Work Zone Safety

Guidelines for Construction, Traffic Maintenance, and Utility Operations

October 2003

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Introduction

The purpose of this handbook is to present guidelines for work zone traffic control and to supplement basic work zone safety training. This handbook covers the basic requirements of Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) with particular emphasis on short term work sites. These requirements apply to construction, maintenance, traffic, and utility work zones.

This handbook presents information and gives examples of typical traffic control applications for two-lane and multi-lane work zones. This information is intended to illustrate the principles of proper work zone traffic control, but is **not** a standard. Part VI of the MUTCD and the Indiana MUTCD Supplement contain the standards for work zone traffic control.

Worksite traffic control diagrams provide **minimum** requirements, additional traffic control or protection can be added. This manual covers work setups as presented in the INDOT maintenance/traffic management system.

Incident Management Situations

The immediate response to an emergency situation must by necessity make use of available devices and equipment. Given the opportunity, however, longer term emergencies should be treated in a manner similar to other temporary traffic control work sites.

Traffic Control Devices

The following types of traffic control devices are used in work zone traffic control:

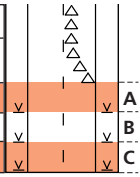
- Signs
- Channelizing Devices
- Warning Lights
- Arrow Displays
- Pavement Markings
- Changeable Message Signs

Signs

Signs used in work zone traffic control are classified as regulatory, guide, or warning. Regulatory signs impose legal restrictions and may not be used without permission from the authority with jurisdiction over the roadway. Guide signs commonly show destinations, directions, and distances. Warning signs give notice of conditions along the roadway.

Spacing of Advance Warning Signs

	Sign Spacing (feet)			
	25-30 mph	35-40 mph	45-55 mph	Expressway/ Freeway
A	200	350	500	1,000
B	200	350	500	1,600
C	200	350	500	2,600



Distances shown are approximate. Sign spacing should be adjusted for curves, hills, intersections, driveways, etc., to improve sign visibility.

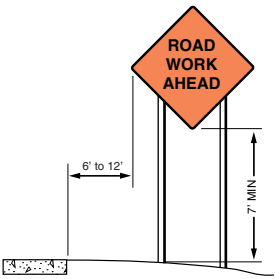
Warning Signs – Construction, maintenance, traffic and utility warning signs are used extensively in street and highway work zones. These signs are normally diamond shaped, having a black symbol or message on an orange background. As a general rule, these signs are located on the right-hand side of the street or highway. Normally, the first advance warning sign used is the ROAD WORK AHEAD sign. The UTILITY WORK AHEAD or WORKERS sign may be substituted where appropriate. Where signs are used to indicate the end of the work zone, the END ROAD WORK or END UTILITY WORK sign may be used as appropriate.

Size – The standard size for advance warning signs in work zones is generally 48 inches by 48 inches. Where speeds and volumes are moderately low, a minimum size of 36 inches by 36 inches may be used (see Part VI of the MUTCD for specific sign sizes). Sign sizes in contract plans or other agency documents may exceed MUTCD minimum requirements and shall be followed.

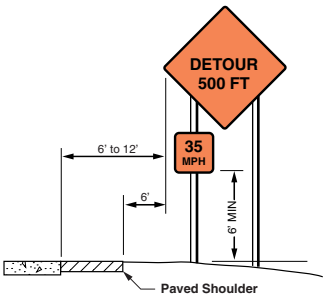
Mounting – Standards for height and lateral clearance of roadside signs are included in Part VI of the MUTCD. Temporary post-mounted signs should be mounted at a height of at least 7 feet, measured from the bottom of the sign. Signs mounted on Type III barricades which close any part of a road or lane should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails. Signs mounted on other portable supports or barricades used solely as a sign support may be at lower heights, but the bottom of the sign shall be not less than one foot above the traveled way.

Illumination and Retroreflectorization – All signs used during the hours of darkness shall be made of retroreflective material or illuminated. (Street or highway lighting is not regarded as meeting the requirements for sign illumination.)

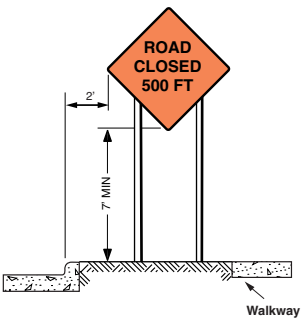
Removal – When work is suspended for short periods, all signs that are no longer appropriate shall be removed, covered, turned, or laid flat so they are not visible to drivers.



RURAL DISTRICT



RURAL DISTRICT WITH ADVISORY SPEED PLATE



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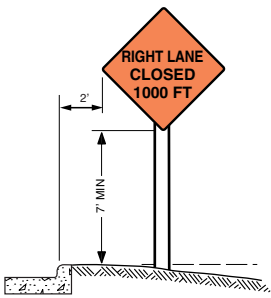

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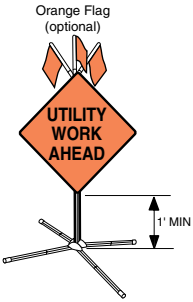
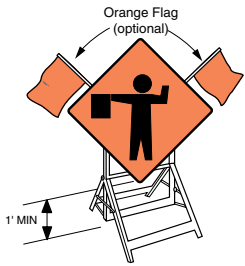
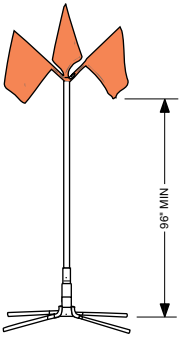
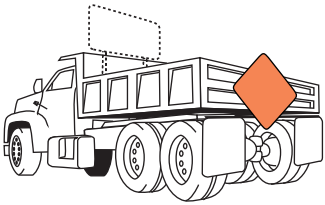


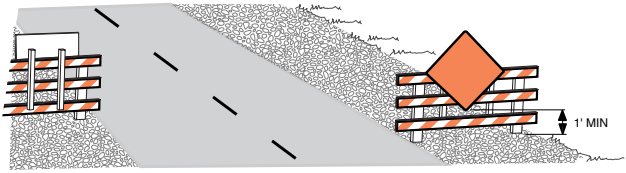




HIGH LEVEL WARNING DEVICE
(Flag Tree)

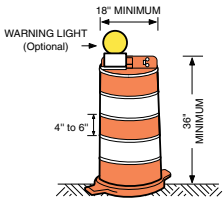


PORTABLE AND TEMPORARY MOUNTINGS

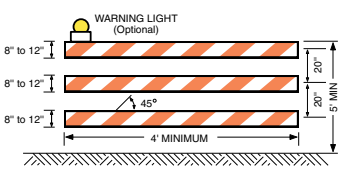


Portable Changeable Message Signs – Portable Changeable Message Signs may be used to supplement other signs, but not to substitute for any required signs. They may display a variety of messages and displays, but are typically only used to display "real-time" or changing condition information. The Changeable Message Sign should not display more than three messages or displays, and the entire message should be readable twice at the usual roadway speed limit.

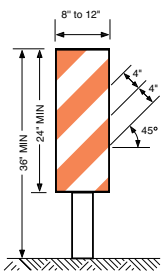
Channelizing Devices



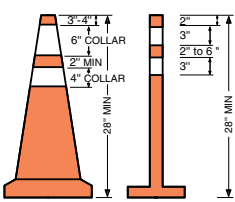
DRUM



TYPE III BARRICADE



VERTICAL PANEL



CONES AND TUBULAR MARKERS

Notes:

1. Stripes on barricade rails slope downward at an angle of 45 degrees toward the direction traffic is to pass.
2. Barricade rail stripe widths shall be 6 inches except where rail lengths are less than 36 inches, then 4 inch wide stripes may be used.
3. The sides of barricades facing traffic shall have retroreflective rail faces.
4. All channelizing devices should meet National Cooperative Highway Research Program (NCHRP) Report 350 Crash Test Requirements.

Channelizing Devices

Channelizing devices are used to warn and alert drivers of conditions in work zones, to protect workers, and to guide and direct drivers and pedestrians safely. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and barriers.

Cones are used most commonly for short-duration maintenance and utility work. Cones used at night shall be retro-reflectorized as shown on page 5. Drums are used most commonly where they will remain in place for a prolonged period. Ballast shall not be placed on top of channelizing devices.

Spacing

INDOT has adopted a policy of 20 foot spacing between channelizing devices on a two-lane road and 40 foot spacing between channelizing devices on a multi-lane road. Cone and or barrel spacing for straight-a-ways should be:

- At 45 mph & below: 1 cone for every 2 skips
- Above 45 mph: 1 cone for every 3 skips

Warning Lights

Warning lights may supplement retroreflectorization on warning and channelizing devices. They are especially useful in areas prone to fog or frequent inclement weather. Warning lights shall have a minimum mounting height of 30 inches. The principal types and uses of warning lights are:

1. **Low intensity Flashing Lights (Type A)**
   May be mounted on barricades or drums to warn of an isolated hazard at night. They may also be mounted on signs.
2. **High intensity Flashing Lights (Type B)**
   May be mounted on advance warning signs, or on independent supports to draw attention to extreme hazards both day and night.
3. **Low intensity Steady-Burn Lights (Type C)**
   May be used in a series to delineate the edge of the travelway and channelize traffic at night.

The warning light and/or emergency flashers shall be used on vehicles, so equipped, when on the roadway or on the shoulder within 15 feet of the pavement edge and in or near the worksite.

Common Conversions:

1 skip = 10’
Gap between skips = 30’

RPM spacing (No Passing Zone) = 40’
RPM spacing (Passing Zone) = 80’

0.1 mile = 528’	0.6 mile = 3168’
0.2 mile = 1056’	0.7 mile = 3696’
0.3 mile = 1584’	0.8 mile = 4224’
0.4 mile = 2112’	0.9 mile = 4752’
0.5 mile = 2640’	1.0 mile = 5280’

Arrow Displays

An arrow display in the arrow or chevron mode may be used to supplement signs and other devices for lane closures on multilane roadways. An arrow display in the caution mode shall be used only for shoulder work, blocking the shoulder, or roadside work near the shoulder.

Panel Type	Roadway Speed	Min. Size	Min. # Lamps	Min. Legibility Distance
A	25-30 mph	24" x 48"	12	1/2 mile
B	35-40 mph	30" x 60"	13	3/4 mile
C	≥ 45 mph	48" x 96"	15	1 mile

OPERATING MODE At least one of the three following modes shall be provided:	PANEL DISPLAY* (Right shown; left similar)
Flashing Arrow	 Move/Merge Right
Sequential Arrow	 Move/Merge Right
Sequential Chevron	 Move/Merge Right
The following mode shall be provided: Flashing Double Arrow	 Move/Merge Right or Left
The following mode shall be provided: Flashing Caution	 or Caution

*Element layout for Type C Panel shown

Pavement Markings

For long-term stationary projects, follow the guidelines of Part VI of the MUTCD in placing and removing pavement markings. The colors of temporary pavement markings and delineators follow the same standard as for permanent markings. When used to enhance the visibility of the roadway edge, white is specified along both sides of two-way roadways and the right side of one-way roadways. Yellow is used on the left side of one-way roadways. Centerlines and lane lines are yellow when separating opposing directions of traffic and white when separating lanes going the same direction.

Where existing pavement marking conflicts with the temporary travel path, additional signing and channelizing devices are appropriate.

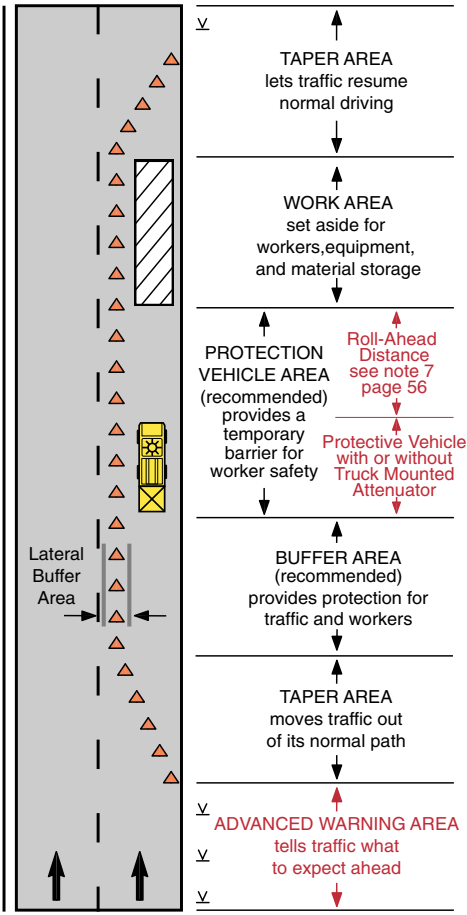
Fundamental Principles

The principles listed below provide a guiding philosophy of good temporary traffic control and enhance the safety of motorists, pedestrians, and workers in the vicinity of temporary traffic control zones.

1. Make traffic safety and temporary traffic control an integral and high-priority element of every project from planning through design, construction, and maintenance.
2. Inhibit traffic movement as little as possible.
3. Provide clear and positive guidance to drivers and pedestrians as they approach and travel through the temporary traffic control zone.
4. Inspect traffic control elements routinely and make modifications when necessary.
5. Pay increased attention to roadside safety in the vicinity of temporary traffic control zones.
6. Train all persons that select, place, and maintain temporary traffic control devices.
7. Establish proper legislative authority to implement and enforce needed traffic regulations, speed zoning, parking controls, and incident management.
8. Keep the public well informed.
9. If there is a sideroad intersection or ramps within the work area, additional traffic control, such as flaggers and appropriate signage, may be needed on the side road approaches or ramps.

Parts of a Traffic Control Zone

The traffic control zone is the distance between the first advance warning sign and the point beyond the work area where traffic is no longer affected. Below is a diagram showing the six parts of a traffic control zone.



Taper Length Criteria for Work Zones

The five types of tapers used in work zone traffic control are:

Type of Taper

1) *Merging Taper* – The number of lanes is reduced on a multilane road

2) *Shifting Taper* – A lateral shift, but no reduction in the number of travel lanes

3) *Shoulder Taper* – The shoulder is closed

4) *Two-way Traffic Taper* – Opposing directions of traffic share one open lane

5) *Downstream Taper* – The work area ends and traffic resumes normal driving (use is optional)

TABLE II: INDOT STANDARD TAPERS

Taper Length	Cone Spacing	Cone Offset	Number of Cones	Description
100′	20′	2′-5″	6	2-Way Tapers
220′	20′	1′-0″	12	Shoulder Tapers
340′	20′	0′-8″	18	Shifting Tapers and Low Speed Merging Tapers
780′	40′	7″	21	Multi-Lane Road Merging Tapers

Buffer Lengths

The buffer area is a recommended part of the work zone. It serves to separate traffic flow from the work area or a potentially hazardous area and provides recovery space for an errant vehicle. The buffer area should not include any work activity nor storage of equipment, vehicles or material.

Guidelines for Buffer Lengths

Speed (mph)	**Length** (ft)	**Speed** (mph)	**Length** (ft)
20	35	45	220
25	55	50	280
30	85	55	335
35	120	60	415
40	170	65	485

A lateral buffer space may also be used to separate passing traffic from the work area. Its use and width is based on conditions at the work site.

Supervisor's Checklist

1. Have a traffic control plan before going to the work site.
2. Ask yourself, "What is the driver's view of the work site—at night, during peak hours, etc."
3. Investigate crashes/incidents to identify if changes are needed in the traffic control plan.
4. For overhead work, traffic control is required for affected lane(s).

Planning the Layout

The key to good traffic control is to apply the guidelines using proper judgment. Consider factors such as duration of work, location of work, and characteristics of the roadway.

Duration of Work

Work duration is a major factor in determining the number and types of devices used in temporary traffic control zones. As a general rule, the longer the operation will last, the more traffic control devices are needed. Also, as the work time is short, the time during which motorists are affected is significantly increased when additional devices are installed and removed. Considering these factors, it is generally held that simplified control procedures are warranted for short-duration activities. Such shortcomings may be offset by the use of other, more dominant devices, such as special lighting units on work vehicles.

Long-Term Stationary – Work that occupies a location more than 3 days.

Intermediate-Term Stationary – Work that occupies a location from overnight to 3 days.

Short-Term Stationary – Daytime work that occupies a location for 1 to 12 hours.

Short Duration – Work that occupies a location up to 1 hour.

Mobile – Work that moves intermittently (stops up to 15 minutes) or continuously.

Location of Work

The choice of traffic control needed for a temporary traffic control zone depends upon where the work is located. As a general rule, the closer the work is to traffic, the more control devices are needed.

What Traffic Control Set-Up Should I Use?

These five questions should be considered and answered in order to provide proper worksite traffic control.

1. What is the type of road (two-lane or multi-lane) on which we will be working?
2. Are we working on the roadway or shoulder?
3. How long will we be at a location?
4. Is extra protection needed?
5. Is the open lane a minimum of 10′ wide? (restricted lanes require channelizing devices and signs)

Curvy and Hilly Locations

These locations may require extra work zone safety measures.

Night Time Traffic Control

Extra care should be taken when scheduling work at night. Plan ahead whenever possible, involving all affected personnel, to ensure that everyone understands what is expected of them and that you have the proper traffic control equipment for the job. As stated on page 1 of this manual, the immediate response to an emergency situation must by necessity make use of available devices and equipment. Given the opportunity, however, longer term emergencies should be treated in a manner similar to temporary traffic control as soon as possible. If you are setting up a Long Term Stationary or Intermediate Term Stationary work-zone you can consult the Manual on Uniform Traffic Control Devices (MUTCD) for guidance.

The work-zone controls mentioned in this manual are the minimum requirements and extra controls should be utilized when needed. Closing additional lanes when possible and the use of message boards are just 2 of the tools available.

Typical Application Diagrams

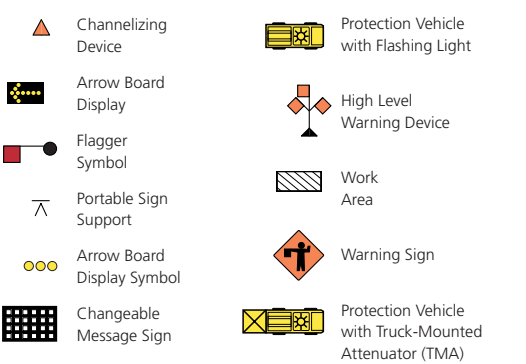
The diagrams on the following pages represent examples of the application of principles and procedures for safe and efficient traffic control in work zones but are not intended to be standards. It is not possible to include illustrations to cover every situation which will require work area protection. These typical layouts are not intended as a substitute for engineering judgment and should be altered to fit the conditions of a particular site. Contract plans or other agency documents may also have applicable layouts to be followed.

The diagrams are not to scale, and the number of channelizing devices shown may not be the number needed at the work site. Work vehicles are not shown in diagrams. Use the tables on the typical diagrams to determine taper and buffer lengths, and use pages 6 and 11 for guidance on the spacing and number of devices.

The notes and tables on the typical diagrams provide important information for the user.

Read all notes before using these diagrams. The information presented in these diagrams and tables are generally minimums. For further information, refer to Part VI of the MUTCD and the Indiana MUTCD supplement. These contain the standards for work zone traffic control.

Legend



Protection vehicle for INDOT shall be a dump truck loaded with sand and parked at an angle. If a TMA is used, the truck shall be loaded per TMA manufacturers specifications, parked parallel to traffic, front wheels angled away from traffic, and may be either a dump or 2 ton stakebed vehicle. Drawings are not to scale. The drawings do not depict the number of channelizing devices to use.

Definitions of Terms

Shall - a mandatory condition. Where certain requirements in the design and application of the device are described with the "shall" stipulation, it is mandatory when an installation is made that these requirements be met.

Should - an advisory condition. Where the word "should" is used, it is considered to be advisable usage, recommended but not mandatory.

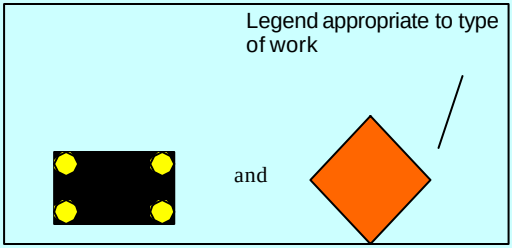
May - A permissive condition. No requirement for design or application is intended.

Not for INDOT use - Not for use on INDOT roads.

Supplemental Notes to the October 2003 Work Zone Safety Manual

- On page 26, add “LEFT LANE CLOSED XX m(FT)” sign between signs A and B. Use spacing B for the distance between this sign and the others.

- On page 58, the arrow board and sign symbols will be replaced (with a sticker placed over the existing symbols) as follows:



- On page 63, arrow board symbols will be added (with stickers) next to the two protection vehicles that don’t have them.

Short Term Stationary

(1 to 12 hours)

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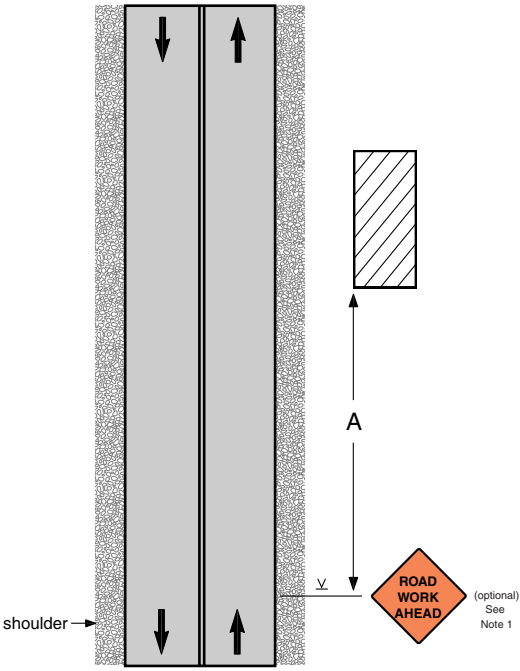
Work Outside the Shoulder

(Short Term Stationary – 1 to 12 hours)

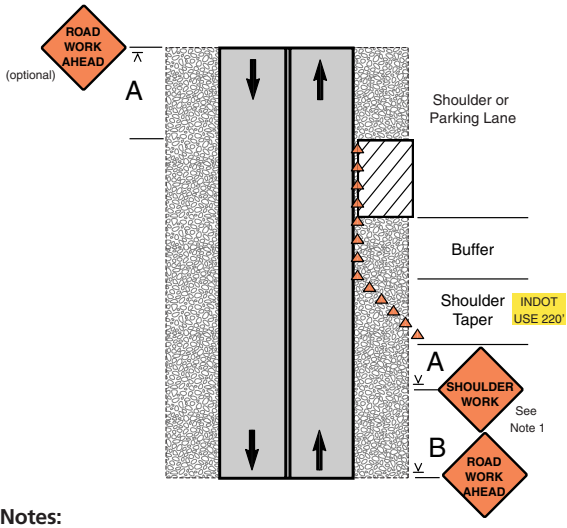


Notes:

1. If vehicle and work activity are both behind a guard rail, more than 2' behind a curb, or 15' or more from the edge of any roadway, *then only an activated flashing or revolving yellow light is needed.*
2. Other acceptable advance warning signs are those indicating SHOULDER WORK, UTILITY WORK AHEAD, or the WORKERS sign.
3. 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.

Work on Shoulder or Parking Lane

(Short Term Stationary – 1 to 12 hours)



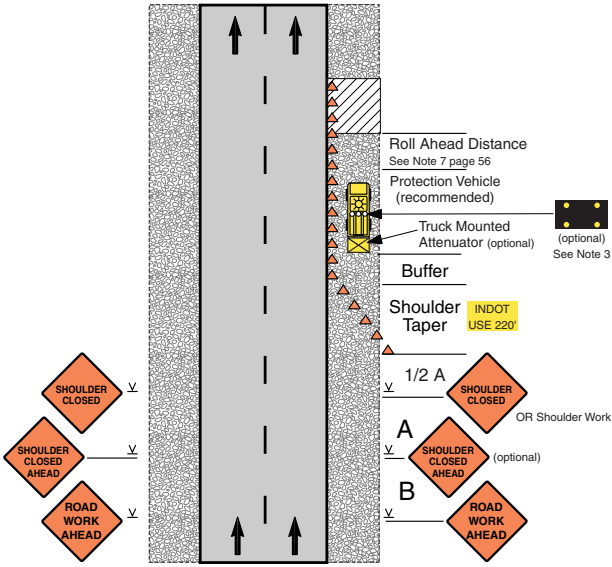
Notes:

1. WORKERS or UTILITY WORK AHEAD signs may be used instead of the SHOULDER WORK or ROAD WORK AHEAD signs.

Speed Limit (mph)	Sign Spacing A (ft)	Sign Spacing B (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335

Shoulder Closed on Divided Roadway

(Short Term Stationary – 1 to 12 hours)



Notes:

1. SHOULDER CLOSED signs should be used on limited-access highways where there is no opportunity for disabled vehicles to pull off the traveled way.
2. UTILITY WORK AHEAD or WORKERS signs may be used instead of the ROAD WORK AHEAD sign.
3. Use of an arrow display is optional. If used, it shall be operated in the caution mode.
4. On non-freeway multilane roads in urban areas, the sign spacing may be reduced as shown in the chart on page 2.

Speed Limit (mph)	Sign Spacing (ft) A	Sign Spacing (ft) B	Buffer (ft)
35	350	350	120
40	350	350	170
45	500	500	220
50	1000	1600	280
55	1000	1600	335
60	1000	1600	415
65	1000	1600	485

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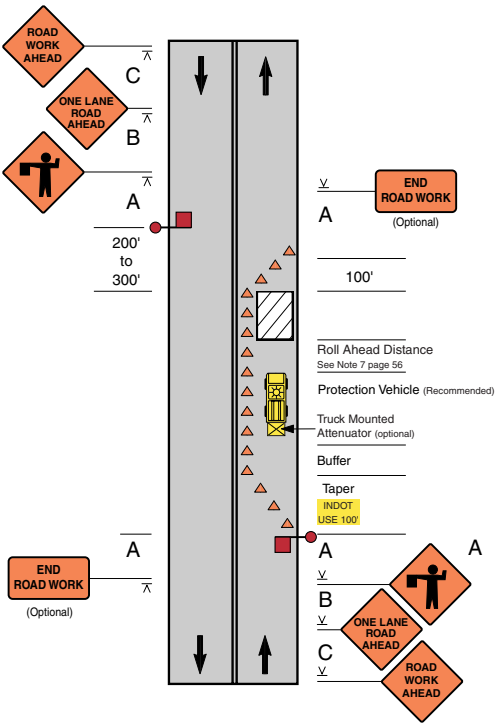
Lane Closure on a Two-Lane Road

(Two Flagger Operation)

(Short Term Stationary – 1 to 12 hours)



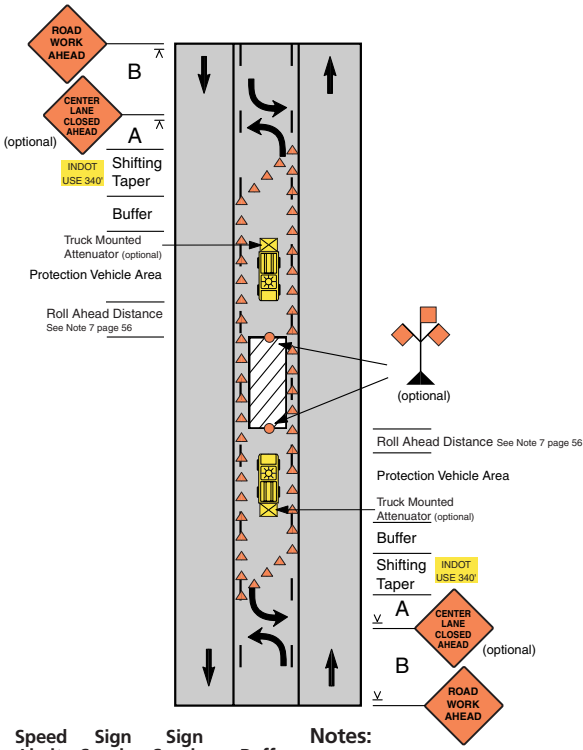
Notes:

1. The flagger or flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
2. If there is a sideroad intersection within the work area, additional traffic control, such as flaggers and appropriate signage, may be needed on the sideroad approaches.

Speed Limit (mph)	Sign Spacing **A** (ft)	Sign Spacing **B** (ft)	Sign Spacing **C** (ft)	Buffer
25	200	200	200	55
30	200	200	200	85
35	350	350	350	120
40	350	350	350	170
45	500	500	500	220
50	500	500	500	280
55	500	500	500	335

Center Turn Lane Closed

(Short Term Stationary – 1 to 12 hours)



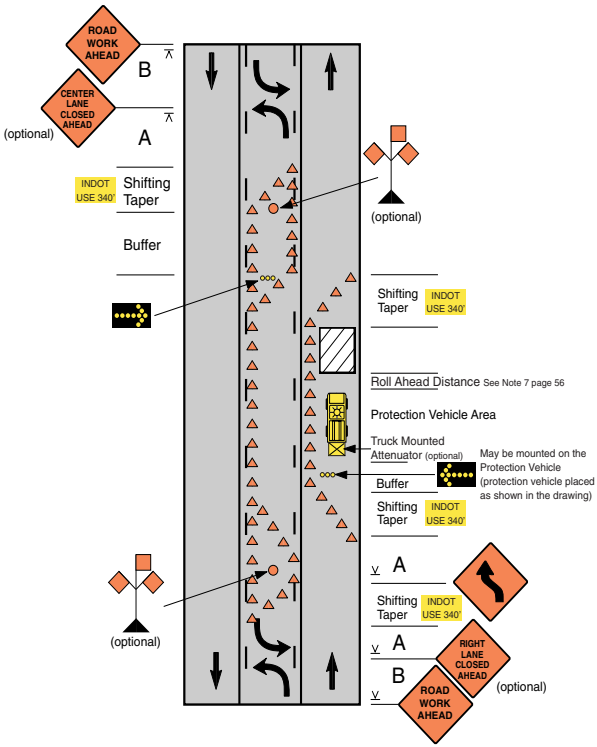
Speed Limit (mph)	Sign Spacing **A** (ft)	Sign Spacing **B** (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335

Notes:

1. LARGE ARROW sign may be used at the shift for added visability.

Lane Shift on a Three-Lane, Two-Way Road

(Short Term Stationary – 1 to 12 hours)



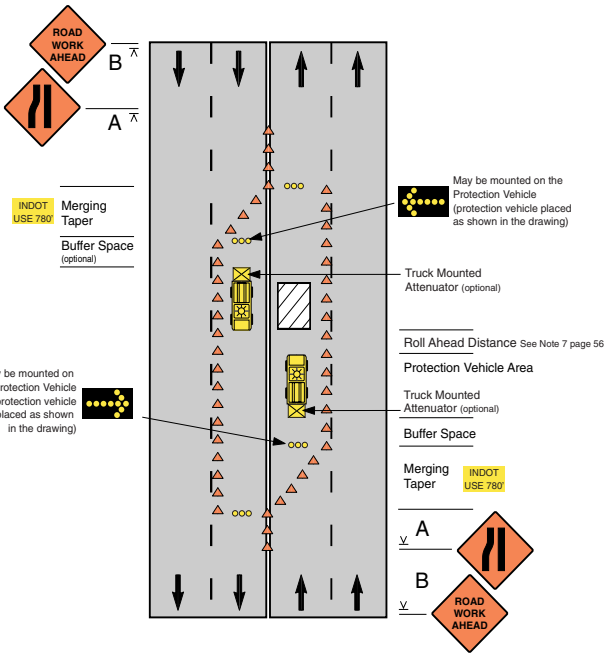
Notes:

1. LARGE ARROW signs may be used at the shifts for added visibility.
2. If the speeds are 30 MPH or less, REVERSE TURN signs shall be used instead of REVERSE CURVE.

Speed Limit (mph)	Sign Spacing A (ft)	Sign Spacing B (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335

Lane Closure on a Four-Lane Undivided Road

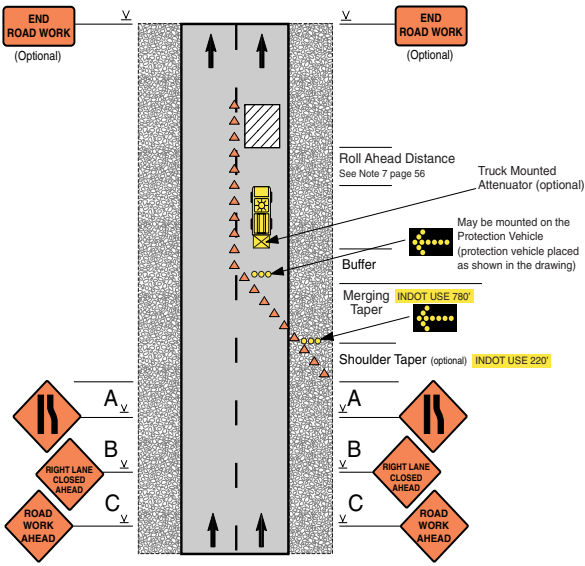
(Short Term Stationary – 1 to 12 hours)



Speed Limit (mph)	Sign Spacing **A** (ft)	Sign Spacing **B** (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335
60	1000	1600	415
65	1000	1600	485

Lane Closure on Divided Roadway or One Way Street

(Short Term Stationary – 1 to 12 hours)



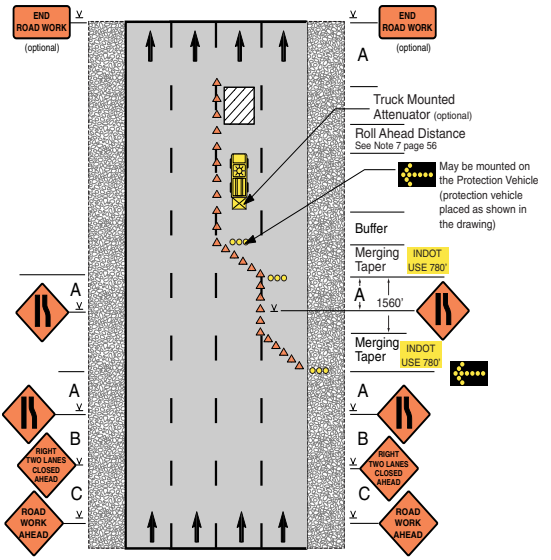
Notes:

1. When a side road intersects the roadway within the work zone, additional devices shall be erected to channelize traffic to/from the side road, and a ROAD WORK AHEAD sign shall be placed on each side road approach.
2. On non-freeway multi-lane roads in urban areas, the sign spacing may be reduced as shown in the chart on page 2.

Speed Limit (mph)	Sign Spacing (ft) A	B	C	Buffer (ft)
30	200	200	200	85
35	350	350	350	120
40	350	350	350	170
45	500	500	500	220
50	1000	1600	2600	280
55	1000	1600	2600	335
60	1000	1600	2600	415
65	1000	1600	2600	485

Double Lane Closure on Divided Roadway

(Short Term Stationary – 1 to 12 hours)



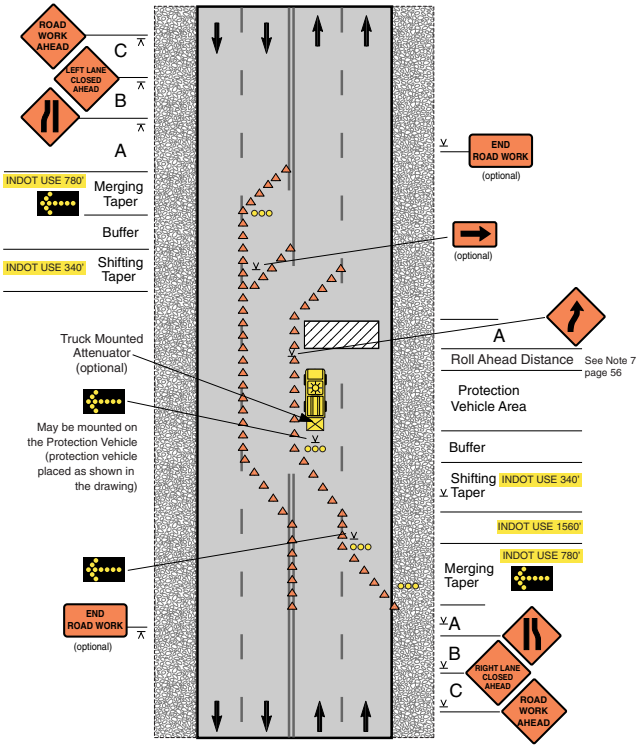
Notes:

1. When a side road intersects the roadway within the work zone, additional devices shall be erected to channelize traffic to/from the side road, and a ROAD WORK AHEAD sign shall be placed on each side road approach.
2. On non-freeway multilane roads in urban areas, the sign spacing may be reduced as shown in the chart on page 2.

Speed Limit (mph)	Sign Spacing (ft) A	B	C	Buffer (ft)
35	350	350	350	120
40	350	350	350	170
45	500	500	500	220
50	1000	1600	2600	280
55	1000	1600	2600	335
60	1000	1600	2600	415
65	1000	1600	2600	485

Half Road Closure on Multilane Roadway

(Short Term Stationary – 1 to 12 hours)



Speed Limit (mph)	Sign Spacing A, B, C (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

Half Road Closure on Multilane Roadway (cont.)

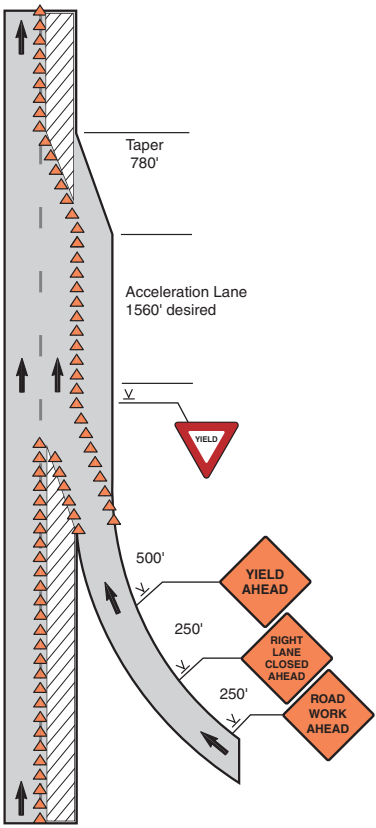
(Short Term Stationary – 1 to 12 hours)

Notes

1. Channelizing devices shall be more closely spaced when the pavement markings conflict with the temporary travel path.
2. When a side road intersects the roadway within the work zone, additional devices shall be erected to channelize traffic to/from the side road and a ROAD WORK AHEAD sign shall be placed on each side road approach.
3. INDOT policy requires the use of four arrow boards when closing a lane on multi-lane highways.

Mainline Right Lane Closed, Entrance Ramp Open

(Short Term Stationary – 1 to 12 hours)

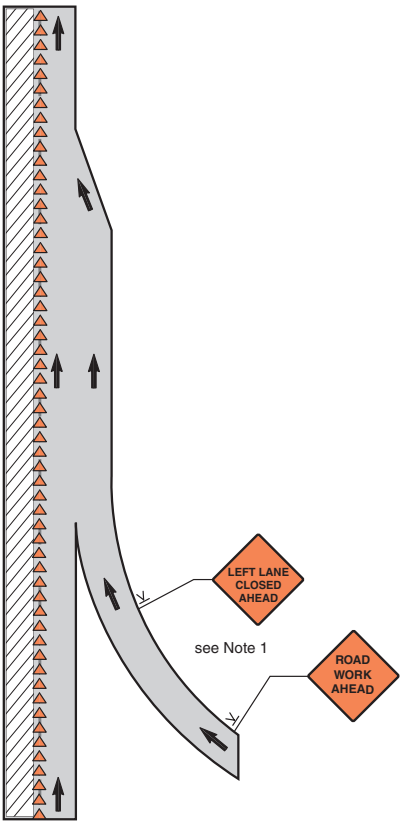


Notes:

1. Black on white 45mph sign on ramp is optional if mainline speed limit has been temporarily reduced to 45 mph.

Mainline Left Lane Closed, Entrance Ramp Open

(Short Term Stationary – 1 to 12 hours)

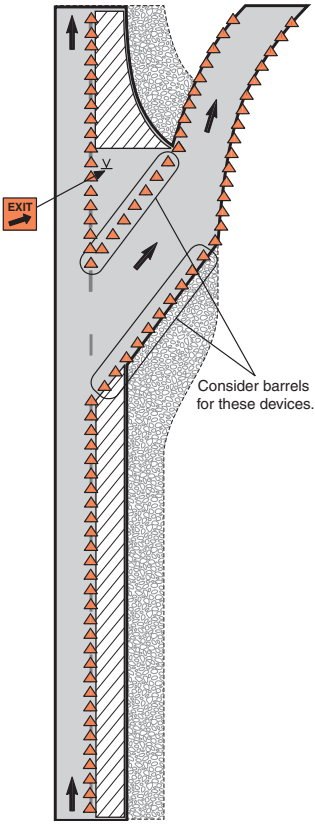


Notes:

1. The advance warning sign spacing is dependent on the ramp length and location of existing signing. The spacing should be as long as possible.
2. Black on white 45 mph sign on ramp is optional if mainline speed limit has been temporarily reduced to 45mph.

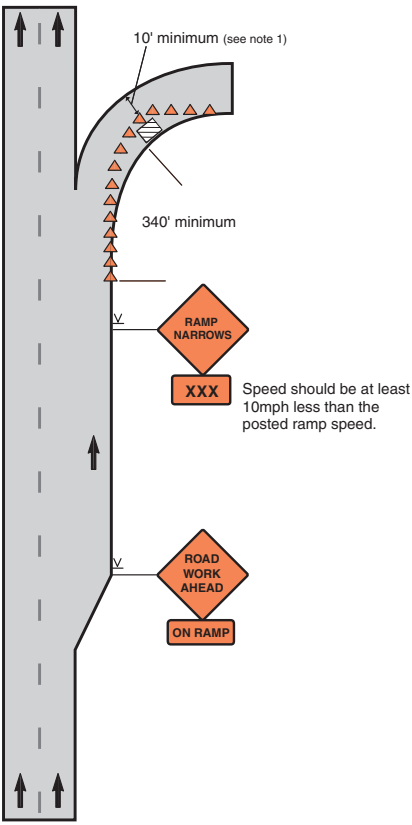
Mainline Right Lane Closed, Exit Ramp Open

(Short Term Stationary – 1 to 12 hours)



Partial Ramp Closure

(Short Term Stationary – 1 to 12 hours)



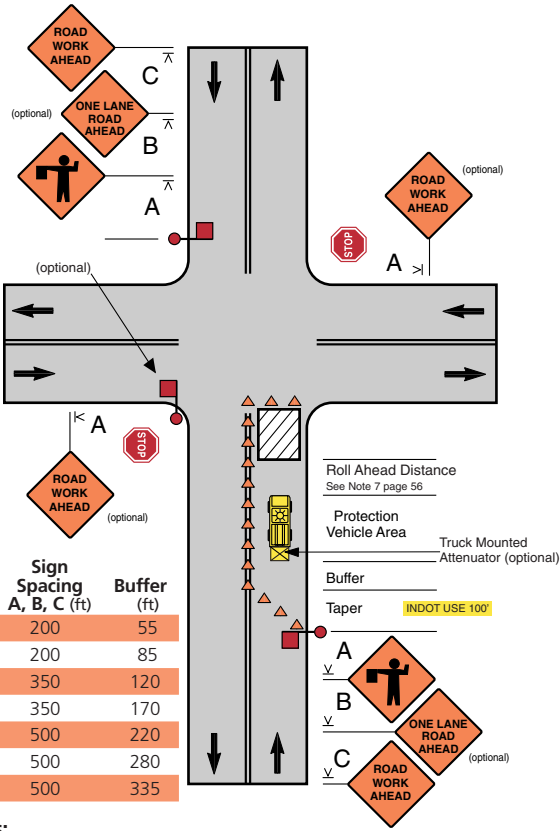
Notes:

1. Truck off-tracking should be considered when determining whether the 10' minimum lane width is adequate.

Lane Closure in Advance of an Intersection

(Work Area on the Through Road)

(Short Term Stationary – 1 to 12 hours)



Speed Limit (mph)	Sign Spacing A, B, C (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

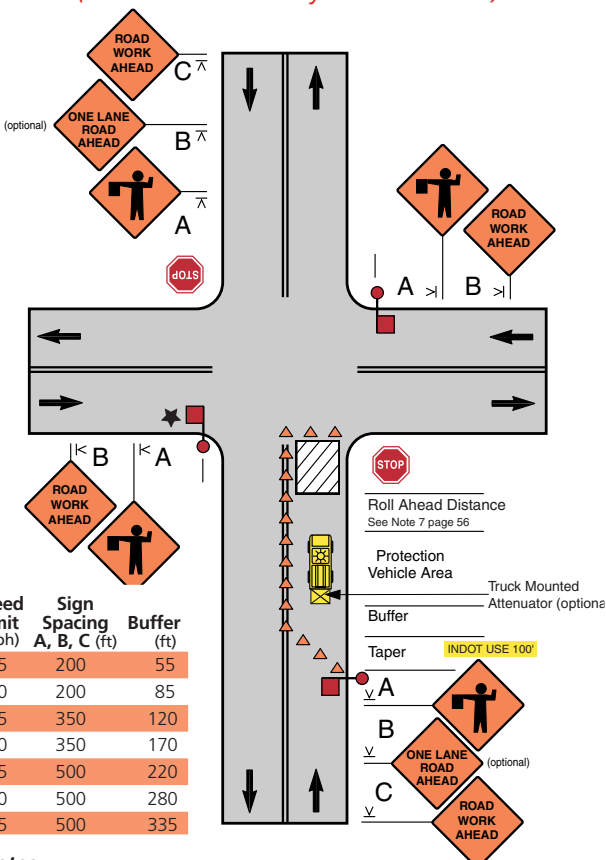
Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed on the side road approaches.
2. The middle flagger (optional) has the best view of traffic from all directions. "Flagger Ahead" signs should be used in all 4 directions when the optional middle flagger is used.
3. If the speed limit is less than or equal to 35mph, at a signalized intersection, then the protection vehicle is optional.
4. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.

Lane Closure in Advance of an Intersection

(Work Area on the Side Road)

(Short Term Stationary – 1 to 12 hours)



Speed Limit (mph)	Sign Spacing A, B, C (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

Notes:

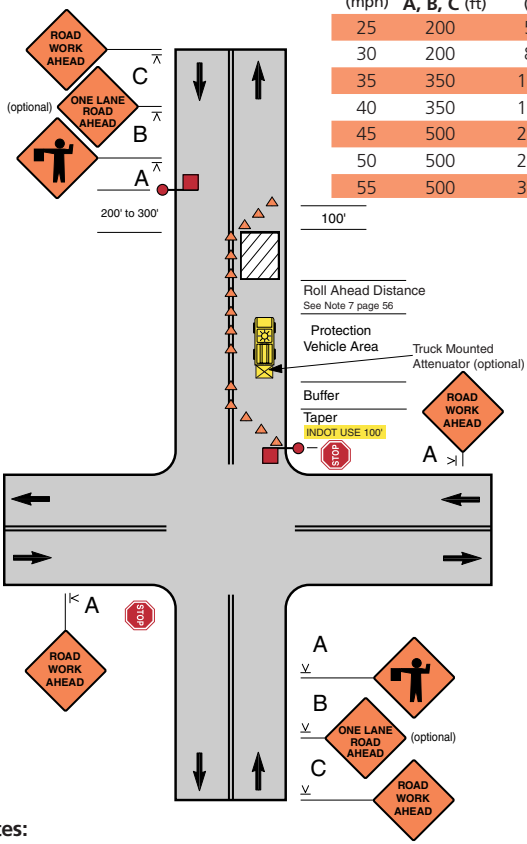
1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed.
2. ✱ The middle flagger has the best view of traffic from all directions. This flagger should be designated ***lead flagger*** and should coordinate the actions of the other flaggers.
3. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
4. If the speed limit is less than or equal to 35mph, at a signalized intersection, then the protection vehicle is optional.

Lane Closure Beyond an Intersection

(Work Area on the Through Road)

(Short Term Stationary – 1 to 12 hours)

Speed Limit (mph)	Sign Spacing A, B, C (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335



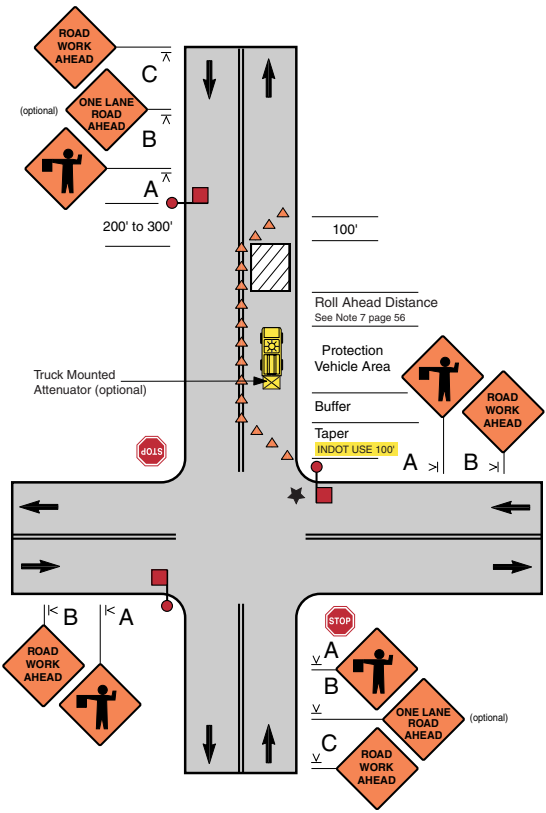
Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed.
2. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
3. When there is insufficient space the Protection Vehicle, Roll Ahead Distance, Taper, and Buffer are not used.
4. If the speed limit is less than or equal to 35mph, at a signalized intersection, then the protection vehicle is optional.

Lane Closure Beyond an Intersection

(Work Area on the Side Road)

(Short Term Stationary – 1 to 12 hours)



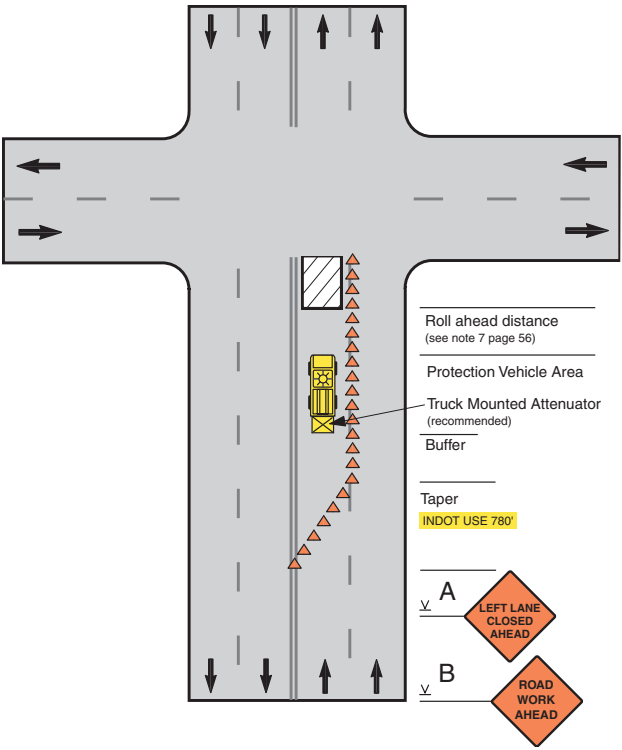
Speed Limit (mph)	Sign Spacing A, B, C (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed.
2. The middle flagger should be designated ***lead flagger*** and should coordinate the actions of the other flaggers.
3. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
4. When there is insufficient space the Protection Vehicle, Roll Ahead Distance, Taper, and Buffer are not used.
5. If the speed limit is less than 35mph at a signalized intersection, then the protection vehicle is optional.

Lane Closure at a Signalized Intersection

(Short Term Stationary – 1 to 12 hours)



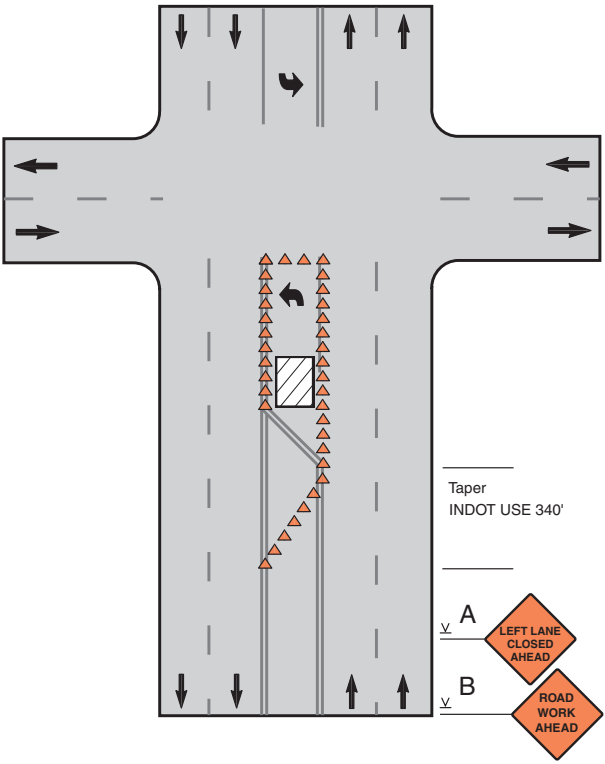
Notes:

1. Protection vehicle is optional if speed limit is less than or equal to 35mph, but a flagger with a flag should be stationed inside cone taper to slow oncomming traffic.
2. If working on far side of intersection, see page 42.
3. The length of tapers may be adjusted when used in close proximity to crossroads, curves, or other influencing factors.

Speed Limit (mph)	Sign Spacing A (ft)	Sign Spacing B (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335

Turn Lane Closure at a Signalized Intersection

(Short Term Stationary – 1 to 12 hours)



Notes:

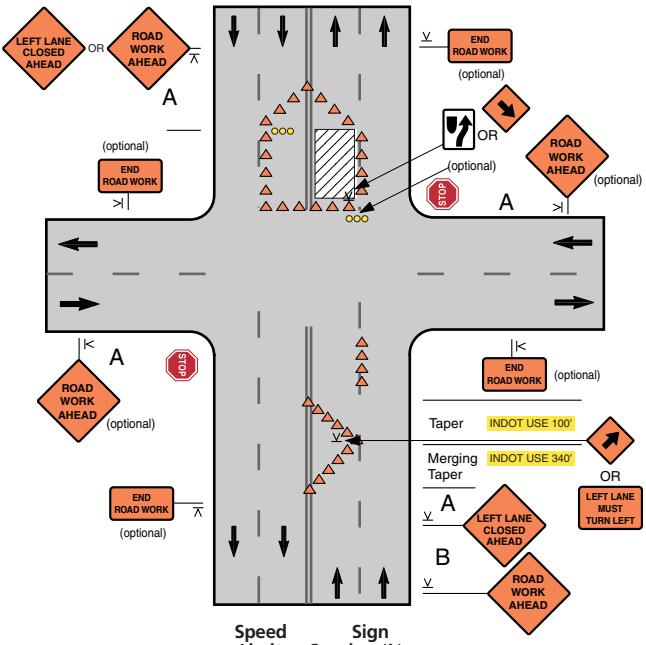
1. Lane may be opened beyond work area.
2. The length of the tapers may be adjusted when used in close proximity to crossroads, curves, or other influencing factors.

Speed Limit (mph)	Sign Spacing A (ft)	Sign Spacing B (ft)
25	200	200
30	200	200
35	350	350
40	350	350
45	500	500
50	500	500
55	500	500

Lane Closure on Far Side of Intersection

(Speeds of 35 mph or Less)

(Short Term Stationary – 1 to 12 hours)



Speed Limit (mph)	Sign Spacing (ft) A	B
25	200	200
30	200	200
35	350	350

Notes:

1. This layout is only appropriate for roads with speeds of 35 MPH or less. For higher speeds, see table on page 26 for advance signing and taper layout.
2. Standard procedure is to close any lane that is not carried through the intersection on the near side of the intersection. However, if this results in the closure of a lane having significant turning movements, then that lane may be converted to a turn bay, and/or the lane may be restricted to turns only, as shown.
3. A LARGE ARROW sign may be used instead of the KEEP RIGHT or DOWN ARROW sign where space permits.

Short Duration

(up to 1 hour)

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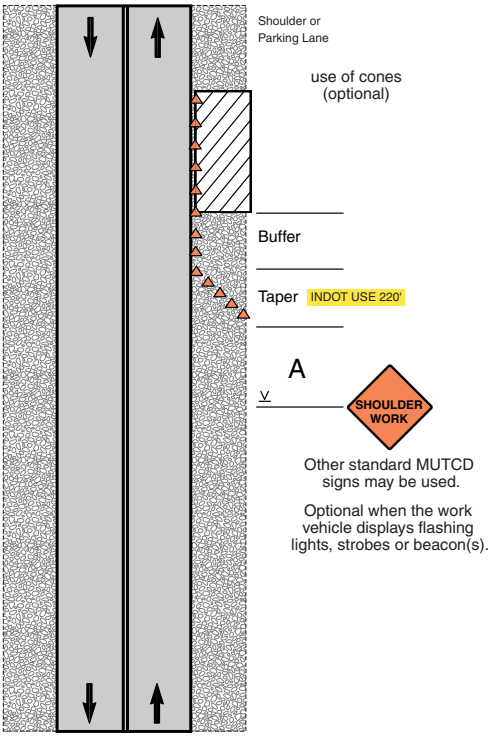
Work on Shoulder or Parking Lane

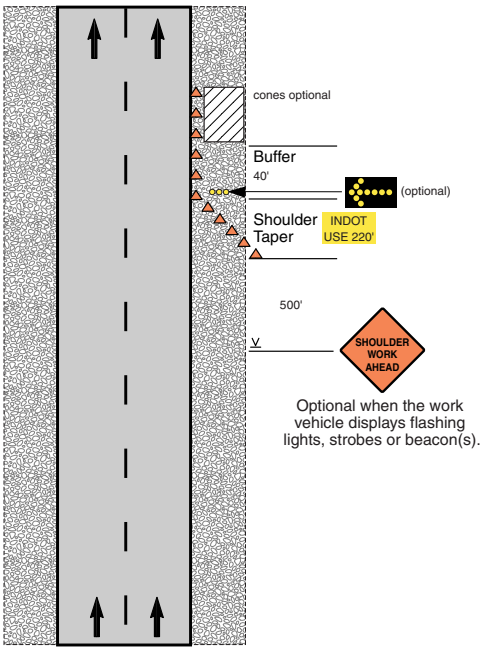
(Short Duration – up to 1 hour)



Speed Limit (mph)	Sign Spacing A (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

Shoulder Closed on Divided Roadway

(Short Duration – up to 1 hour)

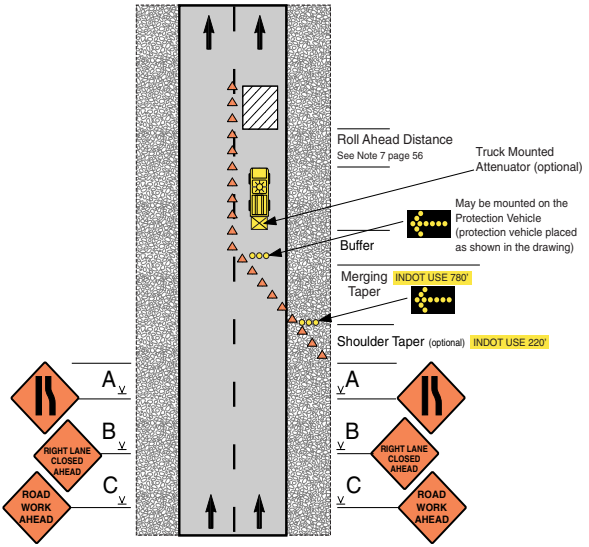


Notes:

1. Use of an arrow display is optional. If used, it shall be operated in the caution mode.

Lane Closure on Divided Roadway or One Way Street

(Short Duration – up to 1 hour)



Notes:

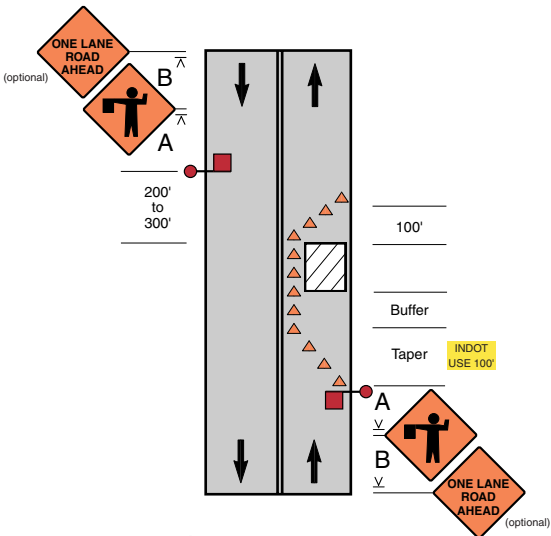
1. When a side road intersects the roadway within the work zone, additional devices shall be erected to channelize traffic to/from the side road, and a ROAD WORK AHEAD sign shall be placed on each side road approach.

Speed Limit (mph)	Sign Spacing (ft) A	B	C	Buffer (ft)
30	200	200	200	85
35	350	350	350	120
40	350	350	350	170
45	500	500	500	220
50	1000	1600	2600	280
55	1000	1600	2600	335
60	1000	1600	2600	415
65	1000	1600	2600	485

Lane Closure on a Two-Lane Road

(Two Flagger Operation)

(Short Duration – up to 1 hour)



Speed Limit (mph)	Sign Spacing A (ft)	Sign Spacing B (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335

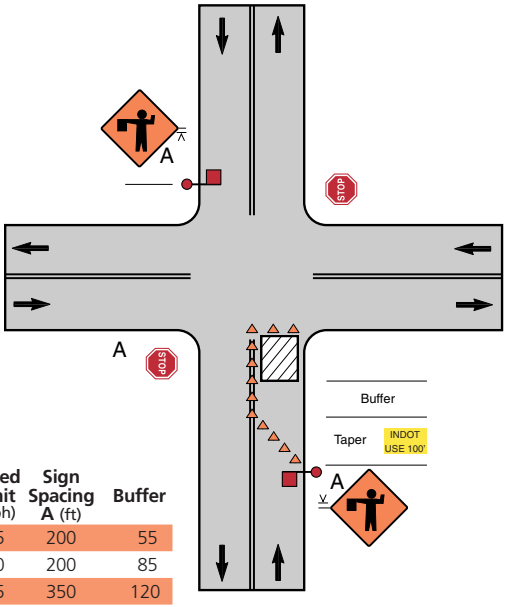
Notes:

1. The flagger or flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
2. If there is a sideroad intersection within the work area, additional traffic control, such as flaggers and appropriate signage, may be needed on the sideroad approaches.
3. Whenever a flagger is present, a FLAGGER AHEAD sign shall be used.

Lane Closure in Advance of an Intersection

(Work Area on the Through Road)

(Short Duration – up to 1 hour)



Speed Limit (mph)	Sign Spacing A (ft)	Buffer
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

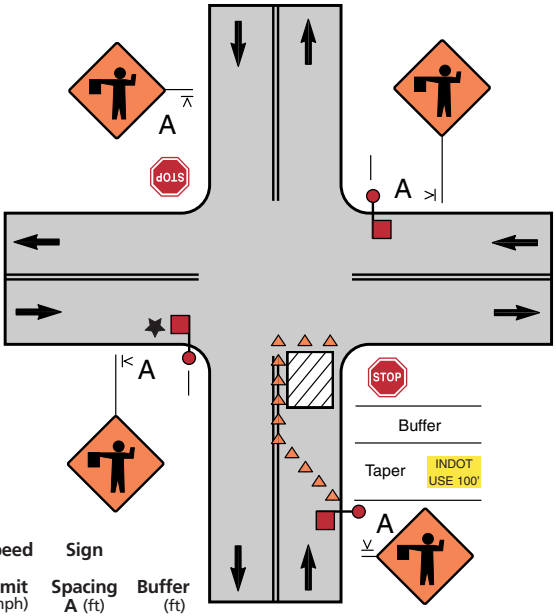
Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed on the side road approaches.
2. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
3. Whenever a flagger is present, a FLAGGER AHEAD sign shall be used.

Lane Closure in Advance of an Intersection

(Work Area on the Side Road)

(Short Duration – up to 1 hour)



Speed Limit (mph)	Sign Spacing A (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

Notes:

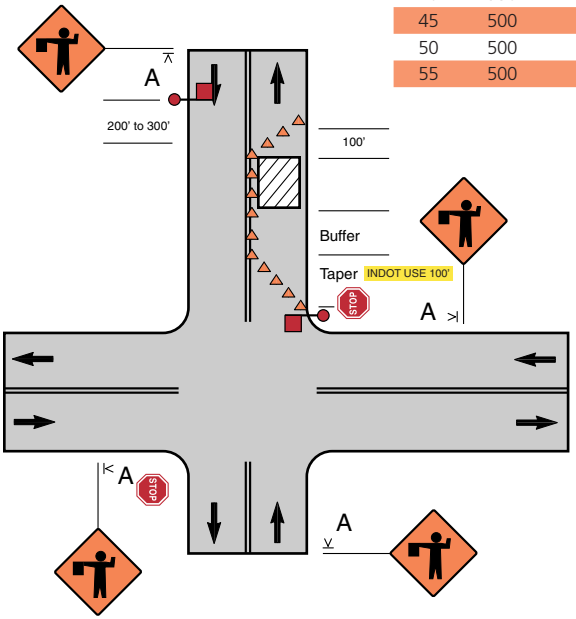
1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed.
2. ★ The middle flagger has the best view of traffic from all directions. This flagger should be designated ***lead flagger*** and should coordinate the actions of the other flaggers.
3. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.

Lane Closure Beyond an Intersection

(Work Area on the Through Road)

(Short Duration – up to 1 hour)

Speed Limit (mph)	Sign Spacing **A** (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335



Notes:

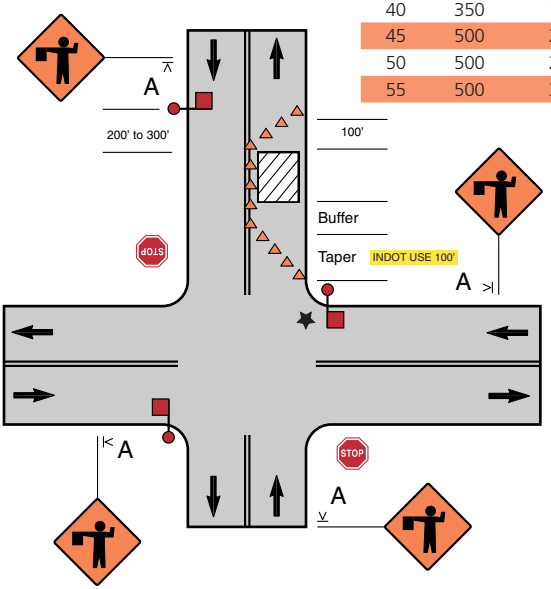
1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed.
2. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
3. When there is insufficient space the Taper and Buffer are not used.

Lane Closure Beyond an Intersection

(Work Area on the Side Road)

(Short Duration – up to 1 hour)

Speed Limit (mph)	Sign Spacing A (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

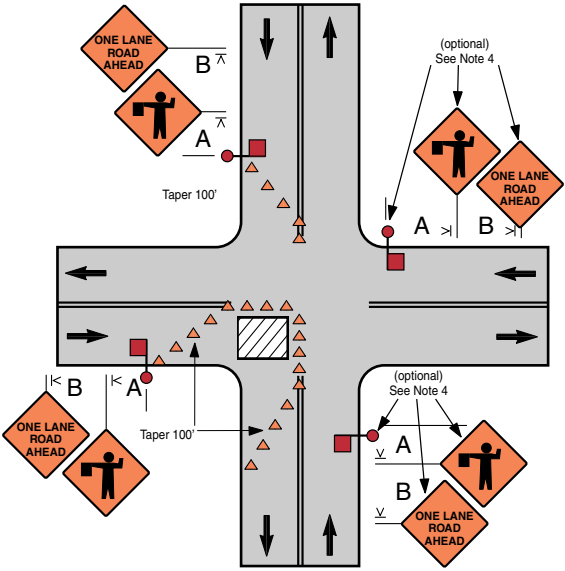


Notes:

1. Depending on traffic conditions, additional traffic control, such as flaggers and appropriate signage, may be needed.
2. ✱ The middle flagger should be designated ***lead flagger*** and should coordinate the actions of the other flaggers.
3. The flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.
4. When there is insufficient space the Taper and Buffer are not used.

Lane Closure at Side of Intersection

(Short Duration – up to 1 hour)



Notes:

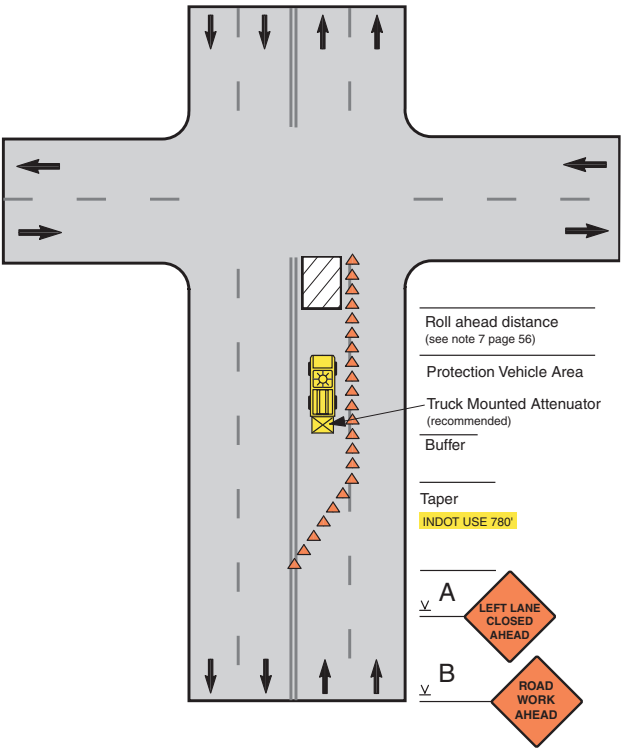
1. For high traffic volumes or when a four-lane street is involved additional flaggers or law enforcement personnel may be used.
2. The situation depicted can be simplified by closing one or more of the intersection approaches. If this can not be done, and/or when capacity is a problem, consideration should be given to diverting through traffic to other roads or streets.

Speed Limit (mph)	Sign Spacing A, B (ft)	Buffer (ft)
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

3. Flashing warning lights and/or flags may be used to call attention to the advanced warning signs.
4. Flaggers and signs for these approaches are optional. If the length of the closure and/or traffic warrant, additional flaggers and the appropriate signs should be used.
5. Cone taper at top of page is optional for stop sign or signalized approaches.

Lane Closure at a Signalized Intersection

(Short Duration – up to 1 hour)



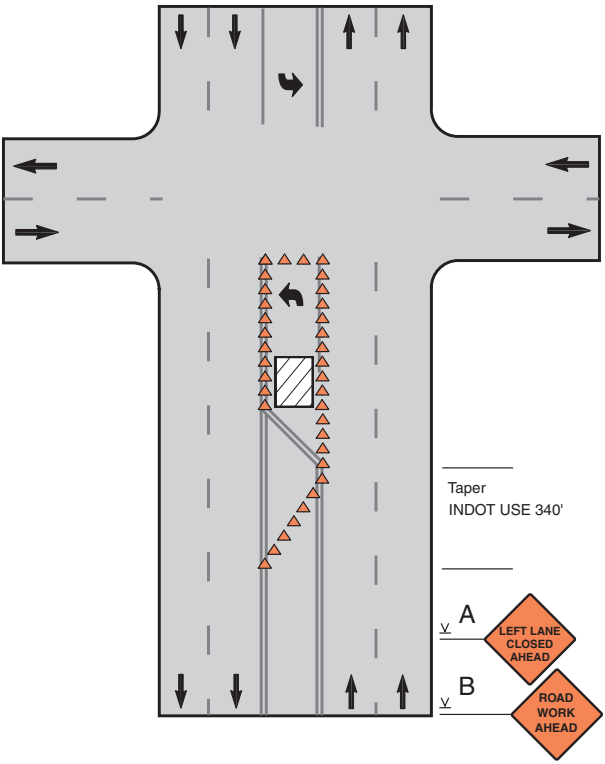
Notes:

1. Protection vehicle is optional if speed limit is less than or equal to 35mph, but a flagger with a flag should be stationed inside cone taper to slow oncomming traffic.
2. If working on far side of intersection, see page 42.
3. The length of tapers may be adjusted when used in close proximity to crossroads, curves, or other influencing factors.

Speed Limit (mph)	Sign Spacing A (ft)	Sign Spacing B (ft)	Buffer (ft)
25	200	200	55
30	200	200	85
35	350	350	120
40	350	350	170
45	500	500	220
50	500	500	280
55	500	500	335

Turn Lane Closure at a Signalized Intersection

(Short Duration – up to 1 hour)



Notes:

1. Lane may be opened beyond work area.
2. The length of the tapers may be adjusted when used in close proximity to crossroads, curves, or other influencing factors.

Speed Limit (mph)	**Sign Spacing A** (ft)	**Sign Spacing B** (ft)
25	200	200
30	200	200
35	350	350
40	350	350
45	500	500
50	500	500
55	500	500

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Mobile Operations

(15 minutes or less)

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Mobile Operations

(Mobile Operations – 15 minutes or less)

Mobile operations are work activities that move along the road either intermittently or continuously. Safety for mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location.

Portable devices should be used. For example, appropriately colored and marked vehicles with flashing or rotating lights, perhaps augmented with signs or arrow displays, may be used in place of signs and channelizing devices.

For mobile operations to be successful, the advance warning area for these operations must move with the work area or be repositioned periodically to provide advanced warning for the motorist.

Intermittent Mobile Operations – These mobile operations often involve frequent short stops, each as much as 15 minutes long that are similar to stationary operations. Warning signs, flashing vehicle lights, and/or channelizing devices should be used.

With operations that move slowly (less than 3 MPH), it may be feasible to use stationary signing that is periodically retrieved and repositioned in the advance warning area. In addition, vehicles may be equipped with such devices as flashing vehicle lights, truck mounted attenuators, and appropriate signs.

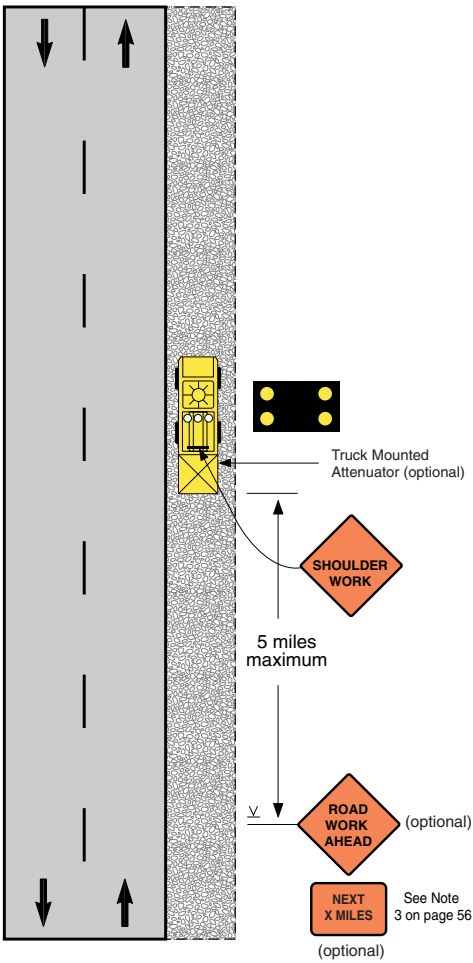
Flaggers may be used, but caution must be exercised so they are not exposed to unnecessary hazards.

Continuously Moving Mobile Operations – These mobile operations include work activities in which workers and equipment move along the road without stopping, (e.g. pavement striping, mowing, street sweeping, or herbicide spraying), usually at slow speeds.

For some continuously moving operations where volumes are light and visibility is good, a well-marked and well-signed vehicle may suffice. If volumes and/or speeds are higher, a shadow or protection vehicle, equipped as a sign truck, should follow the work vehicle. The advance warning area moves with the work area.

Mobile Operation on the Shoulder

(Mobile Operations – 15 minutes or less)



Mobile Operation on the Shoulder (cont.)
(Mobile Operations – 15 minutes or less)

Notes:

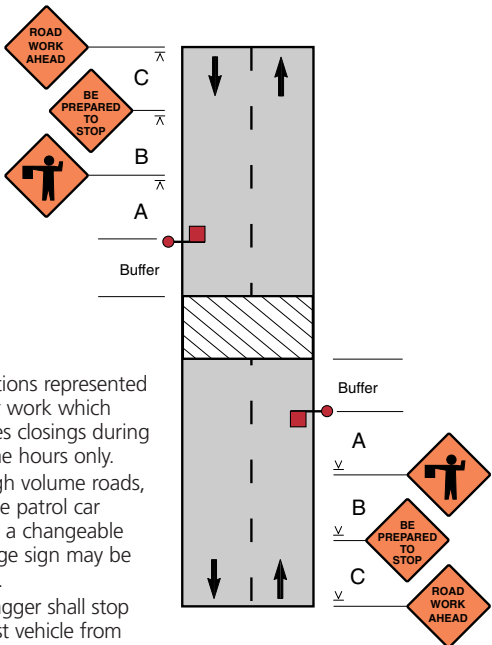
1. If the operation requires encroachment on the travelway, a mobile or stationary lane closure should be used, unless a 10-foot minimum lane width is maintained and the volume is less than 1500 ADT.
2. For operations that move slowly (less than 3 mph) and in situations where multiple work locations in a limited distance make it practical to place stationary signs, the maximum spacing from the advanced warning sign to the beginning of the work is 5 miles.
3. The LENGTH OF WORK sign or a supplemental panel (Next x Miles) may be used for work zones of more than 2 miles in length.
4. This note intentionally left blank.
5. If the distance between work locations is one mile or more, and if the work vehicle travels at traffic speeds between locations, warning signs are not required if the work vehicle displays a flashing or revolving yellow light.
6. Other acceptable advanced warning signs include SHOULDER WORK, UTILITY WORK AHEAD, MOWING, WORKER signs, and ROAD MACHINERY AHEAD.
7. Table below shows recommended roll-ahead distances between a protection vehicle with or without a truck-mounted attenuator (TMA) and the work area for both stationary and mobile operations. Roll-ahead distance for the protection vehicle may vary depending upon recommendations of the TMA manufacturer.

Roll-ahead Distances for TMAs and protection vehicle

Speed	Stationary	Mobile
≤45 mph	100 ft	150 ft
50-55 mph	150 ft	200 ft
60-65 mph	200 ft	275 ft

Temporary Road Closure

(Mobile Operations – 15 minutes or less)



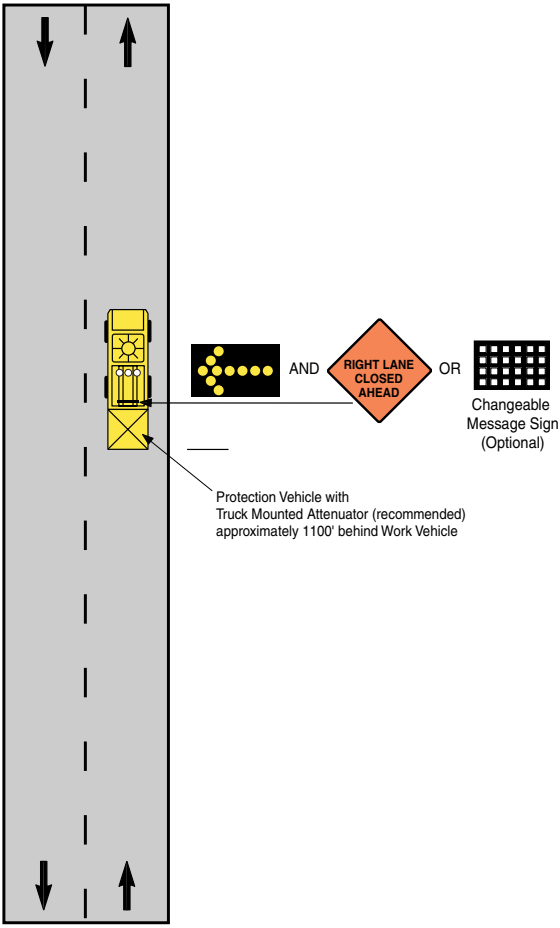
Notes:

1. Conditions represented are for work which requires closings during daytime hours only.
2. For high volume roads, a police patrol car and/or a changeable message sign may be added.
3. The flagger shall stop the first vehicle from the shoulder as shown. After stopping the first vehicle if the view of the flagger is obstructed, then he/she should move to the centerline to stop additional traffic.
4. Flaggers shall use approved flagging procedures according to the MUTCD and as shown on page 68.

Speed Limit (mph)	Sign Spacing A, B, C (ft)	Buffer
25	200	55
30	200	85
35	350	120
40	350	170
45	500	220
50	500	280
55	500	335

Mobile Operation on a Two-Lane Road

(traveling over 3 mph or
Mobile Operations – 15 minutes or less)



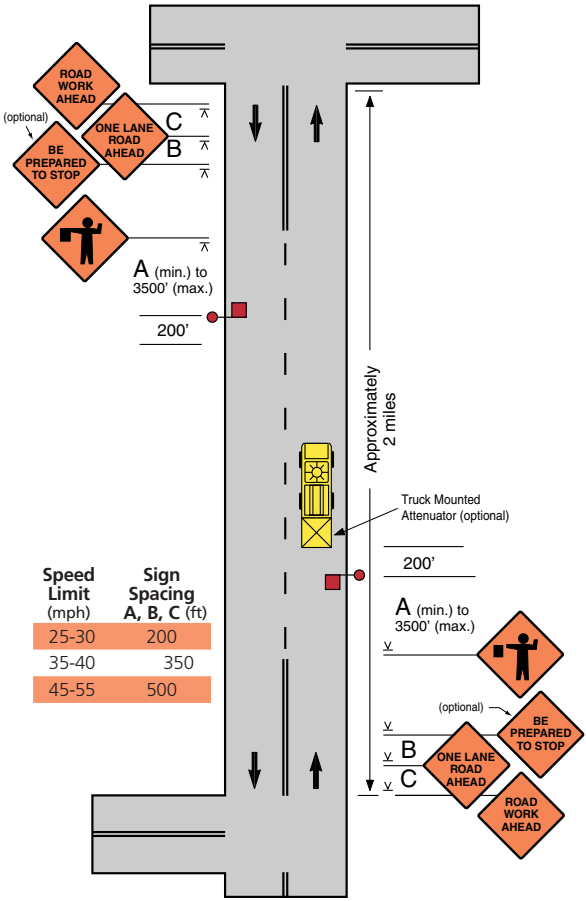
Mobile Operation on a Two-Lane Road (cont.)
(traveling over 3 mph or Mobile Operations – 15 minutes or less)

Notes:

1. Where practicable and when needed, the work and protection vehicles should pull over periodically to allow traffic to pass. If this can not be done frequently, as an alternative, a "DO NOT PASS" sign may be placed on the rear of the vehicle blocking the lane.
2. The distance between the work and protection vehicle may vary according to terrain, paint drying time, and other factors. Protection vehicles are used to warn traffic of the operation ahead. Whenever adequate stopping sight distance exists to the rear, the protection vehicle should maintain the minimum roll ahead distance and proceed at the same speed as the work vehicle. The protection vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.
3. Additional protection vehicles to warn and reduce the speed of oncoming or opposing traffic may be used. Police patrol cars may be used for this purpose.
4. A truck-mounted attenuator (TMA) is recommended to be used on the protection vehicle and may be used on the work vehicle.
5. Sign legends shall be covered or turned from view when work is not in progress.
6. Stationary advance warning signs similar to that on the protection vehicle may be used to provide additional advance warning for the operation. These signs might include: SLOW MOVING TRAFFIC, ROAD WORK AHEAD, PAINT CREW AHEAD, etc. These signs should be considered where speed and/or volumes are high, where sight distance is limited.
7. When at an intersection, flaggers shall be required as shown on page 51. Use of cones are optional.

Mobile Operation on a Two-Lane Road Using Flaggers

(traveling 3 mph or less or Mobile Operations – 15 minutes or less)



Speed Limit (mph)	Sign Spacing A, B, C (ft)
25-30	200
35-40	350
45-55	500

Mobile Operation on a Two-Lane Road Using Flaggers (cont.) (traveling 3 mph or less or Mobile Operations – 15 minutes or less)

Notes:

1. The distance between road work ahead signs should not exceed approximately 2 miles.

2. Where feasible, well defined end points (e.g. intersections, major driveways, city limits, etc.) should be used to establish the limits of the work zone.

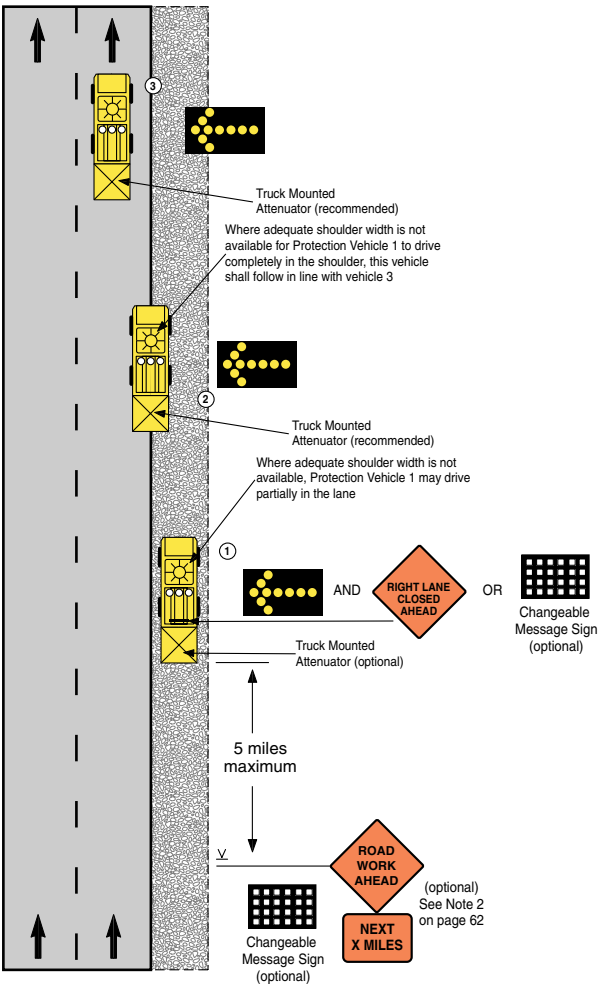
3. FLAGGER warning signs should be repositioned periodically as the operation moves.

4. If there is a sideroad intersection within the work area, additional traffic control, such as flaggers and appropriate signage, may be needed on the sideroad approaches.

5. Additional protection vehicles to warn and reduce the speed of oncoming or opposing traffic may be used. Police patrol cars may be used for this purpose.

Mobile Operation on a Two-Lane Divided Road

(Mobile Operations – 15 minutes or less)

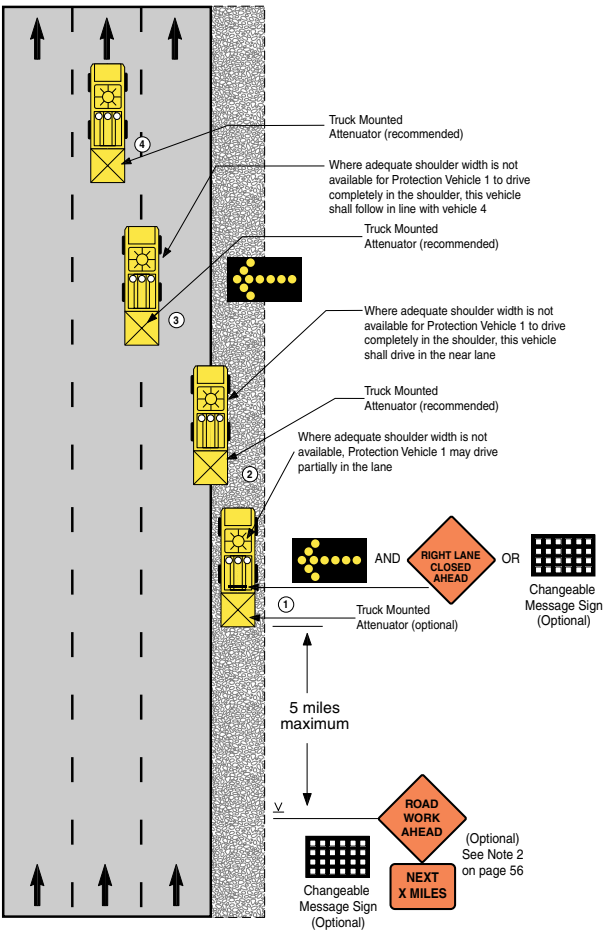


Notes:

see notes #5 and #6 on page 64.

Mobile Operation on a Multi-Lane Divided Road

(Mobile Operations – 15 minutes or less)



Notes:

1. Protection vehicle #1 should travel at a varying distance from the work operation so as to provide adequate sight distance for traffic approaching from the rear.
2. Stationary advance warning signs may be used to provide additional advance warning for the operation. These signs might include: SLOW MOVING TRAFFIC AHEAD, ROAD WORK AHEAD, PAINT CREW AHEAD, etc. These signs and/or a changeable message sign should be used where speeds and volumes are high, or where sight distance is limited.
3. If stationary signs are used and the activity is spread out over a distance of more than 2 miles, the LENGTH OF WORK Sign or a supplemental panel should be used.
4. Work should normally be done during off-peak hours.
5. Protection Vehicle (PV) spacing:
   - 120'-1000' between Work Vehicle and nearest PV
   - Approximately 500' between middle PV's
   - 1000' - 2000' between PV#2 and PV#1

   Urban roadways may require shorter distances. Exact spacing will be determined by the crew leader.
6. In an urban, non-interstate area, the number of protection vehicles may be reduced.

Pedestrian and Worker Safety

Pedestrian Safety

If pedestrian travel paths (sidewalks or footpaths) are closed or disrupted by a construction, maintenance, or utility operation, then pedestrian traffic control is needed. This includes the use of signs, channelizing devices, flags, etc. to direct pedestrian movement through or around the work site.

The major considerations in planning for pedestrian safety in temporary traffic control zones on streets and highways are:

- Pedestrians should not be led into direct conflicts with work site vehicles, equipment, or operations.
- Pedestrians should not be led into direct conflicts with mainline traffic moving through or around the work site.
- Pedestrians should be provided with a safe, convenient travel path that replicates as nearly as possible the most desirable characteristics of sidewalks or footpaths.
- Pedestrians need protection from potential injury and a smooth, clearly defined travel path. Obstructions should be clearly marked, especially at night.

Worker Safety

The safety of workers in a work site is just as important as the safety of the public traveling through the work zone. The best protection for both is good work zone traffic control.

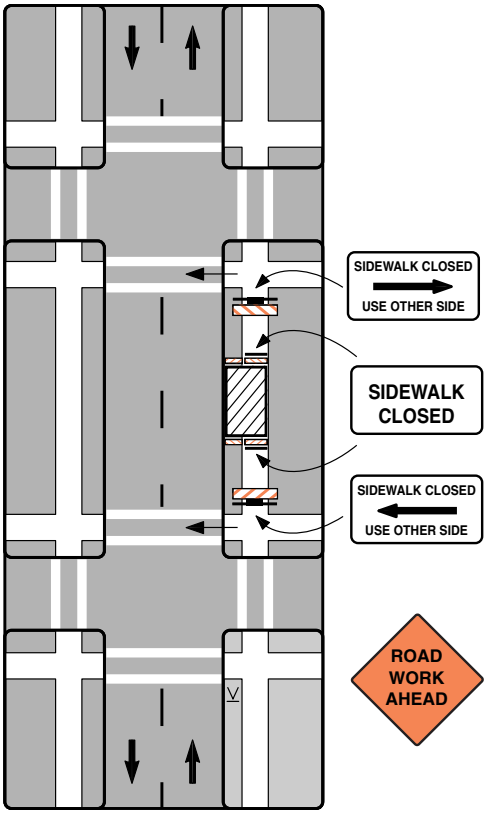
All workers should be trained in how to work next to traffic in a way that minimizes their vulnerability. In addition, workers with specific traffic control responsibilities should be trained in traffic control techniques, device usage, and placement.

Workers exposed to traffic shall be attired in INDOT approved apparel including, but not limited to safety vests and hats.

For nighttime work, similar outside garments shall be retroreflective and shall be designed to identify clearly the wearer as a person and be visible through the full range of body motions (i.e. retroreflective material on the front, back, and both sides of the garment).

Sidewalk Closure

(Pedestrian Detour)

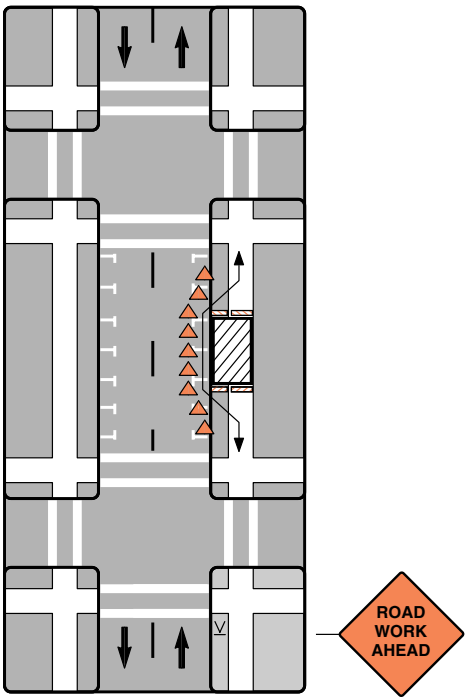


Notes

1. Additional advance warning may be necessary.
2. Only the traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets. Use lane closure signing, ROAD NARROWS or LANE NARROWS signs as needed.
3. For nighttime closures, Type A flashing warning lights may be used on barricades supporting signs and closing walkways.

Sidewalk Closure

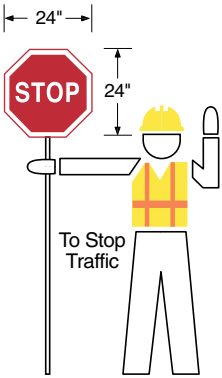
(Pedestrian Walkway Provided)

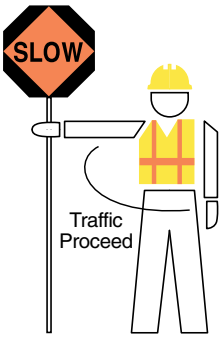


Notes:

1. Additional advance warning may be necessary.
2. Only the traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets. Use lane closure signing, ROAD NARROWS or LANE NARROWS signs, as needed.
3. For nighttime closures, Type A flashing warning lights may be used on barricades supporting signs and closing walkways. Type C steady-burn lights may be used on channelizing devices separating the temporary walkway from vehicular traffic.
4. Where high speeds are anticipated, use a barrier to separate the temporary walkway from vehicular traffic. Refer to Section 6D-1 of Part VI of the MUTCD for information on barriers.
5. Signs may be placed along a temporary walkway to guide or direct pedestrians; for example, KEEP RIGHT or KEEP LEFT signs.

Flagging Procedures





Properly Trained Flaggers

- give clear messages to drivers as shown
- allow time and distance for drivers to react
- coordinate with other flaggers

Properly Equipped Flaggers

- approved sign paddles
- paddles are not to be used in a signalized intersection
- approved safety vest, shirt or coat
- brightly colored hat for better visibility
- retroreflective night equipment

Proper Flagging Stations

- good approach sight distance
- highly visible to traffic
- never stand in moving traffic lane
- always have an escape route

Proper Advance Warning Signs

- always use warning signs
- allow reaction distance from signs
- remove signs if not flagging

Flags should only be used in emergency situations or for controlling traffic at a signalized intersection. Flags used for signaling shall be a minimum of 24" x 24", red in color and mounted on a staff, about 3' long.

Acknowledgments

This pocket guide was adapted for use in Indiana by the Indiana Department of Transportation (INDOT) and the Indiana Local Technical Assistance Program (LTAP) from one produced by the Institute for Transportation Research and Education (ITRE) at North Carolina State University. INDOT and LTAP acknowledge and thank ITRE and the many agencies and associations in North Carolina and South Carolina that were involved in the original development of this pocket guide on work zone traffic control.

The Indiana team that reviewed the ITRE version of the *Work Zone Safety Handbook* and adapted it to reflect Indiana practice included representatives of the operations safety coordinators, maintenance, safety, and traffic sections of INDOT; Allen County; Montgomery County, Tipton County; City of Lebanon; Town of Flora; and the Indiana LTAP Center at Purdue University.

Information and Training

For further information and training opportunities in basic work zone traffic control, flagging, and other street and highway design, operation, and maintenance topics contact the Indiana LTAP Center, a project of the Purdue University Civil Engineering Department, funded as a Local Transportation Assistance Program by the Federal Highway Administration, and Indiana Department of Transportation.

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West Lafayette, IN 47907
800-428-7639 phone (Indiana only)
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