
70	730

Typical Application Diagrams

The diagrams on the following pages represent examples of the application of principles and procedures for safe and efficient temporary traffic control in work zones. The layouts represent minimum requirements. It is not possible to include illustrations to cover every situation which will require work area protection. They are not intended as a substitute for engineering judgment and should be altered to fit the conditions of a particular site. All traffic control devices used must be in compliance with the MUTCD. The diagrams represent short duration and mobile operations except for two diagrams describing short-term maintenance operations. For further information, refer to Part 6 of the MUTCD.



Arrow panel



Arrow panel support or trailer



Traffic Cone



Direction of traffic



Flagger



Warning Flags



Sign (Shown facing left)



Work space



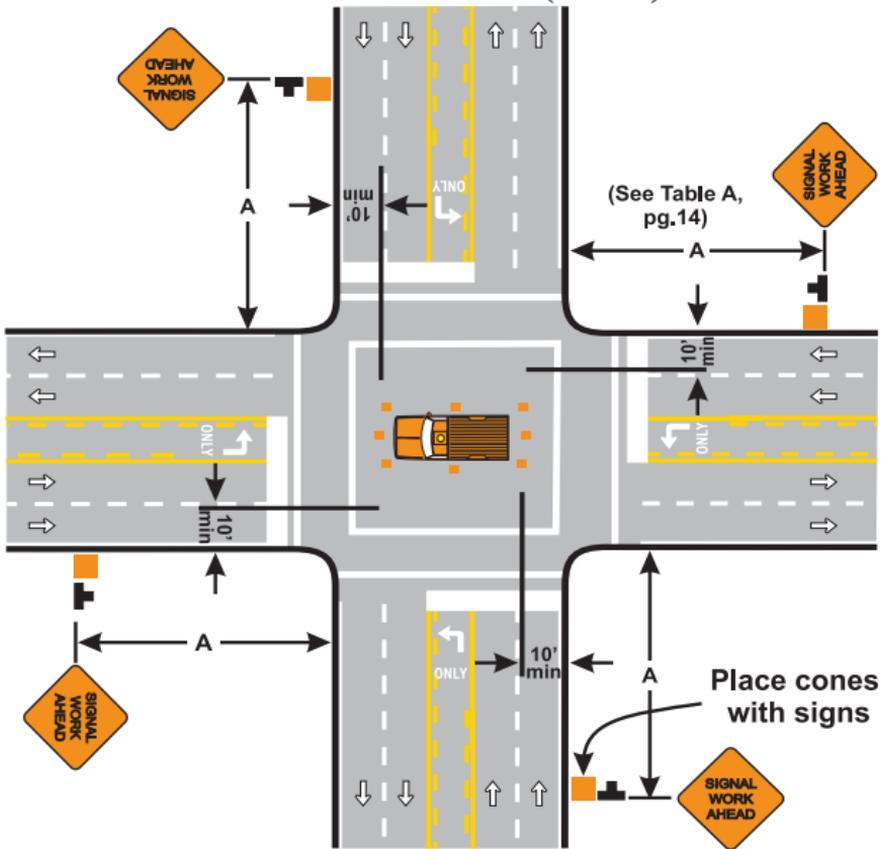
Work vehicle



Shadow/protective vehicle
with attenuator (TMA)

Note: The application diagrams are not to scale.

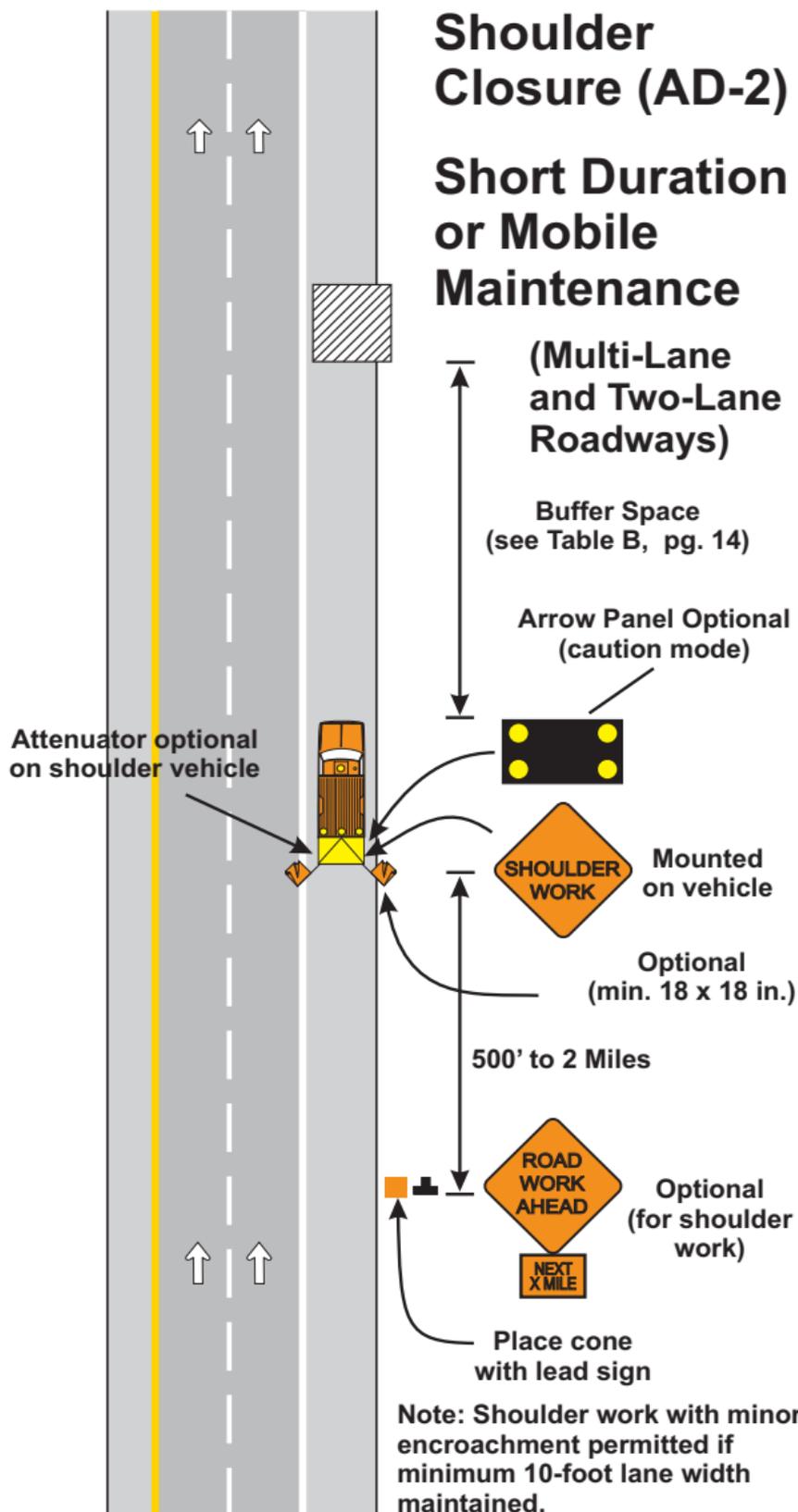
Aerial Work at Signalized Intersection (AD-1)



1. This diagram is not intended to represent all applications using aerial lifts at intersections. Engineering judgment should be used to determine appropriate traffic control applications for a specific site.
2. The use of police officers is suggested where signals are mounted diagonally across the intersection. If police officers are not an option and conditions warrant, place the traffic signal on all-red flash and/or place stop signs on all approaches.
3. No portion of an aerial lift platform, or the supporting structure, shall extend over an open lane of traffic, regardless of working height.
4. A TMA and arrow panel may be used in affected lanes on five or more lane roads with posted speeds of 45 MPH or greater.
5. The aerial lift vehicle shall be appropriately illuminated at night.

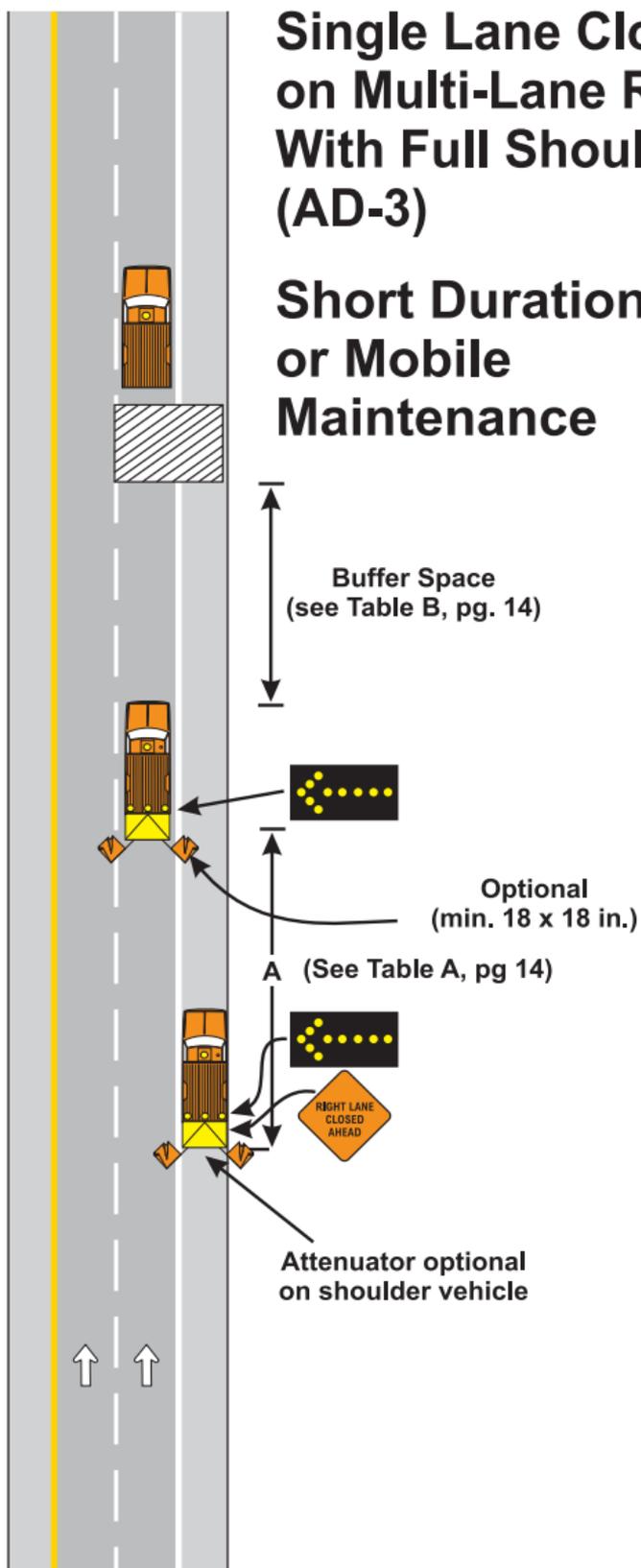
Shoulder Closure (AD-2)

Short Duration or Mobile Maintenance



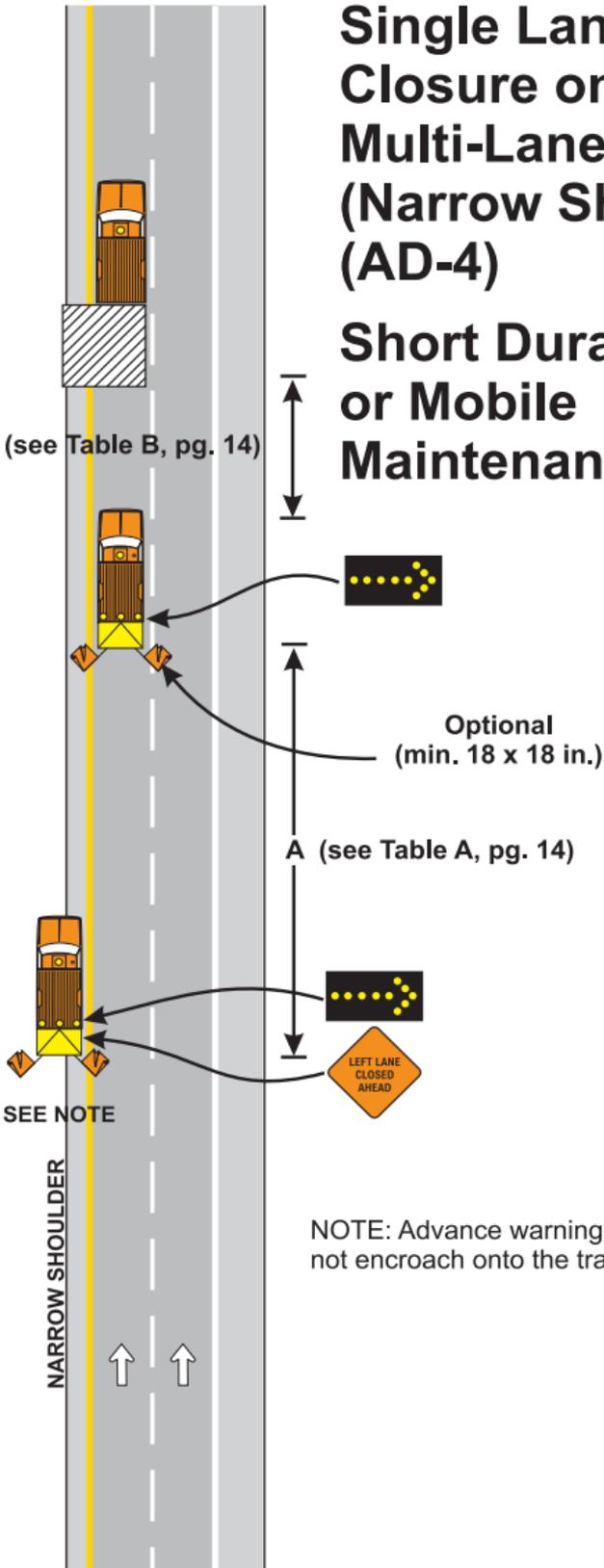
Single Lane Closure on Multi-Lane Road With Full Shoulder (AD-3)

Short Duration or Mobile Maintenance



Single Lane Closure on Multi-Lane Road (Narrow Shoulder) (AD-4)

Short Duration or Mobile Maintenance

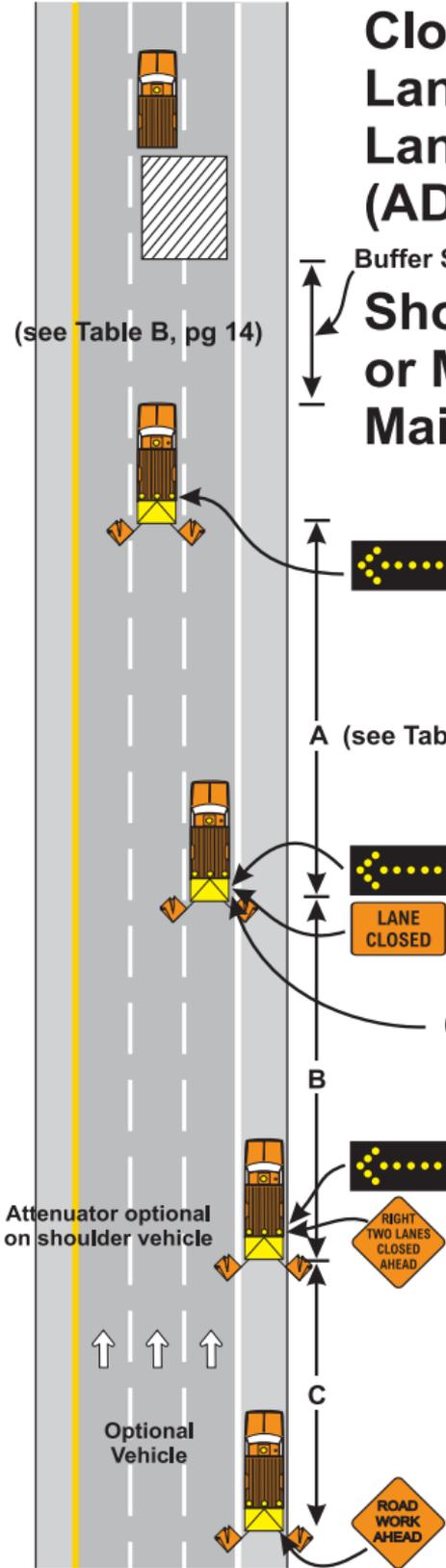


Closure of Two Lanes on Multi-Lane Road (AD-5)

(see Table B, pg 14)

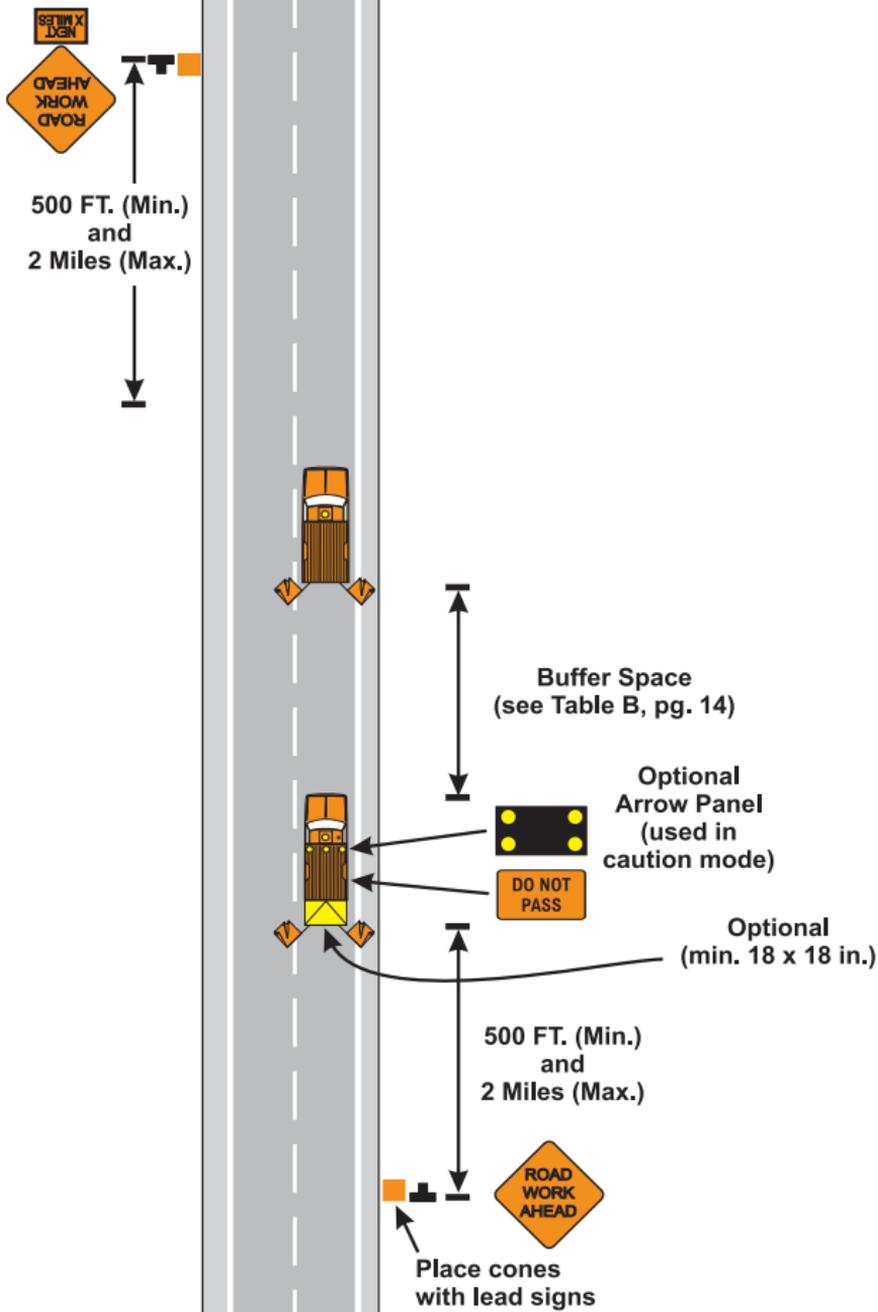
Buffer Space

Short Duration or Mobile Maintenance



Optional
(min. 18 x 18 in.)

Mobile Operation on Two-Lane Road (AD-6)

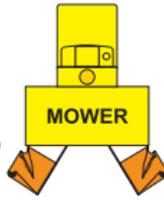


Slow Moving Operation on Multi-Lane and Two-Lane Roadways (Mowing off Shoulder) (AD-7)

Dual mount if multi-lane highway.



Dual Mount if Multi-Lane



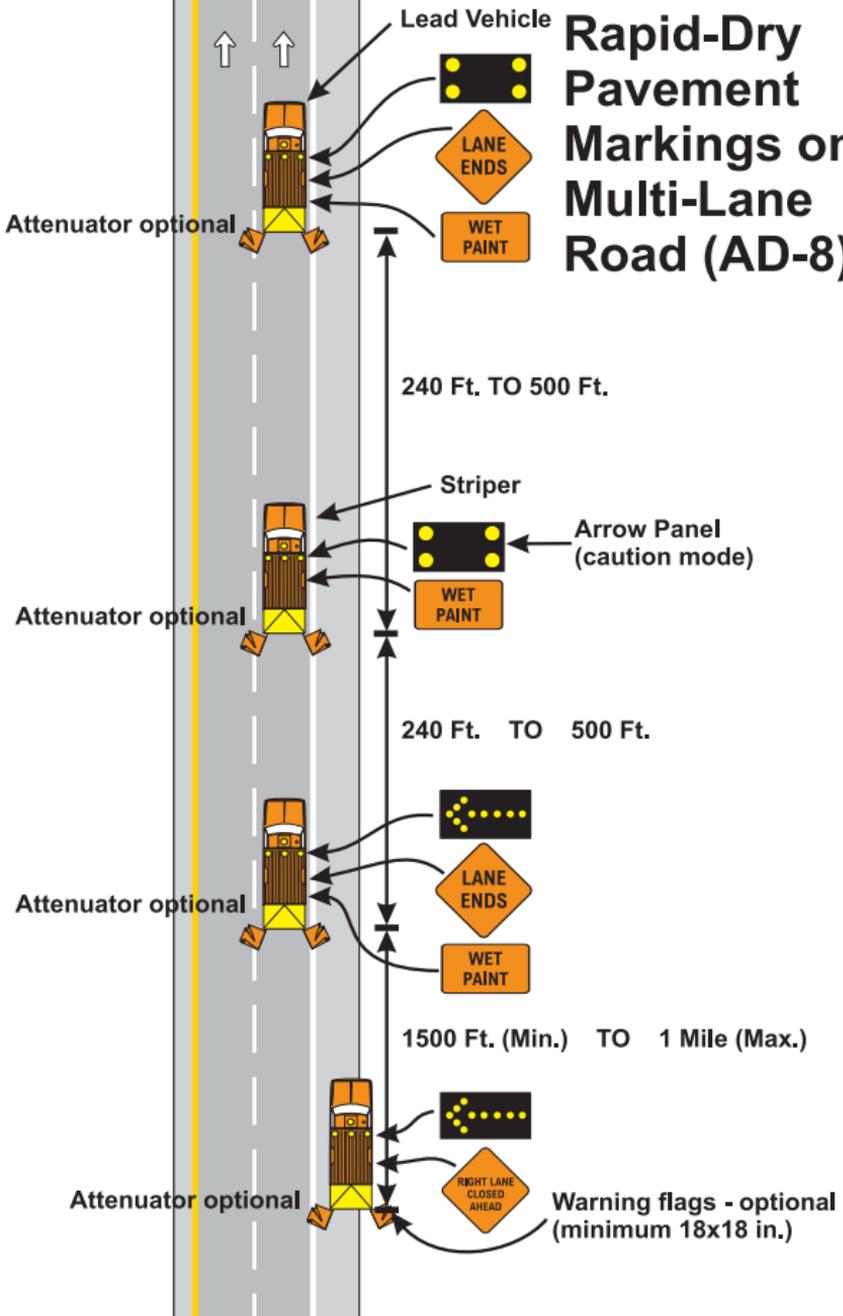
500 FT. (Minimum)
and
2 Miles (Maximum)

Place cones with lead signs

Note: Place signs in opposite direction if two-lane highway

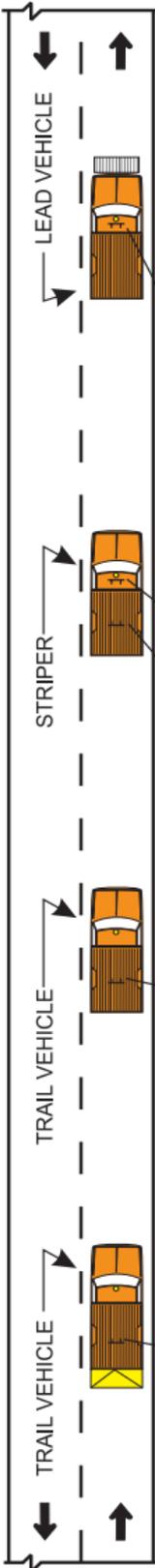
Note: Signs may be repeated at two-mile intervals to extend work zone.

Slow Moving Work Placement of Rapid-Dry Pavement Markings on Multi-Lane Road (AD-8)



Slow Moving Work Placement of Rapid-Dry Pavement Markings Two-Lane Road (AD-9)

SEE NOTE
750 FT (APPROX.)
750 FT (APPROX.)



66" X 30"
**PAINT TRUCK
FOLLOWS**



W1-6
48" X 24"



W1-6
48" X 24"

42" X 30"
**DO NOT
PASS**

WET PAINT

54" X 18"

42" X 30"
**DO NOT
PASS**

WET PAINT

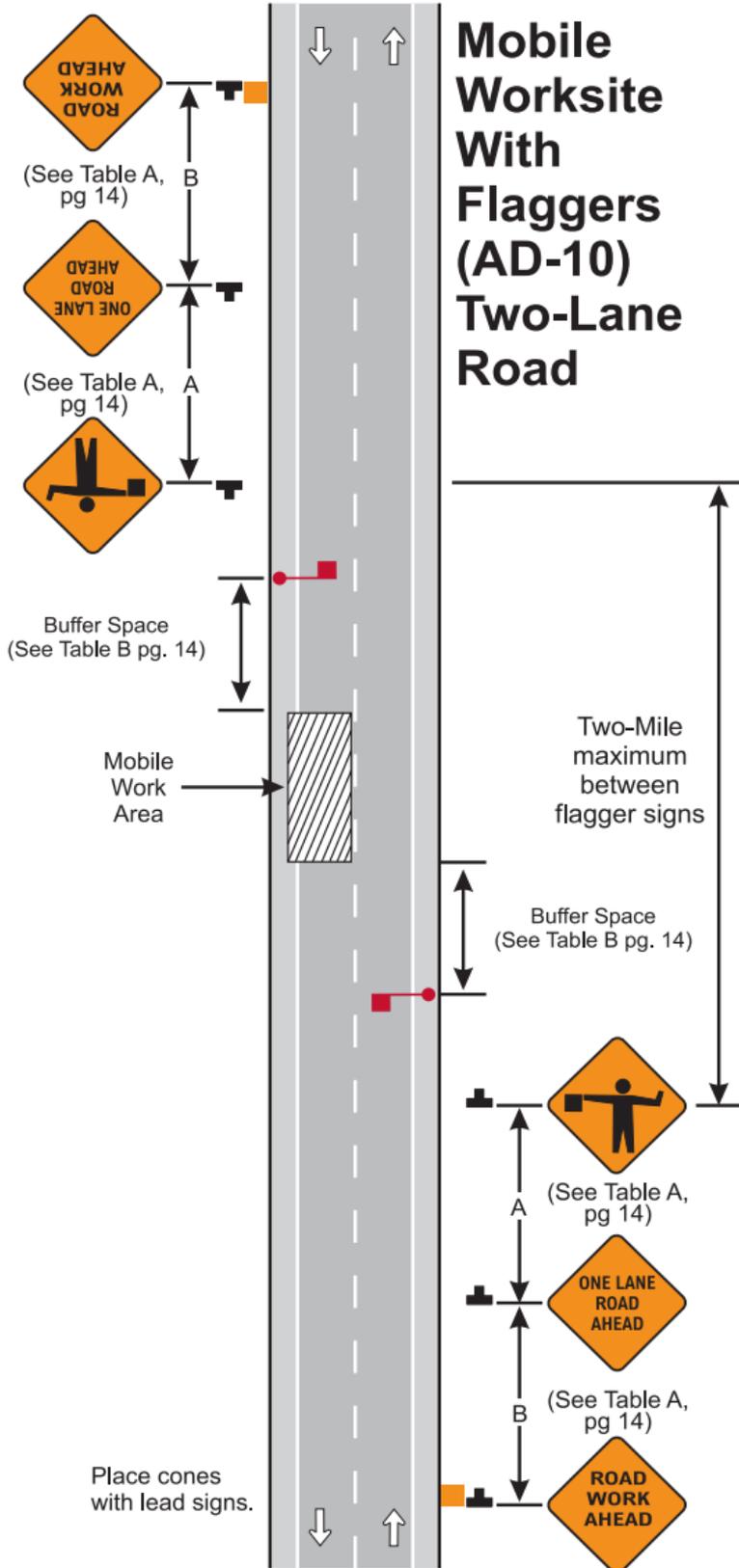
54" X 18"

42" X 30"
**DO NOT
PASS**

WET PAINT

54" X 18"

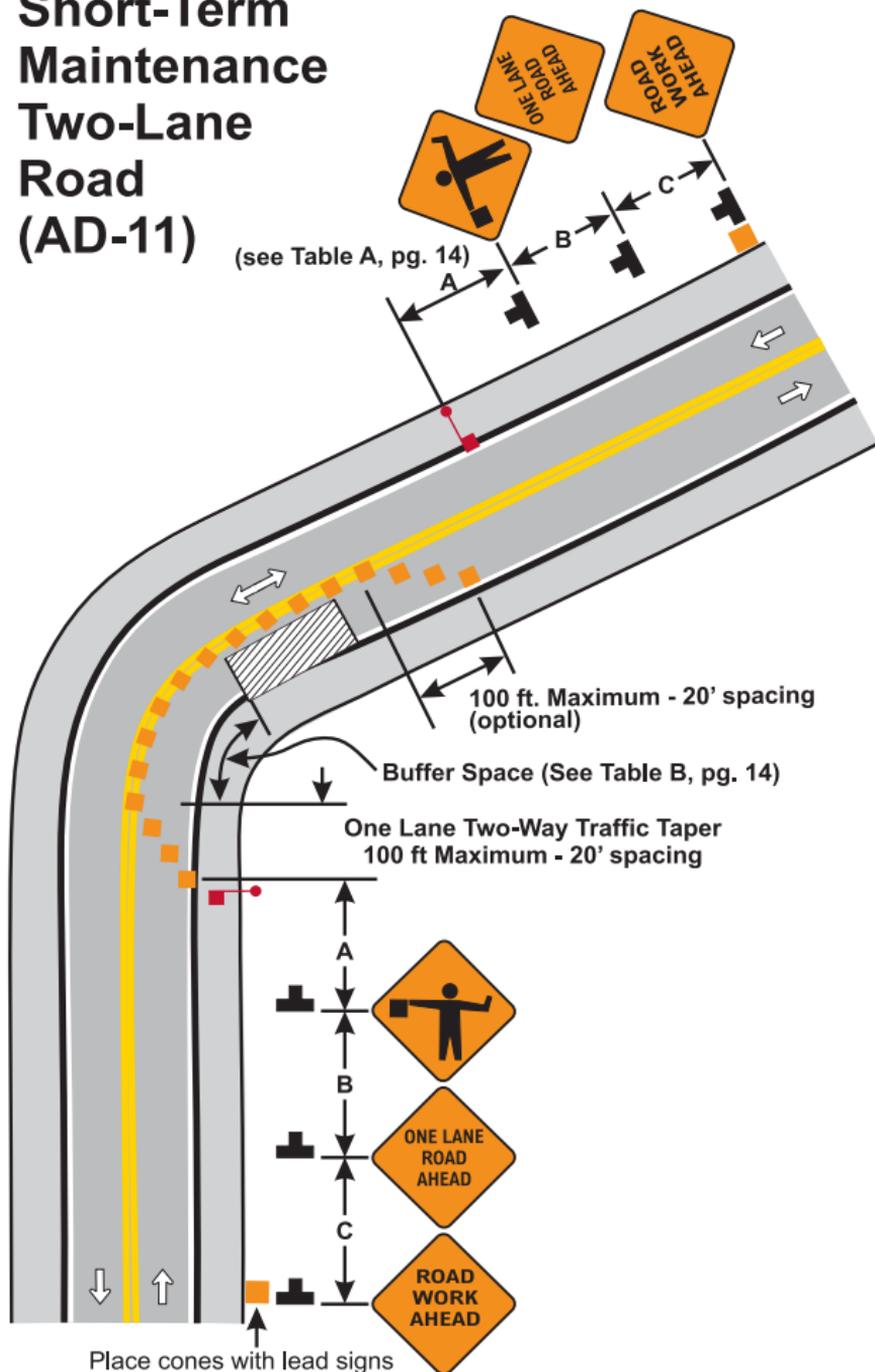
Note: The lead vehicle shall maintain visual contact with the striper whenever possible. The striping train shall be required to pull off the roadway periodically to alleviate traffic congestion.



SUPPLEMENTAL DIAGRAM

Short-Term Maintenance Two-Lane Road (AD-11)

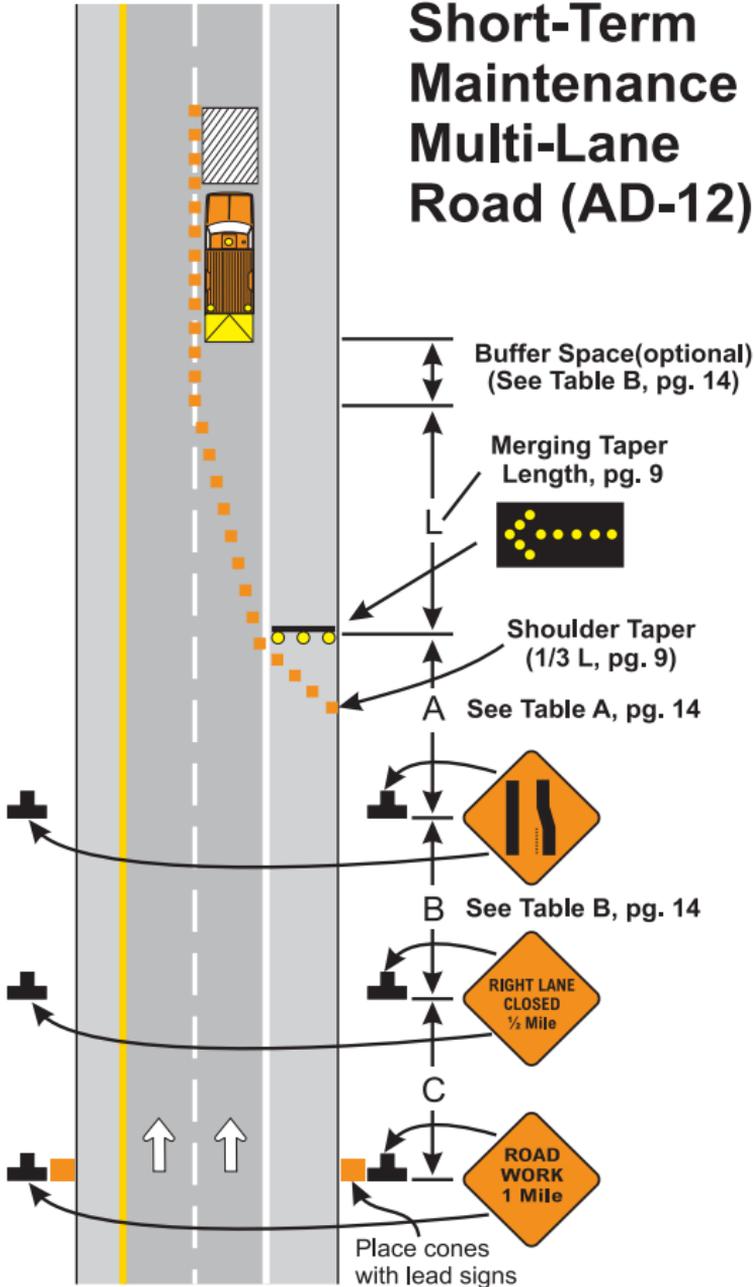
(see Table A, pg. 14)



Note: Cones in activity area should be spaced at 40' intervals.

SUPPLEMENTAL DIAGRAM

Short-Term Maintenance Multi-Lane Road (AD-12)



If a backup is anticipated to exceed 1 Mile advance signs up to 5 miles shall be used. (Variable Message Sign optional in place of signs or in addition).

All vehicles, equipment, workers, and their activities should be restricted to one side of the pavement.

Cones spaced (in feet) equal to speed limit for shoulder and merging taper.

Note: Cones in activity area should be spaced at 40' intervals.

SUPERVISOR'S CHECKLIST

1. *Follow Part 6 of the MUTCD. It is the national standard for work zone traffic control.*
2. *Have a plan before going to the work site.*
3. *Remove the devices in a timely manner.*
4. *Ask yourself, "What is the driver's view of the work site - at night, during peak hours, etc.?"*
5. *Ask yourself, "Would I feel safe driving through this work zone?"*
6. *Investigate crashes/incidents to identify if changes are needed in the traffic control plan.*
 - *Take photographs of all traffic control devices.*
 - *Sketch and dimension all devices. Indicate size of signs, placement from the edge of the travelway, and the height to the bottom of the sign.*

The MUTCD (<http://mutcd.fhwa.dot.gov/>) is the final authority for all questions.



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