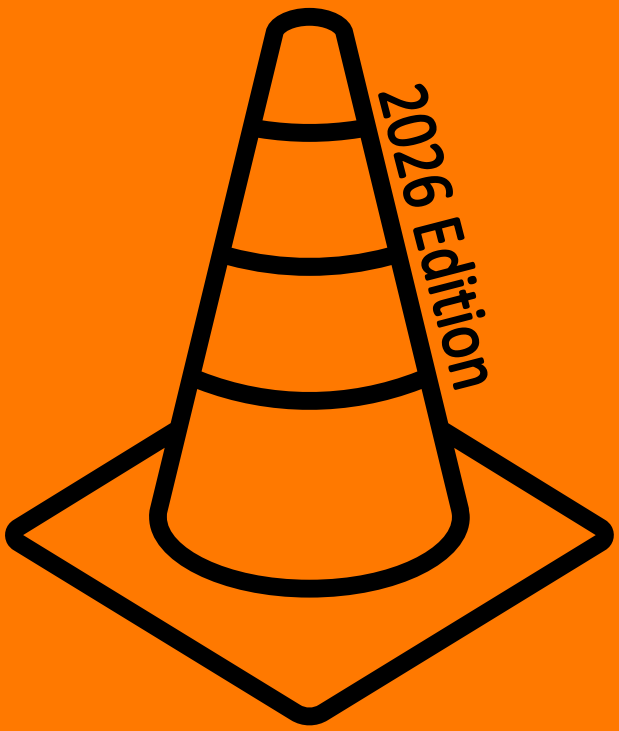
OREGON

Temporary Traffic Control Handbook

For Operations of Three Days or Less



Prepared by the Oregon Department of Transportation

2026 EDITION

We are pleased to bring you this revision to the *Oregon Temporary Traffic Control Handbook* (OTTCH). Within these pages you can find guidance based on the principles set forth in Part 6 of the *11th Edition* of the *Manual on Uniform Traffic Control Devices* (MUTCD) and the *MUTCD Oregon Supplement* to apply to your work needs. The Oregon Transportation Commission (OTC) adopted the standards within this Handbook through OAR 734-020-0005 as the standards for all temporary traffic control in place for three days or less on Oregon public roads.

Printed copies of this Handbook may be ordered from:

Chemeketa Community College
Center for Business & Industry
626 High St NE
Salem, Oregon 97301
503-399-5181

Digital copies of this Handbook can be found on the Oregon Temporary Traffic Control Handbook website:
https://www.oregon.gov/odot/Engineering/Pages/OTTCH.aspx

A copy of the final draft Handbook, as adopted by the Oregon Transportation Commission (OTC), is on file at the Oregon Department of Transportation. Limited editorial changes for consistency and formatting have been made in this document.

ACKNOWLEDGEMENTS

The *Oregon Temporary Traffic Control Handbook* (OTTCH) was prepared by the Oregon Department of Transportation (ODOT) in a cooperative effort with State, City, County, Consultant, and Utility partners. ODOT would like to thank the OTTCH Review Subcommittee for their time, commitment, and advice throughout the course of the OTTCH update. Please see Appendix D for a listing of the members of the OTTCH Review Subcommittee.

ODOT would also like to thank the Oregon Transportation Commission (OTC), Federal Highway Administration (FHWA), Oregon Traffic Control Devices Committee (OTCDC), the stakeholders, and all other interested parties that participated in the comment and review period for their provided insights and feedback.

ODOT has designated the Chemeketa Community College Center for Business and Industry as the administrator of flagger curriculum, materials and flagger certification cards. See the ODOT *Work Zone Safety* website for more information: https://www.oregon.gov/ODOT/Safety/Pages/Work-Zone.aspx

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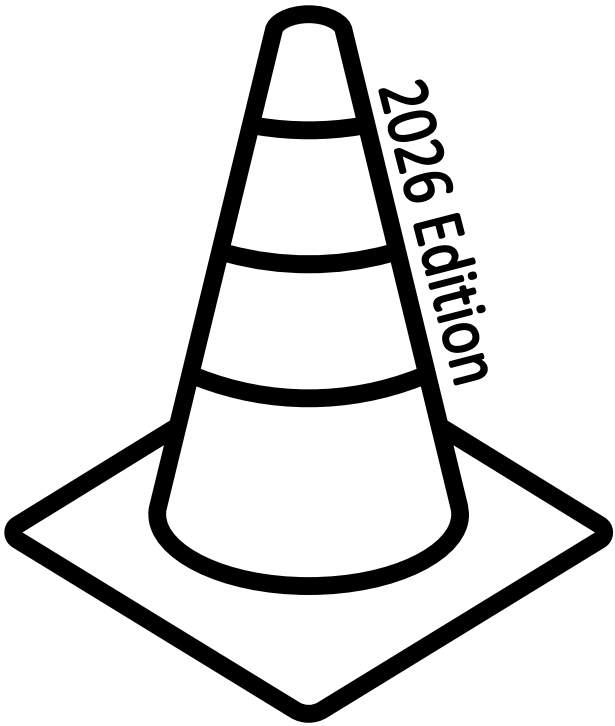

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CHAPTER 1 – GENERAL STANDARDS AND PRACTICES

1.1 Scope

This Handbook provides a reference for the standards and practices for temporary traffic control work zones in place continuously for three days or less on public roads in Oregon. It is based on the principles set forth in Part 6 of the *Manual on Uniform Traffic Control Devices* (MUTCD) and the *MUTCD Oregon Supplement*. A traffic control plan is ***required*** whenever work is being performed on or along all Oregon public roads. This Handbook is not intended to address work requiring devices in place longer than 3 days, or for more comprehensive traffic control plans. For work requiring devices in place longer than three days, or for work zones that are more complicated than the diagrams shown in this Handbook, a more comprehensive traffic control plan (TCP) is required.

The Oregon Transportation Commission (OTC) adopted the standards within this Handbook through OAR 734-020-0005 as the standards for all temporary traffic control in place for three days or less on Oregon public roads.

Each road jurisdiction (City, County, State, or Transit Authority) may have additional or more restrictive requirements and will generally require permits to work within the public right-of-way (ROW). The appropriate road jurisdiction ***should*** be contacted prior to planning or beginning any work within their jurisdiction.

The primary function of temporary traffic control is to provide safe and efficient movement of road users through or around work zones while protecting workers, emergency response personnel, and equipment. Each person whose actions affect work 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.

There are safety concerns for workers while setting up and taking down work zones. As a result, this Handbook is based on the premise, as per the MUTCD, that simplified traffic control procedures are warranted for short-term activities.

1.2 Planned, Emergency, and Special Event Traffic Control

Planned Traffic Control: Includes traffic control for routine activities including construction, maintenance and utility work, repair or new installation of road or roadside hardware, whether road-related or not. Traffic impacts from planned work can be anticipated and the proper equipment that complies with the current MUTCD and this Handbook ***should*** be stocked and available for use as the crew heads out to work.

Emergency Traffic Control: Used during unanticipated events that require an immediate response to control traffic and to aide emergency responders and protects road user safety. Emergency activities take precedence over planned activities.

All traffic control devices or equipment used for temporary traffic control **shall** be in compliance with the MUTCD and this Handbook. However, in emergency situations, the responder may use any available devices or equipment to control and guide traffic through or around the incident response area. As soon as practical, devices and equipment that comply with the MUTCD and this Handbook *should* be placed to control traffic.

Special Event Traffic Control: Designed for planned events that impact the flow of traffic. Traffic analysis *should* be conducted for special events. Analysis includes expected traffic volumes, entry and exit locations, available alternate routes, and normal traffic characteristics. A special event TCP is likely to include significant numbers of devices, personnel, and alternate routes. Each road jurisdiction may have permit or other requirements for special events with traffic impacts on their roads. The appropriate road jurisdiction *should* be contacted as part of the event planning for their assistance and approval of the temporary traffic control.

1.3 Lane Closures, Diversions, and Detours

When redirection of the road users' normal path is required, road users **shall** be directed from the normal path to the new path with appropriate channelizing devices, traffic control devices and/or other temporary traffic control (TTC) methods. Extended traffic queues may result from the loss of road capacity, increasing the chance of collisions. Workers *should* be aware of and monitor traffic conditions and be prepared to install additional traffic control devices or measures when needed.

Onsite conditions may vary requiring modification to the distances shown in the "Typical Applications" if the work is on a curving or hilly section of road. Look for a balance between giving warning in time, keeping the work signs free from other roadside clutter, and having too much distance between the advance warning and the work so that road users are otherwise distracted or have forgotten the warning.

1.4 Worker Safety Apparel

All workers within the ROW who are exposed to traffic, to work vehicles, or construction equipment within the work zone **shall** wear high-visibility safety apparel. Safety apparel **shall** meet the requirements of the ANSI/ISEA 107–2015 publication entitled "*American National Standard for High-Visibility Safety Apparel and Headwear*," or equivalent revisions, and labeled as ANSI 107-2015 or later for standard performance for Class 2 or 3 risk exposure.

1.5 Bicycle and Pedestrian Considerations

All road users (motorists, bicyclists, and pedestrians) **shall** be accommodated through work zones. Pedestrians, including those with disabilities, **shall** be accommodated through work zones by a temporary pedestrian accessible route (TPAR). If accommodation through the work zone is not possible or practical, effective alternate routes **shall** be provided and comply with the current *Americans with Disabilities Act* (ADA) and the MUTCD.

The placement of additional temporary signing and traffic control devices (TCD) for the control of non-motorized vehicles and pedestrians *should* be used when work is expected to last longer than one hour. When work is expected to be for a short duration, pedestrians may be accommodated by removing equipment from the highway to provide access for pedestrians.

Accommodate pedestrians and bicyclists using the following principles. Pedestrians and bicyclists *should*:

1. Not be led into conflicts with vehicles, equipment, and operations.
2. Not be led into conflicts with vehicles moving through or around the worksite.
3. Be provided with a convenient and accessible path, a TPAR, that replicates as nearly as practical the characteristics of the existing sidewalks or paths.

Pedestrian and bicyclist accommodation *should* provide the following:

1. The traffic control plan *should* include provisions for continuous TPAR's through the work zone.
2. Access to businesses, bus stops, and other destinations *should* be maintained.
3. The TPAR's *should* be a smooth, continuous hard surface.
4. The TPAR's *should* have adequate width and be clear of obstructions. Match existing route widths when practical. Minimum standard widths are 5 feet for pedestrian facilities and 4 feet for bicyclists.
5. Guidance through the work zone *should* be provided by signs and traffic control devices that are detectable by pedestrians. Closed routes *should* be completely blocked by detectable devices. Channelizing devices, when used, **shall** be continuous and detectable throughout the length of the work zone.

Refer to Chapter 6C of the MUTCD for additional pedestrian safety information.

For additional bicycle and pedestrian accommodation information, see Chapter 5 of this Handbook.

1.6 Night or Low-Visibility Operations

Working at night when there is less traffic on the road can be the only practical way to accomplish some work tasks. When drivers use their headlights due to low-visibility or night conditions, consideration for adjusting the traffic control **shall** be taken. Use the following basic principles for adjusting your traffic control for night or low-visibility operations:

- Use enough lighting to provide a safe work environment. Avoid creating glare for oncoming traffic.
- All TCD **shall** be retroreflective, including signs, channelization devices, and flagger STOP/SLOW paddles.
- All TCD and worker safety apparel ***should*** be kept in "acceptable" condition, according to the current American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Temporary Traffic Control Devices and Features*.
- If temporary pedestrian facilities are implemented, or obstructions or surface hazards are introduced, check that the path provided for them is lit adequately.
- In residential areas, avoid aiming work space floodlights into homes or yards.
- For information on flagging at night, see the Flagging Section, Chapter 3.

1.7 Roundabouts

Roundabouts pose unique challenges when work or incident management must be done in or around these facilities. It is recommended that work be conducted during off-peak hours.

A roundabout is not designed to hold stopped or waiting traffic during road work. Flagging or a detour may be required if it is likely that work may block traffic from using the circular roadway of a roundabout. Notify emergency services prior to conducting work in a roundabout that will affect response times or if using a detour.

1.8 Pavement Markings

Where permanent pavement markings are removed or conflict with the temporary travel paths, temporary devices (e.g. warning signs, channelizing devices, and delineation) **shall** be used to delineate the appropriate path. Temporary pavement markings and delineation **shall** match existing markings at both ends of the work zone.

For the application of temporary pavement markers used to simulate pavement markings, see Part 6 of the MUTCD, Oregon Department of Transportation (ODOT) Temporary Traffic Control Standard Drawings (TM800 series), and the *Oregon Standard Specifications for Construction*. Additional temporary pavement marker details are given in Chapter 5, Diagram 5-9.

For the application of permanent pavement markings on state highways, see the ODOT *Traffic Line Manual*.

For city or county roadways, refer to Part 6 of the MUTCD and the local road jurisdiction's policy for additional layout of temporary pavement markings.

The intended vehicle path *should* be clearly delineated at all times, day and night, and under both wet and dry pavement conditions.

All devices and markings used at night **shall** be retroreflective.

Temporary, removable, non-reflective preformed tape may be used to cover conflicting existing pavement markings.

If raised pavement markers are used to substitute for pavement markings in work zones, their application **shall** meet the requirements of the MUTCD for the line type they are replacing.

Pavement markings **shall** be in place before the road is re-opened to traffic if:

- Work covers or removes the pavement markings for a distance longer than two skip markings or 80 feet measured along the centerline, or
- Markings are covered or removed for any distance in critical areas such as horizontal curves, vertical curves, or weaving areas.

Temporary pavement markings may be used until the earliest date it is practical and possible to install permanent pavement markings. Temporary markings *should* not remain in place for more than two weeks unless it is impractical to place permanent markings.

If road work obscures or obliterates existing pavement markings within no-passing zones, one of the following ***should*** be done prior to reopening roadway to traffic:

- Install a DO NOT PASS (R4-1) sign at the beginning of each no-passing zone and a PASS WITH CARE (R4-2) sign at beginning of each passing zone, or
- Use temporary pavement markers to simulate required pavement markings.

For three days or less, no-passing zones for a two or three-lane road may be identified by using DO NOT PASS (R4-1) and PASS WITH CARE (R4-2) signs rather than pavement markings. Cover the DO NOT PASS and PASS WITH CARE signs when they conflict with an active work zone.

DO NOT PASS (R4-1) and PASS WITH CARE (R4-2) signs may also be used instead of pavement markings on low-volume roads (400 average daily traffic (ADT) or less) for longer periods and in accordance with the road jurisdiction's policy.

1.9 Portable Traffic Signals

This section covers the use of portable traffic signals that can be used to control traffic through a one-lane, two-way work zone.

Portable Traffic Signal Requirements:

1. All signals added to the state highway system, including portable signals, **shall** be by permit, and approval from the State Traffic Engineer (STE) is required before a permit can be issued. Check with local road authorities for signal approvals on local, non-State roads.
2. Use of portable traffic signal equipment **shall** be listed on the ODOT *Qualified Products List* (QPL). On local roads, check with local jurisdictions for signal approval.
3. Portable traffic signals **shall** be set up for line of sight from one end of the one-lane section to the other. Portable traffic signals **shall** be interconnected to ensure communication between signals.
4. Any intersecting roads or driveways between the portable traffic signals **shall** be signalized or closed.
5. An all-red interval is required that is long enough for road users to clear the single-lane section between portable signals.
6. The portable signal control equipment **shall** have safeguards that eliminate the possibility of conflicting signal indications at each end(s) of the work zone.

7. Portable traffic signals **shall** have vertically arranged 12-inch diameter signal lenses.
8. Each portable traffic signal unit **shall** have at least two signal heads. One signal head **shall** be mounted on a pole over the shoulder with the bottom of the signal head at least a minimum of eight feet above the roadway surface. At least one signal head **shall** be located over the travel lane(s) with a minimum vertical clearance of 17 feet above the roadway surface.
9. The portable traffic signal timing parameters are supplied by the road jurisdiction to the user in order to properly time the signal and **shall** not be changed without prior approval.
10. Portable traffic signals are for stationary work only.
11. The use of portable traffic signals at rail grade crossings are outside the scope of this Handbook.

1.10 Unattended Work Sites

If a work site must be left unattended before the work is completed, all appropriate warning signs and channelization devices **shall** be in place. Turn, cover or remove all inappropriate signs and traffic control devices. Equipment ***should*** be parked 15 feet away from the edge of the traveled way and 50 feet away from all intersections or pedestrian crossings. If equipment must be left on the shoulder less than 15 feet from the edge of travel way, exposed to traffic, or left in a closed lane, the equipment ***should*** be delineated.

Changes in road surface such as rough pavement, excavations, or raised plates in the road **shall** have the appropriate advance warning signs in place. Advance warning signs **shall** also be in place for any roadside obstructions. The obstruction **shall** be delineated and protected by cones, drums or barricades.

All unattended work sites with traffic control left in place ***should*** be routinely inspected by a knowledgeable person for adequate compliance, visibility and condition of the traffic control devices. Immediately replace all damaged or missing TCDs. Devices left in place must be appropriate for all expected or anticipated conditions, at all times.

1.11 Spotter / Work Zone Intrusion Alarm Guidelines

Purpose: To provide a positive, clear set of expectations for the spotter and/or work zone intrusion alarm and employee(s) being protected.

Definitions: A *'spotter'* is an employee whose sole duty is to provide immediate warning of approaching vehicles, equipment, or other hazards to co-workers. A spotter is ***not*** a flagger. A *'work zone intrusion alarm'* is a type

of safety system that is used in a roadway work zone to alert field workers and secure time for them to escape when errant vehicles intrude into the work zone. A work zone intrusion alarm uses audio, visual, and haptic alerts or a combination of thereof to warn field workers of an errant vehicle intrusion into the work area.

The primary function of a spotter and/or work zone intrusion alarm is to provide immediate warning of approaching vehicles, equipment, or other hazards. A spotter and/or work zone intrusion alarm may be used to enhance the safety and efficiency of the work space for both workers and road users. Spotters and/or work zone intrusion alarms may be used for activities such as debris removal, tagging of survey markers, marking utility lines, material delivery, and heavy equipment operations within the work space.

When to use a Spotter or Intrusion Alarm: Do a hazard assessment to determine if using a spotter and/or a work zone intrusion alarm is appropriate for a given activity. Consider using a spotter or work zone intrusion alarm when:

- Workers must have their backs to traffic or other hazards.
- Workers and heavy equipment are working in the same area concurrently.
- Performing work where adequate gaps in traffic allow work to be done in a live travel lane.
- Work encroaches into the roadway, but maintains a minimum 10 ft travel lane (for example, see Diagram 300).
- Sight distances are limited by vegetation or other conditions.
- Posted speeds are 45 mph or higher.

The need for spotters and/or work zone intrusion alarms can be dictated by one or more factors for a given operation or task. Common factors that influence the use of spotters and/or work zone intrusion alarms include:

- Location of task.
- Type of highway.
- Vertical or horizontal alignment.
- Traffic volume or speed.
- Construction or maintenance activity.
- Traffic control used.
- Added safety control.
- Vegetation, trees, roadway geometrics or other conditions that might restrict sight distance or safety of an employee.

Key Components: The following are key components in developing and implementing an effective spotter training and performance program:

1. **Action Plan** – A site or task specific plan along with a hazard assessment for using a spotter and/or work zone intrusion alarm must be completed before a spotter and/or work zone intrusion alarm can be used. All affected parties must understand the action plan before starting work.
2. **Location of Spotter** – A spotter *should* be within visual and verbal contact of employee(s) that are being protected. If visual contact cannot be made with workers, use of an air-horn, two-way radio, or other warning device **shall** be used alert workers of an eminent unsafe condition.
3. **Location of the Work Zone Intrusion Alarm** – the minimum transmission distance between the alarm trigger location and the workers being protected *should* be 400 feet to allow sufficient time for workers to react to the alarm. The transmission distance requirement *should* increase for work zones where posted speeds are 45 mph or greater or locations with historical vehicle travel speeds of 45 mph or greater.
4. **"Alert Call"** – The "alert call" **shall** be agreed upon by all affected parties prior to the use of a spotter and/or work zone intrusion alarm and **shall** be clearly heard above all surrounding noise levels. The "alert call" (made by voice or mechanical means) needs to be clearly heard above all surrounding noise levels when it appears an unplanned safety problem, errant motorist, equipment or other hazard is intruding into the zone of protection.
5. **Escape Route** – A predetermined escape route for both the spotter and the protected employee(s) **shall** be established prior to beginning work and agreed upon by all affected parties.
5. **Commencement of Work** – The spotter and/or work zone intrusion alarm **shall** be in place and prepared to issue alerts before work begins.
6. **Training** – All affected employees **shall** understand the roles and responsibilities of a spotter. All affected employees **shall** be trained in the duties and use of a spotter(s).
7. **Spotter Roles and Responsibilities** include:
    a. When performing the spotter role, this is your ***only*** duty (a spotter is *not* a flagger).
    b. Be within sight or sound of the employee(s) being protected.
    c. Choose a location that provides optimum sight distance and safety.

d. Know the “alert call” or communication plan.

e. Be on alert to sound the alarm.

f. Be in place before the operation begins.

g. Confirm that all affected parties understand the action plan.

Do not control traffic with a spotter. A spotter is *not* a flagger.

1.12 Unpaved Roads

Short-term traffic control on unpaved public roads presents unique challenges where the full application of the standards and requirements within this Handbook may not be applicable. Local road authorities, in accordance with this Handbook and Part 6 of the MUTCD, may apply traffic control devices and measures appropriate for unpaved public roads within their jurisdiction.

CHAPTER 2 – SETTING UP THE WORK ZONE

This section provides guidelines and procedures for setting up work zone, special event, or incident response.

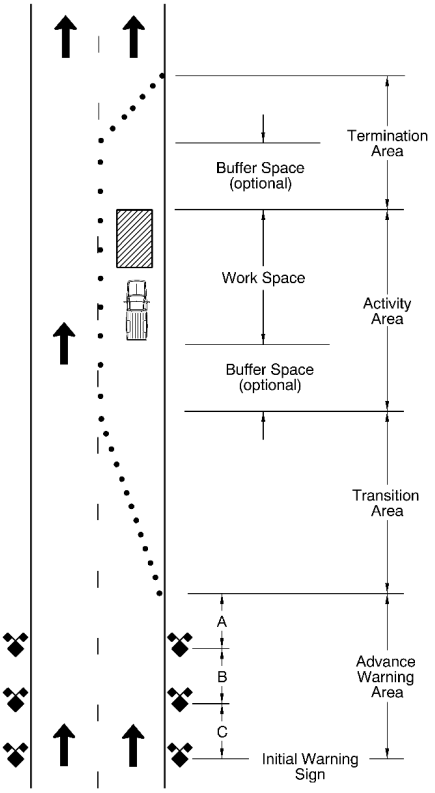
The use of additional devices, such as portable changeable message signs (PCMS), arrow boards, and truck-mounted attenuators (TMA) during set-up and take-down of the work zone may be used to enhance worker safety.

In developing and implementing the traffic control plan (TCP), existing devices **shall** be maintained at an equivalent or better level than existed prior to project implementation.

2.1 Work Zone Components

The work zone, as shown in Figure 2-1 below, consists of four parts and extends from the initial advance warning signs to the last temporary traffic control device or the END ROAD WORK (CG20-2A) sign (optional).

Figure 2-1: Work Zone Components



1. **Advance Warning Area:** An advance warning area is necessary for all work zones. It may vary from a series of signs in advance of the work space to a single sign or flashing lights on a work vehicle.

   The advance warning area ***should*** give road users enough time to react to any downstream changes occurring within the transition area. The length of the advance warning area will vary based on the number of advance warning signs and the posted speed. Use Table 2-4 to determine appropriate sign spacing and specific advance warning area lengths.

2. **Transition Area:** In a transition area, traffic is moved out of normal traffic paths and into a temporary path around the work space. The transition area commonly contains channelization tapers used to shift or close the travel lane(s) or to close a shoulder.

3. **Activity Area:** The area within a work zone is comprised of the following two sections.

   a. **Buffer Space:** A section of closed road in advance of and following the work space which provides an extra margin of safety for both traffic and workers. Keep buffer spaces clear of vehicles, equipment, materials and personnel to provide a clear recovery area for errant vehicles. Buffer spaces ***should*** be provided when space is available, but are optional.

   b. **Work Space:** The portion of the roadway containing the work activity and includes workers, materials and equipment. It ***should*** be sufficiently delineated and protected.

4. **Termination Area:** The termination area provides a short distance for traffic to clear the work space and return to normal operation. The downstream cone taper is optional. An END ROAD WORK (CG20-2A) sign is also optional.

2.2 Tapers

Taper lengths, calculated from Table 2-1 or Table 2-2, or as shown in Table 2-3 and Figure 2-2, are ***minimum*** taper lengths. Longer tapers may be necessary for drivability or to enhance driver performance, for example, around vertical or horizontal curves or steep grades. To determine if a taper length is adequate or needs to be adjusted, monitor traffic as it maneuvers through the work zone.

TAPER TYPES:

Merging Taper: Merges two traffic lanes in the same direction into one lane.

Shifting Taper: Moves traffic from one path to another.

Shoulder Taper: Used to close a shoulder to traffic.

One-Lane, Two-Way Taper: Used as part of a flagging operation. The taper is placed across the lane beyond the flagger station to guide queued vehicles into the open lane and around the work space during one-lane, two-way operations. Taper length is 50 – 100 ft. See Diagrams 320, 325, 340 and 370 for examples.

Downstream Taper: Used to guide the motorist back into their normal travel paths after passing the work space. Taper lengths are 50 – 100 ft.

Figure 2-2: Taper Types

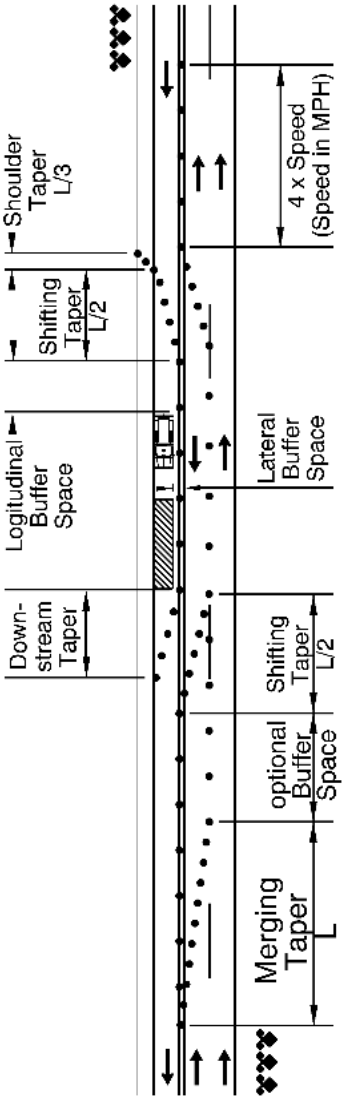


Table 2-1: Taper Length Formulas

POSTED or STATUTORY SPEED	TAPER LENGTH, L (in feet)
40 MPH or Lower	$L = \frac{WS^2}{60}$
45 MPH or Higher	$L = W \times S$

Where: L = Taper length in feet
W = Width of offset in feet
S = Posted Speed in mph

Table 2-2: Taper Types and Lengths

Taper Type	Length (in feet)
Merging Taper (minimum)	L
Shifting Taper (minimum)	(1/2)L or L/2
Shoulder Taper (minimum)	(1/3)L or L/3
One-Lane, Two-Way Taper	50 – 100 feet
Downstream Taper	50 – 100 feet

Table 2-3: Taper Lengths and Device Quantities

Lane Width	10 Feet				11 Feet				12 Feet				Shoulder Tapers	
	MERGING		SHIFTING		MERGING		SHIFTING		MERGING		SHIFTING		SHOULDER	
MPH	L	Cones	L/2	Cones	L	Cones	L/2	Cones	L	Cones	L/2	Cones	L/3	Cones
20	70	5	35	3	75	5	40	3	80	5	40	3	25	3
25	105	6	55	3	115	6	60	4	125	6	65	4	35	3
30	150	6	75	4	165	7	85	4	180	7	90	4	50	3
35	205	7	105	4	225	8	115	5	245	8	125	5	70	4
40	270	8	135	5	295	9	150	5	320	9	160	5	90	4
45	450	11	225	6	495	12	250	7	540	13	270	7	150	6
50	500	11	250	6	550	12	275	7	600	13	300	7	170	6
55	550	11	275	6	605	12	305	7	660	13	330	7	185	6
60	600	11	300	6	660	12	330	7	720	13	360	7	200	6
65	650	11	325	6	715	12	370	7	780	13	390	7	220	7
70	700	11	350	6	770	12	385	7	840	13	420	7	235	7

Taper length “L” are calculated using Table 2-1.
Shoulder taper length “L/3” are based on 10 foot shoulder widths.

2.3 Device Spacing

Taper Spacing: The distance between cones in the taper *should* equal the posted speed in feet. For example, 55 mph = 55 feet.

Offset: At speeds of 45 mph and above, cones in merging tapers *should* be offset one foot. At speeds of 40 mph and below, the offset will vary with the lane width.

One-Lane, Two-Way and Downstream Tapers: Cones in one-lane, two-way and downstream tapers *should* be spaced at 20 foot intervals. The offset (W) is determined by the width of the lane (see Table 2-1). *Four to six cones* are used in one-lane, two-way and downstream tapers.

Buffer & Work Space (Tangent) Cones: The tangent cone spacing along the buffer and work space *should* equal twice the posted speed in feet. For example, 55 mph = 110 feet.

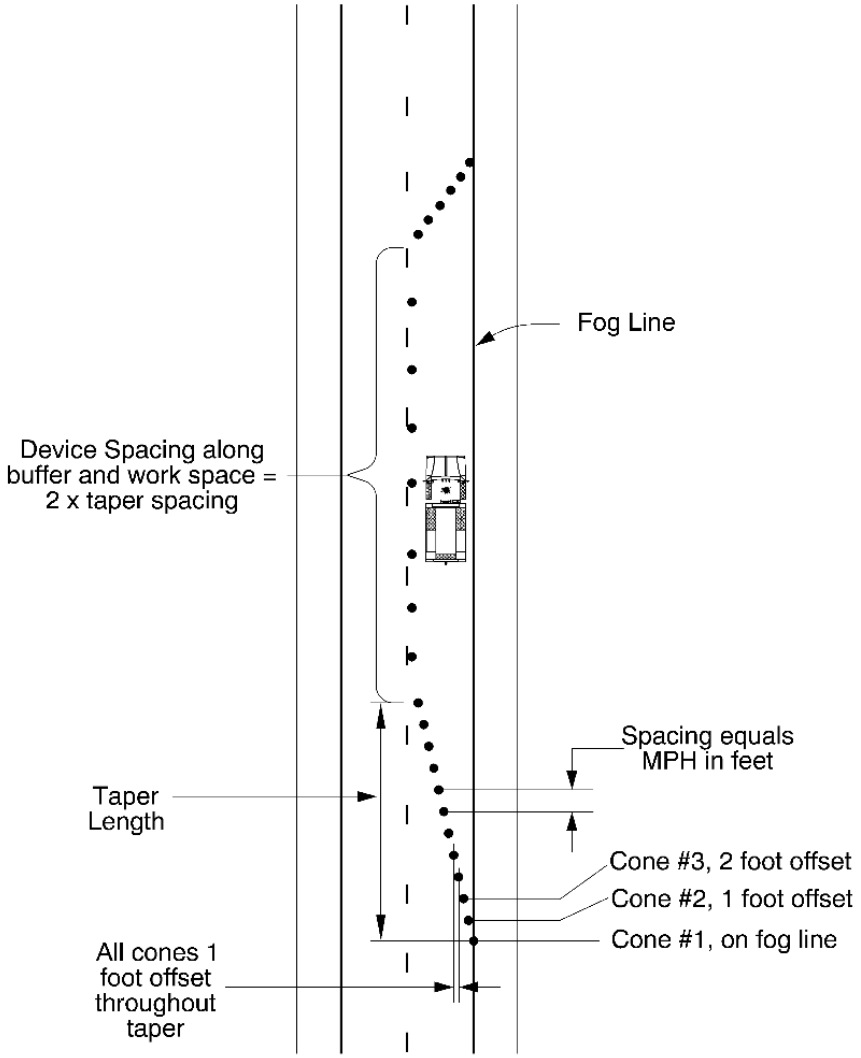
Optional tighter taper and tangent device spacing may be used in areas where traffic may intrude into the work zone:

- *Taper cone spacing* of 20 feet for speeds of 40 mph and below.
- *Taper cone spacing* of 40 feet for speeds of 45 mph and above.
- *Tangent cone spacing* of 40 feet for speeds of 40 mph and below.
- *Tangent cone spacing* of 80 feet for speeds of 45 mph and above.

2.4 Device Placement

1. **Determine the taper length and cone spacing** using the Table 2-3 and Section 2.3, Device Spacing.
2. **Placing the first cone.** Starting at the work space or buffer, measure off the taper length along the edge of travel way or fog line. Place the first cone at the edge of travel way or fog line for merging and shifting tapers, and at the edge of travel way for shoulder work.
3. **Placing the second cone in the taper.** Start back towards the work space, moving along the edge of travel way a distance equal to the posted speed. Then, move over one foot into the roadway and place the second cone (see Figure 2-3).
4. **Placing the third cone.** Again, move towards the work area a distance equal to the posted speed, move over two feet from the edge of travel way and place the third cone.
5. **Placing the remaining cones in the taper.** Continue moving back towards the work area, moving a foot more each time and placing a cone until reaching the end of the taper.
6. **Ensure effective set-up of the work zone** by driving or walking through it and adjust as necessary.

Figure 2-3: Cone Spacing Example



2.5 Signs

All signs mentioned in this section can be found in the *Manual on Uniform Traffic Control Devices* (MUTCD), the Federal Highway Administration (FHWA) *Standard Highway Signs* (SHS) or the Oregon Department of Transportation (ODOT) *Sign Policy and Guidelines*. Use the sign reference numbers to aide in locating signs within the manuals listed.

Choosing Signs: Effective work zone signing tells the road user what to expect, what action to take, what direction to go, or hazard to avoid. Unless otherwise warranted by the activity, avoid exclusively using general warning signs that do not provide any specific information or instruction. For instance, follow a SHOULDER WORK (W21-5) sign with a SHOULDER CLOSED (W21-5a) sign, rather than with a CAUTION sign.

The initial advanced warning sign *should* indicate the type of work or activity the driver can expect. Example initial advanced warning signs include:

- ROAD WORK AHEAD (W20-1)
- BRIDGE WORK AHEAD (CW21-10)
- UTILITY WORK (W21-7)
- SURVEY CREW (W21-6)
- SIGNAL WORK AHEAD (CW21-11)
- SHOULDER WORK (W21-5)
- WORKERS (W21-1)
- DETOUR AHEAD (W20-2)
- WRECK AHEAD (CW15-10)

A distance (e.g. 1/2 MILE, 1000 FT) may be substituted for AHEAD on a warning sign, or added as a rider.

Additional advance or interim signing may be necessary, in some cases, in order to extend advance signing. Signs *should* be appropriate to what the motorist might encounter. Typical signs include, but are not limited to:

- BE PREPARED TO STOP (W3-4)
- Reverse Curve (W1-4)
- Bicycle ON ROADWAY (CW11-1)
- RIGHT LANE CLOSED AHEAD (W20-5)
- Flagger (W20-7)
- LOOSE GRAVEL (W8-7)

Where a symbol sign is available in place of a text sign, the use of a symbol sign is encouraged.

In situations where roadway conditions make it necessary to provide road users with additional regulatory, warning or guidance information, the MUTCD, Section 2A.04, allows state and local highway agencies to develop special word message signs.

Work zone signs **shall**:

- Be clean, fully legible and in good condition.
- Be mounted so that the bottom of the sign is not less than one foot above the traveled way (See MUTCD Figure 6F-2).
- Not be placed in locations that obstructs the travel path of pedestrians or bicyclists, including TPAR's.
- When used on the shadow and work vehicle, they **shall** be facing the rear so that the entire sign face is visible at all times.
- Be appropriate to the conditions drivers will encounter downstream.
- Be turned, covered, or removed when inappropriate, when the work zone is not active, or when a flagger is not present.
    - ✷ ***IF "FLAGGER" SIGNS ARE IN PLACE, A FLAGGER MUST BE ACTIVE*** and at their station, even if only being used to warn drivers of approaching work zone activity.

Sign Enhancements: The following signing enhancements may be used:

- Signs that are larger than the minimum standard may be used any time. Larger signs can be more effective when the visual landscape is crowded or traffic volumes are high.
- Brighter sheeting.
- A flashing warning light may be added to advance signing, if crashworthy, in accordance with MUTCD Section 2A.12.
- Fluorescent sign borders or other sign enhancements from Section 2A.11 in the MUTCD.

Sign Placement: Sign spacing and placement in this Handbook are for open, unobstructed road conditions. Placement *should* adequately control traffic and protect the work space. The layout may be modified as necessary to provide visibility, allow safe passage of pedestrians and cyclists and avoid interference with physical features such as curves, hills, intersections, driveways or other traffic control devices.

- Sign spacing may be adjusted to fit field conditions, allow for proper visibility, and to avoid conflicts with existing signing.
- Signs placed on non-freeways may be installed using spacing dimensions up to 2 times those shown on the Sign Spacing & Buffer Lengths Table (Table 2-4).
- Small adjustments to freeway sign spacing may be made to fit field conditions, but spacing *should* not exceed 1.5 times the dimensions shown on Table 2-4.
- When the same message (sign or PCMS) is placed on both sides of a highway, longitudinally offset the signs on the highway by 30 feet.

Consider the following when determining sign layout:

1. Place the initial work advance signs, such as ROAD WORK AHEAD (W20-1), before entering a horizontal curve or before the crest of a hill if needed to provide adequate sight distance.
2. Space the remaining signs leading up to the work space close enough together to maintain road user awareness and still maintain the sign spacing for the posted speed.
3. If sign spacing needs to be adjusted, keep all the sign spacing distances similar to maintain driver expectancy.
4. If a driveway comes in between the last work zone sign and the work, but the work zone is not apparent from the driveway approach, use a sign or cones at the driveway to alert users.
5. Alter the sign placement, when necessary, to provide a level area. If no level placement is available, make sure the sign is stable and the message is fully visible to approaching drivers.

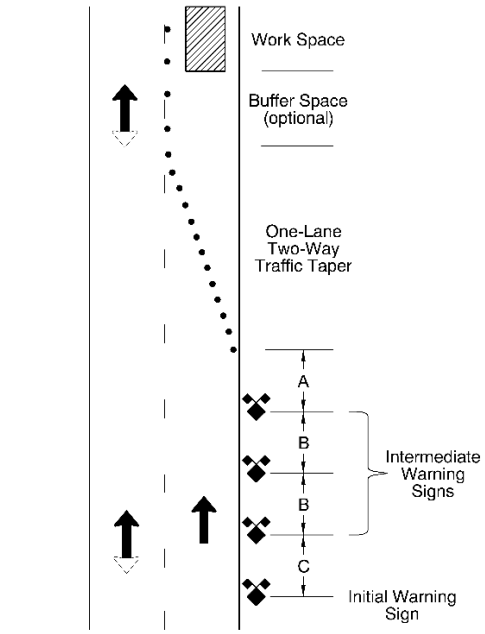
Table 2-4: Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365
Freeways:				
55	1000	1500	2640	250
60				285
65				325
70				365

- All spacing shown in feet.
- Posted Speed: Equivalent to the existing, posted or statutory speed.
- Spacing “A” may be used as suggested trailing distance for shadow vehicles.
- Adjust spacing as field conditions require.
- Non-freeway sign spacing **shall** not exceed 2 times the dimensions shown.
- Small adjustments to freeway sign spacing may be made to fit field conditions, but spacing ***should*** not exceed 1.5 times the dimensions shown.

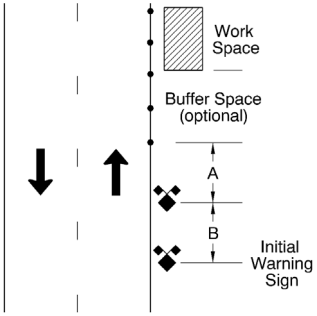
Sign Spacing Examples: The following examples (Figure 2-4 and 2-5) may be used to aid in the proper placement of temporary signing when sign sequences have fewer or more than three signs.

Figure 2-4: Four or More Sign Sequence



NOTE:
For each additional sign added within the sequence, use Spacing "A".

Figure 2-5: Two Sign Sequence



CHAPTER 3 – FLAGGING AND OTHER TRAFFIC CONTROL MEASURES

3.1 Flagging and Other Traffic Control Measures

A variety of Traffic Control Measures (TCM) may be used to control traffic through one-lane, two-way work zones. Flagging, pilot cars, portable signals and Automated Flagger Assistance Devices (AFAD) are effective TCM.

Flagging operations are typically used when one direction of a roadway is closed and traffic must alternately share the remaining lane. Flagging operations must accommodate all road users, including pedestrians and bicyclists. When only using flagging, the distance between the Flagger (W20-7) signs ***should*** not exceed one mile. When the distance between Flagger (W20-7) signs exceeds one mile, a pilot car ***should*** be used.

Pilot cars are used to escort traffic through longer work zones, often where flaggers cannot see from one flagger station to the next. A pilot car operation uses a flagger at each end of the one-lane, two-way section.

Portable traffic signals may be used to control traffic through one-lane, two-way sections when it is more practical than using flaggers. Portable traffic signals must be approved by the Oregon Department of Transportation (ODOT) State Traffic Engineer (STE) for state highways, or the appropriate official for the local road authority.

AFADs may be used in lieu of flaggers to control one-lane, two-way traffic under certain circumstances. See Section 3.11 – Automated Flagger Assistance Device (AFAD) Operations for additional AFAD details.

Additionally, special care must be taken whenever a work zone may cause traffic to backup up to and/or across a rail crossing.

3.2 Flagging Qualifications

Flaggers who have completed formal training and have certification in Oregon, Washington, Idaho, or Montana, may practice as a certified flagger in Oregon. Flaggers ***should*** have a flagger card present when flagging, or be able to readily produce flagger certification when requested. Flaggers ***should*** be able to satisfactorily demonstrate the following abilities, as outlined in the *Manual on Uniform Traffic Control Devices* (MUTCD), Chapter 6D:

1. Ability to receive and communicate specific instructions clearly, firmly, and courteously.
2. Ability to move and maneuver quickly in order to avoid danger from errant vehicles.

3. Ability to control signaling devices (such as STOP/SLOW paddles) in order to provide clear and positive guidance to drivers approaching a work zone in frequently changing situations.
4. Ability to understand and apply safe traffic control practices, sometimes in stressful or emergency situations.
5. Ability to recognize dangerous traffic situations and warn workers in sufficient time to avoid injury.
6. Flaggers **shall** be 18 years of age or older.

3.3 Flagger Training Requirements

Flagger training requires a course of instruction covering the following topics, as a minimum:

Example Flagger Training Course Outline:

- Fundamental Principles from Part 6 of the MUTCD
- The four parts of work zones
- Main traffic control devices (TCD)
    - Signs
    - Cones
    - Barricades
    - Arrow boards
    - Portable changeable message signs (PCMS)
- Proper use and placement of devices
- Flagging principles
    - Qualifications
    - Clothing
    - Tools
    - Positions
    - Use of hand-signaling devices
    - Pilot car operations

Training **shall** be repeated every three years. Certified training courses and sources for this training will depend on the individual road jurisdiction. Contact the appropriate road jurisdiction for information on their flagger training courses and specific requirements.

3.4 Flagging Principles

1. Flagging **shall** be used only when other traffic control methods are inadequate to safely guide traffic through a work space or assure the safety of workers.

2. **FLAGGING OPERATIONS SHALL NOT CONFLICT WITH NORMAL INTERSECTION TRAFFIC CONTROL.** Traffic cannot be flagged to proceed through an intersection when facing a red traffic signal light or STOP sign, nor flagged to stop when the traffic signal is green, unless it is an emergency. The normal intersection traffic control *should* be turned off or covered when flagging through an intersection.

   Contact the appropriate road jurisdiction for permission to turn off a traffic signal. Coordinate with city, county or state electrical crew personnel or local police. For work under ODOT permit, this *should* be included in the permit.

   Flagging **shall** continue until the signal is back in operation or until alternative traffic control, approved by the road jurisdiction, is in place.

   Cover conflicting existing regulatory signs (e.g. STOP (R1-1), YIELD (R1-2) or Right Turn ONLY (OR3-5R), etc.).

   Only uniformed police officers may control traffic by flagging in conflict with traffic control devices under Oregon law (ORS 811.265).

3. Under normal conditions, vehicles *should* not be delayed longer than 20 minutes at the flagger station. In emergency situations or for clearing the road in operations such as blasting, longer delays may be allowed with advance signing. Every effort *should* be made through media communications to alert the public of long delays.

4. Flaggers *should* describe the last vehicle in the queue to the flagger at the other end of the work zone.

5. Flaggers *should* accommodate pedestrians through work zones by stopping vehicles and directing or guiding pedestrians through the work zone.

6. For some activities, a flagger may be used to slow traffic. Roadways with high average daily traffic (ADT) volumes and high speeds (e.g. freeways) may not benefit from the placement of a flagger slowing traffic due to potentially significant speed differentials and driver interpretation of the “SLOW” message, or to the sudden presence of a flagger where one is not normally expected.

7. To slow traffic on high-speed, high ADT facilities, consider using PCMS messages, tighter channelization device spacing, additional static signing, or other mechanical measures. Use of a truck-

mounted attenuator (TMA) may provide additional protection for workers.

Example PCMS Messages:

WORKERS IN ROAD 1 MILE	WORKERS IN ROADWAY	SLOWED TRAFFIC 1 MILE	WORKERS IN LANE SLOW	TRAFFIC SLOWED AHEAD

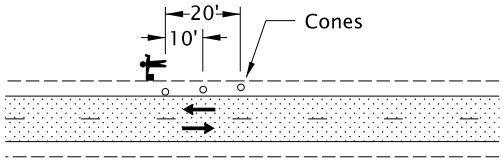
3.5 Flagger Station Practices

Under normal operating conditions:

1. Flagger stations **shall** be located such that approaching road users will have sufficient sight distance to be able to stop at the intended stopping point.
2. Flagger stations *should* be kept clear of all equipment and vehicles. Flaggers **shall** not leave an active flagger station unattended.
3. Flaggers *should* identify an unobstructed escape route to avoid errant vehicles.
4. Flagger stations *should* include, as feasible, one to three cones on the shoulder at an angle in front of the flagger station to enhance the visibility of the flagger station (Figure 3-1).
5. Flaggers *should* be as visible as practical while reducing their exposure to traffic by standing within closed lanes or on the shoulder.
6. After stopping the first few vehicles, flaggers may move from the shoulder to near centerline to be more visible to approaching traffic.
7. Flaggers *should* stand alone, never permitting a group of workers to congregate around the flagger station.

Figure 3-1: Flagger Station Delineation

- As feasible, include 3 cones in shoulder taper on 10 feet spacing for flagger station delineation.



3.6 Flagging Signs & Equipment

A Flagger sign (symbol or text) **shall** always precede flaggers. The Flagger symbol sign (W20-7) is preferred over the Flagger text sign.

The ONE LANE ROAD AHEAD (W20-4) sign, as shown in the MUTCD Typical Applications for flagging, is optional and should be considered on high-volume or high-speed roads, or when extended queues may be expected.

The Flagger sign (symbol or text) and the BE PREPARED TO STOP (W3-4) sign **shall** be removed, covered or turned away from traffic when flagging is not being done. Flags on portable signs **shall** also be removed or turned down.

1. Flaggers **shall** use a minimum 18 x 18-inch octagon-shaped retroreflective STOP/SLOW paddle. The paddle **shall** be made of a rigid material and the full face of the STOP and the SLOW sides **shall** be visible and legible at all times when the paddle is in use.

   A 24 x 24-inch paddle is recommended on high-speed roadways or in other situations where increased visibility is needed. Roll-up STOP/SLOW paddles are only for emergency use.

2. Do not use a flag to control traffic, unless in an emergency.

3. Flaggers **shall** use only those hand signals approved as shown in the MUTCD, Figure 6D-1.

4. Extended traffic queues can form when a line of vehicles stopped at a work zone extend beyond the initial ROAD WORK AHEAD (W20-1) sign. Additional advance signing ***should*** be used when queues repeatedly extend past the initial advance warning sign or when restrictive features in the work zone limit visibility of vehicles from being able to stop for queues (See Diagram 5-7). An advance flagger ***should*** be used to assist in warning approaching traffic before they reach the end of the stopped traffic queue.

   a. If queue lengths change frequently and significantly, particularly on roadways posted at 45 mph or higher, consider installing a PCMS approximately ½ mile in advance of the initial ROAD WORK AHEAD (W20-1) sign. Example PCMS messages:

PREPARE	TRAFFIC
TO STOP	STOPPED
1/2 MILE	AHEAD

   b. Advance flaggers use 18 x 18-inch minimum octagonal paddle with the SLOW message facing traffic. The STOP

side of the paddle **shall** be covered. As an option, advance flaggers may use a SLOW/SLOW paddle for this activity.

5. If using a staff or extended handle for the STOP/SLOW paddle, the bottom of the sign *should* be above the flagger's eye level. Equipment or other objects attached to the staff **shall** be secured and not allowed to hang freely or loosely. Do not tie clothing to the staff.
6. Flagger apparel:
    a. While on duty, flaggers **shall** be fully clothed. Do not wear abbreviated clothing such as swimsuits, shorts, tank tops or halter tops.
    b. Flaggers **shall** wear safety apparel meeting ANSI 107-2015 Class II risk exposure. Flaggers *should* use Class III high-visibility safety apparel during night operations.

Figure 3-2: Use of Hand-Signaling Devices by Flaggers

Flagging Procedures as described in the MUTCD, Section 6D.05 and shown in MUTCD Figure 6D-1:

- 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.

TO STOP TRAFFIC

- 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.

  Flags **shall** not be used to signal road users to proceed.

TO LET TRAFFIC PROCEED

- 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.

  To further alert or slow traffic, the flagger may motion up and down with the free hand, palm down.

TO ALERT AND SLOW TRAFFIC

3.7 Flagging Through Intersections

Flagging through intersections is especially hazardous for both road users and workers. Other traffic control measures (e.g. full closures with detours) that minimize impacts to the normal operation of the intersection *should* be considered to accommodate the work.

Concepts applicable to all intersections:

1. Contact the road jurisdiction traffic office ahead of time for help in determining what closures or detours can be set up. All closures **shall** be approved by the road jurisdiction.
2. Avoid flagging, if possible, during peak traffic times, especially on major commuter routes.
3. There *should* be one flagger for each approach (See Diagram 620). One flagger may be used to control the entire intersection if the intersection has an approach ADT of 400 vehicles per day (vpd) or less.
4. With multiple flaggers, designate one as the lead flagger. Effective means of communication, such as radio devices, *should* be used.
5. Approach lanes *should* be reduced to a single through lane. Consider closing lanes that are not a major movement, such as right-turn lanes with only occasional use. Consider prohibiting left turns if there is work or obstructions within the intersection.
6. Dedicated lanes may be provided for major turning movements with appropriate regulatory signing such as Right Turn ONLY (OR3-5R) or RIGHT LANE MUST TURN RIGHT (R3-7R) signs. Non-conflicting turning movements may be combined with other movements.
7. Flagging operation **shall** not conflict with other traffic control devices. Turn or cover existing traffic control devices when they conflict with the flagging operations (signal indications, STOP (R1-1), YIELD (R1-2), or Right Turn ONLY (OR3-5R) signs)

3.8 Night Flagging

When flaggers and/or pilot cars are necessary during night operations, flagger stations **shall** be illuminated, and **shall** be illuminated separately from the work space. Flaggers **shall** wear safety apparel meeting ANSI 107-2015 Class II risk exposure. Flaggers *should* use ANSI Class III high-visibility safety apparel during night operations. Consider using additional high-visibility safety apparel and/or lighted safety apparel for increased visibility.

Nighttime flagger illumination strategies *should* include the following:

1. Locate lighting on the same side of the roadway as the flagger.
2. Flagger station lighting *should* meet the following criteria:

a. Locate lighting on the shoulder approximately 5-10 feet from the edge of the traveled way at a 15 degree angle away from the travel lane in advance of the flagger, without impacting the flagger's escape route.

b. Illuminate the flagger station with lighting 15-21 feet above the roadway.

c. Light output of less than 2,500 watts.

d. Provides a lighted area of at least 40 feet diameter at ground level.

e. Illuminate the roadway surface throughout the designated flagging area, with at least 5 foot-candles.

f. Illuminate the flagger so that the flagger is visible, and is discernable as a flagger, from a distance of 1,000 feet.

g. Spot lights ***should*** not be used.

3. For low-volume roads and emergencies, where there is no room for the light equipment on the shoulder, the flagger illumination may be stationed on the roadway. Consider using the following to increase visibility during night flagging:

    a. Light Emitting Diode (LED) lights on the STOP/SLOW paddle, as allowed by the MUTCD. LED STOP/SLOW paddles are available on the ODOT QPL.

    b. Using a 24 x 24-inch STOP/SLOW paddle.

    c. Adding 2-inch-wide diagonal bands of alternating white and red retroreflective sheeting on the staff of the STOP/SLOW paddle.

    d. Lighted safety apparel.

3.9 Flagging on Bridges and Other Structures

Avoid locating flagger stations on a bridge, viaduct or other roadway section where there is no feasible escape route. When possible, move flagger stations to the ends of bridges to provide an escape route.

On very long bridges with high traffic volumes where flagger stations cannot be moved to the ends, include a "Buffer" space between the flagger and the work space (see Table 2-4).

3.10 Pilot Car Operation

Pilot cars may be used to guide traffic through long sections of one-lane, two-way work spaces. Consider using pilot cars if a clear line of sight cannot be made between flagger stations, or to control speeds through the work

area. In a flagging operation, when the distance between Flagger (W20-7) signs exceeds one mile, a pilot car *should* be used.

Cones or tubular markers may be used to separate the work spaces from the open travel lane.

Pilot Car Operational Requirements:

1. Operation of the pilot car **shall** be coordinated with flagging operations.
2. The PILOT CAR FOLLOW ME (G20-4) sign **shall** be mounted in a conspicuous location on top or on the rear of the vehicle. A vehicle-mounted PCMS may be used for the pilot car sign.
3. The pilot car guides traffic through the work zone by driving in front of the traffic queue, maintaining a safe speed.
4. Radios or other communications *should* be available between the pilot car driver, the flaggers and the work superintendent or designated worker at all times.
5. No vehicles *should* be allowed to pass the pilot car.
6. Flaggers *should* describe the last vehicle in the queue to the flagger at the other end of the work space. In the event that radio communications between the flagger stations cannot be maintained, a pilot car *should* be used.
7. The pilot car *should* display the name of the road jurisdiction or the contractor prominently on the vehicle.
8. Instead of flaggers, the WAIT FOR PILOT CAR (CR4-20) sign may be posted on side roads or accesses intersecting state highways when pilot cars are being used to control traffic on the mainline through the work zone, provided:
    a. Accesses or side road traffic is being stopped for no more than 20 minutes (per Section 00220 of the *Oregon Standard Specifications for Construction*, and Chapter 3 of the *Oregon Temporary Traffic Control Handbook*.
    b. Access or side road is a dead-end facility or has no immediate alternate access, has an ADT of 100 vpd or less, and does not access public service facilities (e.g. parks, rest stops, waysides, ranger stations, landfills, utility hubs, treatment plants, etc.).

    For private residential driveways, see sign CR4-20a.

    Intersection or accesses using the WAIT FOR PILOT CAR sign *should* be checked regularly to ensure safe and effective traffic operations.

    For a facility with an ADT greater than 100 vpd, but not exceeding 400 vpd, the sign may be used only if closed monitored and frequently checked for traffic compliance, operation and safety. If operation issues are observed at these or any other location using the WAIT FOR PILOT CAR sign, the sign *should* be replaced by flagging or other traffic control measures as quickly as practical.

3.11 Automated Flagger Assistance Device (AFAD) Operations

AFADs may be used to control traffic through a one-lane, two-way work zone or in place of a flagger. AFADs are preferred over flaggers, as this enables the flagger(s) who are operating the AFAD to be positioned out of the lane of traffic. The AFAD operator **shall** control the AFAD from a designated area. The designated *should* maintain an unobstructed line of sight to the AFAD and *should* be at least 50 feet away from the AFAD. The designed area *should* have an escape route available to the operator. These devices are designed to be remotely operated either by a single flagger at one end of the work zone or at a central location, or by separate flaggers near each device's location.

AFADs **shall** ONLY be used in situations where there is a single lane of approaching traffic in the direction to be controlled. If an AFAD is to be used on a multi-lane facility, you must merge all lanes of the approaching control direction of traffic into a singular lane in advance of the work zone.

There are two types of AFADs: a Red/Yellow Lens AFAD and STOP/SLOW AFAD. The Yellow/Red Lens AFAD is approved for use in Oregon. The STOP/SLOW AFAD is not approved for use in Oregon.

AFAD use is appropriate for one-lane, two-way work zones. Line of sight between AFAD units *should* be maintained. When line of sight cannot be maintained, a pilot car *should* be used.

When used at night, the AFAD location **shall** be illuminated, similar to flagger stations, such that approaching traffic has sufficient distance to stop in advance of the gate arm.

AFADs **shall** be set up according to Figure 3-3.

AFADs **shall** be operated only by a flagger who has been trained on the operation of the AFAD. The flagger(s) operating the AFAD(s) **shall** not leave the AFAD(s) unattended at any time while the AFAD(s) are actively controlling traffic.

AFADs **shall** conform to one of the following methods:

1. An AFAD at each end of the work zone (Method 1), or
2. An AFAD at one end of the work zone and a flagger at the opposite end (Method 2).

A single flagger may simultaneously operate two AFADs (Method 1) *only* if *all* of the following conditions are present:

1. The flagger has an unobstructed view of both AFAD(s);
2. The flagger has an unobstructed view of approaching traffic in both directions; and,
3. AFADs are less than 800 ft apart.

The following signs *should* be used with an AFAD:

- ROAD WORK AHEAD (W20-1)
- BE PREPARED TO STOP (W3-4)
- SIGNAL AHEAD (W3-3a or W3-3)
- STOP HERE ON RED (R10-6 or R10-6a)

When the AFAD is not in use, the signs associated with the AFAD **shall** be removed or covered.

An AFAD **shall** alternate between a steadily illuminated CIRCULAR RED lens and a flashing CIRCULAR YELLOW lens to control traffic. If post-mounted, the bottom of the lens housing (including brackets) **shall** be at least 7 feet above the pavement. If located over any portion of the highway that can be used by motor vehicles, the bottom of the lens housing (including brackets) **shall** be at least 15 feet above the pavement.

An AFAD **shall** include a gate arm that descends to a down, horizontal position across the approach lane of traffic when the steady CIRCULAR RED lens is illuminated. Then, when the flashing CIRCULAR YELLOW lens is illuminated, the gate arm **shall** ascend into an upright position.

The gate arm **shall** be fully retroreflectorized on both sides, and **shall** have vertical alternating red and white stripes at 16-inch intervals measured. When the arm is in the down position blocking the approach lane:

1. The minimum vertical aspect of the arm and sheeting **shall** be 2 inches; and,
2. The end of the arm **shall** reach at least to the center of the lane being controlled.

To inform road users to stop, the AFAD **shall** display a steadily illuminated CIRCULAR RED lens and the gate arm **shall** be in the down position. To inform road users to proceed, the AFAD **shall** display a flashing CIRCULAR YELLOW lens and the gate arm **shall** be in the upright position.

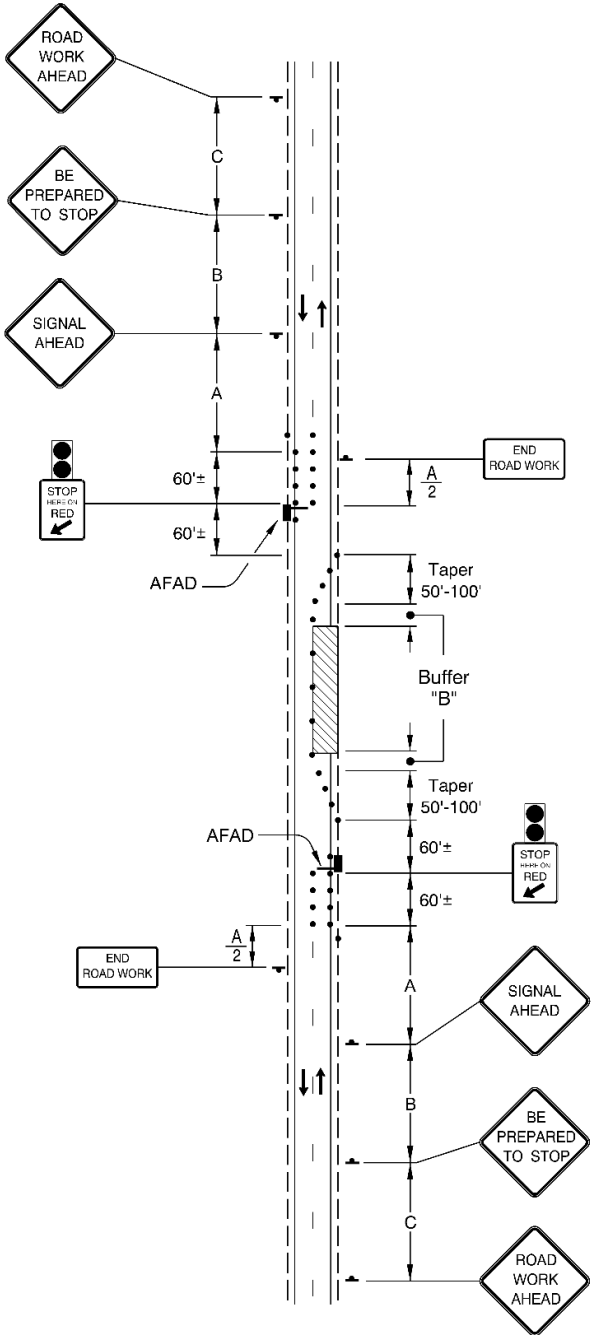
AFADs **shall** incorporate mechanical safeguards to prevent the flagger(s) from actuating a simultaneous display of a flashing CIRCULAR YELLOW lens at each end of the work zone. Additionally, the flagger **shall** not actuate the AFAD's display of the flashing CIRCULAR YELLOW lens until all oncoming vehicles have cleared the one-lane portion of the work zone.

The transition between the flashing CIRCULAR YELLOW and the steady CIRCULAR RED *should* be at least 5 seconds. During the change interval, the CIRCULAR YELLOW lens **shall** be steadily illuminated. The gate arm **shall** remain in the upright position during the display of the steadily illuminated CIRCULAR YELLOW change interval.

Figure 3-3, below, shows the use of two RED/YELLOW LENS AFAD units to control one-lane, two-way traffic.

Figure 3-3: Red/Yellow Lens Automated Flagger Assistance Device (AFAD)

Two-Lane, Two-Way Roadway Configuration



CHAPTER 4 – EQUIPMENT SPECIFICATIONS

All temporary traffic control devices (TCD) and worker safety apparel **shall** be kept in "acceptable" condition, according to the current American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Temporary Traffic Control Devices and Features*.

All TCD, including sign and sign support combinations, **shall** be crashworthy per the American Association of State Highway and Transportation Officials (AASHTO) *Manual for Assessing Safety Hardware* (MASH) requirements. Existing devices that comply with the Transportation Research Board (TRB) *National Cooperative Highway Research Program* (NCHRP) 350 requirements may be used through their useful lives, at which point they *should* be replaced with devices that comply with MASH requirements.

All traffic control devices used on state highways **shall** be listed on the Oregon Department of Transportation (ODOT) *Qualified Products List* (QPL).

4.1 Signs

Unless otherwise noted, all warning signs used for temporary traffic control **shall** have standard black legends and borders on an orange background, except signs for emergency response, which may be black legends and borders on fluorescent pink. A fluorescent yellow border may be added to truck-mounted signs to enhance their visibility.

Temporary signs may have the same shapes and colors as the corresponding permanent signs.

All warning and regulatory signs used for temporary traffic control **shall** be retroreflective.

Flexible ("roll up") signs may be installed on portable sign supports or delineator posts. Rigid signs (sign sheeting installed on a rigid substrate – e.g. plywood, sheet aluminum) may be used on barricades or other supports when crashworthy or when mounted on a vehicle.

Existing rigid signs may only be used in emergency situations and may be used through their life cycle. When these signs are replaced, the replacement signs **shall** meet current standards. Temporary rigid signs **shall** be mounted in a crashworthy manner, as shown in ODOT *Standard Drawing TM821* and *TM822*.

Standard sign sizes for the diamond shape warning signs can be found in Table 4-1.

Table 4-1: Diamond Warning Sign Sizes

Roadway Type	Diamond Warning Sign Size
Non-Freeways	36 x 36-inch
Freeways	48 x 48-inch
Non-State Highways with ADT less than 400	30 x 30-inch (minimum)

- For standard and minimum sizes of other sign shapes (e.g. rectangular), see Chapter 6, Table 6G-1 of the MUTCD, the FHWA *Standard Highway Signs* (SHS), and Chapter 6 of the ODOT *Sign Policy and Guidelines*.
- Contact local road jurisdiction for permission before using 30 x 30-inch signs.

Signs on portable supports may have two 16 x 16-inch minimum fluorescent orange or orange-red flags mounted at the top of the sign. When used, flags **shall** be mounted so that the entire sign legend is visible.

All signs **shall** be crashworthy, as a combination with the sign support and/or any warning light attached and meet the federal crash worthiness requirements. This can be researched on the Federal Highway Administration (FHWA) website or through the ODOT QPL.

Sign Supports: Signs may be mounted on portable sign supports. For frequently moving work, signs may be placed on a vehicle. Place ballast on portable sign supports or barricades only on the bottom feet or frame. Sign supports or barricades **shall** only be ballasted with maximum 25 pound sandbags.

4.2 Barricades, Cones, Drums, Tubular Markers and Pedestrian Channelizing Devices (PCD)

Barricades: Barricades are classed as Type I, Type II, or Type III. They have from one to three rails with alternating orange and white stripes sloping downward at an angle of 45 degrees in the direction road users are to pass. The minimum length for Type I and Type II barricades **shall** be 24 inches and the minimum length for Type III barricades **shall** be 48 inches. The sides of barricades facing traffic **shall** have retroreflective rail faces.

Barricades **shall** be crashworthy. Ballast may be placed on the lower parts of the frame or stays. Do not place ballast on top of any striped rail. Do not use non-deformable objects such as rocks or chunks of concrete as ballast.

Signs and flashers may be installed on barricades. The combination of sign, and/or flasher, and barricade **shall** be crashworthy.

Cones: Standard cone height is 28 inches. Cones used only during daylight and on low-speed roads may have a minimum height of 18 inches. Twenty-

eight-inch (28-inch) cones **shall** be used on roads with speeds of 45 mph or greater, or at night. All cones **shall** have a weighted base and be capable of remaining upright and in place during normal traffic flow and wind conditions common to the area.

Cones used at night **shall** be retroreflectorized. Twenty-eight-inch (28-inch) cones **shall** have a minimum 6-inch wide retroreflectorized band 3 to 4 inches below the top and a 4-inch wide band a minimum of 2 inches below the 6-inch band. Cones may be equipped with lighting devices for maximum visibility. The combination of cone and light **shall** be crashworthy.

Plastic Drums (Barrels): Drums used for traffic control **shall** be constructed of lightweight, flexible, and deformable materials, be a minimum of 36 inches in height, and have at least an 18-inch minimum width, regardless of orientation. The markings on drums **shall** be horizontal, full circumference, alternating orange and white retroreflective stripes 4 to 6 inches wide. Each drum **shall** have a minimum of two orange and two white stripes. Any non-retroreflective spaces between horizontal orange and white stripes **shall** not exceed 2 inches wide. Drums **shall** have closed tops that will not allow collection of construction debris or other debris. Drums *should* not be used to mark pedestrian paths. Metal drums **shall** not be used.

Tubular Markers: Tubular markers are cylindrical in shape with a weighted base. The tube **shall** be a minimum of 2 inches wide facing traffic. Standard tubular marker height is 28 inches. Tubular markers used only during daylight and on low-speed roads may have a minimum height of 18 inches. Speeds of 45 mph or greater or night work require 28-inch tubular markers.

Tubular markers used at night **shall** be retroreflectorized. Twenty-eight-inch (28-inch) tubular markers **shall** have two 3-inch wide bands no more than 2 inches below the top with no more than 6 inches between bands.

Non-cylindrical tubular markers may be used only if they are secured in a way which ensures that the width facing traffic meets the minimum requirements.

Pedestrian Channelizing Devices (PCD): PCD indicate a suitable path of pedestrian travel around or through the work zone. PCD **shall** be crashworthy. PCD **shall** be detectable to all pedestrians, including pedestrians with disabilities. When used to close a sidewalk, PCD **shall** cover the entire width of the sidewalk. PCD include retroreflective sheeting.

The top surface of the PCD **shall** be no lower than 32 inches above the ground. The bottom surface **shall** be no higher than 2 inches above the walkway. The PCD **shall** be smooth and continuous with guiding top rail for hand trailing and bottom rail for continuous detection. Refer to the MUTCD, Section 6K.02, for additional requirements.

4.3 Lights and Lighted Signs

Warning Lights (Flashers & Steady-Burn): Flashing warning lights are vehicle-mounted, high-intensity, rotating, flashing, oscillating or strobe warning lights with 360-degree visibility.

Flashing warning lights are optional under the following scenarios:

- When construction vehicles are located behind a rigid barrier system.
- When construction vehicles are behind retroreflective channelization devices (cones, tubes, or drums).
- When construction vehicles are more than 15 feet from the travel lane.

Flashing warning lights may be added to temporary signs or barricades as a means to increase device visibility in poorly lit areas, during inclement weather, or at night. The combination of sign and light or barricade and light must be crashworthy. Obtain proof of crashworthiness from vendors or manufacturers of the devices being used.

Flashing warning lights **shall** not be used for delineation. Warning lights may be used to supplement other TCD in accordance with the MUTCD. Warning lights may be used to warn traffic when setting up or taking down TCD, use the warning lights in a shoulder closure taper configuration in advance of the setup or take down of work zones. When used with channelizing devices, the warning lights *should* be steady-burn, any sequential flashing **shall** only occur in a merging taper. Do not mount warning lights to TCD, unless crashworthy. Warning lights *should* not be mounted to channelization devices, but may be placed under devices to draw attention to them. Maximum spacing for warning lights *should* match device spacing requirements. All lights, when crashworthy and mounted to a TCD, **shall** be mounted a minimum of 30 inches from the ground to the bottom of the lens.

Type A, B, C and D flashing warning lights **shall** be portable, enclosed, self-powered, lens-directed, amber-colored lights. All types **shall** be in accordance with the current Institute of Transportation Engineers (ITE) *Purchase Specification for Flashing and Steady-Burn Warning Lights*. All lights **shall** be visible on a clear night from 3,000 feet.

Type A: Low-intensity flashing warning light used during night hours.

Type B: High-intensity flashing warning light. **Shall** be visible on a sunny day from 1,000 feet. Used during day, night hours, or 24-hour use.

Type C: Flat lens, steady-burn warning light. Used at night to delineate edge of traveled way. If used in curved section, place only on outside of curve.

Type D: Steady-burn, 360-degree warning light. Used at night to delineate edge of traveled way. If used in curved section, place only on outside of curve.

Arrow Boards (Sequential Arrows): Sign panels conforming to the requirements of the MUTCD with a matrix of lights capable of either flashing or sequential display of directional mode arrows or chevrons or non-directional (caution) mode. Caution mode may consist of three different patterns, as follows:

- A four-corner display with all four lights flashing simultaneously.
- A mid-position, full horizontal bar flashing steadily or on and off.
- Two, full-height, diamonds flashing simultaneously.

When an arrow board is flashing in caution mode, it **shall** not show any sequential movement. See Chapter 5, Diagram 5-1, for graphical examples of allowable caution modes.

- Arrow boards in directional mode **shall** be used for freeway lane closures.
- Arrow boards in directional mode *should* be used for non-freeway multi-lane roads to advise approaching traffic of a lane closure in situations involving night work, heavy traffic volumes, limited sight distances, speed limits greater than or equal to 45 mph, or at other locations and under other conditions where road users are less likely to expect such lane closures.
- For shoulder closures, use arrow boards only in caution mode. The use of arrow boards in caution mode is recommended for shoulder closures on freeways.
- On two-lane, two-way roads, arrow boards **shall** be used in caution mode only.
- When arrow boards are used to close multiple lanes, a separate arrow board **shall** be used for each closed lane.

For lane closures, the arrow board *should* be located on the shoulder at the beginning of the cone taper. Where the shoulder is too narrow, they may be placed in the lane being closed. For closure of more than one lane, an arrow board *should* be used per each additional closed lane.

Table 4-2: Minimum Arrow Board Sign Sizes

Panel Type		Minimum Size	Minimum Legible Distance	Minimum # Elements
A	Urban, Low-Speed	48 x 24-inch	½ mile	12
B	Standard	60 x 30-inch	¾ mile	13
C	Freeway	96 x 48-inch	1 mile	15

Type B arrow boards may be used for maintenance or mobile operations on freeways.

Arrow boards used for night operations **shall** be capable of 50% dimming from their full rated lamp voltage.

Floodlights: Floodlights *should* be used to illuminate the work space, flagger stations, equipment crossings and other areas such as nearby intersections during nighttime operations. Flagger stations **shall** be illuminated separately from the work space. Ensure that each setup does not aim excessive light into the eyes of oncoming drivers nor produce excessive glare making it difficult to see beyond the main illuminated area. The best way to determine if floodlighting is well placed is to drive through the set up after dark from each approach direction.

Research indicates that 50-lux (5 footcandle) is a desirable nighttime illumination level where workers are active. If everything in the light is clearly visible, the lighting level is satisfactory. Sidewalks or pedestrian detours *should* be included in the lighted perimeter.

Portable Changeable Message Signs (PCMS): Also described as Portable Variable Message Signs (PVMS), PCMS include a message sign panel, control system, power source and mounting and transporting equipment. They **shall** conform to all requirements in the MUTCD and **shall** be listed on the ODOT QPL for use on state highways. PCMS are used mainly as a supplement to and not as a substitute for conventional signs, pavement markings and lighting. Standard messages and abbreviations *should* be used whenever possible. See ODOT's *Variable Message Sign Operation Manual* and *Portable Changeable Message Sign Handbook* for information on standard messages.

PCMS **shall** not be used for STOP or YIELD signs. PCMS may be used in lieu of required warning signs for frequently changing situations. The display of a PCMS *should* be visible from ½ mile away under both day and night conditions. Try to select a location such that the entire message can be read at least twice by approaching drivers.

For mobile work zones, a series of truck-mounted PCMS displaying the advance warning messages and moving with the work is recommended for all roads.

A message may contain up to three lines per panel, although less is best. Display may be one or two panels. The display rate **shall** be set so that the entire message can be read at least twice when approached at the posted speed. It is appropriate to consider the operating speed if it is much higher than the posted speed when setting the display rate.

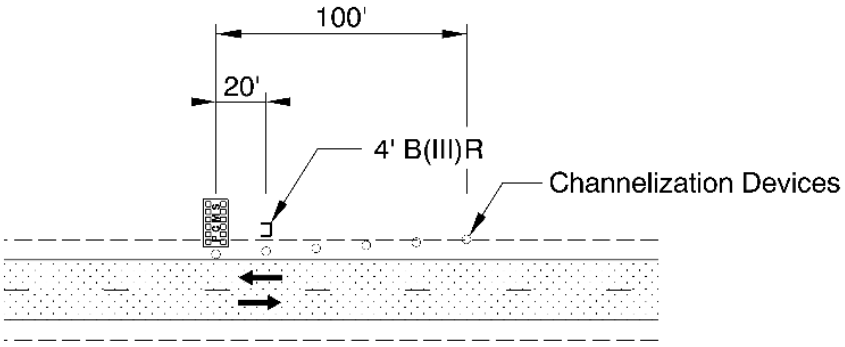
Only two panels **shall** be used; however, if three panels are required for the entire message, a second PCMS unit must be used and set up at the appropriate sign spacing so that drivers have the opportunity to see the entire message twice.

PCMS (trailer or truck-mounted) **shall** be mounted a minimum of seven feet above the road when in operating mode. PCMS *should* be placed on the shoulder of the road or, if practical, further from the travel lane. The installation *should* not block pedestrian facilities. The face of the sign *should* be located and angled to be legible to approaching traffic for the needed distance.

For greater visibility, trailer-mounted PCMS **shall** be delineated by a shoulder taper of six cones or drums. If space allows, drums may be used in place of cones for greater visibility. Maximum spacing is 20 feet.

For work lasting more than eight hours, one or more Type III barricade(s) *should* be placed facing traffic, in front of the equipment and behind the cones or drums, and 20 feet in front of the sign (See Figure 4-1, below).

Figure 4-1: Portable Changeable Message Sign (PCMS) Installation



4.4 Shadow and Protection Vehicles

Shadow Vehicle: Used as a warning and traffic control vehicle in a *mobile* work zone (See Diagram 120). Shadow vehicles provide both the advance warning and lane or shoulder closures for a mobile work zone. See Table 2-4 for suggested trailing distances. Additional vehicles may be used to warn oncoming or opposing traffic.

Protection Vehicle: Used in *stationary* operations to protect the workers and work activity (See Diagram 310). The protection vehicle is placed after the buffer space and sufficiently in advance of the work space to allow for run-out if struck, but not so far in advance that road users can drive between the protection vehicle and the work space. A protection vehicle with a truck-mounted attenuator (TMA) *should* be used when the posted speed is 45 mph or greater and workers are not behind positive protection and are exposed to traffic. For posted speeds less than 45 mph, a protection vehicle *should* be used when workers are not behind positive protection and are exposed to traffic.

Shadow and protection vehicles are strategically placed to protect the workers and work activity and to warn traffic of the operation ahead. A TMA may be used on either vehicle (see Section 4.5 Truck-Mounted Attenuators).

If using shadow or protection vehicles, flashing warning lights *should* be installed on or attached to all vehicles, where practical. Arrow boards in use on shadow or protection vehicles may be used in place of flashing warning lights.

Vehicle-mounted arrow boards may be used to display directional mode arrows, chevrons, or may be used in caution mode (See Section 4.3 Arrow Boards for details). Vehicle hazard lights may be used only as a supplement to the flashing warning lights. Vehicle hazard lights **shall** not be used as a replacement for flashing warning lights.

Signs *should* be mounted in a manner such that they are not obscured by equipment or supplies. Signs *should* be covered or turned and flashing warning lights turned off when traveling to and from the work space and work is not in progress.

4.5 Truck-Mounted Attenuators (TMA)

Truck-mounted attenuators (TMA) are a crash cushion system that lower the severity of a rear-end collision with an errant vehicle. TMA are located to protect the work vehicle(s) and workers ahead of the vehicle with the TMA.

TMA are designed for use on different classes of vehicles and for specific speed ranges. The manufacturer's rating **shall** be considered in choosing equipment for any particular job site. TMA used on freeways *should* be rated for high speeds. Use of a TMA/vehicle combination rated for less than the posted speed where you will be working *should* only be considered when more appropriate equipment is not available.

When traveling to or from the work site, the TMA **shall** be in an upright position. When in use, the attenuator **shall** be deployed in the full down and locked position.

For stationary operations, the TMA-equipped vehicle's parking brake *should* be set, and when possible, the front wheels turned to direct the vehicle away from the work site if hit and into a safe area. Placement of the run-out distance of the TMA *should* be based on manufacturer's recommendations.

For mobile operations, the shadow vehicle with a TMA **shall** be positioned far enough in advance of the workers or work equipment being protected so that there is sufficient distance for run-out from impact, but not so far in advance that errant vehicles can travel around the shadow vehicle and strike the workers or equipment. When there is less TMA available that what is shown on a diagram, conduct a hazard assessment to determine which vehicles will be equipped with the TMA.

CHAPTER 5 – TYPICAL APPLICATIONS

5.1 Temporary Traffic Control

Mobile Operations: Operations where work activities and equipment move continuously along the roadway at speed (averaging 3 mph, but depends on the activity). The advance warning area (See Diagrams 110 and 130 for examples) moves with the work space. Mobile work does not include stopping in the travel lane to perform the work. Example work activities include side cast brooming and striping.

Mobile operations provide for safe traffic control by displaying signs on the work vehicles. This typically requires at least one shadow vehicle (with the exception of some lower-speed roads). See applicable notes on the Diagrams in this chapter. On freeways, at least two shadow vehicles are required.

The mobile work zone can be bordered using static advance signing to alert road users of the presence of the slow-moving work train ahead. Signing can cover a distance that includes the location of the work space for a significant period of time.

Care **shall** be taken that the road user is still alert to the hazard by the time they reach the active work space. This can be achieved with a NEXT XX MILES (W7-3aP) rider on the static advance warning sign and the placement of occasional cones along the shoulder of the road with interim signing.

Stationary Work: Work that can take just a few minutes in one place, or can take an entire day. The activity can be off the traveled portion of the road or occupy one or more travel lanes and directions. Work may proceed without any disruption of normal traffic flow, or may require traffic to stop and alternate direction of flow through the work space. Stationary work activities include:

- Signal work.
- Paving operations or crack sealing.
- Bridge joint or deck drain work.
- Sign installation and maintenance.

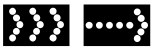
Accordingly, the diagrams in this chapter for stationary operations are arranged by the location of the work on the road, the extent of traffic control needed and the time required by the work activity or emergency response.

The diagrams in this Handbook do not cover every possible situation. Please refer to the principles described in this Handbook as well as Part 6 of the *Manual on Uniform Traffic Control Devices* (MUTCD) when applying these diagrams to your situation.

5.2 Detail Drawings

The following tables and detail drawings *should* be used in developing and implementing your traffic control plan for any short-term work.

Symbol Definitions — Diagram 5-1



Sequential Arrow Board (shown in Arrow or Chevron mode)

Sequential Arrow Board (shown in Caution mode)
NOTE: Last option shown is "Double Flashing Diamonds" as both diamonds flash simultaneously (*NOT* "Dancing Diamonds").

Sequential Arrow (shown facing down)

Portable Changeable Message Sign (PCMS)

Channelizing device (cone, tubular marker, or drum)

Direction of traffic

Flagger

Automated Flagger Assistance Device (AFAD)

Post-mounted sign

Roll-up warning sign

Roll-up warning or regulatory sign

Traffic signal

Truck-mounted Impact Attenuator (TMA)

Type II or III barricade

Pedestrian Channelizing Device (PCD)

Work space (Includes workers, materials, equipment)

Work vehicle

Sign Spacing and Buffer Lengths Diagram 5-2

Use the following table to determine proper spacing between temporary signs and the proper length for buffer spaces used in work zones. Use the posted speed or statutory speed for the section of road where the work is being conducted in determining sign spacing and buffer space lengths.

Sign Spacing and Buffer Lengths (feet)

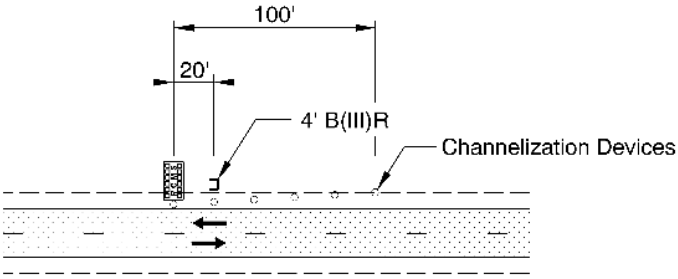
Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365
Freeways:				
55	1000	1500	2640	250
60				285
65				325
70				365

- All spacing shown in feet.
- Posted Speed: Equivalent to the existing, posted or statutory speed.
- Spacing “A” may be used as suggested trailing distance for shadow vehicles.
- Adjust spacing as field conditions require.
- Non-Freeway sign spacing **shall** not exceed 2x the dimensions shown.
- Small adjustments to freeway sign spacing may be made to fit field conditions, but spacing ***should*** not exceed 1.5 times the dimensions shown.

Portable Changeable Message Sign (PCMS) Installation

Diagram 5-3

Portable Changeable Message Sign (PCMS) Installation: A trailer-mounted PCMS requires a shoulder taper using six cones, tubular markers or drums; and, a single Type III barricade placed 40 feet in front of the PCMS, as shown.



NOTES:

- Install PCMS beyond the outside shoulder, when possible.
- Use the appropriate type of barricade panels for PCMS location.
  Right shoulder, use Type B(III)R
  Left shoulder, use Type B(III)L
- Use six channelization devices (cones, tubes, drums) in taper on 20' spacing.
- Detail as shown may also be used for Portable Traffic Signal installation.

Portable Transverse Rumble Strips (PTRS), Flagging

Diagram 5-4

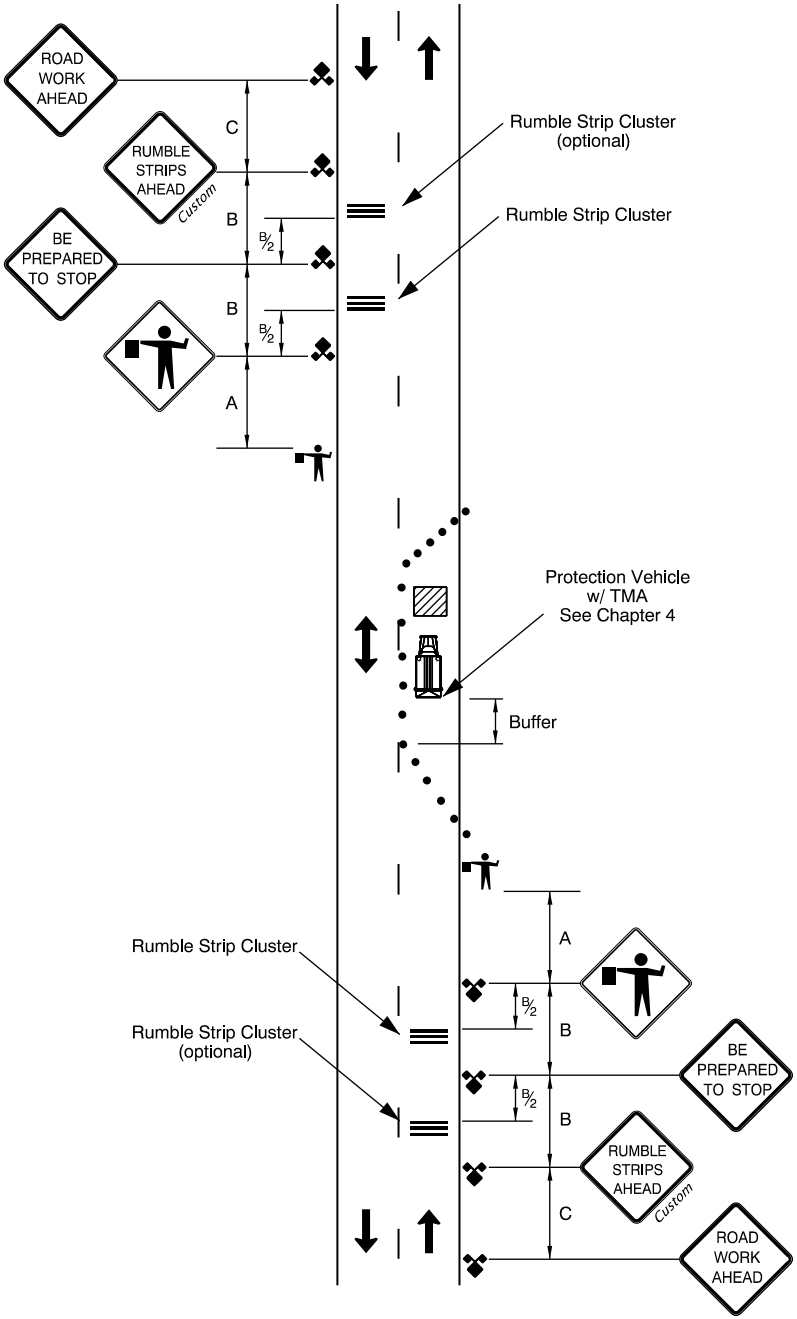
This section covers the use of portable transverse rumble strips (PTRS) that can be used to warn traffic in a one-lane, two-way work zone.

Portable transverse rumble strip (PTRS) requirements:

1. PTRS are portable rumble strips that are used to warn traffic of an upcoming condition, usually a stopped condition. PTRS can be used for any stopped condition, including flaggers, automated flagger assistance devices (AFAD), portable signals, etc. PTRS are intended for short-term work zones. On the State Highway system, approval is required for PTRS when used for intermediate-term work or night work. Approval is not required for short-term work during daylight hours. Check with local road authorities for PTRS approvals on local, non-State roads.
2. Use PTRS from the Oregon Department of Transportation (ODOT) *Qualified Products List* (QPL). Do not use white or other colored material for PTRS.
3. The PTRS ***should*** be located in advance of the warning sign used for the approaching condition, for example, in a flagging operation the PTRS would be located in advance of the Flagger (CW23-3) sign.
4. Two PTRS clusters ***should*** be used to warn traffic. When the average daily traffic (ADT) of the highway is less than 4,000 vehicles per day (vpd), only one cluster of PTRS is required.
5. A RUMBLE STRIP AHEAD (custom) sign ***should*** be used in advance of PTRS.
6. A BUMP (W8-1) sign may be placed at each PTRS cluster for additional warning.
7. PTRS clusters ***should*** consist of three individual rumble strips and follow the manufacturer's recommendations for PTRS clusters.

Portable Transverse Rumble Strips (PTRS), Flagging

Diagram 5-4



Portable Transverse Rumble Strips (PTRS), AFAD

Diagram 5-5

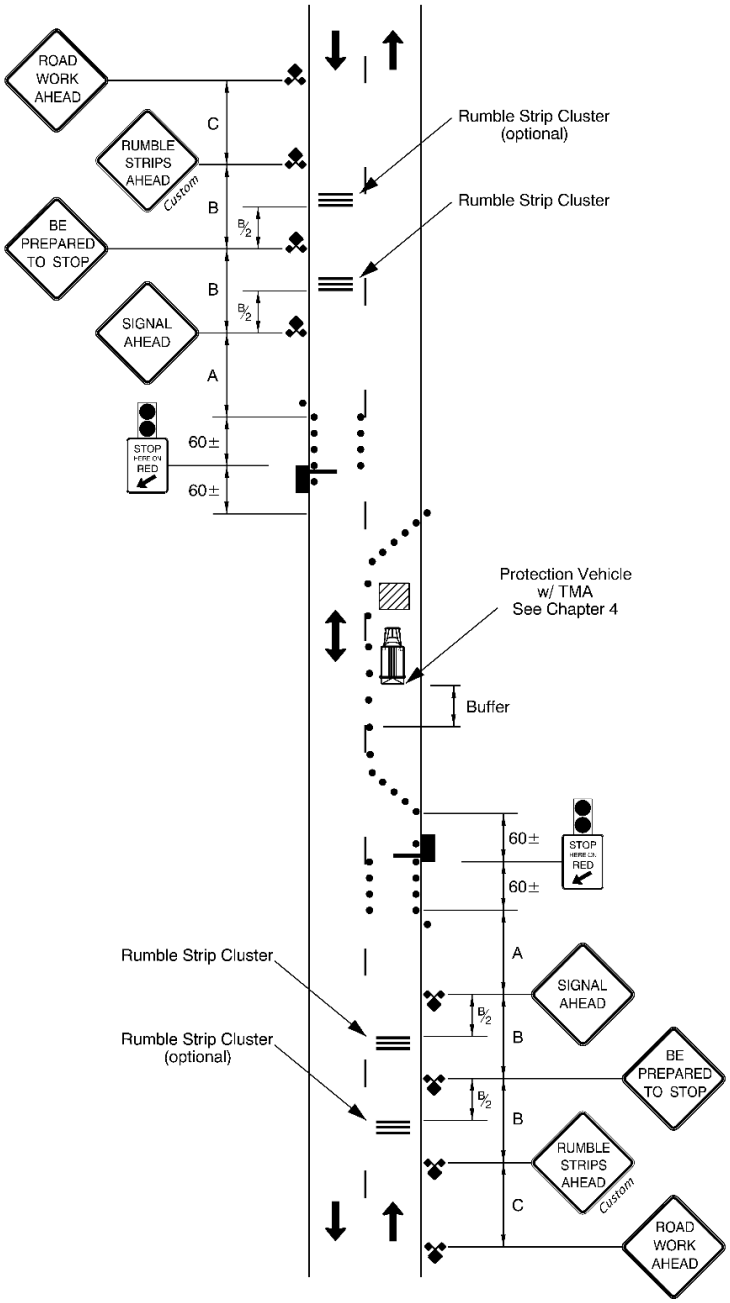
This section covers the use of portable transverse rumble strips (PTRS) that can be used to warn traffic in a one-lane, two-way work zone.

Portable transverse rumble strip (PTRS) requirements:

1. PTRS are portable rumble strips that are used to warn traffic of an upcoming condition, usually a stopped condition. PTRS can be used for any stopped condition, including flaggers, automated flagger assistance devices (AFAD), portable signals, etc. PTRS are intended for short-term work zones. On the State Highway system, approval is required for PTRS when used for intermediate-term work or night work. Approval is not required for short-term work during daylight hours. Check with local road authorities for PTRS approvals on local, non-State roads.
2. Use PTRS from the Oregon Department of Transportation (ODOT) *Qualified Products List* (QPL). Do not use white or other colored material for PTRS.
3. The PTRS ***should*** be located in advance of the warning sign used for the approaching condition, for example, in a AFAD operation the PTRS would be located in advance of the SIGNAL AHEAD (W3-3a) sign.
4. Two PTRS clusters ***should*** be used to warn traffic. When the average daily traffic (ADT) of the highway is less than 4,000 vehicles per day (vpd), only one cluster of PTRS is required.
5. A RUMBLE STRIP AHEAD (custom) sign ***should*** be used in advance of PTRS.
6. A BUMP (W8-1) sign may be placed at each PTRS cluster for additional warning.
7. PTRS clusters ***should*** consist of three individual rumble strips and follow the manufacturer's recommendations for PTRS clusters.

Portable Transverse Rumble Strips (PTRS), AFAD

Diagram 5-5



Extended Traffic Queues Diagram 5-6

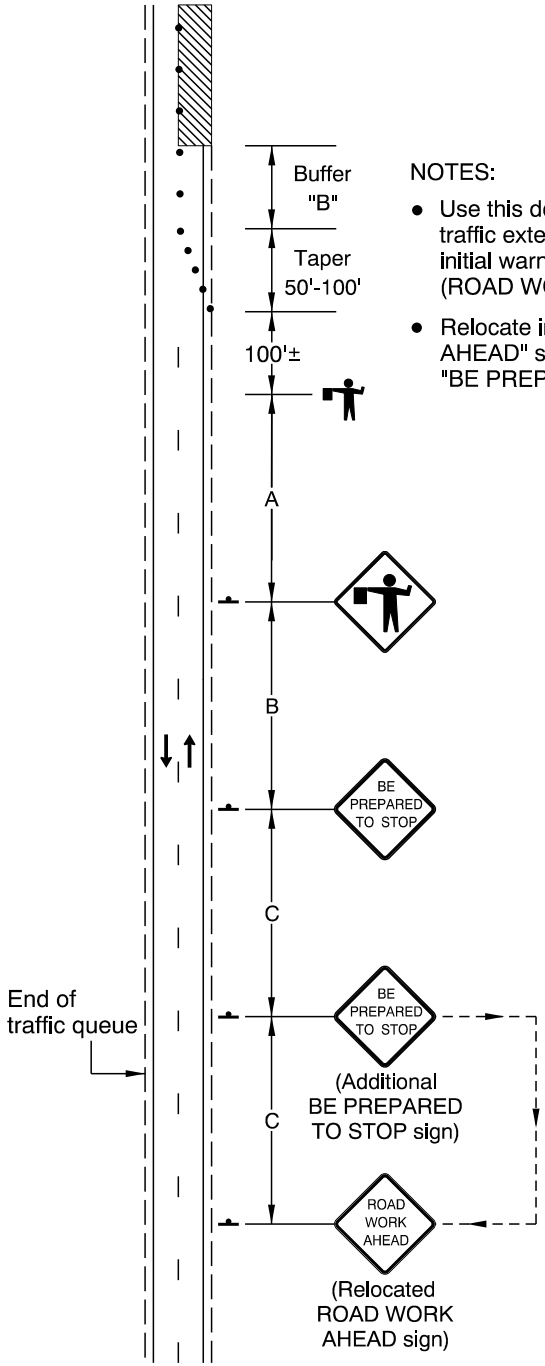
Use the Extended Traffic Queues diagram when flagging operations generate traffic queues that extend beyond the initial advance warning sign (e.g. ROAD WORK AHEAD).

- Consider using Diagram 5-6 on high-speed, high-volume roadways, or where traffic may be stopped for up to 20 minutes.
- Move the initial advance warning sign (e.g. ROAD WORK AHEAD), as shown, to the beginning of the sign sequence prior to installing any additional signing.
- The ROAD WORK AHEAD (or BRIDGE, or SHOULDER) sign is always the first sign the road user sees and is seen only once per approach to the work zone.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Extended Traffic Queues Diagram 5-6



NOTES:

- Use this detail when traffic extends beyond initial warning sign (ROAD WORK AHEAD).
- Relocate initial "ROAD WORK AHEAD" sign in advance of additional "BE PREPARED TO STOP" sign.

Advance Flagger for Extended Queues Diagram 5-7

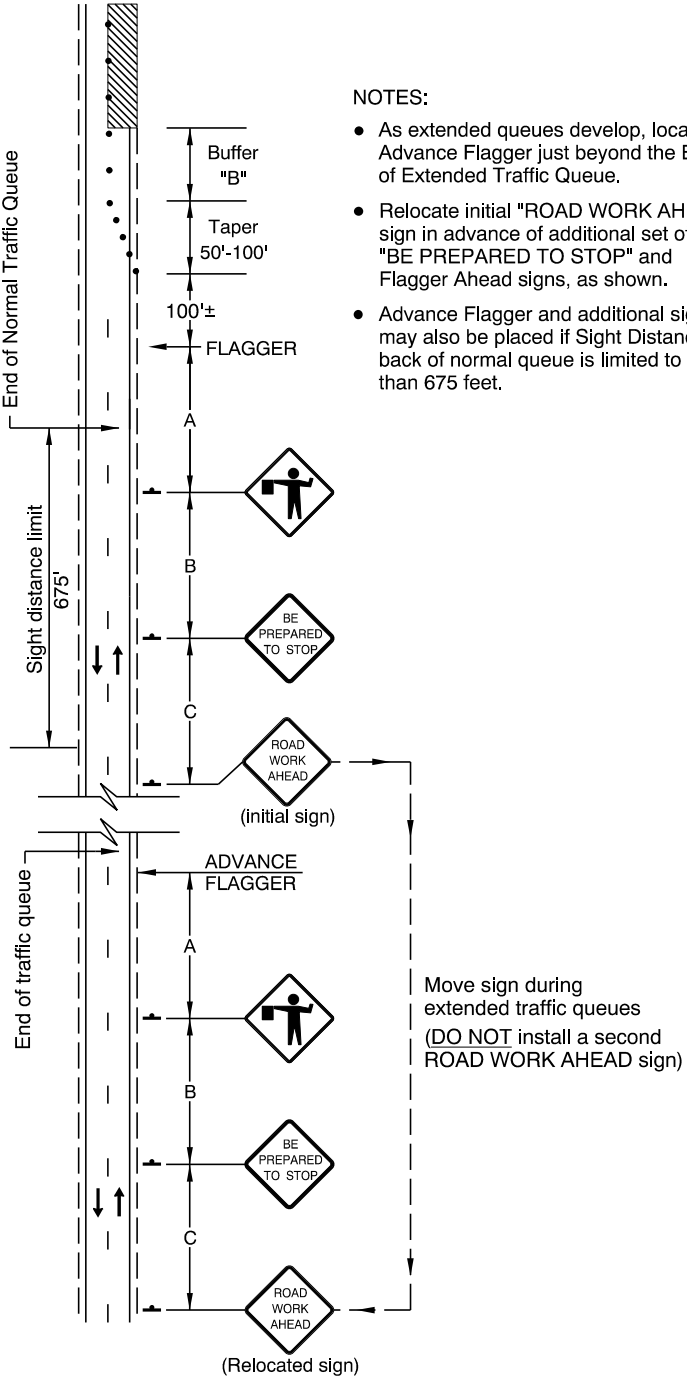
Use the Advance Flagger for Extended Queues diagram to further enhance the control of approaching traffic during peak volume periods.

- Consider using this detail if traffic queues extend beyond the initial advance warning sign (e.g. ROAD WORK AHEAD), as shown.
- Move the initial advance warning sign (e.g. ROAD WORK AHEAD) to the beginning of the sign sequence prior to installing any additional signing.
- The ROAD WORK AHEAD (or BRIDGE, or SHOULDER) sign is always the first sign in the sign sequence. Road users ***should*** only see this initial warning sign once when entering the work zone.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Advance Flagger for Extended Queues Diagram 5-7



NOTES:

- As extended queues develop, locate Advance Flagger just beyond the End of Extended Traffic Queue.
- Relocate initial "ROAD WORK AHEAD" sign in advance of additional set of "BE PREPARED TO STOP" and Flagger Ahead signs, as shown.
- Advance Flagger and additional signage may also be placed if Sight Distance to back of normal queue is limited to less than 675 feet.

Rail Grade Crossing Diagram 5-8

Diagram 5-8 covers work in the travel lanes near an at-grade rail crossing. This drawing *should* be consulted whenever traffic control may cause traffic queues to form up to and/or across the rails.

1. When work will be done within the railroad right-of-way, the railroad or transit authority **shall** be notified. When work is performed within 500 feet of a railroad crossing, ODOT CCD Rail Crossing (CCDRailCrossing@odot.oregon.gov) and ODOT Railroad Coordination Program (UtilityandRailProgra@odot.oregon.gov) **shall** be contacted.

2. Minimize the possibility that vehicles may be stopped within the rail crossing, defined as being 15 feet either side of the closest and farthest rail. Position the work or shadow vehicle to keep traffic from stopping near the rails.

3. If any permanent DO NOT STOP ON TRACKS (R8-8) signs are obscured or if none are posted, a regulatory DO NOT STOP ON TRACKS (R8-8) sign **shall** be placed on the approach to the tracks.

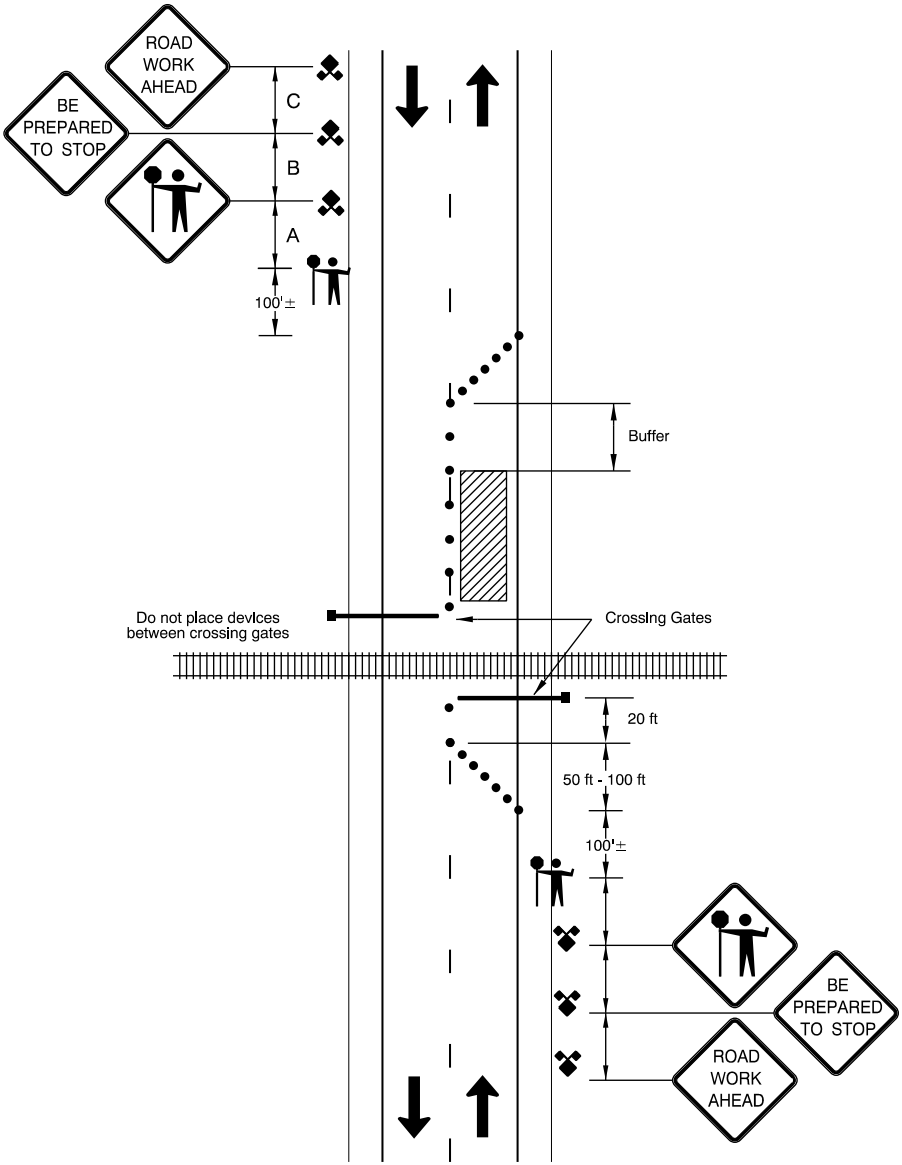
4. Place the DO NOT STOP ON TRACKS (R8-8) sign on the right and near the stop bar, if there is one. If there is no stop bar, place the sign at least 8 feet from the tracks. On multi-lane roads, a left side sign may be needed especially if there are three or more lanes in any one direction.

5. If the queuing of vehicles across the tracks cannot be avoided, a law enforcement officer or flagger **shall** be provided at the crossing to prevent vehicles from stopping within the rail crossing, even if automatic warning devices are in place. Flaggers **shall** be certified.

    a. Do not use automated flagger assistance devices (AFAD) when flagging rail grade crossings.

6. Maintain pedestrian access across the tracks or close the pathway. Use pedestrian channelization devices (PCD) and a SIDEWALK CLOSED (R9-9) sign if work impacts the pedestrian crossing. Place the closure where pedestrians are directed to an alternate safe passage. Flaggers *should* accommodate pedestrians through work zones by stopping vehicles and directing or guiding pedestrians through the work zone.

Rail Grade Crossing Diagram 5-8



Temporary Pavement Markers Diagram 5-9

When work activity obliterates existing pavement markings (i.e. paving or other preservation projects) and placement of permanent markings cannot be done following completion of the work, temporary markings must be placed to provide guidance for drivers. However, permanent markings *should* be placed within two weeks of completing the work.

When the existing centerline striping is obliterated, do the following:

- For roadways where:
    - ADT volume less than 5,000, with a posted speed greater than or equal to 45 mph, or
    - ADT volume less than 10,000, with a posted speed less than 45 mph

  Use temporary paint, temporary tape, or install temporary flexible pavement markers for temporary centerline marking as follows:
    - To simulate a skip stripe, a group of two markers spaced five feet apart **shall** be used. Leave a gap of 35 feet between each group of two markers.
    - To simulate a solid line, equally space one marker every 10 feet.

- For roadways where:
    - ADT volume greater than 5,000, with a posted speed greater than or equal to 45 mph, or
    - ADT volume greater than 10,000, with a posted speed less than 45 mph

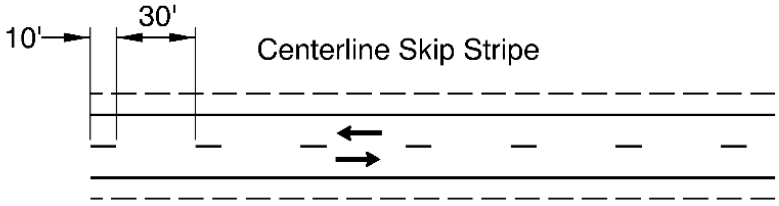
  Use temporary paint, temporary tape, or install temporary flexible pavement markers for temporary centerline marking as follows:
    - To simulate a skip stripe, a group of three markers spaced five feet apart **shall** be used. Leave a gap of 30 feet between each group of three markers.
    - To simulate a solid line, equally space one marker every 10 feet.

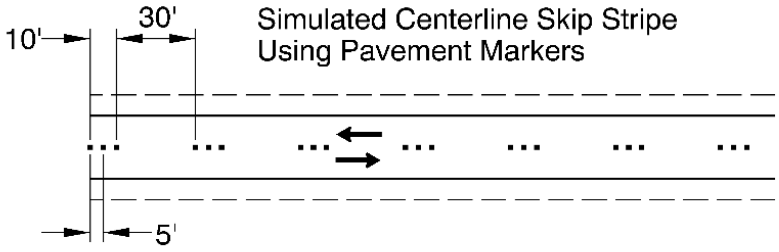
Use temporary painted or temporary tape for right-hand and left-hand edge markings or use channelization devices on maximum 200 feet spacing on shoulder for delineation. Raised pavement markers *should* not substitute for right-hand edge line markings, unless engineering judgment indicates the benefits of the markers outweigh:

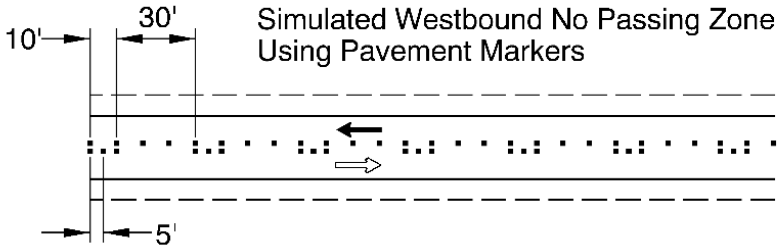
- Possible impacts to bicycles using the shoulder.
- Spacing of the markers on the right-hand edge line is close enough to avoid drivers misinterpreting the line as a broken line during wet, night conditions.

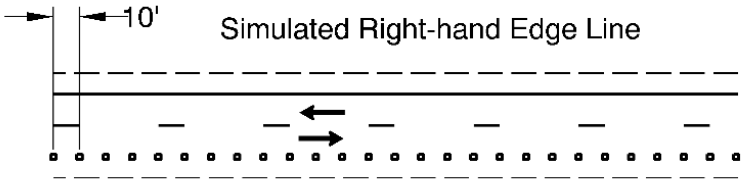
If pavement markers are used as a right-hand edge line, equally space one marker every 10 feet. Marker colors **shall** match the color of the line they are simulating.

Temporary Pavement Markers Diagram 5-9









5.3 Bicycle and Pedestrian Accommodations

The following practices and details address the accommodation of bicycles and pedestrians within work zones. The following diagrams *should* be incorporated, where appropriate, into the traffic control plan for any short-term work.

1. See Section 1.5 – Bicycle and Pedestrian Considerations for additional guidance.
2. Stay alert for pedestrians and bicycle traffic and accommodate safe passage for them by providing an alternate route or temporary pedestrian accessible route (TPAR).
3. The work space *should* be protected from pedestrian and bicyclist intrusion by using pedestrian channelization devices (PCD) or bicycle channelization devices (BCD).

5.4 Bicycle Accommodation Diagrams

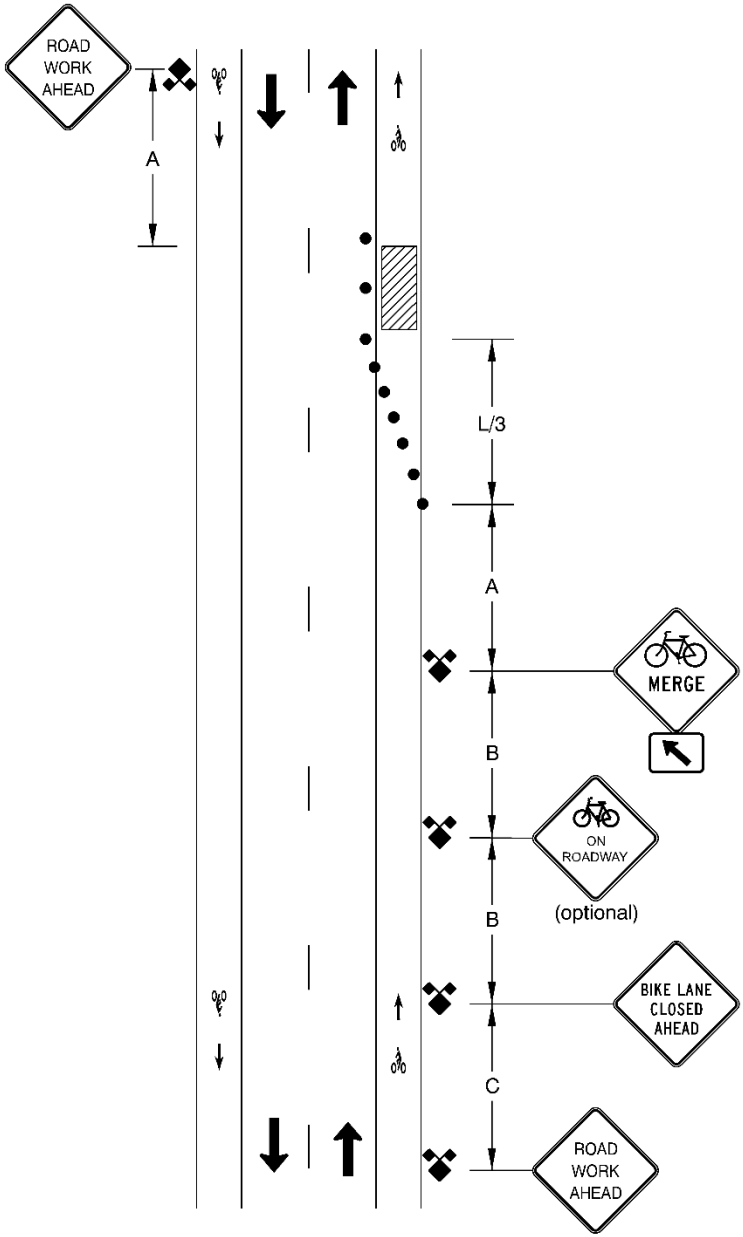
Bicycle Accommodation Principles:

1. Where neither roadway width nor alternate routes are available, a "shared roadway" may be provided. When closing a dedicated bike lane, provide signs for bicycles and vehicles merging or an alternate route. When there is no existing dedicated bike lane, if a "shared roadway" is provided, install a Bicycles ON ROADWAY (CW11-1) sign or the Bicycle (W11-1) sign with an ON ROADWAY (OBW1-5) rider, in advance of the work area. A "shared roadway" *should* be used only where the posted speed limit is 40 mph or less.
2. Install temporary signing off the paved shoulder, within the planter (buffer) strip, or share the width needed between the shoulder and the sidewalk, as available.
3. Signs are to remain in place until the surface is restored and the width made available for bicycle use. See Diagram 5-10 for typical bicycle signing placement.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Bicycle Accommodation Diagram 5-10



5.5 Pedestrian Accommodation Diagrams

See Diagrams 5-11 through 5-13, below, for pedestrian accommodations in work zones.

Pedestrian Accommodation Principles:

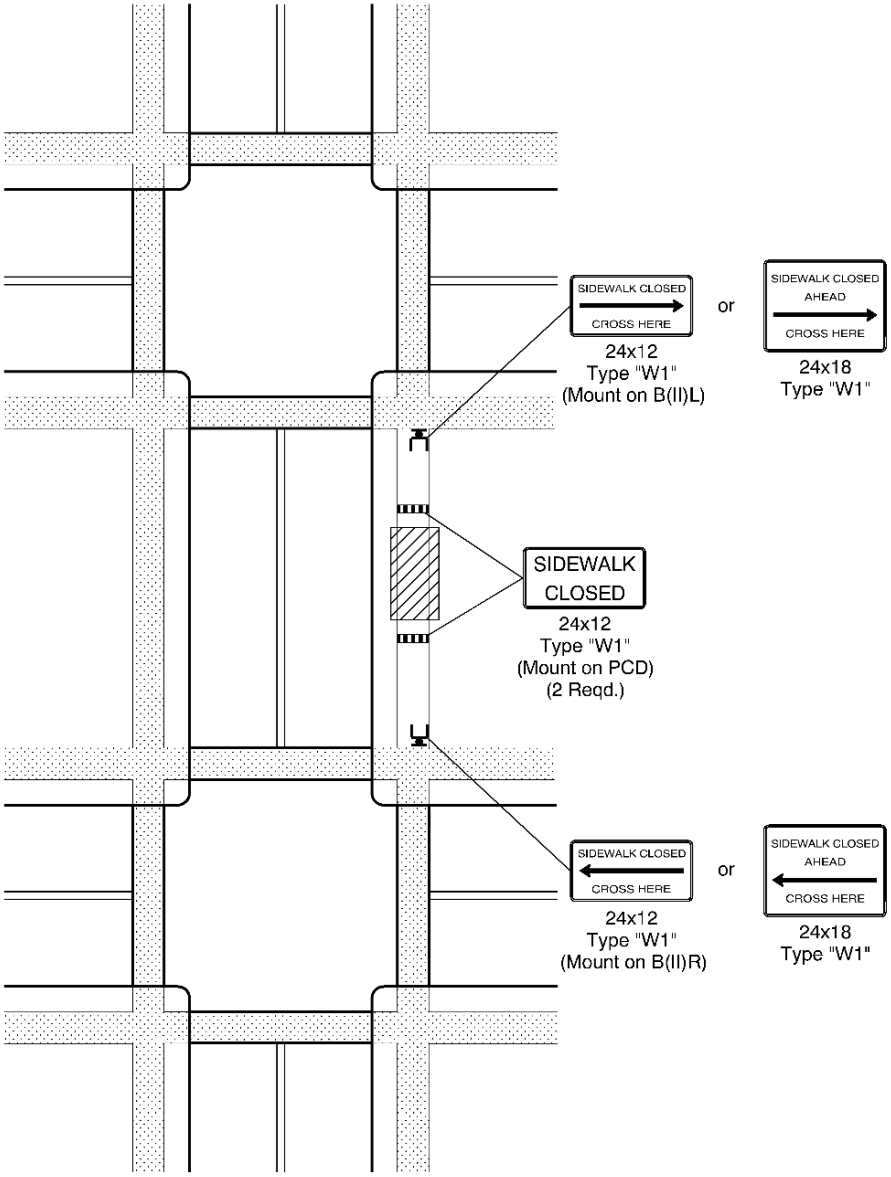
1. If the work impacts the sidewalk or pedestrian facility, provide a TPAR.
2. If not practical to match the width of the existing pedestrian facilities, maintain a 5 feet minimum width.
3. Provide a TPAR with minimal out of direction travel. When a TPAR cannot be provided through the work zone, an alternate route *should* be used as the TPAR, pedestrians *should* be directed with advance signing to cross the road at existing crossings. Do not divert pedestrians into travel lanes.
4. Install pedestrian closure or detour signing directly on the PCD. If pedestrian signing cannot be accommodated on the PCD, install signing on a Type II barricade and place the barricade in a location that does not affect the TPAR or cause an additional tripping hazard.

Make every practical effort to satisfy the following:

- If work closes a sidewalk or sidewalk ramp, close sidewalks at a point where an alternate crossing point or route can be provided. Minimize the amount of out-of-direction travel for pedestrians.
- Use a combination of SIDEWALK CLOSED (R9-9), SIDEWALK CLOSED USE OTHER SIDE (R9-10), SIDEWALK CLOSED AHEAD CROSS HERE (R9-11), and SIDEWALK CLOSED CROSS HERE (R9-11a) signing to direct pedestrians to an alternate facility.
- Where there are business destinations between the nearest crosswalk and the work area, close the sidewalk at the business access nearest the work area, where practical using the SIDEWALK CLOSED (R9-9) sign. Include the SIDEWALK CLOSED AHEAD CROSS HERE (R9-11) sign at the nearest crosswalk prior to the closure.

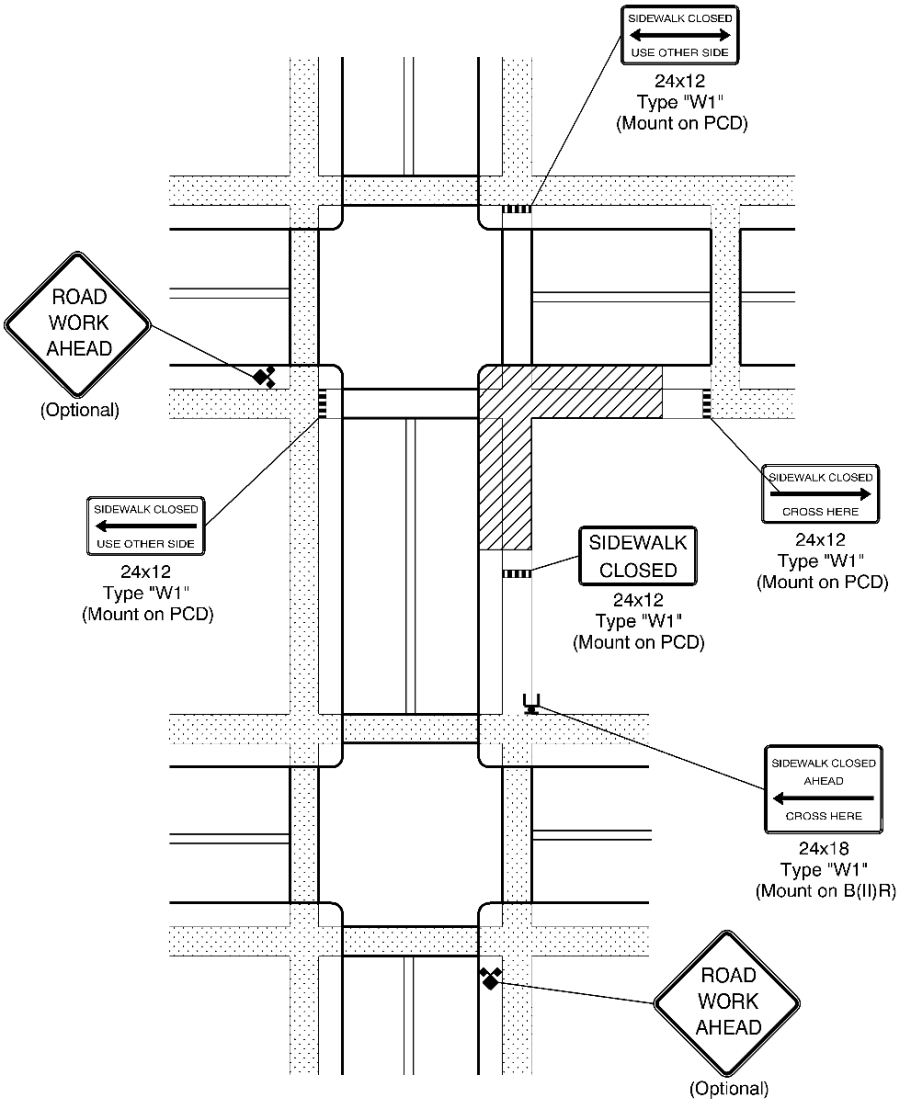
Sidewalk Closure, Mid-Block Diagram 5-11

The sidewalk *should* be closed at the nearest intersection on each side of the work area when a TPAR through the work zone is not available.



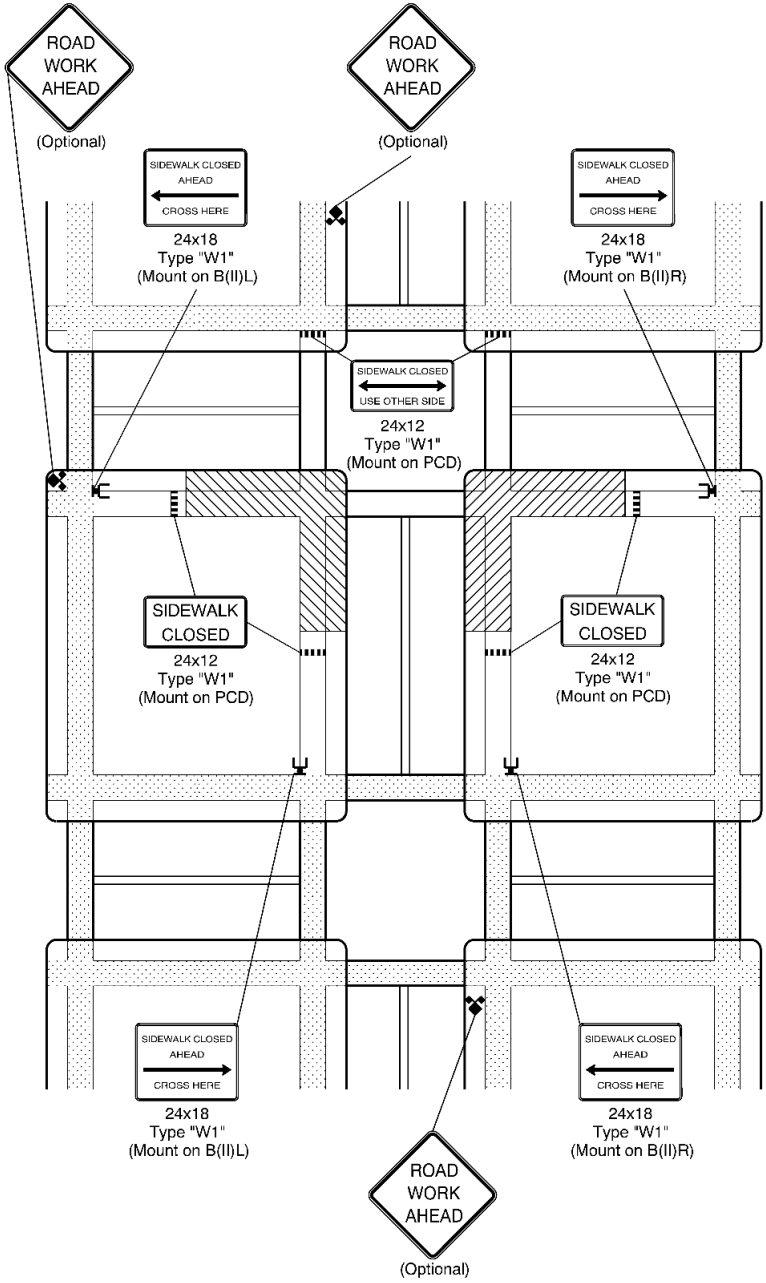
Sidewalk Closure, Corner Diagram 5-12

For work near an intersection, close crosswalks and/or sidewalks as necessary when a TPAR uses an alternate route around the work zone.



Sidewalk Closure, Two Corners Diagram 5-13

For work near an intersection, close crosswalks and/or sidewalks as necessary when a TPAR uses an alternate route around the work zone.



5.6 Mobile Operations

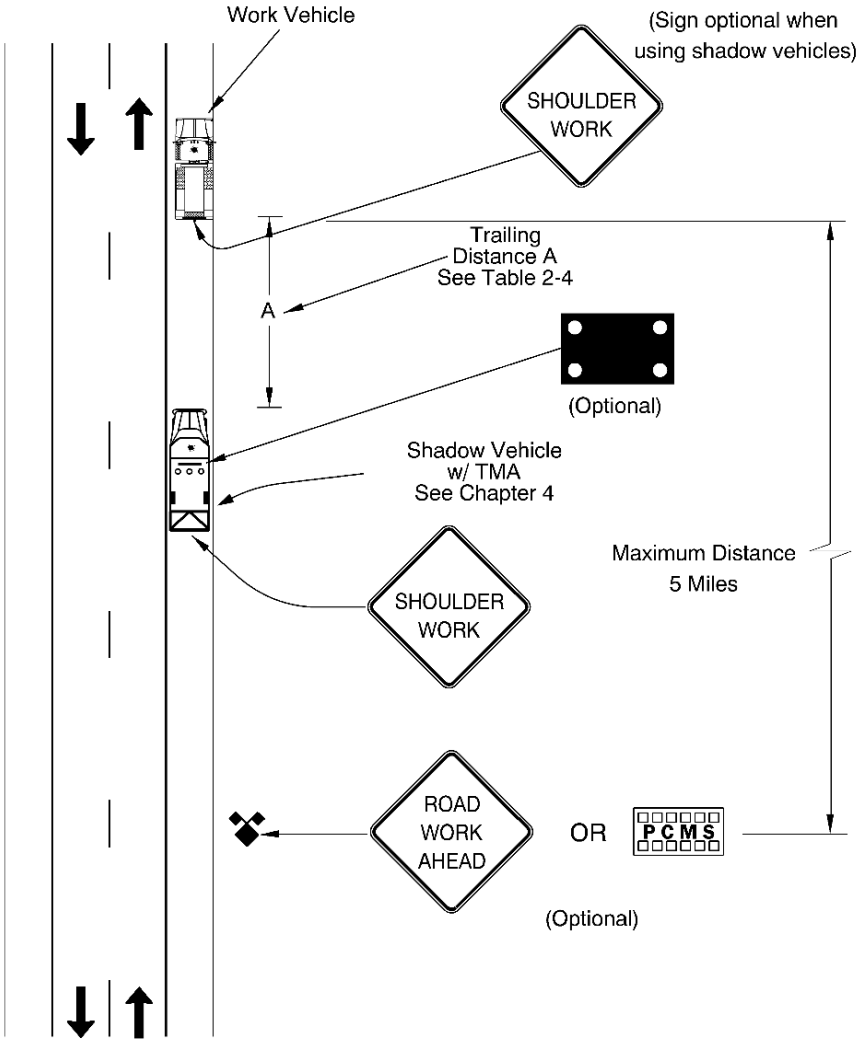
Mobile Operation on Shoulder Diagram 100

Diagram 100 covers a typical continuous moving operation on the shoulder of a conventional road (for Freeway work see Section 5.7).

1. Use truck-mounted flashing warning lights on work and shadow vehicles.
2. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.
3. If the work equipment has to be partially in the travel lane, maintain a lane width of ten feet or occupy the adjacent travel lane and use the appropriate mobile lane closure diagram. On low-volume roads, a minimum lane width of 9 feet may be allowed.
4. A shadow vehicle *should* be used when:
    a. Sight distance is periodically less than 750 feet, or
    b. Dust created by the operation, fog or other low-visibility conditions reduces sight distance to less than 500 feet.

    If the above conditions are not met, the shadow vehicle is optional.
5. A shadow vehicle is also optional when the volume is below 400 ADT.
6. When a shadow vehicle is used:
    a. Signs on work vehicle are optional, and
    b. The shadow vehicle may replace the advance warning signs.
7. The shadow vehicle *should*:
    a. Adjust the space between the work vehicle and between each additional shadow vehicle to maintain traveling distances found in Table 2-4; and,
    b. Slow down in advance of curves that restrict sight distance.
8. If a shadow vehicle is not used:
    a. Advance warning signs or PCMS *should* be used, and
    b. The signs may cover up to five miles and *should* include the distance on the sign.
9. When the work vehicle is traveling alone, a truck-mounted attenuator (TMA) *should* be considered. The initial vehicle, either work or shadow vehicle, which will be exposed to traffic on the shoulder *should* be equipped with an TMA.
10. Use SHOULDER WORK (W21-5), RIGHT SHOULDER CLOSED (W21-5aR), or other work-appropriate sign on the initial vehicle. Minimum sign size is 36 x 36-inch. A PCMS may be used in place of signs.
11. Where practical and when needed, the work and shadow vehicles *should* pull over periodically to allow motor vehicle traffic to pass.

Mobile Operation on Shoulder Diagram 100



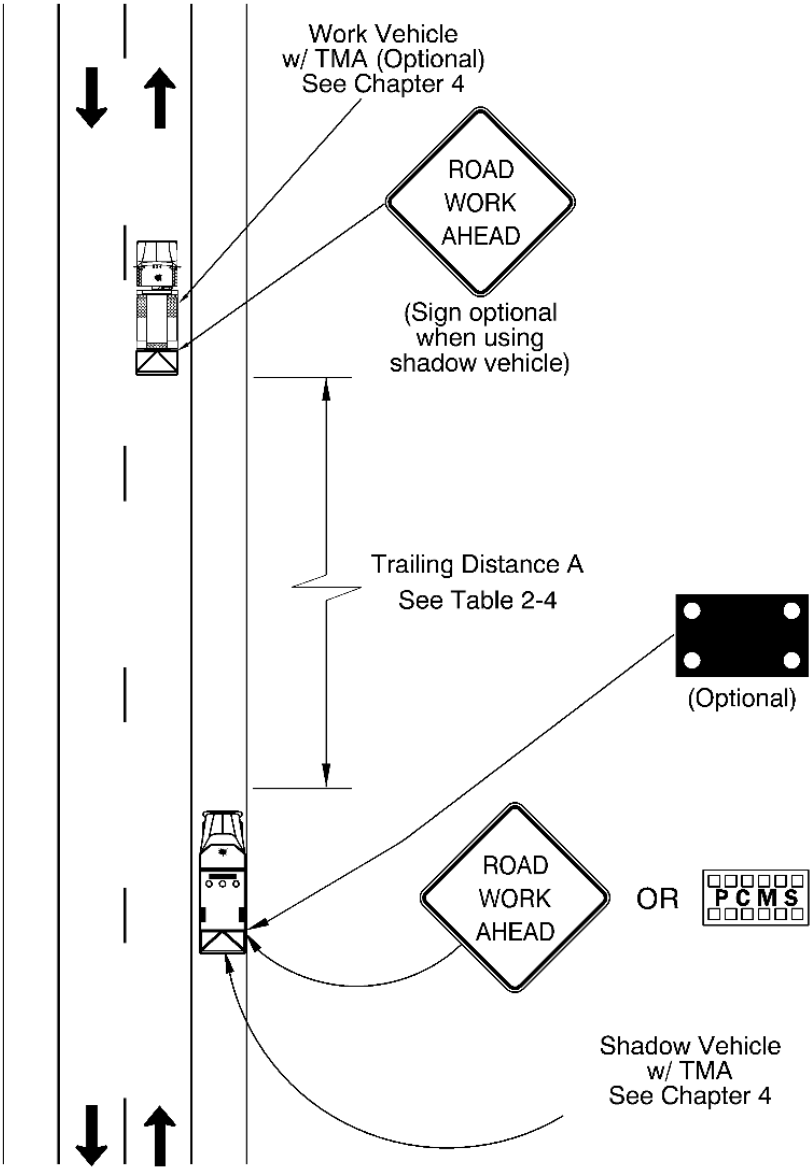
Mobile Operation on Two-Lane, Two-Way Roads Diag. 110

Use this detail for continuous slow-moving operations in the travel lane of a two-lane, two-way road. It does not include a layout for every possible work situation, but shows the minimum requirements for this type of operation.

For striping operations, use this detail, then move on to the next detail - Striping on Two-Lane, Two-Way Roads, Diagram 120 – for additional information.

1. Use truck-mounted flashing warning lights on work and shadow vehicles.
2. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.
3. A shadow vehicle ***should*** be used when:
   a. Sight distance is less than 750 feet; or,
   b. Dust created by the operation, fog, or other low-visibility conditions reduces the sight distance to less than 500 feet; or,
   c. Speed is 45 mph or higher with the work vehicle operating within the lane.
4. The shadow vehicle is optional when the traffic volume is less than 400 ADT.
5. When a shadow vehicle is used:
   a. Signs on work vehicle are optional.
   b. The shadow vehicle may replace the advance warning signs.
6. The shadow vehicle ***should***:
   a. Adjust the space between the work vehicle and each additional shadow vehicle to maintain traveling distances found in Table 2-4.
   b. Slow down before vertical or horizontal curves that restrict sight distance.
   c. Maintain a position on the right side of the highway as far as practical.
7. If a shadow vehicle is not used:
   a. Advance warning signs or PCMS ***should*** be used.
   b. Signs may cover up to five miles and ***should*** include the distance on the sign.
8. When the work vehicle is traveling alone, a TMA ***should*** be used. The initial vehicle, either work or shadow vehicle, which will be exposed to traffic in the travel lane ***should*** be equipped with an TMA.
9. Where practical and when needed, the work and shadow vehicles ***should*** pull over periodically to allow motor vehicle traffic to pass.
10. Use ROAD WORK AHEAD (W20-1), ROAD MACHINERY AHEAD (W21-3) or other appropriate rear-mounted signs with a minimum dimension of 36”. If there are limited opportunities to pass, the sign may be substituted with a combination YIELD (R1-2) sign and TO ONCOMING TRAFFIC (R1-2a) rider; or, a DO NOT PASS (R4-1) sign.
11. A PCMS may be placed at the beginning of the section of road to warn traffic of the work ahead. The PCMS ***should*** state the type of work on panel one and “NEXT XX MILES” on panel two. The distance between the work and the PCMS ***should*** be limited to five miles or less.
12. For unpaved roads, refer to the guidance given in Section 1.12.

Mobile Operation on Two-Lane, Two-Way Roads Diag. 110



Striping on Two-Lane, Two-Way Roads Diagram 120

Diagram 120 covers striping operations on a two-way, two-lane road. The left-hand drawing illustrates a typical layout when using paint equipment, which marks up to two lines from the side of the equipment. Consider using an advanced vehicle if striping the center line. The right-hand drawing illustrates a typical layout when the paint equipment straddles and marks a single line at a time. These drawings cover any equipment configuration which accomplishes the applicable marking operation.

1. Use truck-mounted flashing warning lights and appropriate signs on work and shadow vehicles.

2. Arrow boards ***should*** be used in caution mode. Arrow mode ***should*** only be used when a traffic lane is being closed and directed to merge with an adjacent lane. A truck-mounted PCMS may be used in lieu of an arrow board.

3. Appropriate messages for a PCMS include: “WET PAINT/KEEP RIGHT (LEFT)” or “WET PAINT/DO NOT PASS.”

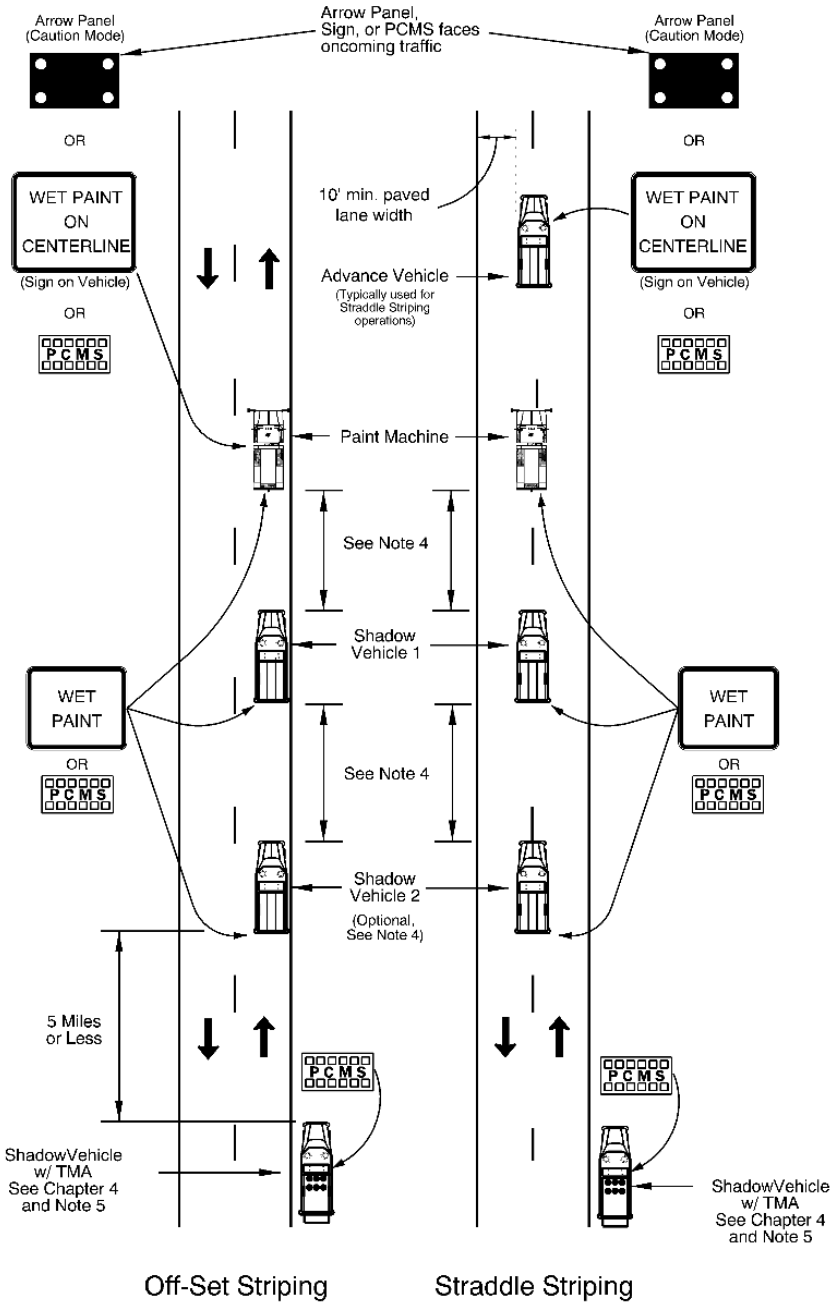
4. The number of vehicles and vehicle spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately to take traffic without smearing.

5. A vehicle with truck-mounted PCMS may shadow the work array on the right shoulder as advance warning. This vehicle may be the service truck for the paint machine.

6. A PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The PCMS ***should*** identify the type of work on the first panel and “NEXT XX MILES” on the second panel.

7. The distance between the work and the PCMS ***should*** be limited to five miles or less.

Striping on Two-Lane, Two-Way Roads Diagram 120



Mobile Operation on Multi-Lane Roads Diagram 130

Diagram 130 covers mobile operations occupying one lane of a multi-lane road, *non-freeway* (see Section 5.12 – Freeway Work). Work *should* normally be done in off-peak hours on high-speed or high-volume roads.

For striping operations on multi-lane roads and freeways, use this detail, and Diagram 140 – Striping on Multi-Lane Roads and Freeways for additional information.

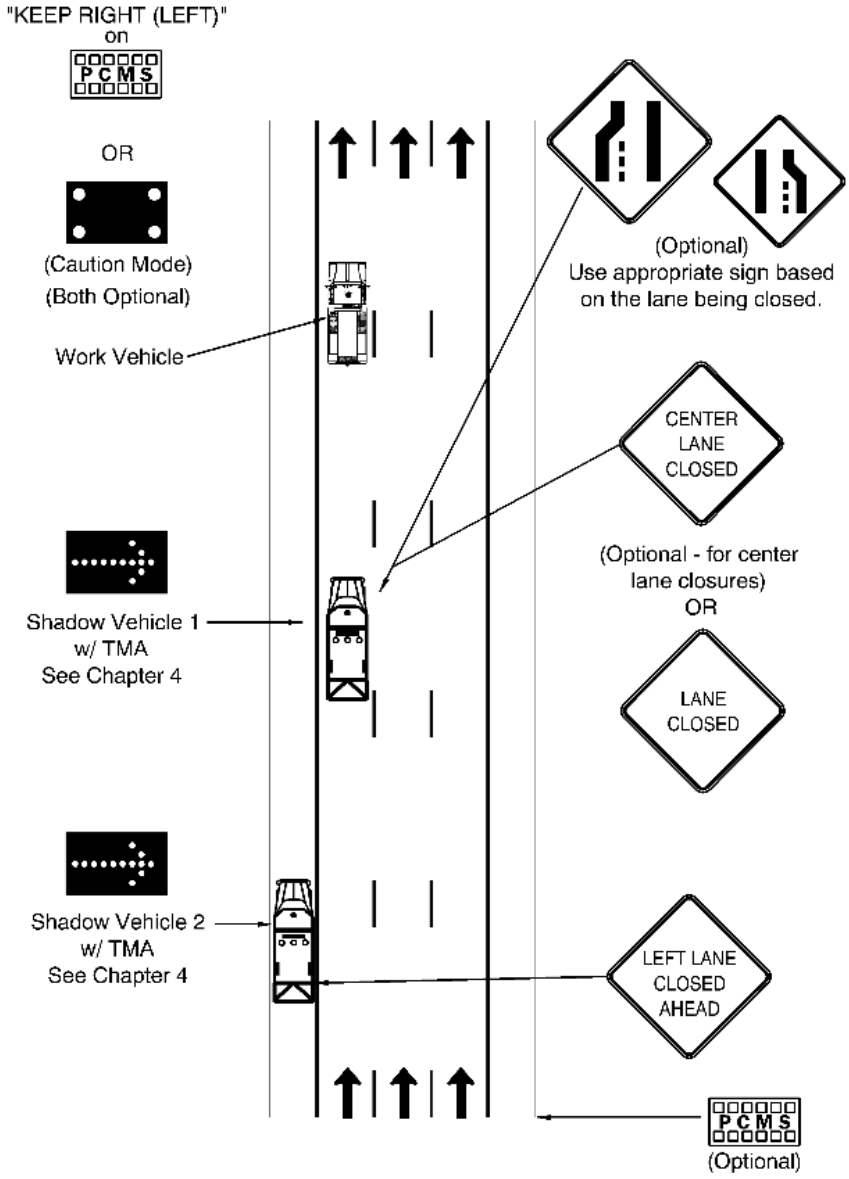
1. Use truck-mounted flashing warning lights on work and shadow vehicles. Arrow boards or PCMS are desirable.
2. A shadow vehicle *should* be used on multi-lane roads when workers are exposed directly to traffic, use Table 5-1 to determine the need for a shadow vehicle on multi-lane roads.

Table 5-1: Shadow Vehicle Requirements

Speed	Shadow Vehicle
0 – 40 mph	Optional
45 mph and above	One, Minimum

3. All shadow vehicles *should*:
    a. Be equipped with an arrow display or PCMS. A TMA *should* be used where speed is 45 mph or greater.
    b. Have an appropriate lane closure sign placed on the vehicle so as not to obscure the arrow display.
    c. Adjust the space between the work vehicle and each additional shadow vehicle to maintain traveling distances found in Table 2-4.
    d. Vary distance from the work operation so as to provide adequate sight distance for traffic approaching from the rear.
    e. Not protrude into traffic any further than the work vehicle.
4. Additional shadow vehicles may be used. The trailing shadow vehicle *should* be on the shoulder. A second vehicle would drive in the closed lane. If inadequate shoulder width, the trailing vehicle may drive partially in the lane.
5. A PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The sign *should* state the type of work on panel one and “NEXT XX MILES” on panel two. The distance between the work and the PCMS *should* be limited to five miles or less.
6. For mobile operations in center lanes, see Diagram 135 – Mobile Operation in Center Lanes.

Mobile Operation on Multi-Lane Roads Diagram 130



Mobile Operation in Center Lanes Diagram 135

Diagram 135 addresses mobile operations occupying the center or middle lane(s) of a multi-lane road or freeway.

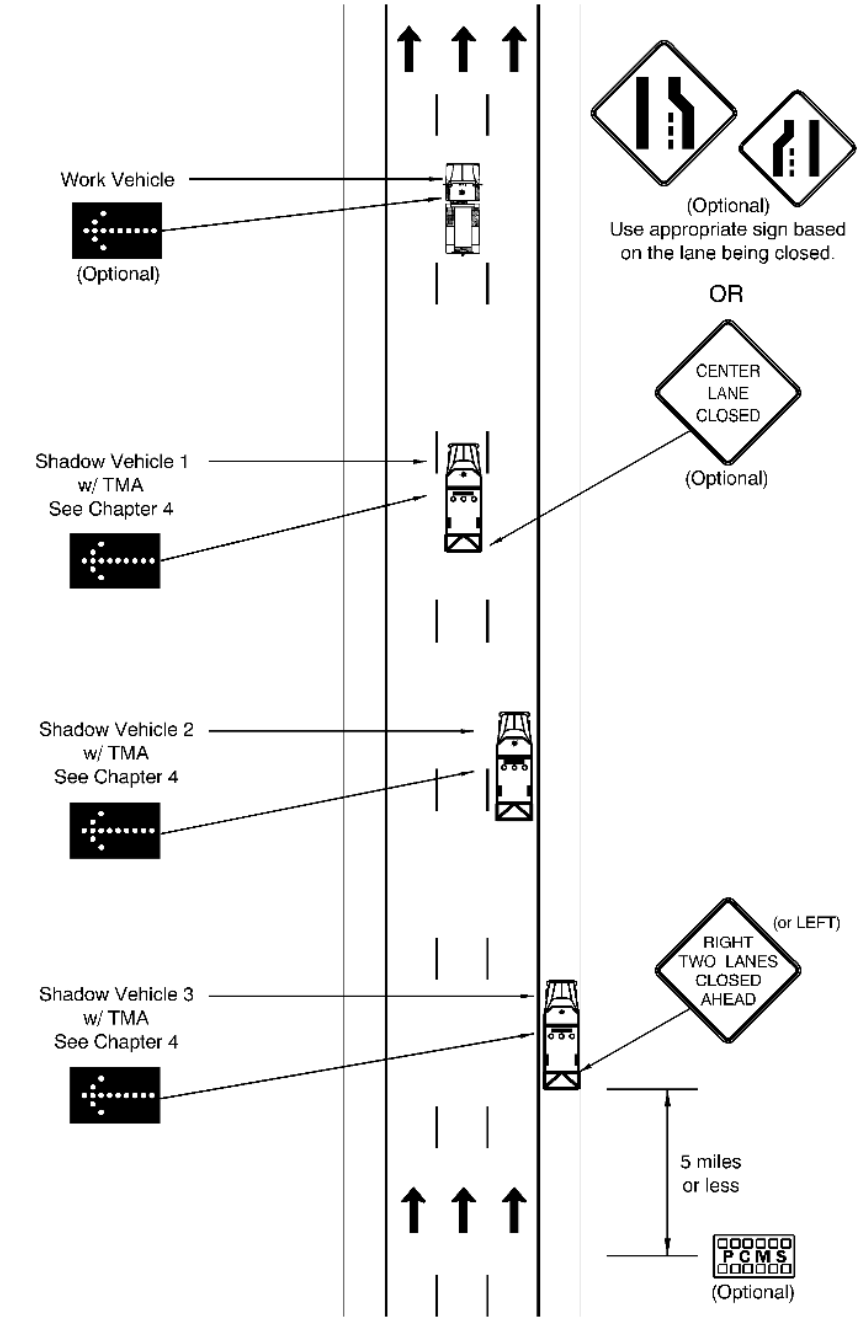
For striping operations on multi-lane roads and freeways, see Diagram 140 – Striping on Multi-Lane Roads and Freeways for additional information. See Section 5.12 – Freeway Work for additional information on freeway work.

Work ***should*** normally be done in off-peak hours on high-speed or high-volume roads.

1. Use truck-mounted flashing warning lights on work and shadow vehicles. Arrow boards or PCMS are desirable.
2. Use Note 2 and Table 5-1 from Diagram 130 to determine the need for a shadow vehicle.
3. All shadow vehicles ***should***:
    a. Be equipped with an arrow display or PCMS. A TMA ***should*** be used where the posted speed is 45 mph or greater.
    b. Adjust the space between the work vehicle and each additional shadow vehicle to maintain traveling distances found in Table 2-4.
    c. Vary distance from the work operation so as to provide adequate sight distance for traffic approaching from the rear.
4. Shadow vehicle 3 ***should*** be on the shoulder and display appropriate signing – for example, RIGHT (LEFT) TWO LANES CLOSED AHEAD (CW20-5a). If inadequate shoulder width, vehicle may drive partially in the adjacent lane.
5. Shadow vehicle 2 ***should*** drive in the first closed lane and display the arrow panel in “arrow” mode.
6. Shadow vehicle 1 ***should*** drive in the second closed lane and display the arrow panel in “arrow” mode. Additional lane closure signing may be used (e.g. CENTER LANE CLOSED).
7. Additional shadow vehicles may be used.
8. A PCMS may be placed at the beginning of the road work section to warn traffic of the closures ahead. Messages ***should*** state the type of work on panel one (e.g. “STRIPING AHEAD”) and “NEXT XX MILES” on panel two.

    Distance between the work and the PCMS ***should*** be five miles or less.

Mobile Operation in Center Lanes Diagram 135



Striping on Multi-Lane Roads and Freeways Diagram 140

Use for line marking (striping) operations on a one-way, multi-lane road or freeway. See Diagram 700 for additional information on freeway work.

1. Use truck-mounted flashing warning lights and appropriate signs on work and shadow vehicles.

2. Maintain at least a ten foot lane in the adjacent travel lanes.

3. When striping the center lane of a three lane or more highway, additional devices and advance warning may be needed. See Diagram 135.

   Use corresponding legend on lane closure signs based on which lane is closed.

4. A trailing vehicle may shadow the work array on the shoulder at a distance of up to ½ mile in advance, as a warning (½ mile min. for freeways). Vehicle may be the service truck for the paint machine. A vehicle with a truck-mounted PCMS is preferable for warning traffic. If a PCMS is not available, a ROAD WORK AHEAD (W20-1) sign ***should*** be used. Do not use an arrow display for this vehicle as it is too far from the work.

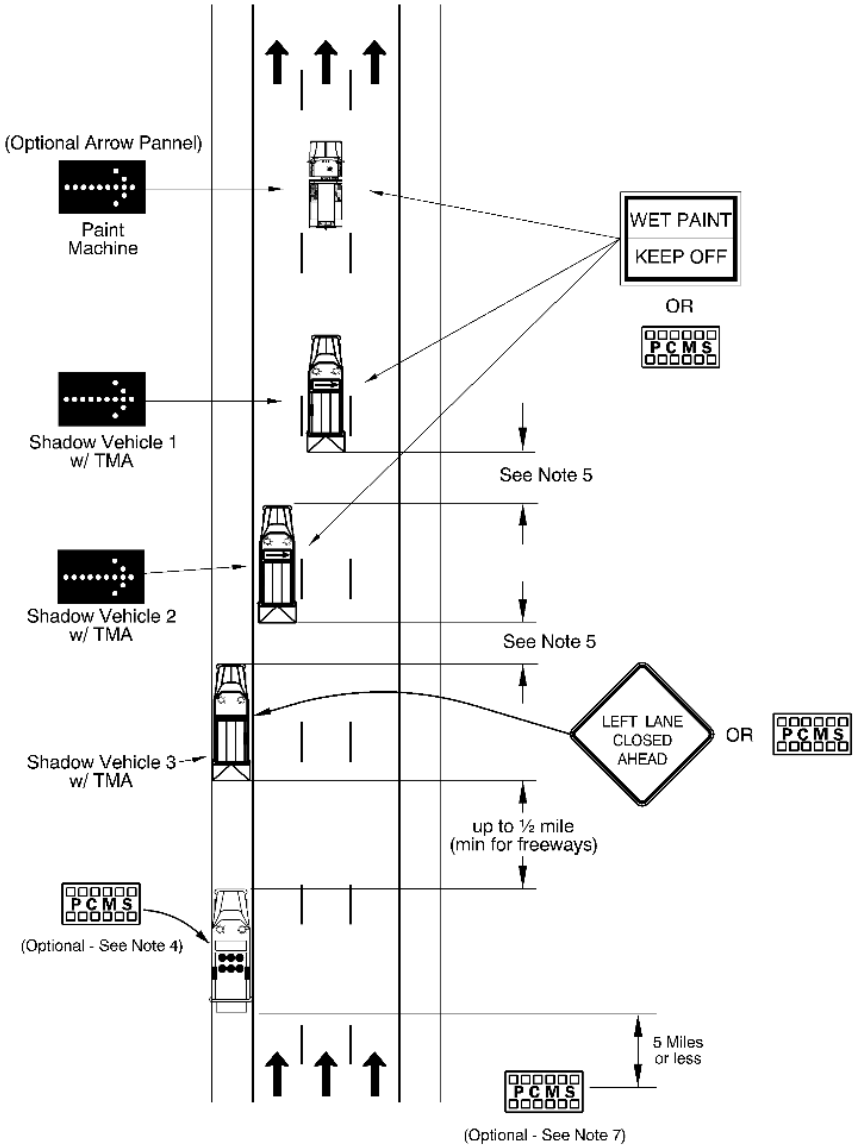
5. The vehicle array and spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately without smearing. However, the spacing ***should*** not encourage traffic to travel in the space between work vehicles. This may be the deciding factor in how many vehicles to use.

6. Use of TMA on freeways is required. On other roads with a posted speed of 45 mph or more, use of at least one TMA is recommended. If used, the TMA ***should*** be on the first vehicle exposed to traffic in any part of the travel lane. In this case, a hazard assessment conducted by the supervisor will determine which vehicle ***should*** be equipped with the TMA.

7. A PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The PCMS ***should*** identify the type of work on the first panel and “NEXT XX MILES” on the second panel.

8. The distance between the work and the PCMS ***should*** be limited to five miles or less.

Striping on Multi-Lane Roads and Freeways Diagram 140



Rolling Slowdown Diagram 150

A rolling slowdown provides short road closures for such activities as cleaning debris from the road, pushing disabled vehicles to the shoulder or pulling power lines across the road. Although rolling slowdowns are typically done on freeways, they may be used on other limited access roads as well. The diagram shows the standard configuration for performing a rolling slowdown.

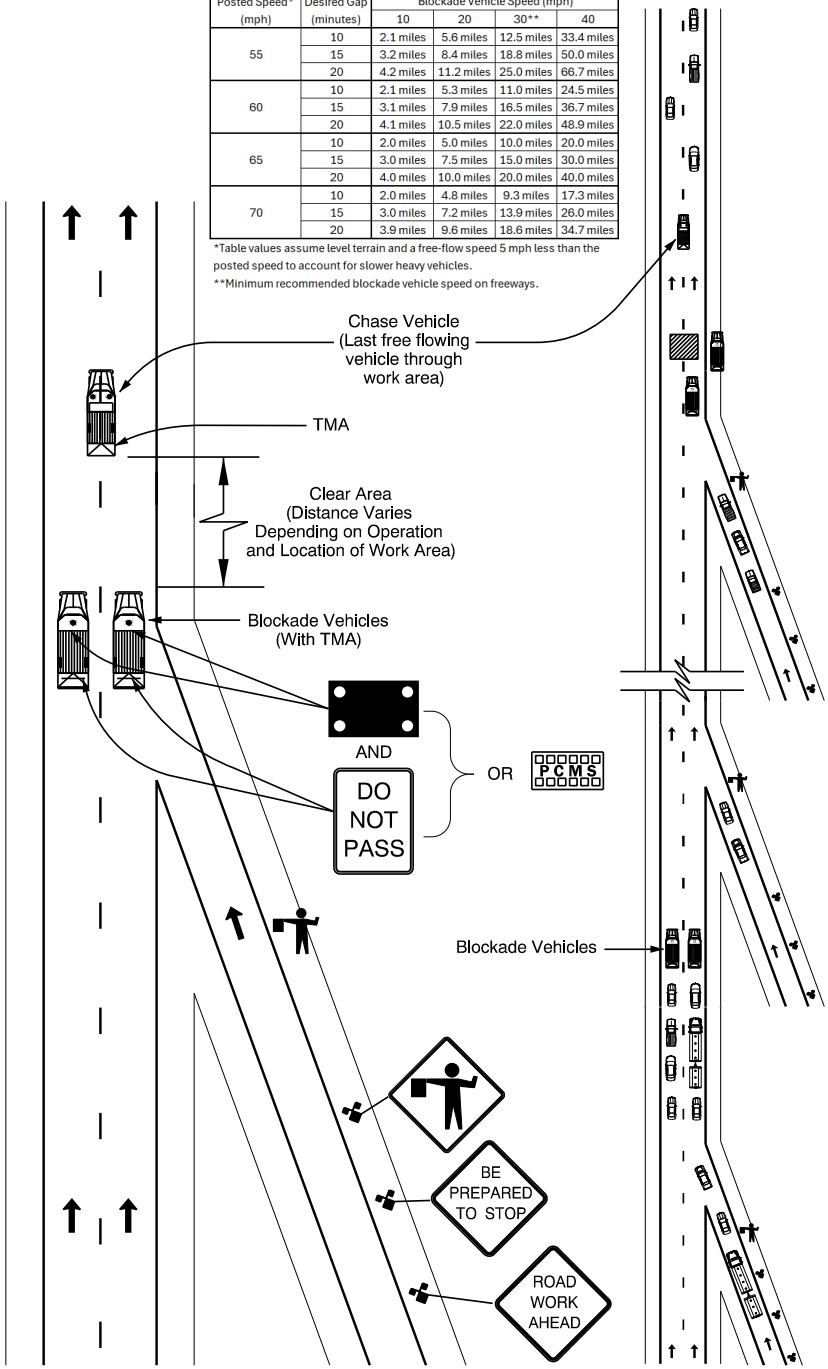
1. The slowdown *should* be scheduled during off-peak traffic periods except in emergencies. Inform all local enforcement.
2. Use truck-mounted flashing lights on work and blockade vehicles.
3. The minimum recommend slowdown speed for highways is 15 mph and for freeways is 30 mph. If the work is progressing more slowly than planned, the traffic speeds can be reduced as needed. The queue *should* never stop completely. Use the table on Diagram 150 to determine the proper slowdown vehicle speed for the desired control delay gap.
4. Advance warning is required at least ½ mile before the start of the slowdown. Changeable messages signs, either portable or permanent, are required at least as the initial sign.
    a. A typical message sequence would be “SLOW TRAFFIC AHEAD/PREPARE TO SLOW.”
    b. The slowdown may be announced in advance on changeable message signs. Consider public service announcements when there is primarily local traffic.
    c. Start the sign displays when the blockade vehicles are ready to enter the road and continue until the traffic speeds are close to normal.
5. Advance signing **shall** be placed at the approach to each entry ramp except when not practical for emergency operations.
6. All ramps and entrances to the road between the moving blockade and the work space **shall** be temporarily closed.
7. One blockade (slowdown) vehicle per lane *should* be used. Each vehicle **shall** have an arrow panel in caution mode with a DO NOT PASS (R4-1) sign or a truck-mounted PCMS displaying “DO NOT PASS/ROLLING SLOWDOWN”.
8. The slowdown proceeds as follows:
    a. The chase vehicle follows the last free moving vehicles and communicates when it is safe to begin work.
    b. Traffic is held at every entrance until the rolling slowdown passes.
    c. The blockade vehicles notify flaggers when to release traffic.
9. Good communication is essential among all traffic control vehicles, flaggers, chase vehicle and the job site. Assign a competent person at the job site to keep in contact with the blockade vehicles and work crew for adjustments.

Rolling Slowdown Diagram 150

Minimum Controlled Delay Area Table					
Posted Speed* (mph)	Desired Gap (minutes)	Blockade Vehicle Speed (mph)			
		10	20	30**	40
55	10	2.1 miles	5.6 miles	12.5 miles	33.4 miles
	15	3.2 miles	8.4 miles	18.8 miles	50.0 miles
	20	4.2 miles	11.2 miles	25.0 miles	66.7 miles
60	10	2.1 miles	5.3 miles	11.0 miles	24.5 miles
	15	3.1 miles	7.9 miles	16.5 miles	36.7 miles
	20	4.1 miles	10.5 miles	22.0 miles	48.9 miles
65	10	2.0 miles	5.0 miles	10.0 miles	20.0 miles
	15	3.0 miles	7.5 miles	15.0 miles	30.0 miles
	20	4.0 miles	10.0 miles	20.0 miles	40.0 miles
70	10	2.0 miles	4.8 miles	9.3 miles	17.3 miles
	15	3.0 miles	7.2 miles	13.9 miles	26.0 miles
	20	3.9 miles	9.6 miles	18.6 miles	34.7 miles

*Table values assume level terrain and a free-flow speed 5 mph less than the posted speed to account for slower heavy vehicles.

**Minimum recommended blockade vehicle speed on freeways.



5.7 Shoulder Work

Short-Duration Road Work Diagram 200

Diagram 200 covers activity in the roadway of 15 minutes or less with vehicles parked on the shoulder. Typical work includes debris removal, tagging of survey markers, or marking utility lines. Work in the roadway coincides with gaps in the traffic so flow is not impeded.

1. Do not use this diagram if traffic must be controlled to gain safe access to the work space due to conditions such as high travel speeds or traffic volumes. Use the appropriate lane closure or mobile work zone layout.

2. Use truck-mounted flashing warning lights on work vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

3. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.

4. The work vehicles ***should*** be parked as far off the travel lanes as practical.

5. If a 10-foot minimum travel lane cannot be maintained or when opposing direction of traffic cannot safely pass, use the appropriate lane closure diagrams, such as Diagrams 310 through 350.

6. The initial warning sign ***should*** be used if the sight distance is less than 750 feet and traffic volumes are over 400 ADT.

7. A spotter or work zone intrusion alarm may be used to warn workers of approaching traffic. This is especially appropriate when sight distances are limited or speeds are high. See Section 1.11 – Spotter / Work Zone Intrusion Alarm Guidelines for additional information.

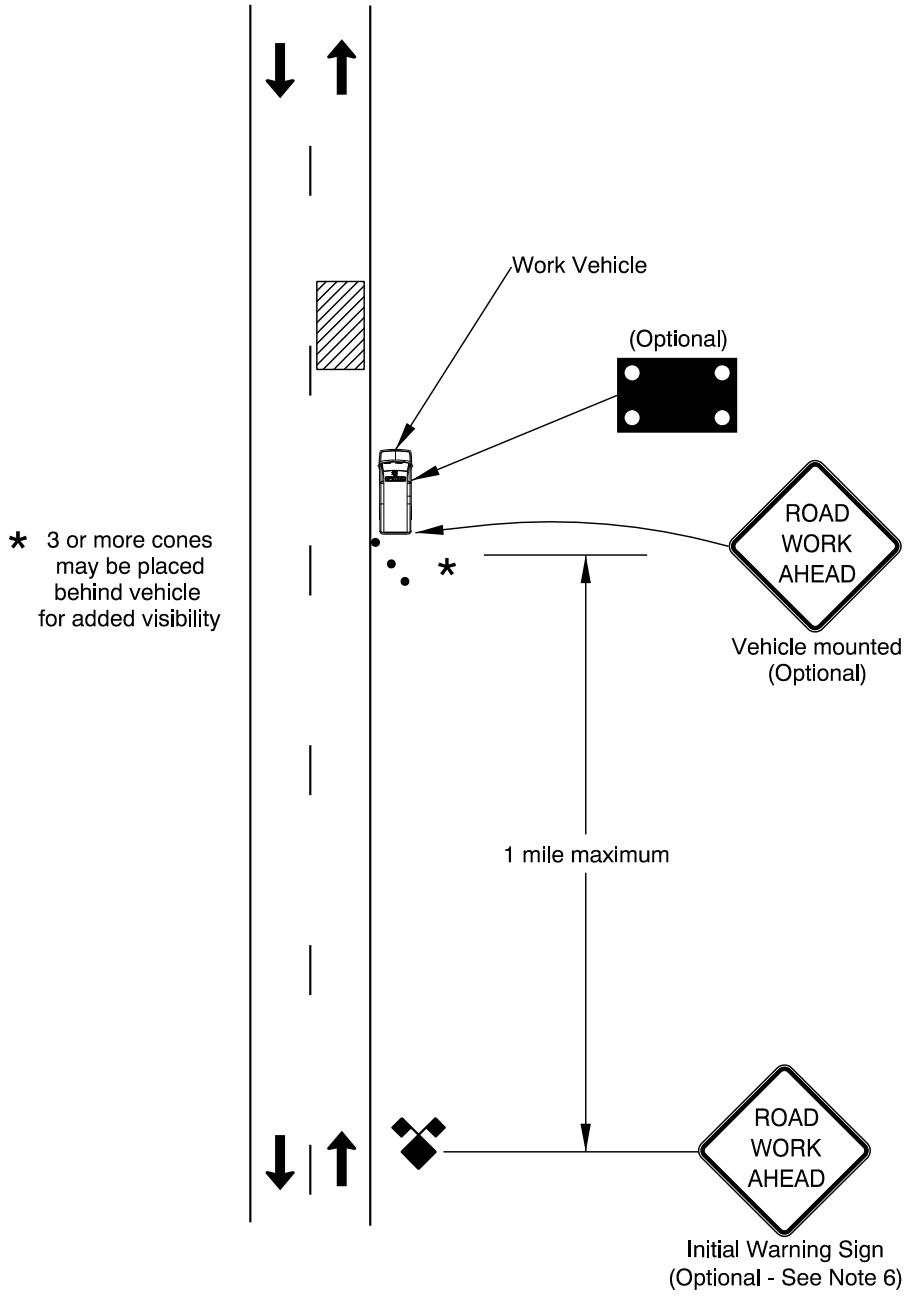
8. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:

    a. Providing a dedicated TPAR;

    b. Temporarily suspending the work and making the route passable; or,

    c. Guiding pedestrians through or around the work area.

Short-Duration Road Work Diagram 200



Work on Shoulder Diagram 210

Diagram 210 covers stationary work with work or parked equipment on the shoulder. For work on freeway shoulders, use Diagram 710 – Freeway Shoulder Work.

1. Vehicles ***should*** be parked as far off the roadway as practical.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.
4. Arrow panels in caution mode are recommended for work on roads with posted speeds of 45 mph or greater, and where traffic volumes are greater than 2,000 ADT.
5. Requirements for signing and devices are shown in Table 5-2, below.
6. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:
    a. Providing a dedicated TPAR;
    b. Temporarily suspending the work and making the route passable; or,
    c. Guiding pedestrians through or around the work area.

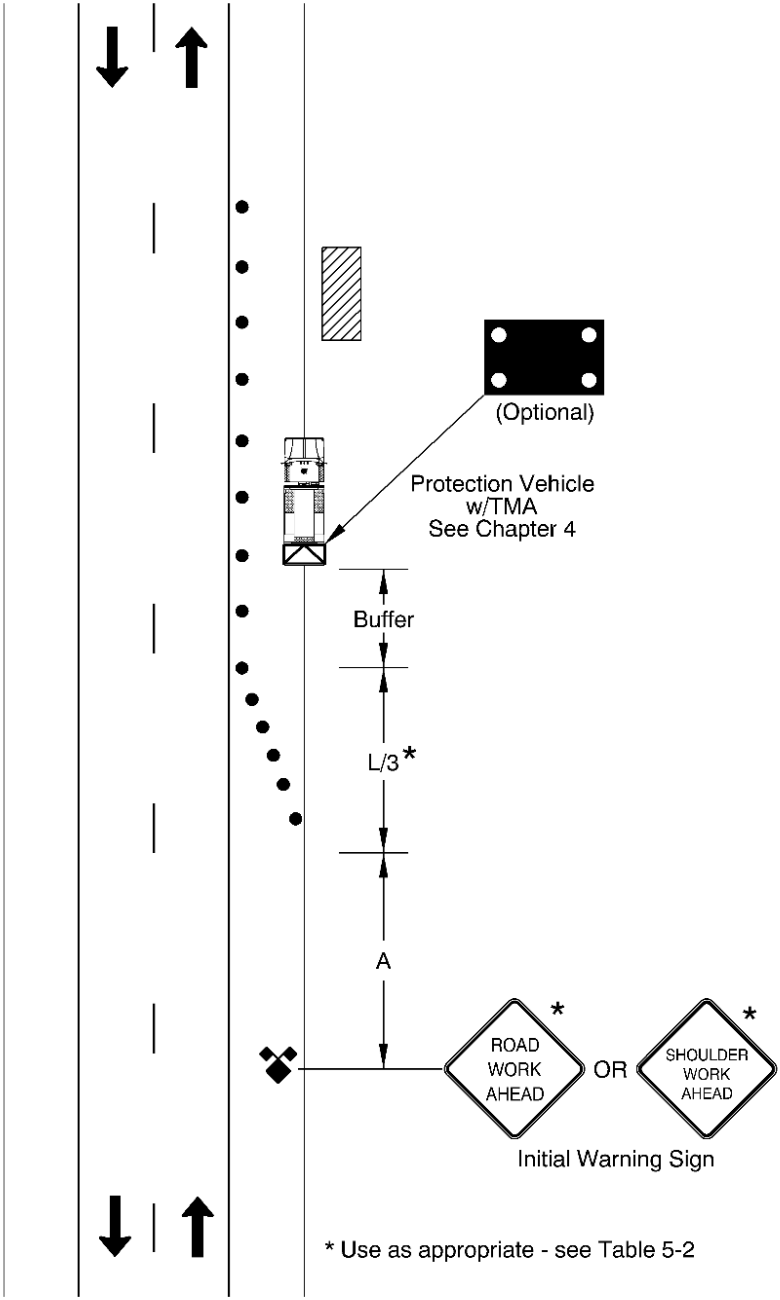
Table 5-2: Device and Signage Guidelines

	Proximity to Edge of Traveled Way	
	More than 15 feet or behind Barrier or Guardrail	**Less than 15 feet**
Work in Place More than 1 Hour	Advance warning signs, devices, and flashing warning lights are optional.	One advance warning sign is required, and two signs are recommended. Shoulder taper is required. Cones along the edge of traveled way are optional.
Work in Place Less than 1 Hour	Advance warning signs and devices are optional.	

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work on Shoulder Diagram 210



5.8 Two-Lane, Two-Way Roads

Shoulder Work with Minor Road Encroachment Diag. 300

Use this detail for non-freeway work which extends into a travel lane and maintains a minimum 10 foot travel lane. If a minimum 10 foot travel lane cannot be maintained, or when traffic cannot safely pass by in both lanes simultaneously, use the appropriate lane closure diagrams – for example, Diagrams 310 through 350.

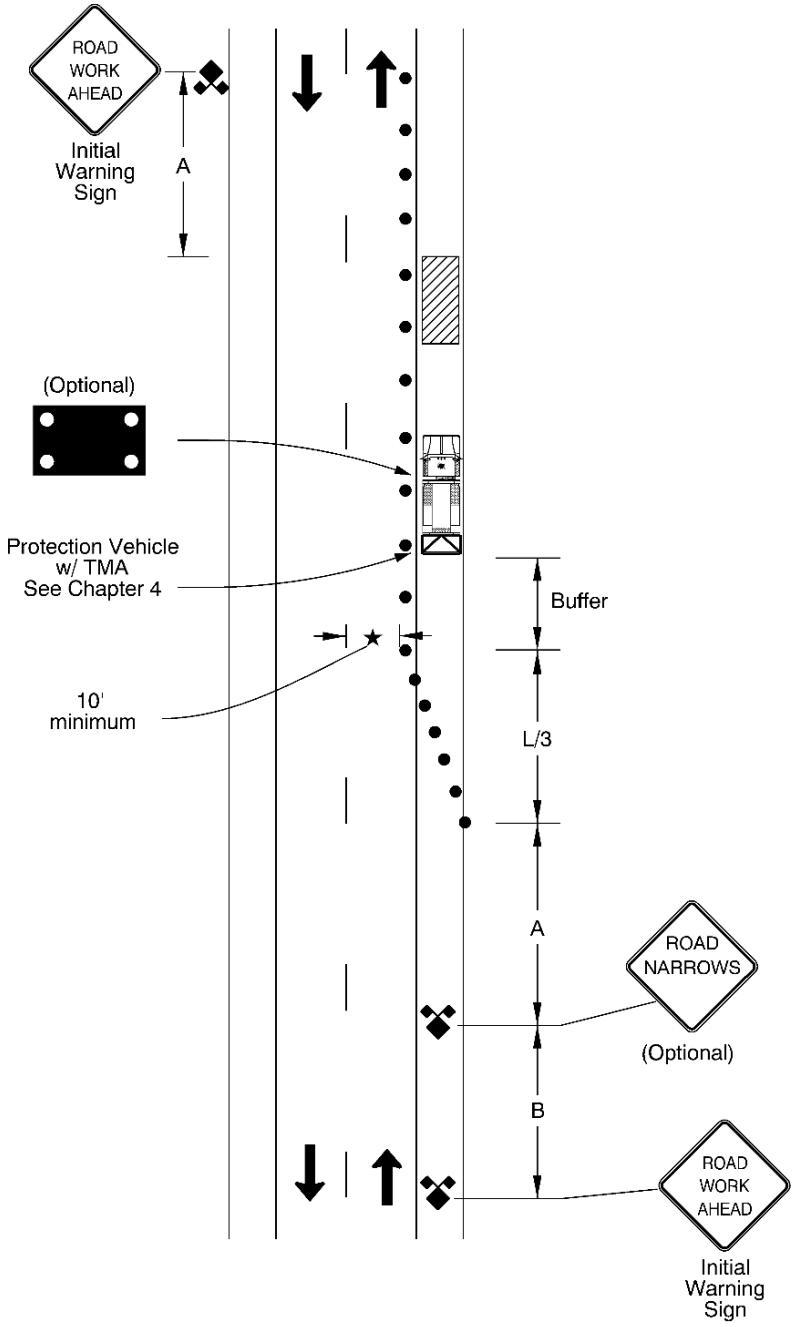
A lane closure may be appropriate for conditions such as high traffic volumes, high speeds, and inadequate approach sight distance to the work space, or heavy equipment adjacent to the travel lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. Cones **shall** be placed along the entire length of the work space. If a protection vehicle is used and work is in place one hour or less, the taper and tangent devices may be omitted.
4. If the speed is 45 mph or higher, volumes exceed 2,000 ADT, or there is limited sight distance, consider placing cones or tubular markers on centerline.
5. An arrow board in caution mode or truck-mounted PCMS with “SHOULDER WORK” or other appropriate message may be used for higher visibility.
6. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:
    a. Providing a dedicated TPAR;
    b. Temporarily suspending the work and making the route passable; or,
    c. Guiding pedestrians through or around the work area.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Shoulder Work with Minor Road Encroachment Diag. 300



Two-Lane Traffic Diversion Using Shoulder Diagram 310

Diagram 310 covers shifting traffic lanes on a two-lane, two-way roadway around the work site with one lane partially or fully on the shoulder.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. All travel lanes *should* have a minimum 10 foot lane width.

4. Shoulder **shall** be adequate in width and surfacing to carry traffic.

5. Two advance warning signs are required.

6. Place cones as shown. Cones along the far edge of travel lane, farthest from the work space, are optional and may be added to clearly mark the travel path.

7. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:

    a. Providing a dedicated TPAR;

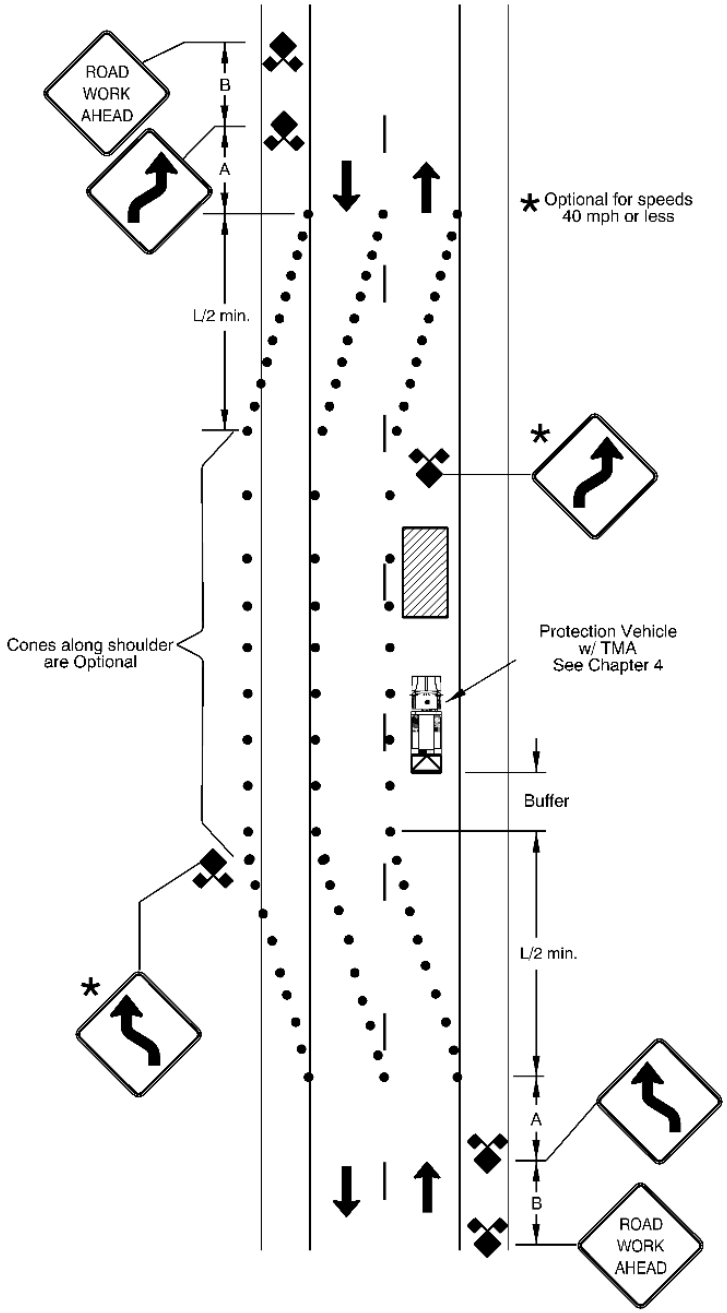
    b. Temporarily suspending the work and making the route passable; or,

    c. Guiding pedestrians through or around the work area.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Two-Lane Traffic Diversion Using Shoulder Diagram 310

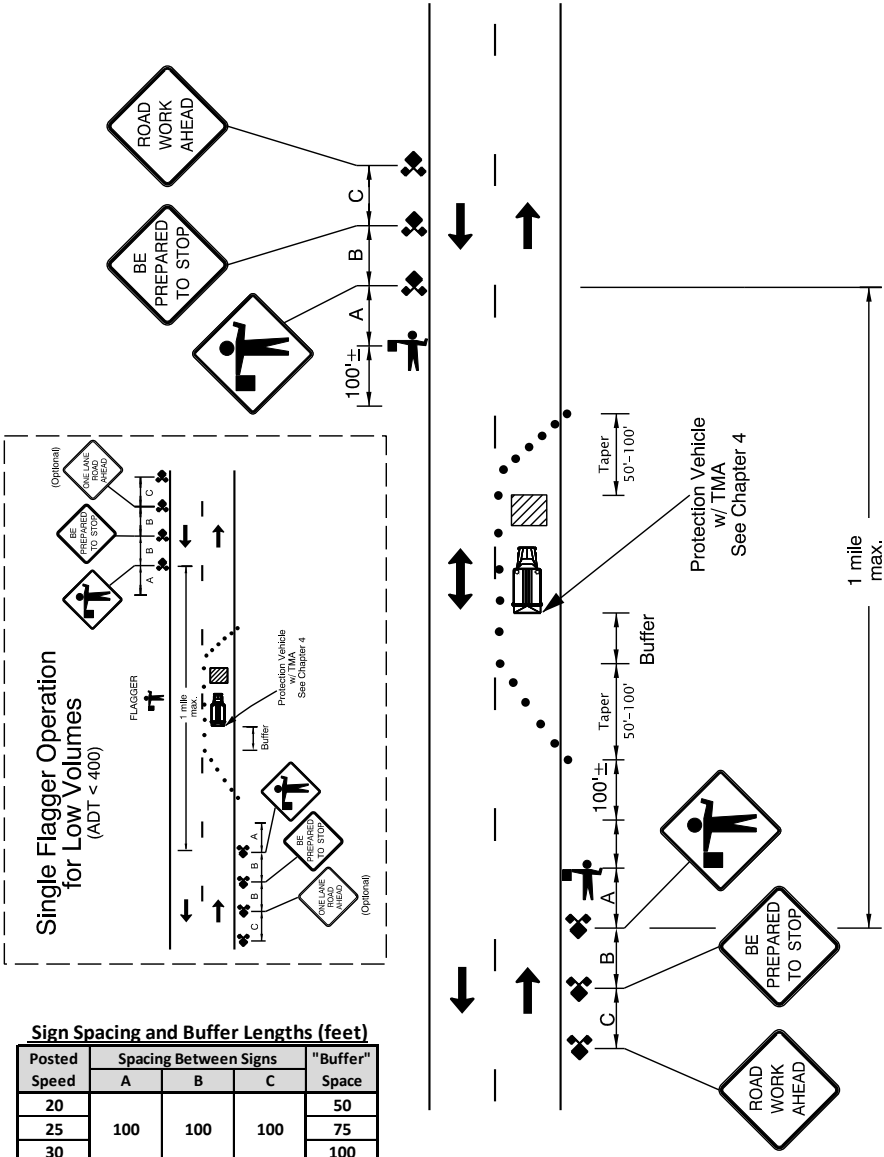


Stationary Lane Closure with Flagging Diagram 320

Diagram 320 covers the closure of one lane of a two-lane, two-way roadway. See the diagram inset for the layout if using a single flagger to control both directions of traffic on low-volume roads (less than 400 ADT) with good sight distance as discussed below.

1. AFADs may be used in place of flaggers to control traffic. See Section 3.11 – Automated Flagger Assistance Device (AFAD) Operations and Figure 3-3.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. Flagging at each approach are required if ***any*** of the following conditions exist:
    a. Night operations;
    b. Work space is over 200 feet in length;
    c. Sight distance is less than 750 feet from each approach through the lane closure; or,
    d. Traffic volumes are greater than 400 ADT.
5. The distance between the Flagger (W20-7) signs ***should*** not exceed one mile. When the distance between Flagger signs exceeds one mile, use Diagram 340 – Lane Closure with Pilot Car.
6. Channelizing devices (cones) ***should*** be used along the work space in all work zones, especially when posted speeds are 45 mph or greater, when working under heavy traffic, when curves or other roadway alignments prevent clear direction to the motorist, or when travel lanes are narrower than 11 feet. Channelizing device spacing may be increased for short-term operations or when construction vehicles need to frequently access the work space.
7. Extended queue signing (see Diagram 5-6) ***should*** be used when traffic queues extend beyond the initial advance warning sign.
8. When flagging near an intersection, the Flagger (W20-7) sign ***should*** be visible to traffic entering from any side road. Additional advance warning and Flagger signs may be placed on the side road(s).
9. Sign set-up and flagging placement shown may be used for intermittent full road closures of 20 minutes or less.
10. Flaggers ***should*** accommodate pedestrians through the work zone by stopping vehicles and directing or guiding pedestrians.

Stationary Lane Closure with Flagging Diagram 320



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Operation with Moving Flagger Stations Diagram 325

Diagram 325 covers work activities that move along the road intermittently and involve frequent short stops.

1. AFADs may be used in place of flaggers to control traffic. See Section 3.11 – Automated Flagger Assistance Device (AFAD) Operations and Figure 3-3.

2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

4. As work progresses, flagger stations ***should*** progress through moving flagger locations 1 through 4, as shown. Flaggers ***should*** coordinate location of the moving flagger stations. Flaggers **shall** be stationed for the best visibility for the situation and within sight distance of the active work space except at curves or crests on the road.

5. When the flagger is more than 1,000 feet from the FLAGGER NEXT MILE (CW20-7b) sign, intermittent cones **shall** be placed on the shoulder, as shown.

6. Flaggers are required at each end of the work space if ***any*** of the following conditions exist:
    a. Night operations;
    b. Work space is over 200 feet in length;
    c. Sight distance is less than 750 feet from each approach through the lane closure; or,
    d. Traffic volumes are greater than 400 ADT.

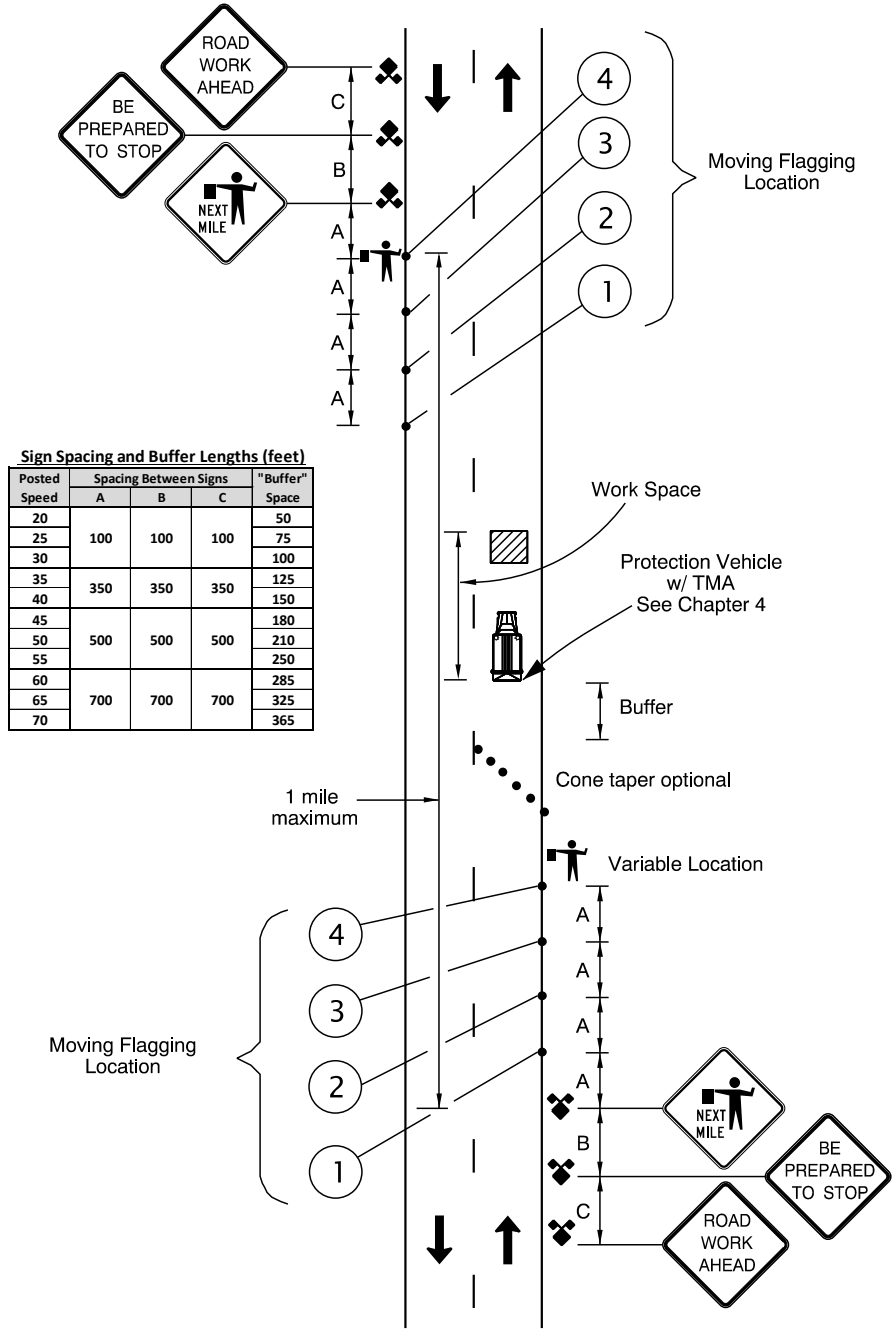
7. The length between Flagger (W20-7) signs **shall** not exceed one mile in length.

8. Extended traffic queue signing (see Diagram 5-6) ***should*** be used when traffic queues extend beyond the initial advance warning sign.

9. When flagging near an intersection, the Flagger (W20-7) sign ***should*** be visible to traffic entering from any side road. Additional advance warning and Flagger signs may be placed on the side road(s).

10. Flaggers ***should*** accommodate pedestrians through the work zone by stopping vehicles and directing or guiding pedestrians.

Operation with Moving Flagger Stations Diagram 325



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

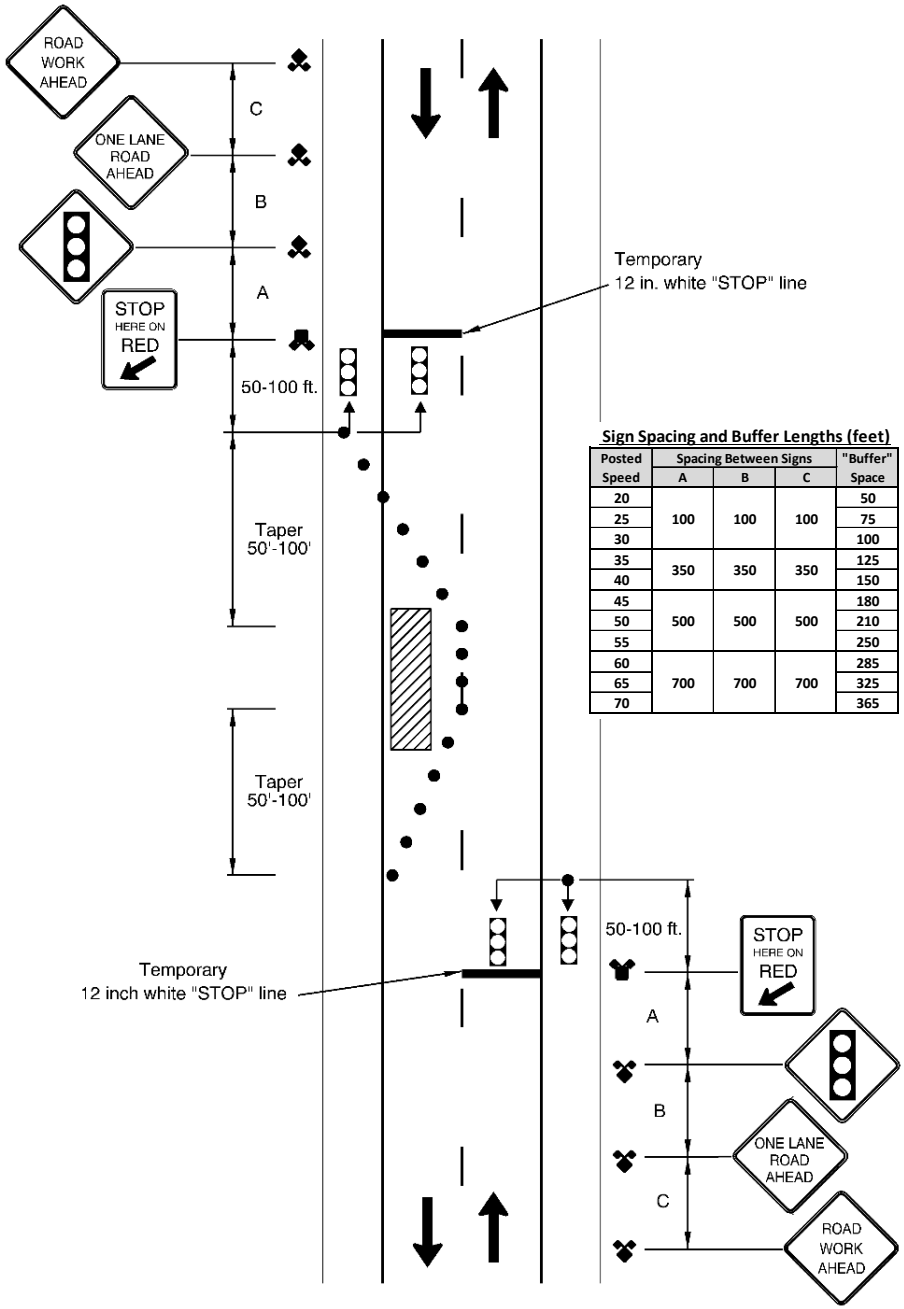
Lane Closure with Portable Traffic Signals Diagram 330

Use this detail for a lane closure on a two-lane, two-way road using portable traffic signals. The distance between STOP bars *should* be less than 1,000 feet. Traffic volumes *should* be less than 3,500 ADT.

Place one dual-head unit per direction with the overhead signal head between the center of the approach lane and centerline, and the pole mounted signal head on the shoulder.

1. Provide line of sight at all times between stop bars.
2. The signal timing parameters on which the signal timing will be based **shall** be provided by the traffic engineering staff of the road jurisdiction. The parameters **shall** not be changed without approval. The red light time **shall** allow sufficient time for all vehicles to clear the work space completely before opposing traffic is released. Provide a TPAR through the work zone by providing a shoulder for pedestrians or by including bicycle and pedestrian signal accommodations.
3. Place enough warning signs to provide adequate warning for traffic approaching the end of the traffic queue. It may be necessary to add a second set of signs or adjust the placement during the day. There **shall** be a Signal Ahead (W3-3) warning sign at distance “A” from the stop bar.
4. A temporary stop bar is required for work that will be in place for more than one hour.
5. The closest edge of the signal head on the pole and/or the trailer **shall** be at least two feet back from the edge of travel lane.
6. The bottom of the pole-mounted signal head **shall** be eight to 19 feet above the road surface or sidewalk. The bottom of the overhead signal head **shall** be 17 to 19 feet above the road surface.
7. Direct each head for maximum visibility of the lens to vehicles approaching at 550 feet in rural areas to a minimum of 200 feet on low-speed urban streets.
8. On state highways, approval from the State Traffic Engineer is required before the required permit is issued for portable traffic control signals. Also for state highways, equipment **shall** be listed on the ODOT QPL. On local roads, check with local jurisdictions for signal approval and approved equipment lists.

Lane Closure with Portable Traffic Signals Diagram 330



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure with Pilot Car Diagram 340

Use this detail when closing a long section of one lane on a two-lane, two-way road and using a pilot car to guide traffic through the closure past the work space.

1. AFADs may be used in place of flaggers to control traffic. See Section 3.11 – Automated Flagger Assistance Device (AFAD) Operations and Figure 3-3.
2. A pilot car ***should*** be used when closing a lane and there is more than one mile between Flagger (W20-7) signs, when approaching traffic cannot see from one flagger station to the other, or when conducting work at night.
3. A pilot car operation ***should*** be limited to 3-5 miles, depending on traffic volume and roadway geometry.
4. Operation of the pilot car **shall** be coordinated with flagging operations at each end of the one-lane section.
5. Radios or other reliable communications **shall** be used between flaggers, the pilot car and the work superintendent, or designated worker, at all times.
6. Instead of flaggers, the WAIT FOR PILOT CAR (CR4-20) sign may be posted on side roads or accesses intersecting state highways when pilot cars are being used to control traffic on the mainline through the work zone, provided:
    a. Access or side road traffic is being stopped for no more than 20 minutes (per Section 00220 of the *Oregon Standard Specifications for Construction*, and Chapter 3 of the *Oregon Temporary Traffic Control Handbook*).
    b. Access or side road is a dead-end facility or has no immediate alternate access, has an ADT of 100 vpd or less, and does not access public service facilities (e.g. parks, rest stops, waysides, ranger stations, landfills, utility hubs, treatment plants, etc.).

    For private residential driveways, see sign CR4-20a.

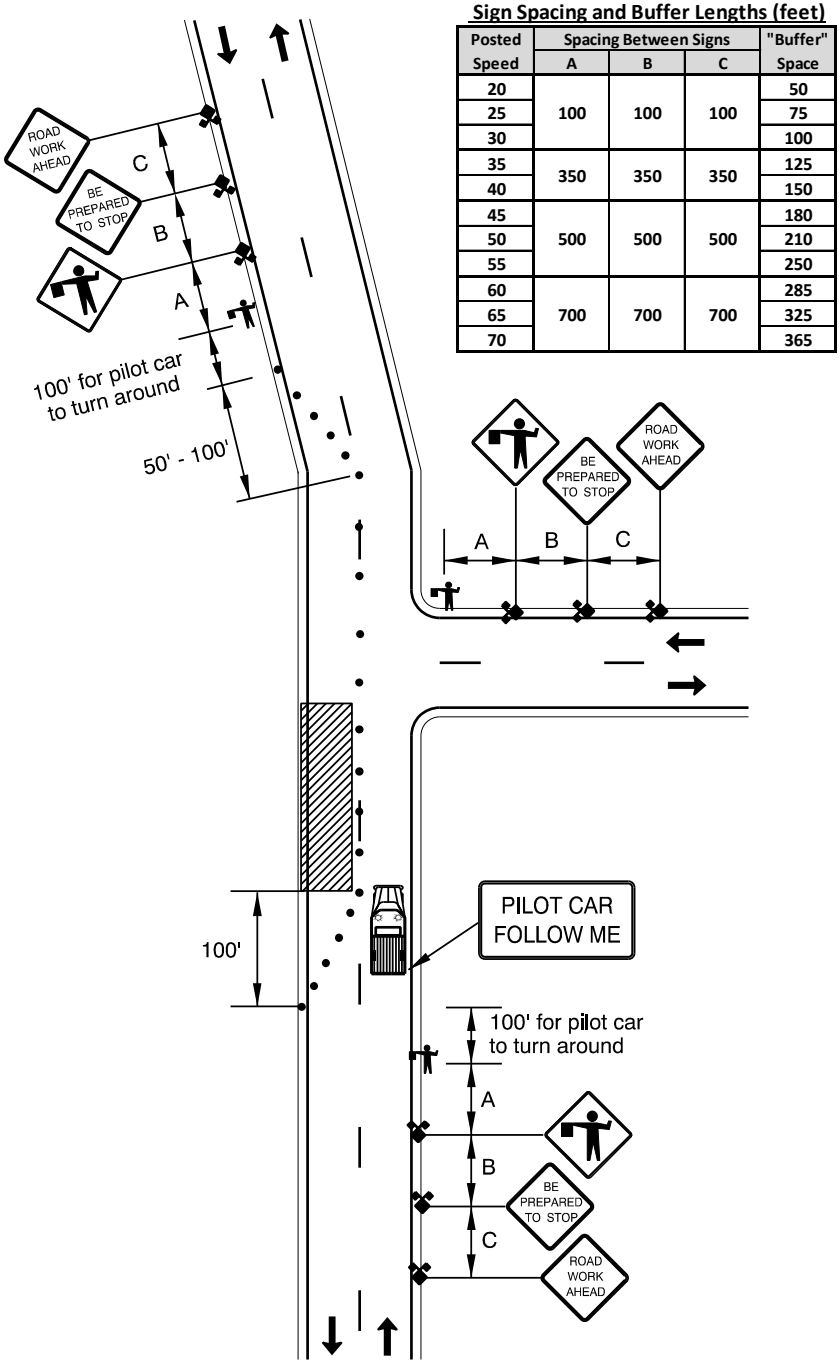
    Intersections or accesses using the WAIT FOR PILOT CAR (CR4-20) sign ***should*** be checked regularly to ensure safe and effective traffic operations.

    For a facility with an ADT greater than 100 vpd, but not exceeding 400 vpd, the sign may be used only if closely monitored and frequently checked for traffic compliance, operation and safety. If operational issues are observed at these or any other location using the WAIT FOR PILOT CAR sign, the sign ***should*** be replaced with a flagger or other traffic control measure as quickly as practical.
7. Mount the PILOT CAR FOLLOW ME (G20-4) sign in a conspicuous location on the top or on the rear of the pilot car. A truck-mounted PCMS may be substituted for the PILOT CAR FOLLOW ME sign.
8. The last vehicle in the pilot car queue can be identified by communication between flaggers. Alternately, the last vehicle may be identified by handing off a flag between the driver and flaggers.
9. No vehicles ***should*** be allowed to pass the pilot car.
10. Channelizing devices (cones) ***should*** be used along the work space in all work zones, especially when posted speeds are 45 mph or greater, when working under heavy traffic, when curves or other roadway alignments prevent clear direction to the motorist, or when travel lanes are narrower than 11 feet. Channelizing devices spacings may be increased for short-term operations or when construction vehicles need to frequently access the work space.
11. Flaggers ***should*** accommodate pedestrians through the work zone by stopping vehicles and directing or guiding pedestrians.
12. For oiling and chip seal operation details, see Diagram 345.

Lane Closure with Pilot Car Diagram 340

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365



Oiling and Chip Seal Operation Diagram 345

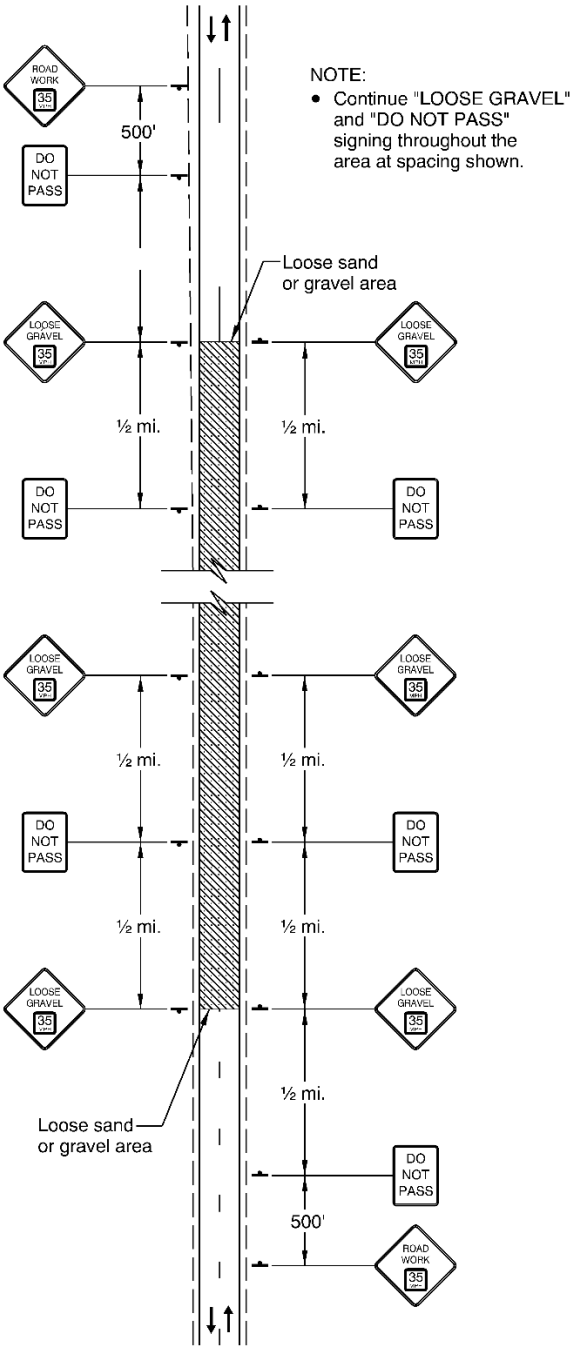
Use this diagram to identify and locate traffic control devices used for emulsified asphalt surface treatments ("EAST" – commonly referred to as "chip seals") and oiling operations.

1. When traffic is allowed on loose gravel, the following signs (or equivalent) ***should*** be used to warn traffic of the changed pavement surface. Use a speed appropriate for the conditions – typical speeds used range from 30 – 35 mph:
    a. For chip seal projects, use the LOOSE GRAVEL XX MPH (CW8-7a) sign, as shown in the diagram.
    b. For oiling operations, use the ROAD WORK XX MPH (CW20-1a) in place of the LOOSE GRAVEL XX MPH signs shown in the diagram.
2. Signs ***should*** remain in place until the majority of loose rock is removed.
3. The sign sequence ***should*** be repeated, as shown, throughout the affected area in both directions.
4. See Diagram 5-9 for temporary centerline pavement markings.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Oiling and Chip Seal Operation Diagram 345



Self-Regulating Lane Closure Diagram 350

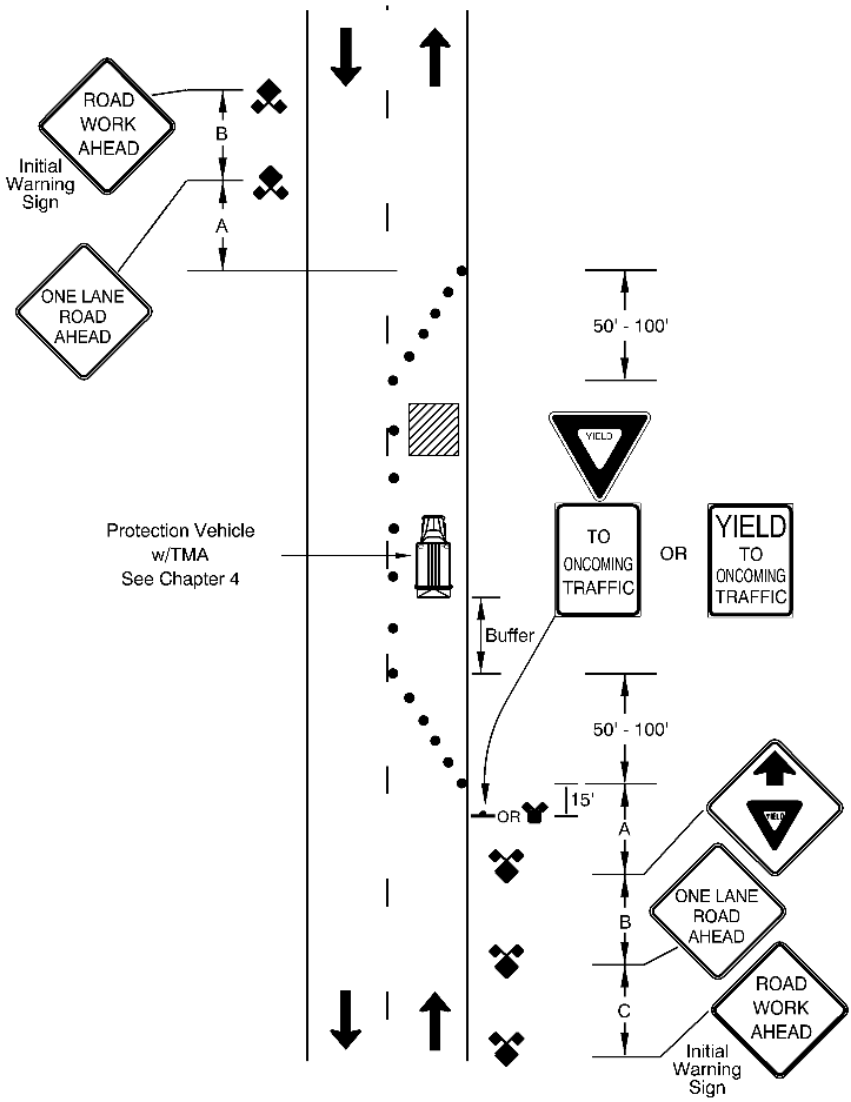
Use this detail for closures of one lane of a low-speed, two-lane, two-way road.

1. Use this diagram only if all of the following are true:
    a. Work space is less than 200 feet.
    b. The posted speed is 40 mph or less (unless not posted and speed governed by basic rule).
    c. ADT is less than 400.
    d. Sight distance is more than 750 feet at each end.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, a truck-mounted arrow panel or PCMS in caution mode may be used.
4. A Right Lane Ends (W4-2R) sign, or RIGHT LANE ENDS (W9-1R) sign, may be placed inside the cone taper for more emphasis.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Self-Regulating Lane Closure Diagram 350



Work in Center of Low-Speed Roads Diagram 360

Use Diagram 360 only on two-lane, two-way roads with a posted speed of 40 mph or less (unless not posted and speed governed by basic rule); and when there is sufficient lane and shoulder width to allow a minimum of 10 feet on each side of the work space.

1. When work vehicle(s) are in the work space, use truck-mounted flashing lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions. Allow a sufficient distance between the vehicle and work activity for safe run out if the vehicle is struck.

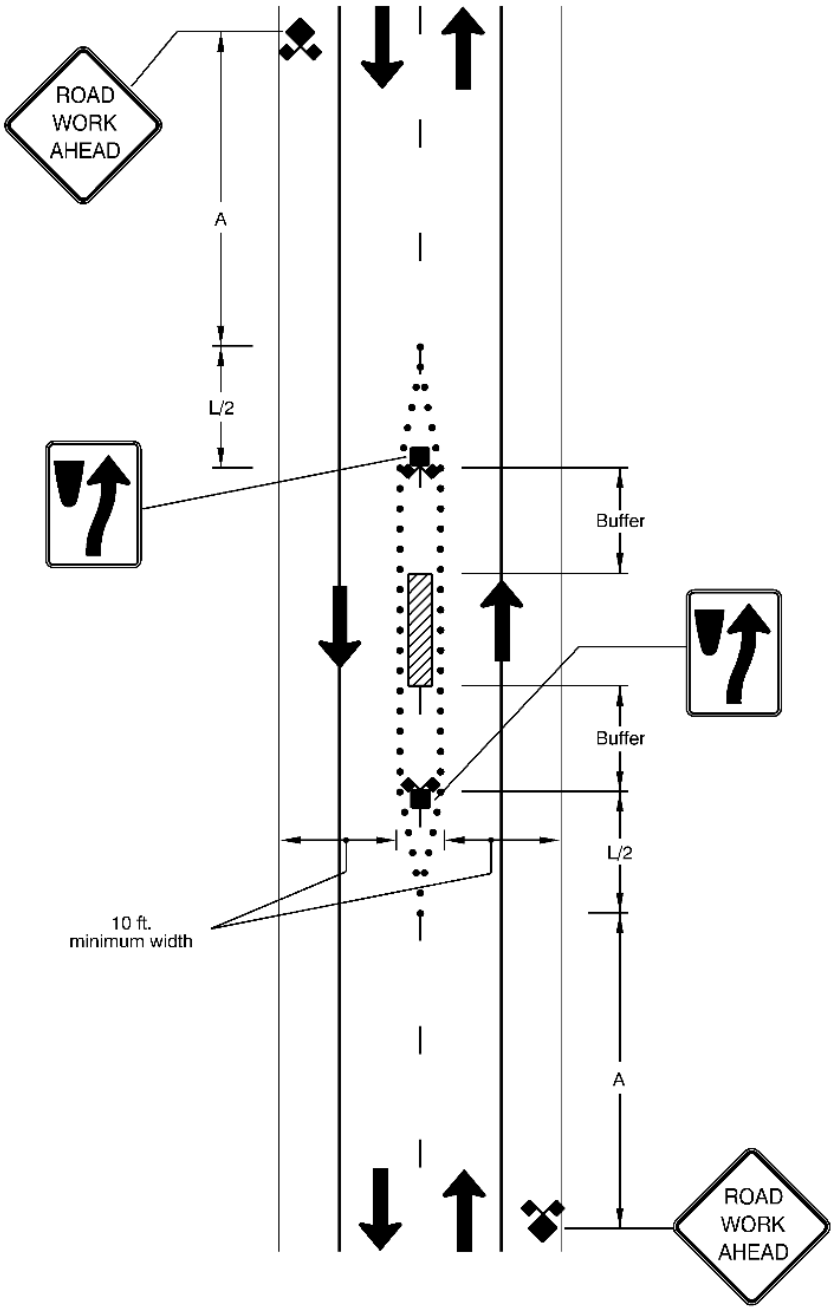
2. Cones and signs shown are required.

3. The Keep Right (R4-7) symbol sign may be mounted on a portable sign support or a barricade, if crashworthy.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in Center of Low-Speed Roads Diagram 360



Work with In-Street Running Transit Tracks Diagram 370

Use Diagram 370 where work is within or adjacent to two-way streets which include in-street running transit rail tracks. The rail or transit "right-of-way" (the width needed and path used by the rail or transit vehicle) may occupy and share one traffic lane of the roadway.

1. Do not block transit right-of-way or impede train traffic with temporary signs, barricades or channelization devices.

2. Traffic control plans **shall** be approved by the railroad or transit authority. Review of traffic control plans may define additional requirements beyond those shown in the diagram.

3. Workers and flaggers **shall** be trained and authorized in track access procedures or worker protection safety prior to work in or adjacent to the right-of-way and grade crossings by the railroad or transit authority.

4. Emergency traffic control for work zones that are outside the right-of-way may require vehicles to enter the right-of-way. The railroad or transit authority **shall** be notified of such work zones.

5. Railroad signals and signs **shall** not be covered or deactivated without permission from the railroad or transit authority.

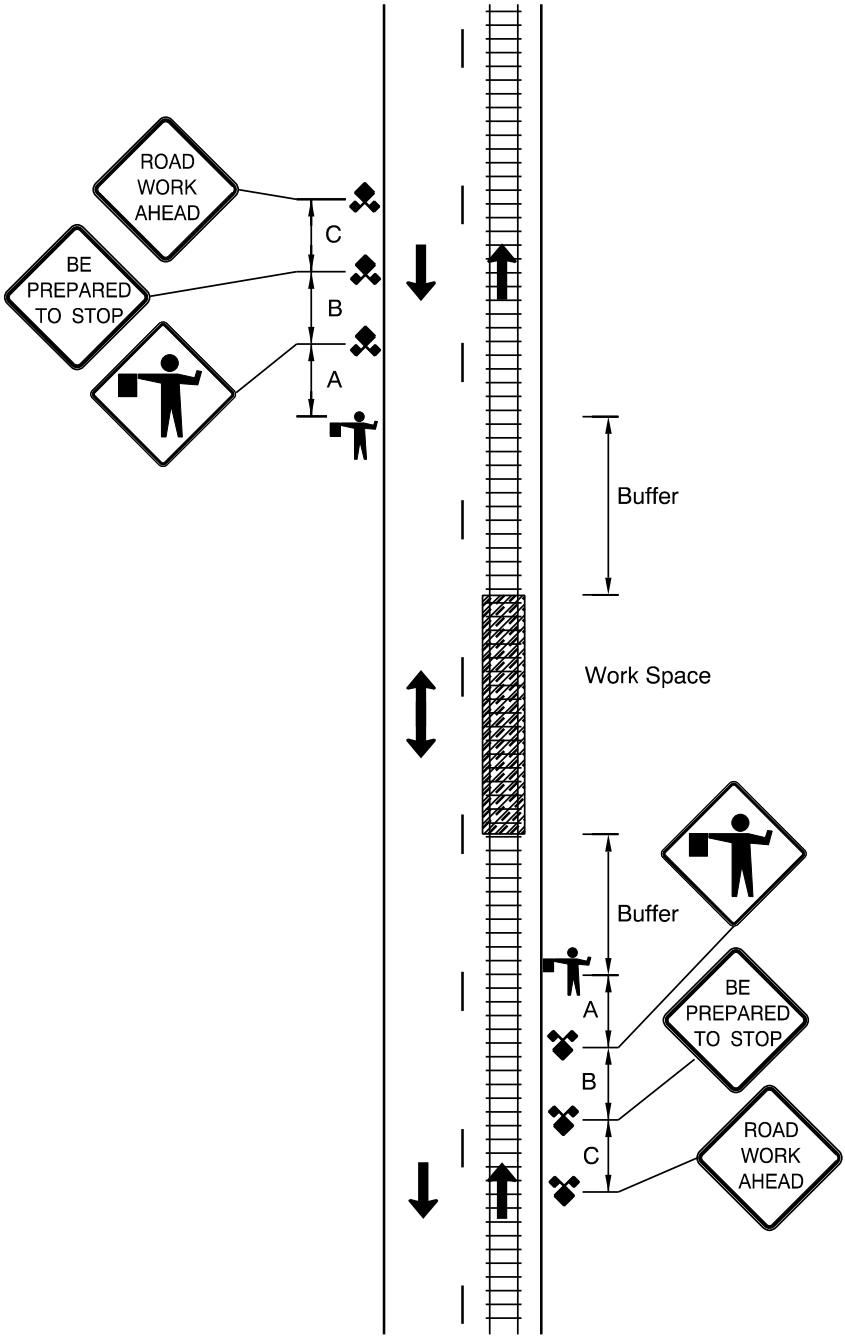
6. The grade of side roads approaching a crossing may block sight distance. Use additional advance warning signing and spacing, as needed.

7. Flaggers *should* accommodate pedestrians through the work zone by stopping vehicles and directing or guiding pedestrians.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work with In-Street Running Transit Tracks Diagram 370



5.9 Two-Way Roads with Passing Lanes

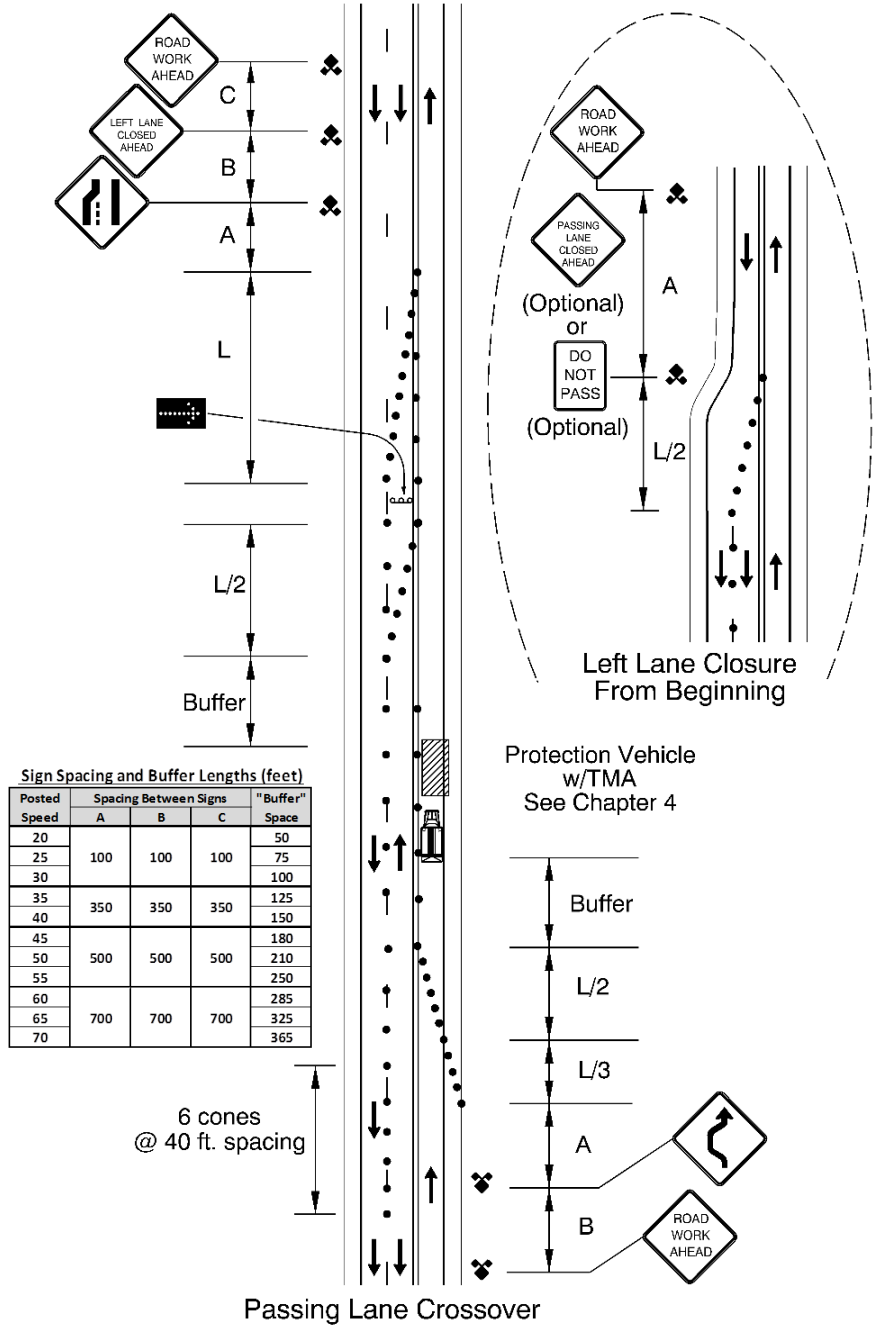
Work in the Single-Lane Direction Diagram 400

Diagram 400 shows work in the single lane direction of a three-lane, two-way road with two travel lanes in one direction and a single travel lane in the opposing direction.

Use the diagram to close the single travel lane and maintain a travel lane for each direction.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. Arrow boards in directional mode ***should*** be used for non-freeway multi-lane roads to advise approaching traffic of a lane closure in situations involving night work, heavy traffic volumes, speed limits greater than or equal to 45 mph, and/or limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. On the single lane approach, cover any passing lane signs such as YIELD CENTER LANE TO UPHILL TRAFFIC.
5. On the single lane approach, extending the cones across the shoulder in a shoulder taper (L/3) is recommended.
6. On the two lane approach, the use of 3 to 6 cones on centerline in advance of the taper is recommended.
7. An advance PCMS may be used, when closing a passing lane.
8. If there is less than 1,000 feet of passing lane remaining beyond the lane closure, the passing lane ***should*** be closed to the end.
9. If the work space is less than ½ mile from the beginning of the passing lane:
    a. The passing lane ***should*** be closed from the beginning.
    b. For details, see Diagram 400 “Left Lane Closure from Beginning” option.
    c. Cover the permanent advance passing lane signs. For example, PASSING LANE 1 MILE, Lane Ends (W4-2), and KEEP RIGHT EXCEPT TO PASS signs.
10. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:
    a. Providing a dedicated TPAR;
    b. Temporarily suspending the work and making the route passable; or,
    c. Guiding pedestrians through or around the work area.

Work in the Single-Lane Direction Diagram 400



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

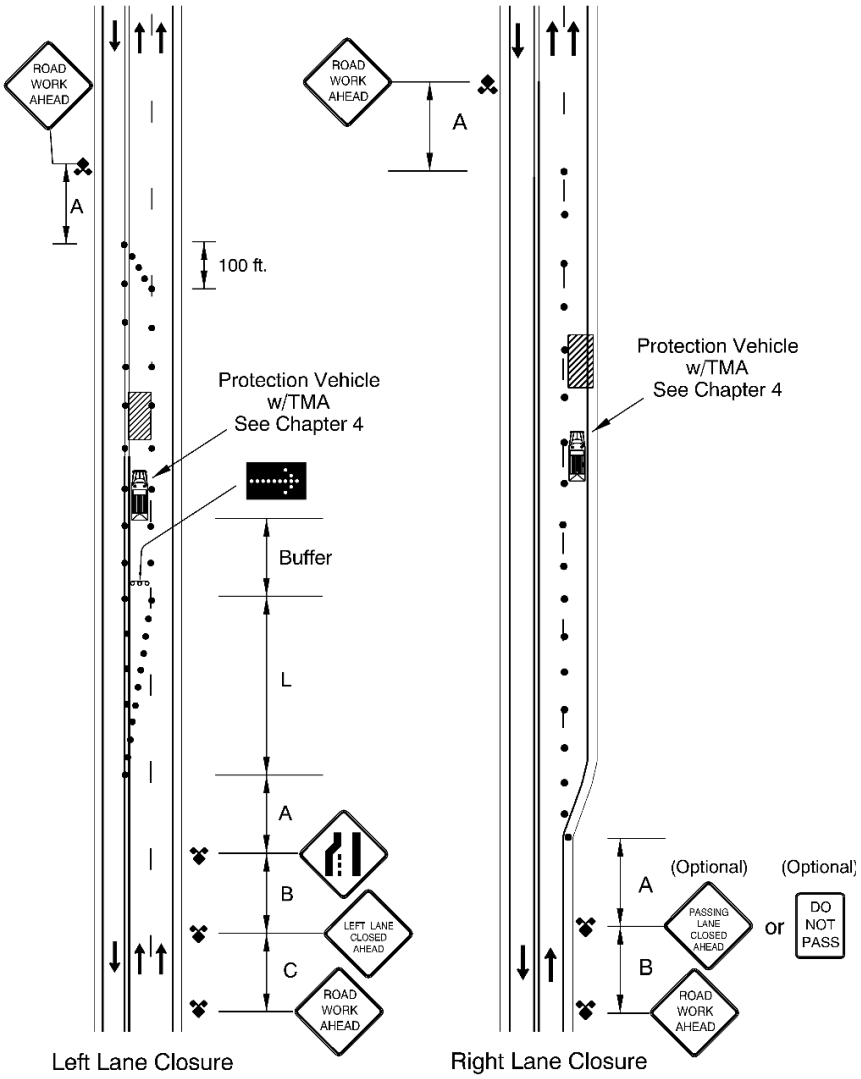
Work in the Two-Lane Direction Diagram 410

Diagram 410 shows work in the two-lane direction of a three-lane, two-way road with two travel lanes (e.g. a passing lane) in one direction and a single travel lane in the opposite direction. Use this diagram to close one lane of the two-lane section, maintaining one open lane in each direction.

Refer to Diagram 500 for right lane closure information when the work is greater than ½ mile from the beginning of the passing lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. Arrow boards in directional mode ***should*** be used for non-freeway multi-lane roads to advise approaching traffic of a lane closure in situations involving night work, heavy traffic volumes, speed limits greater than or equal to 45 mph, limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. For a middle lane closure, 3 to 6 cones on centerline in advance of the closed area in the single lane direction may be used, especially at speeds of 45 mph or greater.
5. For a right lane closure, cones may be placed on the yellow center line if lanes are narrow, sight distances are limited, or the extra separation is needed for other conditions.
6. PASSING LANE CLOSED AHEAD (CW23-6) and DO NOT PASS (R4-1) signs are optional.
7. On the single lane approach, cover any passing lane signs such as, YIELD CENTER LANE TO UPHILL TRAFFIC (OR4-11).
8. An advance PCMS is recommended and ***should*** be considered when closing a passing lane.
9. If there is less than 1,000 feet of passing lane remaining beyond the lane closure, the passing lane ***should*** be closed to the end.
10. If the work space is less than ½ mile from the beginning of the passing lane:
    a. The passing lane ***should*** be closed from the beginning.
    b. For left lane closure details, see Diagram 400.
    c. Cover the permanent advance passing lane signs. For example, PASSING LANE 1 MILE, Lane Ends (W4-2), and KEEP RIGHT EXCEPT TO PASS signs.
11. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:
    a. Providing a dedicated TPAR;
    b. Temporarily suspending the work and making the route passable; or,
    c. Guiding pedestrians through or around the work area.

Work in the Two-Lane Direction Diagram 410



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in a Two-Way Left-Turn Lane Diagram 420

Diagram 420 shows work in the continuous two-way left-turn lane of a two-way road with three or more lanes.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For operations of more than one hour, cones and signs are required as shown. Protection vehicles are optional.

4. For operations between 15 minutes and one hour, including work that will relocate intermittently, cones are required and signs may be replaced by protection vehicles with flashing lights.

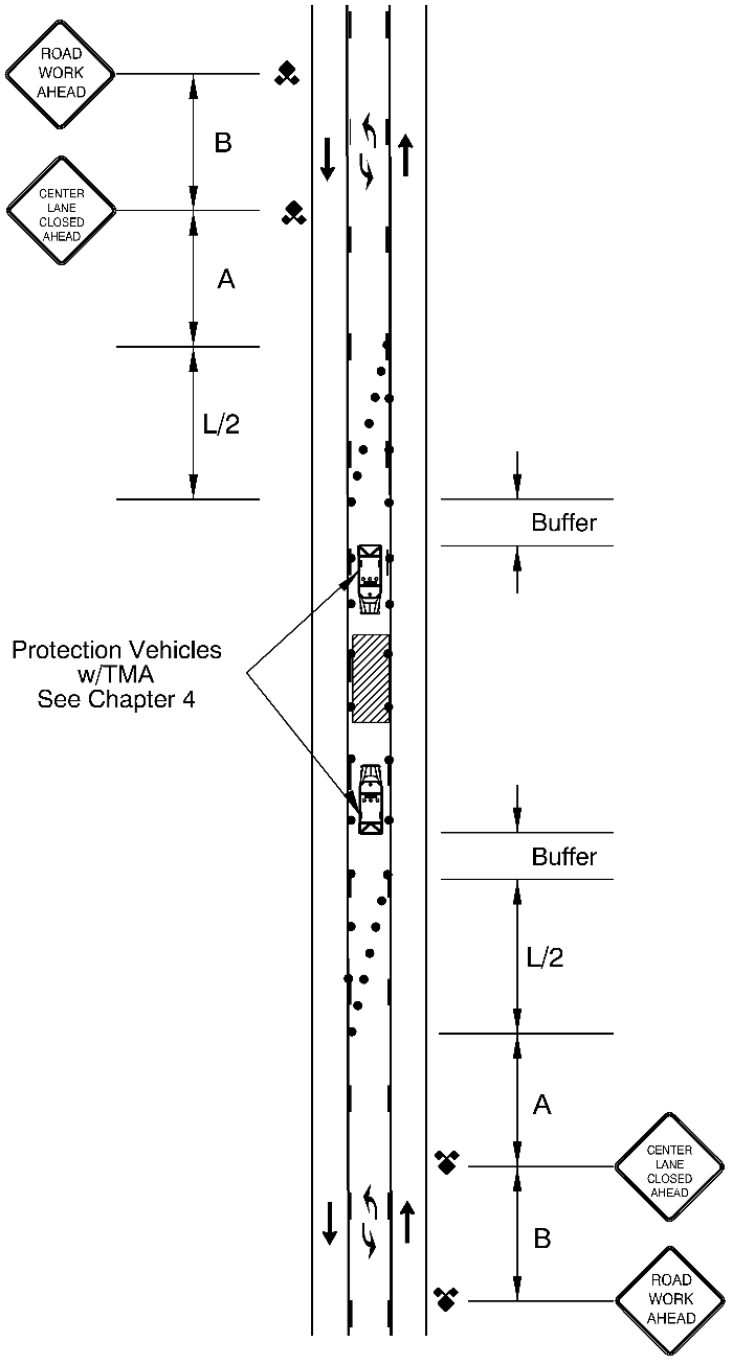
5. For operations of 15 minutes or less, signs and cones may be replaced by one or more protection vehicles with flashing lights.

6. When only one protection vehicle is used, the use of a spotter(s) is recommended to warn workers of approaching traffic.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in a Two-Way Left-Turn Lane Diagram 420



Diversion in a Two-Way Left-Turn Lane Diagram 430

Diagram 430 shows work in the travel lane(s) next to a continuous two-way left-turn lane with one direction of traffic diverted into the continuous two-way left-turn lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. When two or more travel lanes are reduced to a single lane before the diversion, each lane **shall** be closed separately. Layout traffic control according to ODOT Standard Drawing TM 852 for 5-lane sections.

4. A shifting taper (L/2) may be added in the diverted traffic direction across the continuous two-way left-turn lane (as shown). This option is recommended when the speed is 45 mph or greater.

5. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:

    a. Providing a dedicated TPAR;

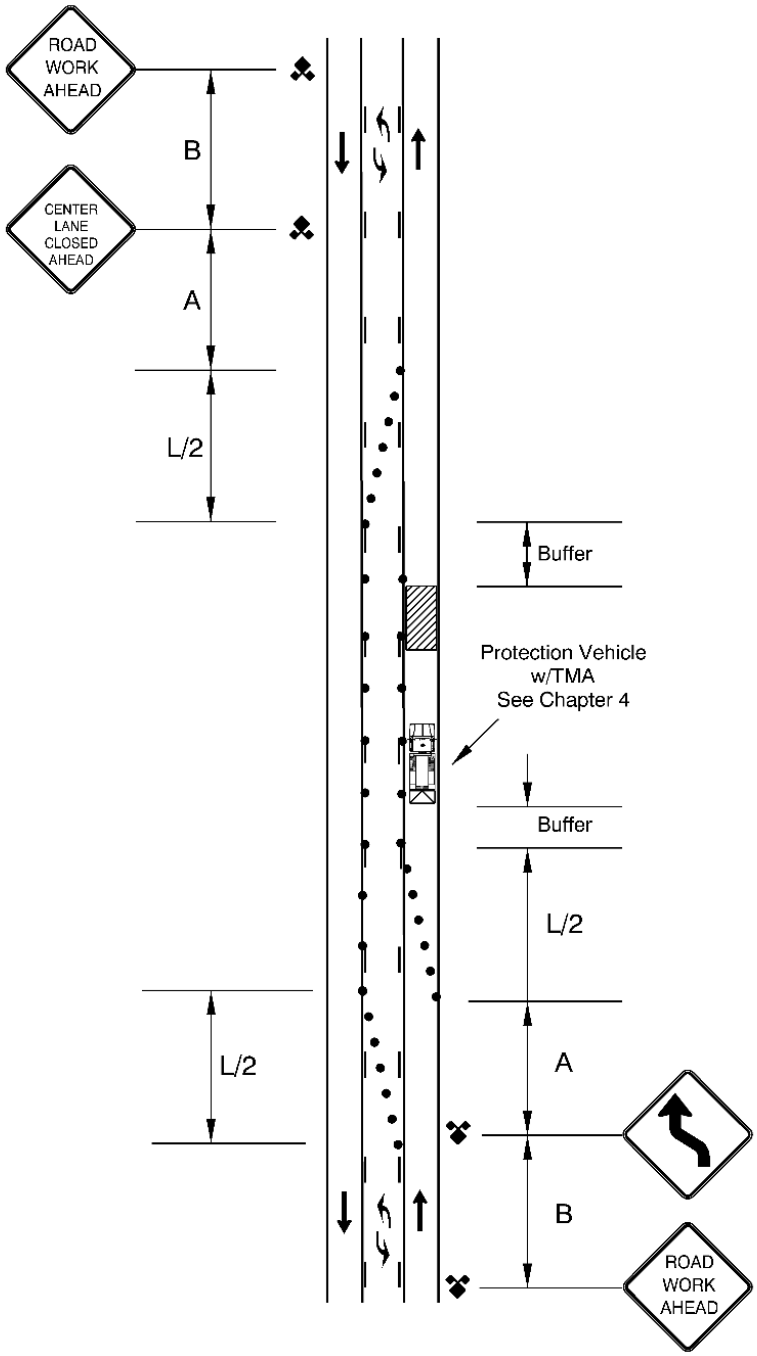
    b. Temporarily suspending the work and making the route passable; or,

    c. Guiding pedestrians through or around the work area.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Diversion in a Two-Way Left-Turn Lane Diagram 430



5.10 Multi-Lane Roads

Right Lane Closure, Multi-Lane Non-Freeway Diagram 500

Diagram 500 covers work which closes the right lane of a multi-lane non-freeway road.

If closing more than one lane on a multi-lane road, provide a minimum tangent distance of 2L between the end of the first lane closure taper and the beginning of the second lane closure taper.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. Arrow boards in directional mode ***should*** be used for non-freeway multi-lane roads to advise approaching traffic of a lane closure in situations involving night work, heavy traffic volumes, speed limits greater than or equal to 45 mph, limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.

3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

4. Signs **shall** be located on the same side of the roadway where work is occurring. On divided highways signs ***should*** be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS ***should*** be installed on the same side of the roadway where work is occurring.

5. When the posted speed is 40 mph or less, the RIGHT LANE CLOSED AHEAD (W20-5) signs may be omitted.

6. If flagging is needed for work vehicle ingress/egress, use Diagram 500 - Flagger Layout Detail (see inset).

7. When blocking or restricting the use of a pedestrian route, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:

    a. Providing a dedicated TPAR;

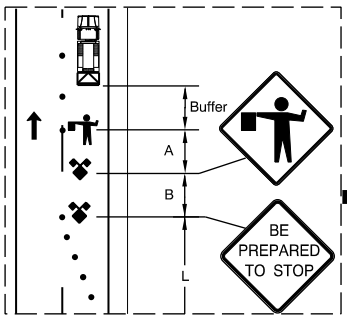
    b. Temporarily suspending the work and making the route passable; or,

    c. Guiding pedestrians through or around the work area.

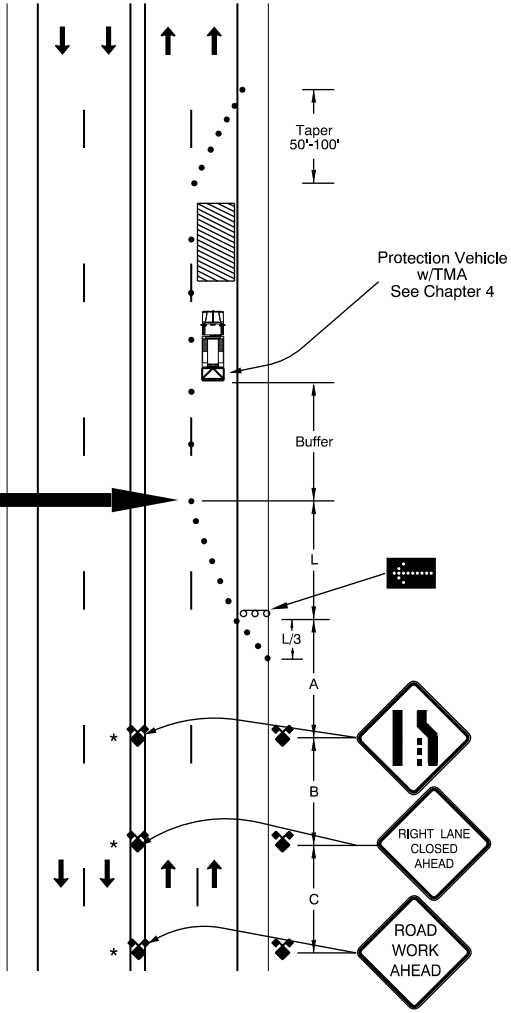
Right Lane Closure, Multi-Lane Non-Freeway Diagram 500

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365



Flagger Layout Detail



* See Note 4

Interior Lane Closure, Multi-Lane Non-Freeway Diag. 510

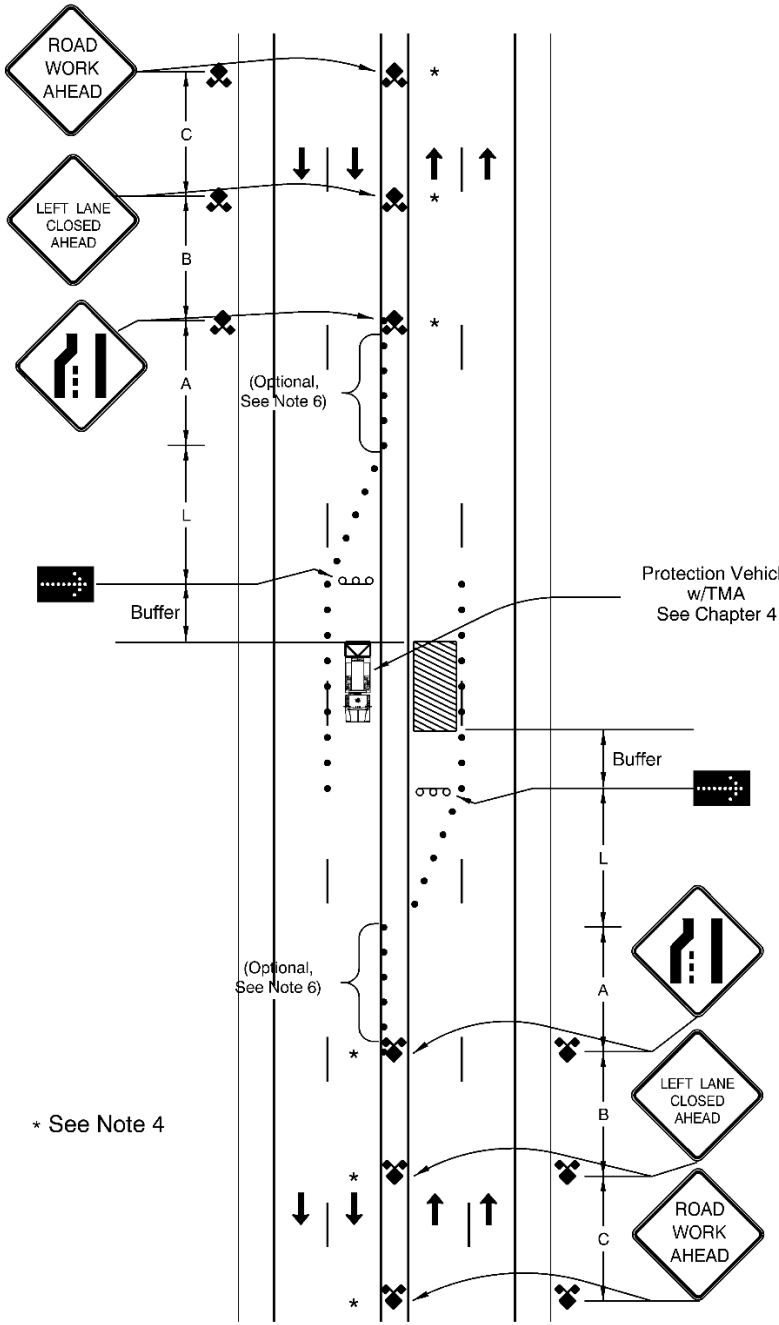
Diagram 510 covers work which will block the left lane(s) of a multi-lane non-freeway road.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. Arrow boards in directional mode *should* be used for non-freeway multi-lane roads to advise approaching traffic of a lane closure in situations involving night work, heavy traffic volumes, speed limits greater than or equal to 45 mph, limited sight distances, or at other locations and under other conditions where road users are less likely to expect such lane closures.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. Signs **shall** be located on the same side of the roadway where work is occurring. On divided highways, signs *should* be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS *should* be installed on the same side of the roadway where work is occurring. When the posted speed is 40 mph or less, the LEFT LANE CLOSED AHEAD (W20-5) signs may be omitted.
5. If the adjacent lane in the opposing direction is not closed, cone off the work space placing the cones in the median or along the centerline if there is one.
6. Cones may be placed as shown on centerline in advance of the work to better gain the attention of motorists.
7. Work vehicle(s) with or without a TMA may be used to protect the workers and work space.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Interior Lane Closure, Multi-Lane Non-Freeway Diag. 510



5.11 Intersection Operations

For all intersection operations diagrams, the diagrams can be used at T intersections by omitting the temporary traffic control (TTC) shown on the non-existing leg.

Lane Closure, Near Side of Intersection Diagram 600

Diagram 600 covers closure of an intersection approach lane. Work vehicles may or may not be in the work space.

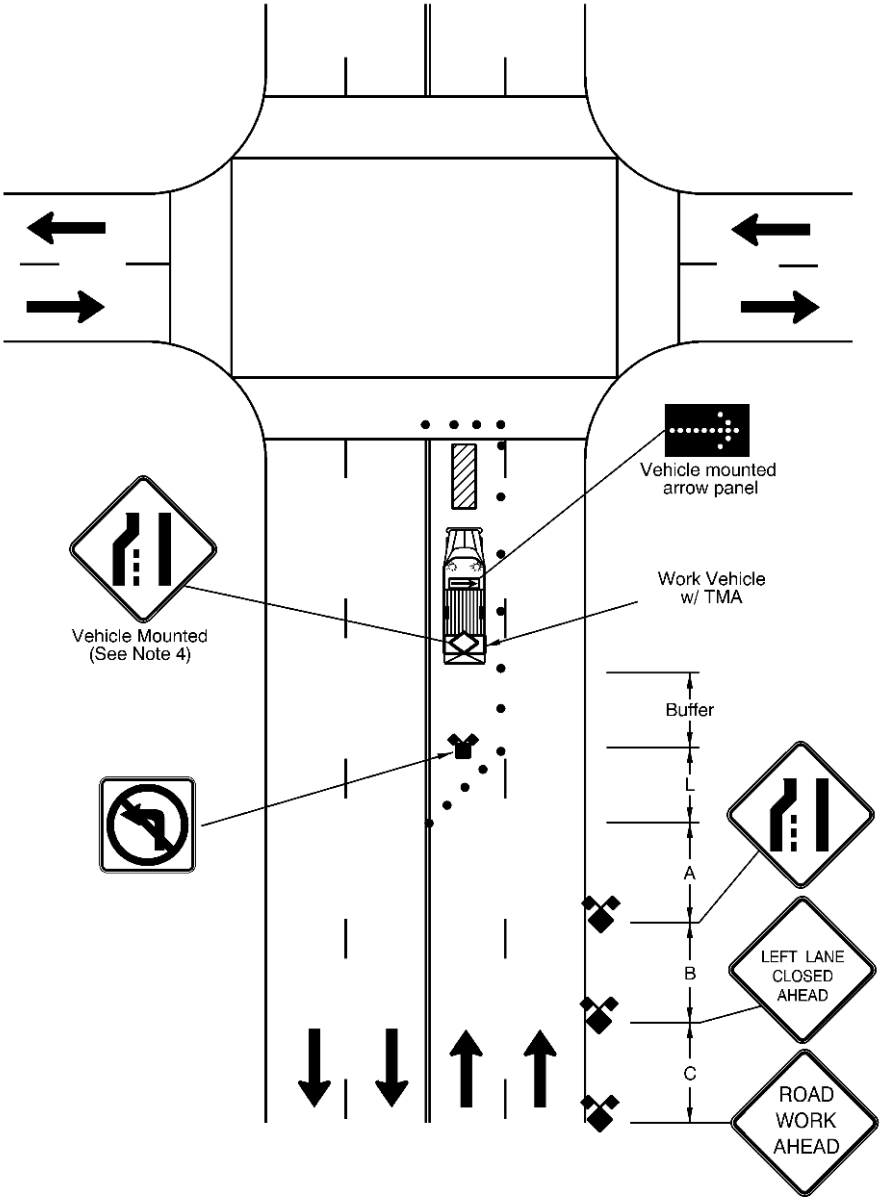
Movement of traffic through the intersection is regulated by existing traffic control only.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. For speeds 40 mph or less and for work in place less than 15 minutes, a truck-mounted arrow panel or PCMS in arrow mode may be used in place of signs shown on the shoulder.
4. For speeds over 40 mph and for work in place more than 15 minutes, a 36 x 36-inch minimum Lane Ends (W4-2) or Lane(s) Closed (W20-5) sign is required inside the merging taper or mounted on the work vehicle. The sign may be displayed using a truck-mounted PCMS.
5. Prohibiting left turns will require additional advance warning and regulatory signs. Check with the road jurisdiction before placing regulatory No Left Turn (R3-2) signs.
6. The lane closure merging taper shown is required for all speeds and work durations.
7. Where space allows, install advance warning signs in the median on multi-lane roads, especially for left lane closures.
8. A No Left Turn (R3-2) sign may be installed on a Type II barricade inside the closure taper.
9. When closing an interior lane of a three or more-lane facility, the closure taper **shall** direct traffic into only one of the adjacent lanes, but not both.

Sign Spacing and Buffer Lengths (feet)

Posted	Spacing Between Signs			"Buffer"
Speed	A	B	C	Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure, Near Side of Intersection Diagram 600



Lane Closure, Far Side of Intersection Diagram 605

Diagram 605 covers work within an area immediately downstream of an intersection. Work vehicles may or may not be in the work space. Movement of traffic through the intersection is regulated by existing traffic control only.

1. When left turns can be prohibited, use Diagram 605 No Left Turn Option (see inset).

2. If left turns cannot be prohibited, a left-turn lane may be set up after the lane closure by leaving an opening long enough for vehicles to enter. There *should* be a minimum of 75 feet of storage beyond the opening in the left-turn lane. Adjust the length of the lane closure to accommodate the left-turn lane.

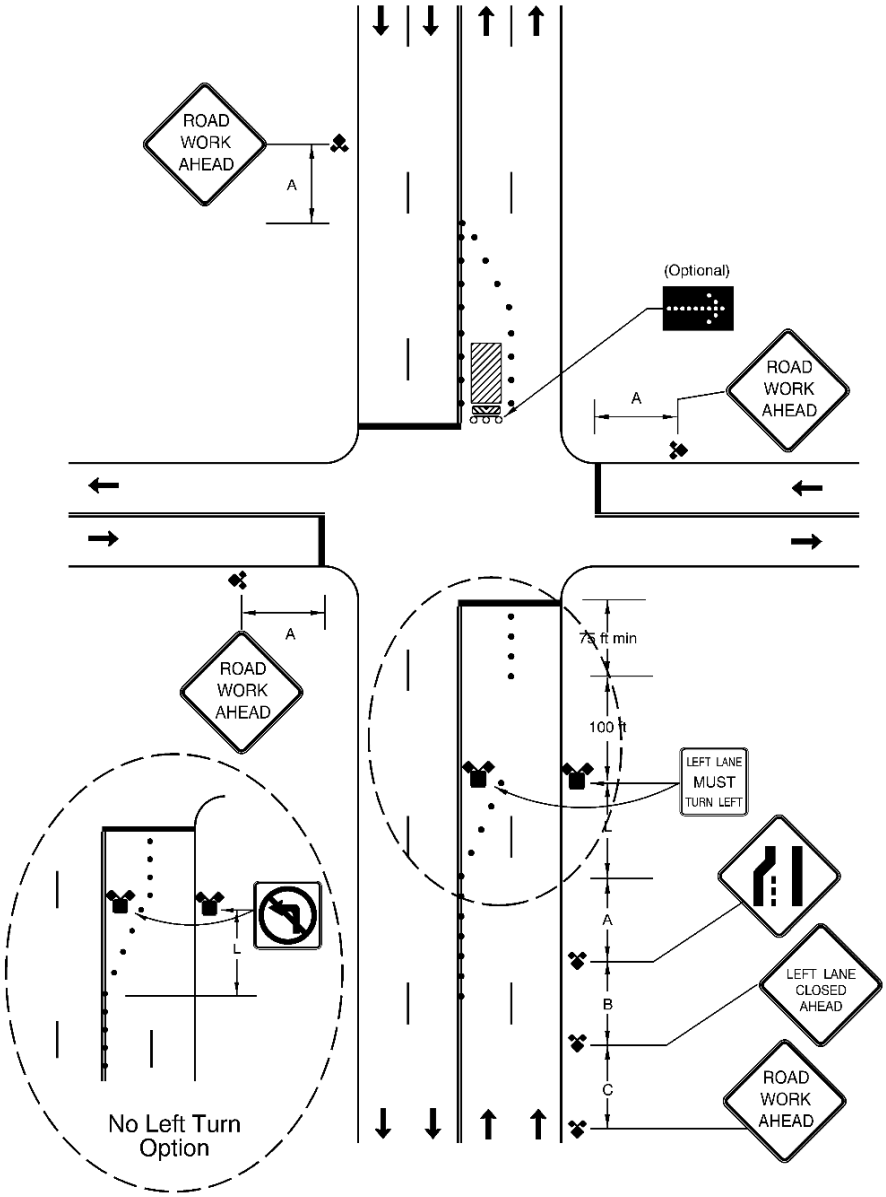
3. If providing a left-turn lane, place black-on-white, rectangular, LEFT LANE MUST TURN LEFT (R3-7L) signs on the right shoulder and inside the closed lane in advance of the left-turn opening and in place of the No Left Turn (R3-2) sign(s).

4. When closing an interior lane of a three-or-more lane facility, the merging taper **shall** direct traffic into only one of the adjacent lanes, but not both.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure, Far Side of Intersection Diagram 605



Right-Turn Lane Closure Diagram 610

Diagram 610 covers work which closes an exclusive right-turn lane. When working in a right-turn lane, close the entire turn lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For speeds 40 mph or less and for work in place less than 15 minutes, a truck-mounted arrow panel or PCMS in arrow mode may be used in place of signing shown on the shoulder. Turn lane closure taper is required, as shown.

4. For speeds over 40 mph and for work in place more than 15 minutes, a 36 x 36-inch minimum RIGHT TURN LANE CLOSED (CW23-13R) sign is required inside the cone taper or mounted on the work vehicle. The sign may be displayed using a truck-mounted PCMS.

5. Right-turn movements can be made from the right-most through-lane unless regulatory signs prohibit turns from that lane. Check with the road jurisdiction before placing regulatory No Right Turn (R3-1) signs.

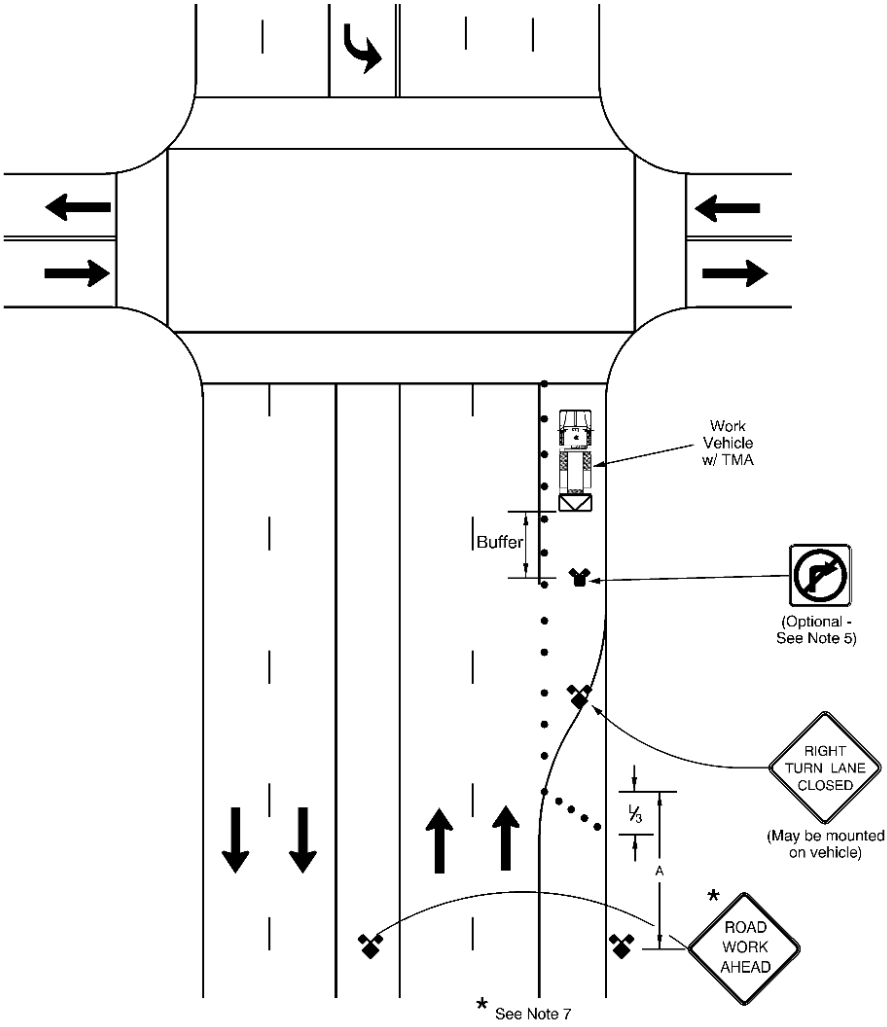
6. The right-turn lane closure merging taper shown is required for all speeds and work durations.

7. If the median is not a continuous two-way left-turn lane and there is adequate space available, place an additional advance warning sign in the median.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Right-Turn Lane Closure Diagram 610



Left-Turn Lane Closure Diagram 615

Diagram 615 covers work which closes an exclusive left-turn lane. When working in a left-turn lane, close the entire turn lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For speeds 40 mph or less and for work in place less than 15 minutes, a truck-mounted arrow panel or PCMS in arrow mode may be used in place of signing shown on the shoulder. Turn lane closure taper is required, as shown.

4. For speeds over 40 mph and for work in place more than 15 minutes, a 36 x 36-inch minimum LEFT TURN LANE CLOSED (CW23-13) sign is required inside the cone taper or mounted on the work vehicle. The sign may be displayed using a truck-mounted PCMS.

5. Left-turn movements can be made from the left-most through-lane unless regulatory signs prohibit turns from that lane. Check with the road jurisdiction before placing regulatory No Left Turn (R3-2) signs.

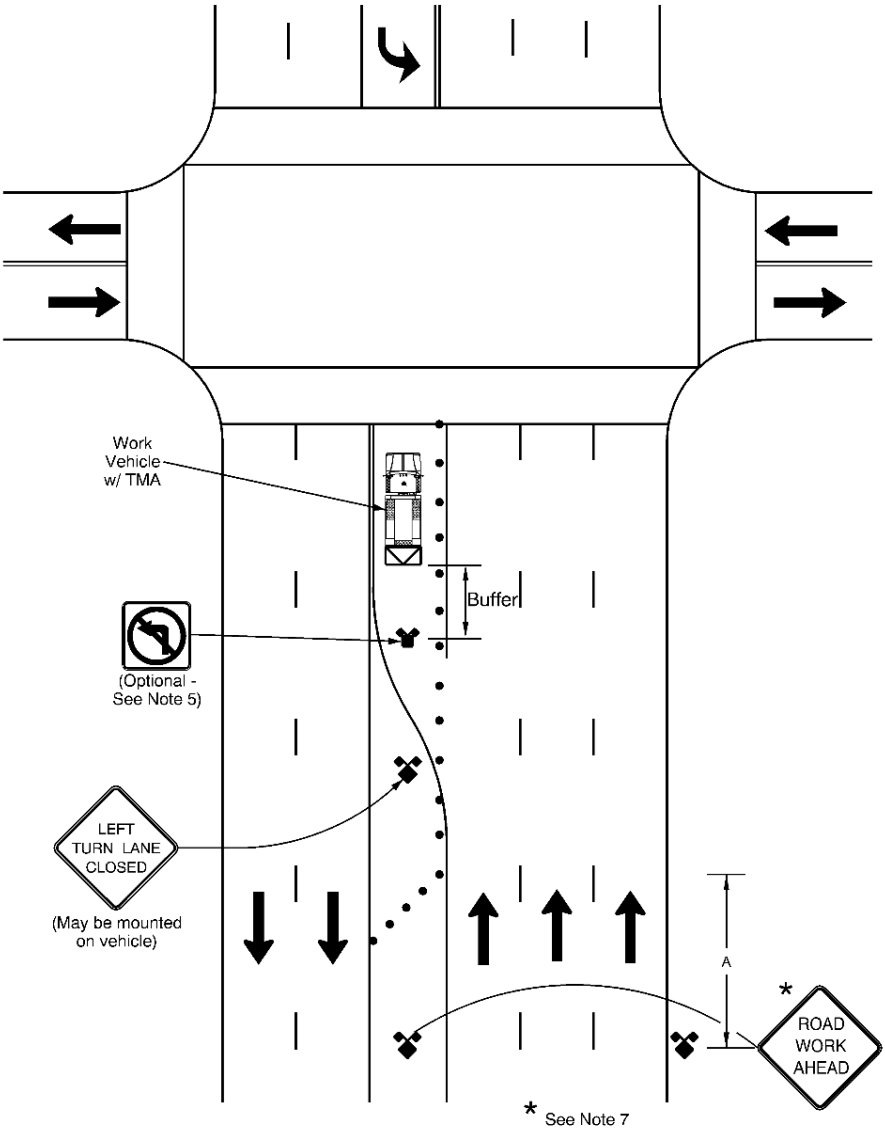
6. The left-turn lane closure merging taper shown is required for all speeds and work durations.

7. If the median is not a continuous two-way left-turn lane and there is adequate space available, place an additional advance warning sign in the median.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Left-Turn Lane Closure Diagram 615



Lane Closure at Intersection with Flagging Diagram 620

Diagram 620 covers work within an intersection when normal traffic control must be interrupted. Work vehicles may or may not be in the work space.

1. AFADs may be used in place of flaggers to control traffic. See Section 3.11 – Automated Flagger Assistance Device (AFAD) Operations and Figure 3-3.

2. During flagging, traffic signals **shall** be turned off. Contact the road jurisdiction for approval and assistance (see Chapter 3).

3. For multi-lane facilities, traffic approaching the intersection **shall** be reduced to a single lane on each approach. See Chapter 3 for information on flagging through intersections.

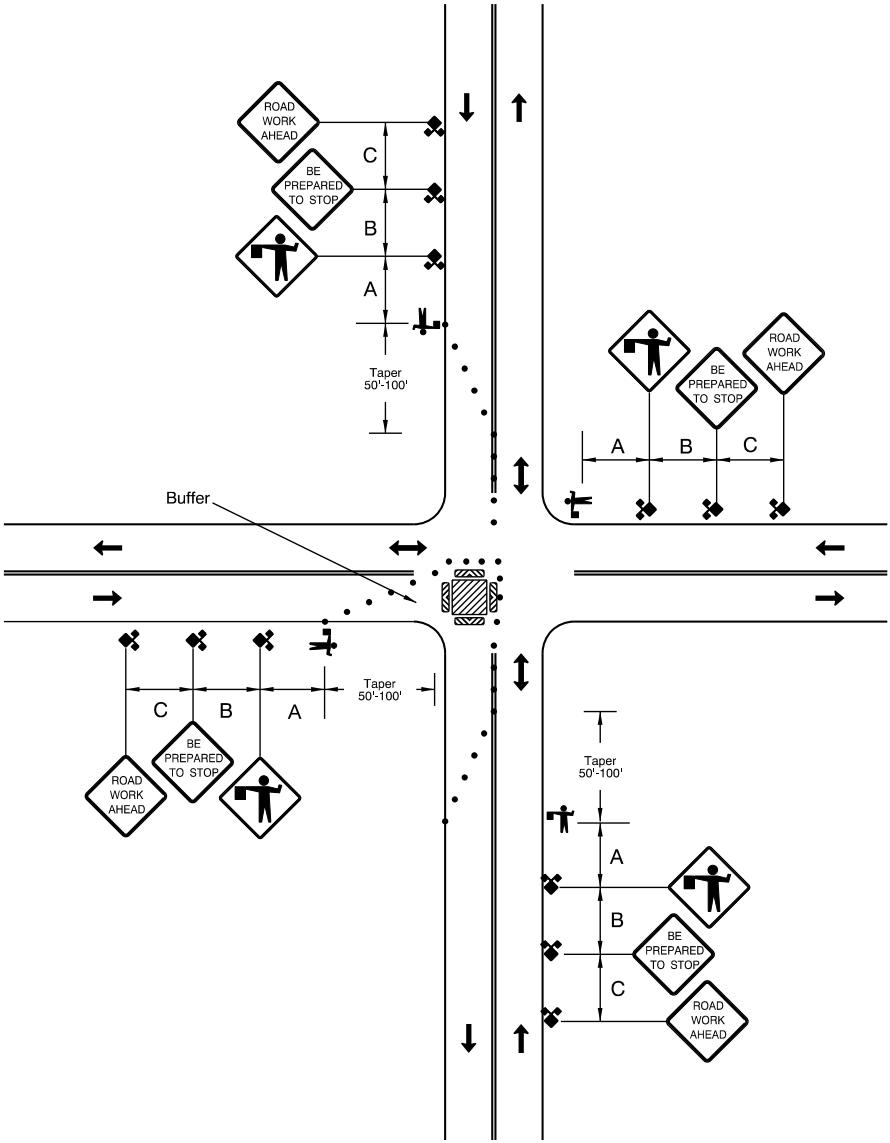
4. There *should* be one flagger for each approach. One flagger may control two adjacent approaches if sight distance, low volumes on side roads, and flagger position allows for safe operation and clear direction to motorists. For low traffic volume intersections (fewer than 400 entering vpd), one flagger may be used.

5. Flaggers *should* accommodate pedestrians through the work zone by stopping vehicles and directing or guiding pedestrians.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure at Intersection with Flagging Diagram 620



Work in the Center of an Intersection Diagram 630

Diagram 630 covers work within an intersection of two-way streets. Movement of traffic through the intersection is regulated by existing traffic control only.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For multi-lane approaches, merge traffic into one lane in advance of the intersection.

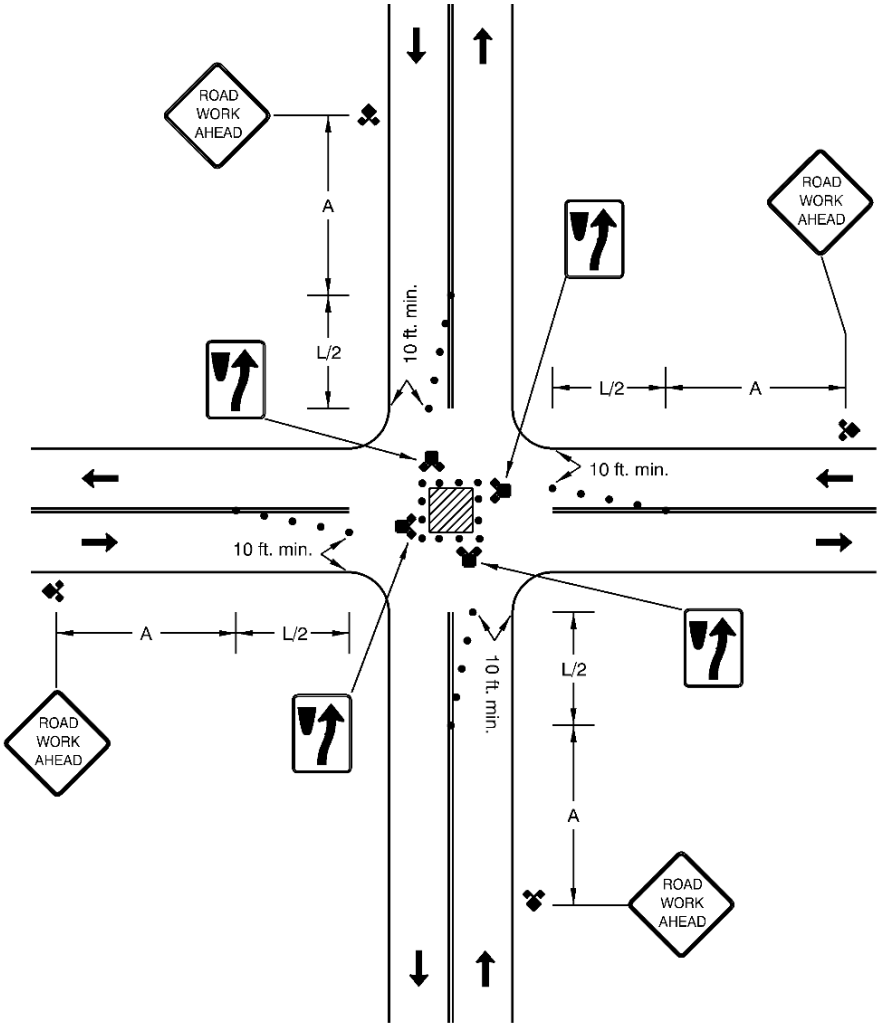
4. For high-speed or high traffic volume operations, consider using flaggers to control traffic.

5. When the posted speed is 40 mph or less and work is in place for less than 15 minutes, cones and signs are not required.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer"
	A	B	C	Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in the Center of an Intersection Diagram 630

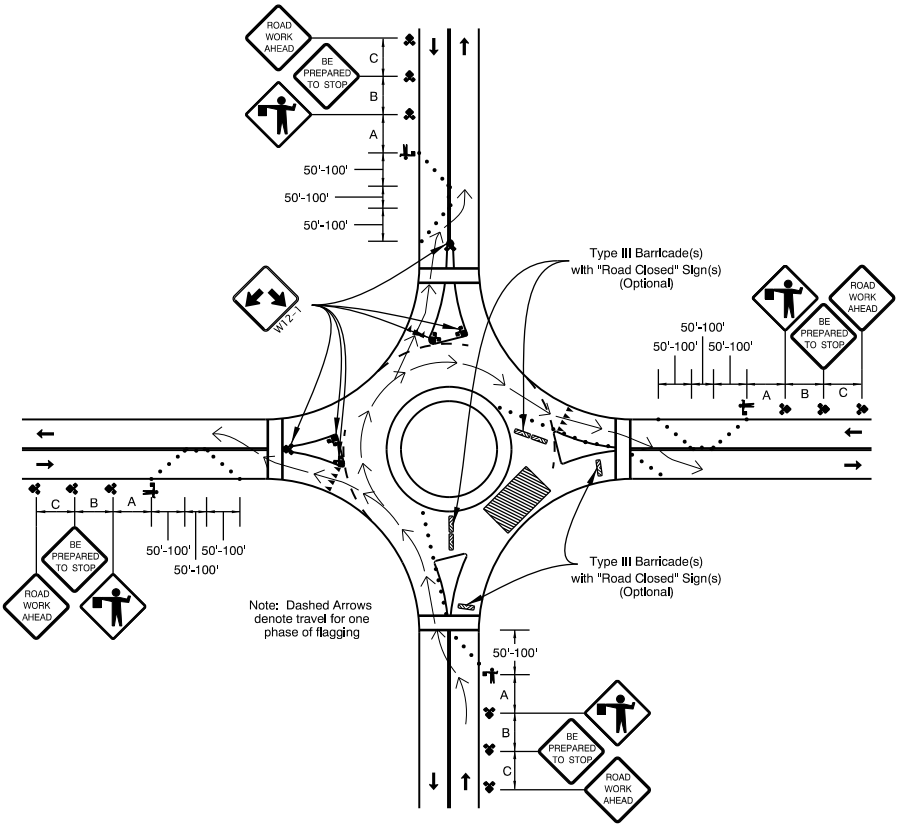


Work in a Roundabout Diagram 640

Diagram 640 covers an example of work within a roundabout. The diagram shows closure of a portion of the roundabout with flagging control of alternating one-way traffic.

1. AFADs may be used in place of flaggers to control traffic. See Section 3.11 – Automated Flagger Assistance Device (AFAD) Operations and Figure 3-3.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. If any of the road approaches cannot access the intersection due to the work space, a detour may be required. Road closure approval and the detour route *should* be provided by the road jurisdiction. For short closures of 20 minutes or less, traffic may be held in place.
5. For work within the roundabout island, initial advance warning signs are required on each approach leg. If the work and all work vehicles are off of the travel lanes and island apron, a single sign per approach is all that is required.
6. If the center island apron will be impacted by the work or equipment, treat it as a shoulder closure for the length of work. But, consider diverting truck traffic due to large vehicle off-tracking.
7. For multi-lane roundabouts, if work can be done without closing both travel lanes, flaggers may not be needed. Appropriate signs for the lane closure at each entry are required.
8. Cones may not be needed along the splitter islands on the approaches if these are raised islands. In such cases, the flagger may have to move far enough ahead on the approach of the splitter island so that traffic can maneuver into the roundabout.
9. If work occurs in an approach leg, a minimum of two flaggers **shall** be used to control traffic. High approach volumes may require additional flaggers for the remaining legs. The ROAD WORK AHEAD (W20-1), BE PREPARED TO STOP (W3-4) and Flagger (W20-7) signs are required in advance of each leg as shown.
10. If a travel lane width of at least ten feet can be maintained for shoulder work on an approach lane, the lane can remain open to traffic. Close the work space with a shoulder taper and tangent cones. An initial advance sign and a SHOULDER CLOSED (W21-5a) sign are required unless the work will take less than 15 minutes.
11. In multi-lane roundabouts, merge traffic into one through lane prior to work.
12. See Diagram 645 – Roundabout Detour Alternative for details needed if using a detour route in lieu of flagging.
13. Flaggers *should* accommodate pedestrians through the work zone by stopping vehicles and directing or guiding pedestrians.

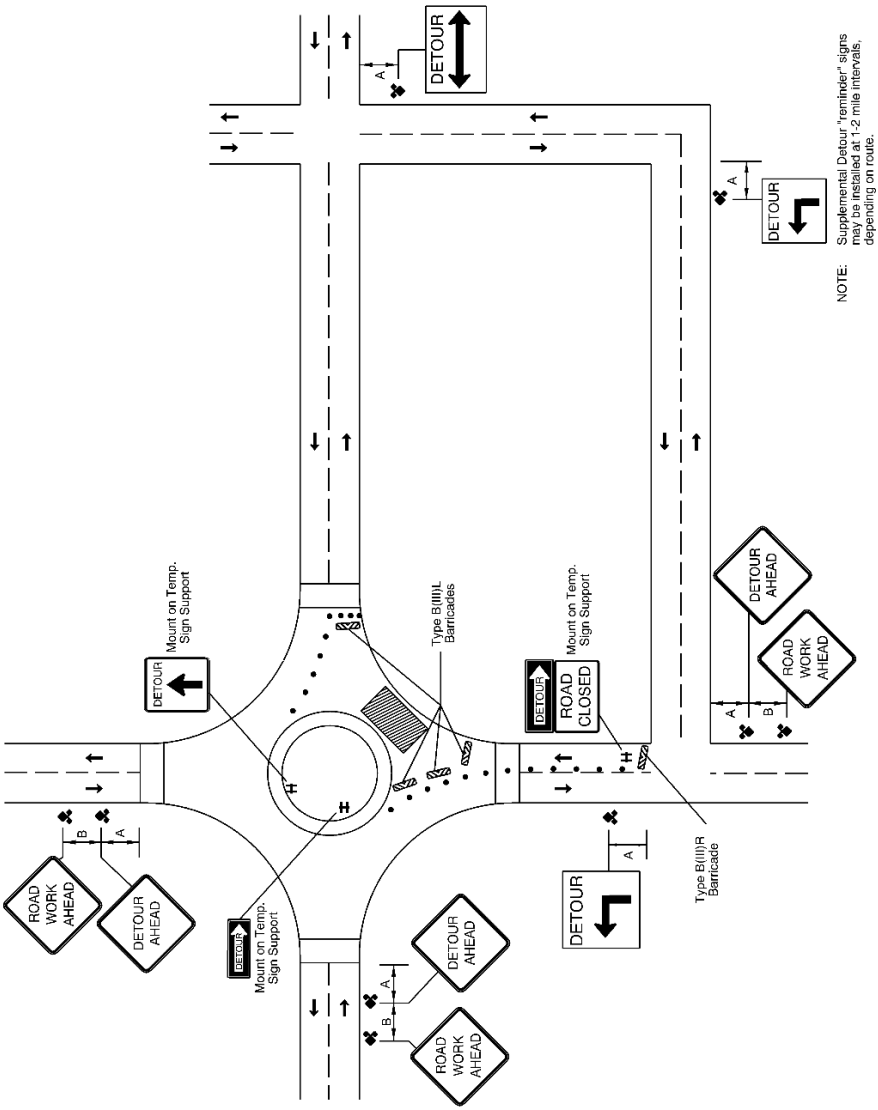
Work in a Roundabout Diagram 640



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Roundabout Detour Alternative Diagram 645



Note: Roundabouts pose unique problems. The traffic control and flagger communications need to be adapted to accommodate each situation.

5.12 Freeway Work

Freeways are defined by separation of traffic directions, high-speed road design and controlled accesses. Freeways have only separated grade interchanges with exit and entrance ramps which are considered part of the freeway.

The high speeds and normally uninterrupted traffic flow on freeways increases the risks for workers and road users. More visibility, better protection and earlier advance warning are needed for freeway work spaces than on other roads.

Some highways may have portions with freeway-like characteristics (e.g. high speeds, grade-separated interchanges, access control, or positive separation of traffic directions), yet still function overall as a multi-lane highway. For such facilities, diagrams in Section 5.10 – Multi-Lane Roads may be the more appropriate for temporary traffic control conducted on these roads.

Depending on the type of work and at the discretion of the responsible person, the freeway applications shown in this section may be applicable.

Some Oregon freeway interchanges have limited merging or diverging capacities, or limited sight distances. At these locations, engineered traffic control plans ***should*** be prepared for the work being done. If an interchange is reconstructed or improved, the traffic control plans ***should*** be updated to reflect these changes.

When blocking or restricting the use of a pedestrian route on a freeway, provide a temporary means of allowing pedestrian access through the work area by one or more of the following:

1. Providing a dedicated TPAR;
2. Temporarily suspending the work and making the route passable; or,
3. Guiding pedestrians through or around the work area.

Freeway Mobile Operation Diagram 700

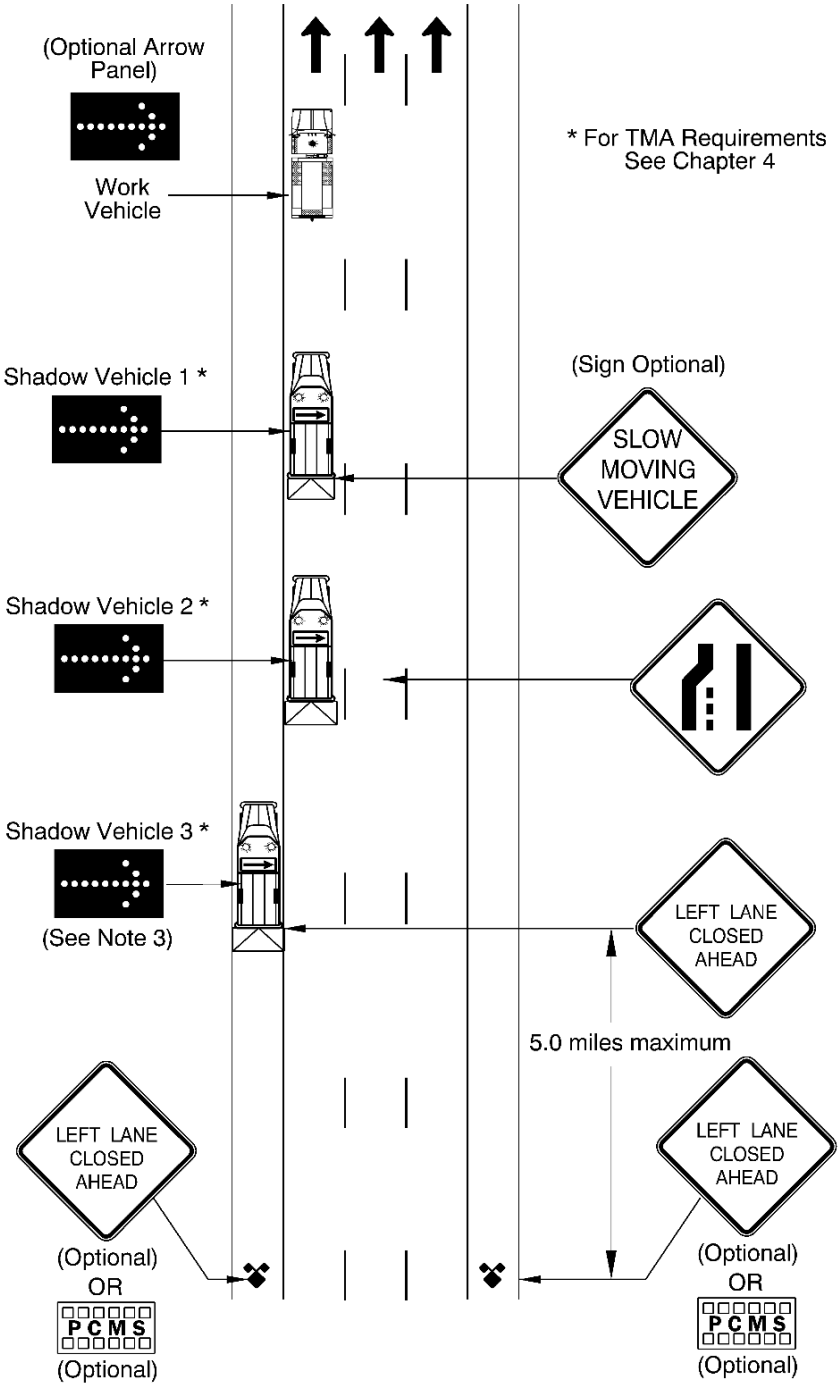
Diagram 700 covers mobile operations occupying one lane or the shoulder of a freeway. See Diagram 140 – Striping on Multi-Lane Roads and Freeways for line marking (striping) details on freeways.

1. Use truck-mounted flashing warning lights on work and shadow vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. Moving operations that take place on the shoulder (i.e. brooming and spraying) where there is no encroachment and the operation does not stop, one shadow vehicle with an advance warning sign is required. An additional sign or PCMS are recommended if sight distance of 1,000 feet cannot be maintained.
3. Two shadow vehicles are required (three recommended) when work is in the travel lane. All shadow vehicles **shall** be equipped with an arrow board or PCMS. Any signs placed on the vehicle **shall** not obscure the arrow board or PCMS.
4. Each shadow vehicle ***should*** vary the trailing distance from the next shadow or work vehicle to provide adequate sight distance for traffic approaching from the rear.
5. Spacing between work vehicles and shadow vehicles ***should*** be controlled to deter road users from driving in between.
6. A TMA **shall** be equipped on the first vehicle exposed to approaching traffic in any part of a travel lane.
7. Shadow Vehicle 1 stays in the closed lane and covers the Work Vehicle. Shadow Vehicle 1 displays a truck-mounted SLOW MOVING VEHICLE (W21-4) sign, or equivalent, so the full message can be read by approaching traffic.
8. Shadow Vehicle 2 displays a truck-mounted Lane Ends (W4-2) sign, or as an option, a RIGHT (LEFT) LANE CLOSED AHEAD (W20-5) sign, so the full message can be read by approaching traffic.
9. Shadow Vehicle 3, when used, displays a truck-mounted sign such as, RIGHT (LEFT) LANE CLOSED AHEAD (W20-5) or other appropriate message so the full message can be read by oncoming traffic. When adequate shoulder width is not available, Shadow Vehicle 3 ***should*** stay as far onto the shoulder as practical and not protrude into traffic any further than necessary.
10. A truck or trailer-mounted PCMS or advanced warning sign placed at the start of the work section is optional. Panel one of the PCMS ***should*** give warning of the type of work with “NEXT XX MILES” on panel two.
11. Signs and PCMS ***should*** be moved during the day to keep them within five miles of the work.

For Striping Operations:

1. When striping the center lane(s) of a multi-lane (3 or more) freeway, place additional advance warning signage on the right shoulder.
2. The vehicle array and spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately without smearing. However, the spacing ***should*** not encourage traffic to travel in the space between work vehicles. This may be the deciding factor in how many vehicles to use.

Freeway Mobile Operation Diagram 700



Freeway Shoulder Work Diagram 710

Diagram 710 covers stationary work with work operations and/or parked equipment on the shoulder and not encroaching on the travel lanes.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For work that is in place less than 15 minutes and within 15 feet of the travel lane, if more than 1,000 feet of stopping sight distance is maintained, no signs or devices are needed.

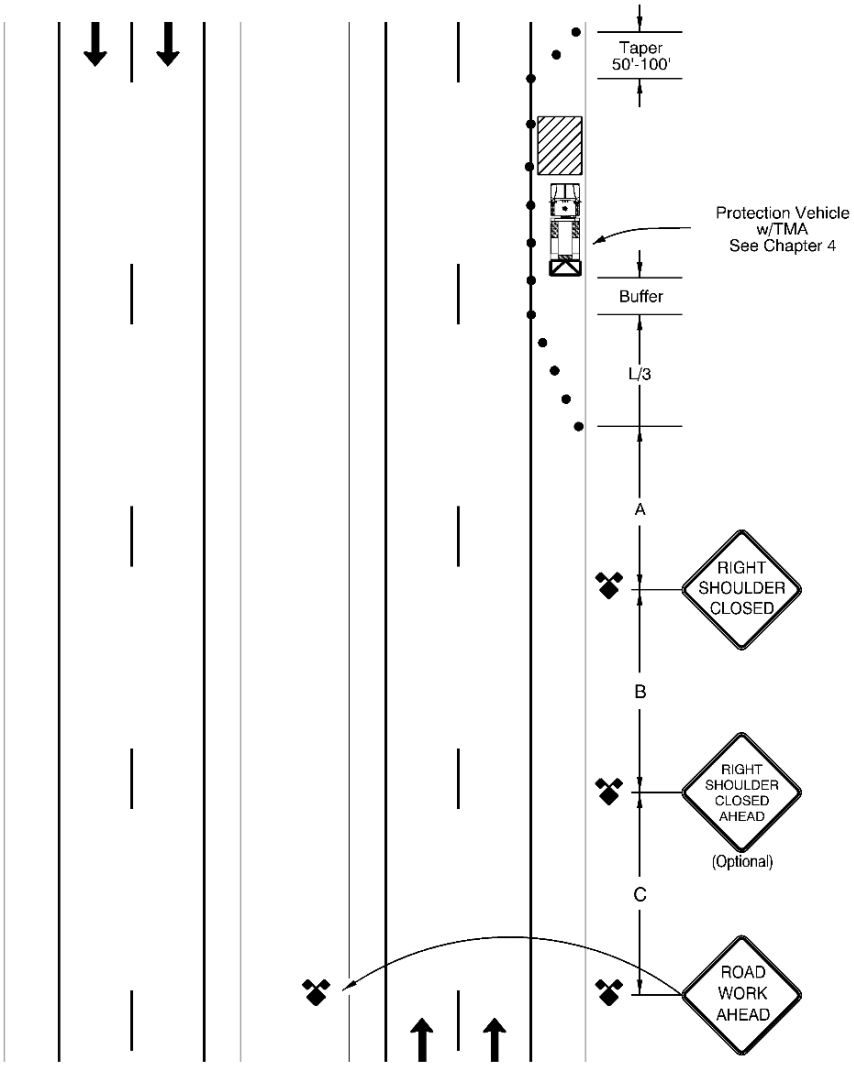
4. The shoulder *should* be closed as shown with cones and a minimum of two signs for work lasting longer than 15 minutes and if the work is within 15 feet of the travel way.

5. Signs **shall** be located on the same side of the roadway where work is occurring. On divided freeways, signs *should* also be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS *should* be installed on the same side of the roadway where work is occurring. For work that moves frequently, advance warning signing may be placed to cover a distance that includes all work locations for a maximum 5 miles.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Freeway Shoulder Work Diagram 710



Freeway Lane Closures Diagram 720

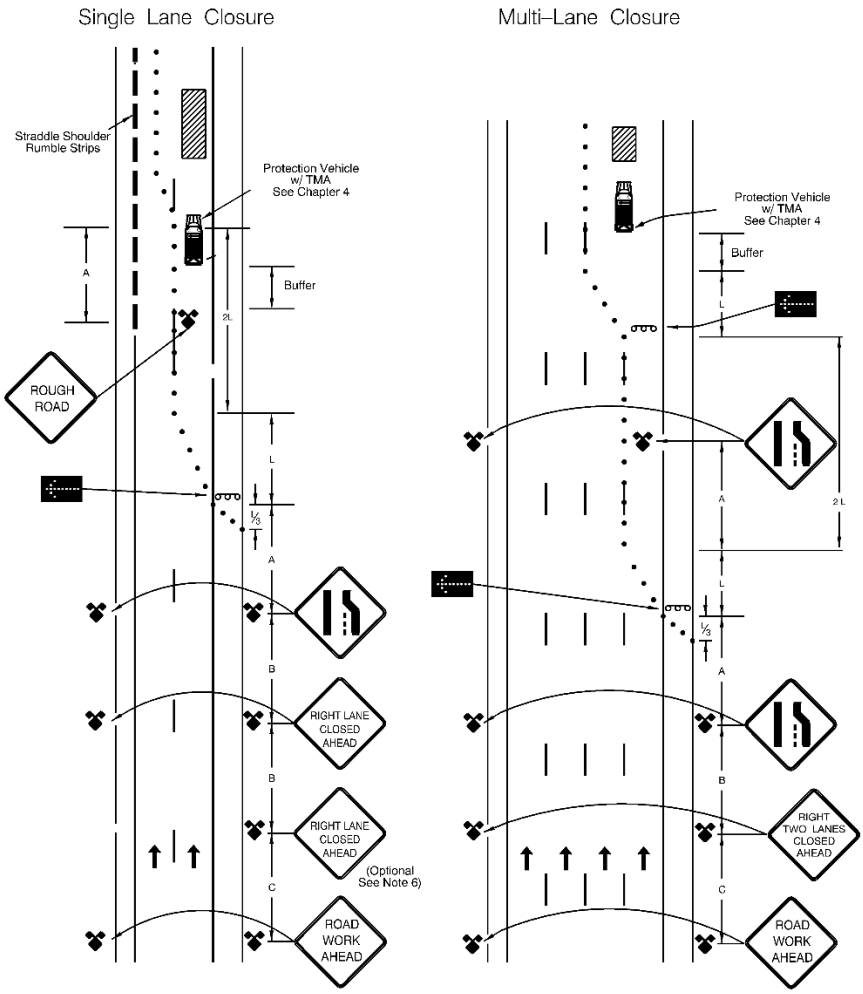
Diagram 720 covers lane closures on a freeway. It is recommended that lane closures only be in place during off-peak hours. The traffic control *should* be placed during the lowest traffic volume period available.

1. A minimum of three advance warning signs is required.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. An arrow panel or PCMS in arrow mode is required for each lane closure. Only one arrow panel per lane closure is allowed.
5. When an interior lane must be closed, close the adjacent lanes from the shoulder toward the work space. Start from the closest shoulder to minimize the number of closed lanes. When closing lanes from the median side, extra attention *should* be given to advance warning and good sight exposure for the transition areas.
6. Signs **shall** be located on the same side of the roadway where work is occurring. On divided freeways, signs *should* also be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS *should* be installed on the same side of the roadway where work is occurring.
7. The length of lane closures *should* be adjusted and sign spacing may be lengthened to provide for safe transition movements in unusual situations, such as crest or horizontal curves.
8. A downstream taper may be used at the end of the lane closure(s) to transition traffic back to normal lane use.
9. If traffic backs up beyond the initial advance warning signs, place additional appropriate advance warning signs.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Freeway Lane Closures Diagram 720



Work Near an Exit Ramp Diagram 730

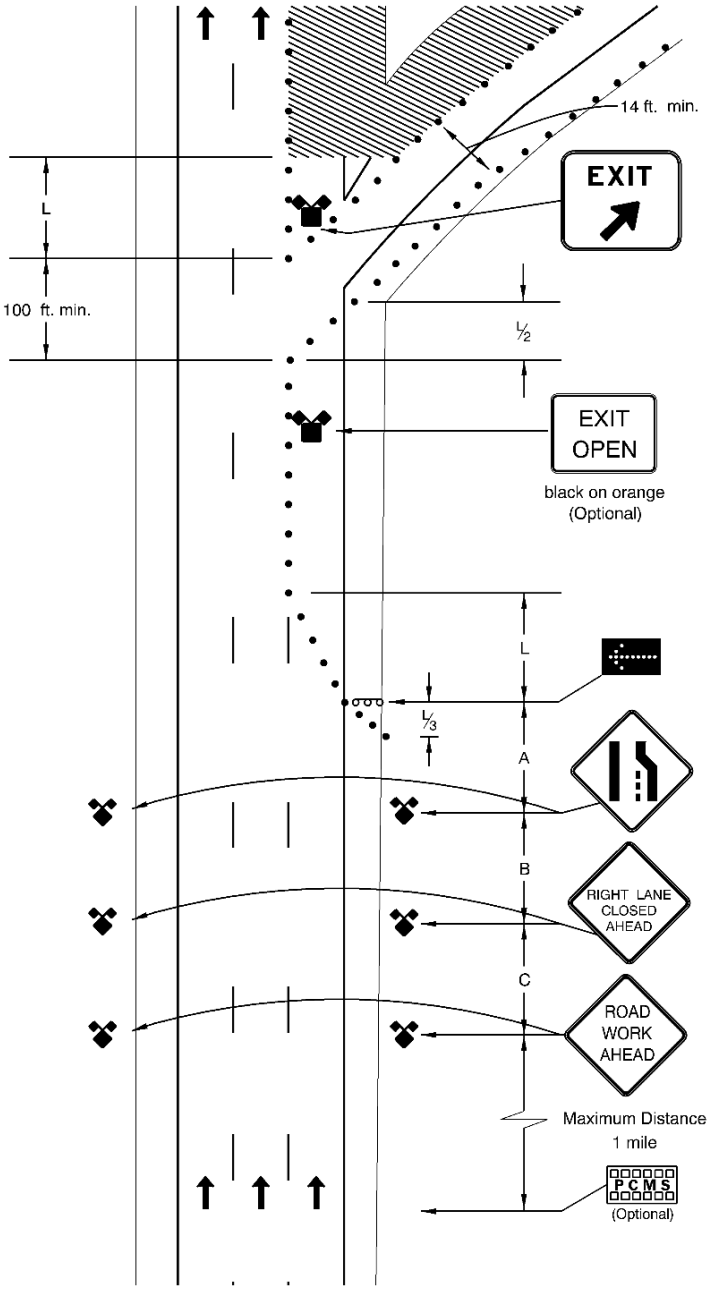
Diagram 730 covers work that affects the approach to an exit ramp. The drawing shows work in the gore area. Similar traffic control would be placed for work near the entry area and shoulder. Traffic control *should* make the exit path clear to approaching motorists.

1. Use enough cones, barricades, or tubular markers to provide a clear, smooth exit for motorists.
2. A EXIT or arrow (E5-1) sign **shall** be located in the gore if the exit point is moved or re-shaped and the permanent sign is obscured or directs traffic inappropriately. Cover or remove inappropriate permanent EXIT or arrow (E5-1) sign.
3. A black-on-orange EXIT OPEN (E5-2) sign or a trailer or truck-mounted PCMS may be used to indicate the point of exit in advance.
4. For multi-lane exits, keep exiting vehicles to one lane until past the work space.
5. Park equipment and construction vehicles inside the coned off area.
6. Signs **shall** be located on the same side of the roadway where work is occurring. On divided freeways, signs *should* also be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS *should* be installed on the same side of the roadway where work is occurring.
7. A PCMS located at least ½ mile before the initial advance warning sign is recommended. The PCMS *should* give the closed lane information, for example, “RT LANE CLOSED AHEAD” or “RT LANES CLOSED AHEAD”.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Work Near an Exit Ramp Diagram 730



Work On an Exit Ramp Diagram 740

Diagram 740 covers work that encroaches on the travel lane of an exit ramp.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. Maintain a minimum 14 foot width for traffic. Truck off-tracking ***should*** be considered.

3. Use enough cones, drums or tubular markers to provide a clear, smooth exit for motorists.

4. Place SHOULDER CLOSED (W21-5a) sign(s), as needed.

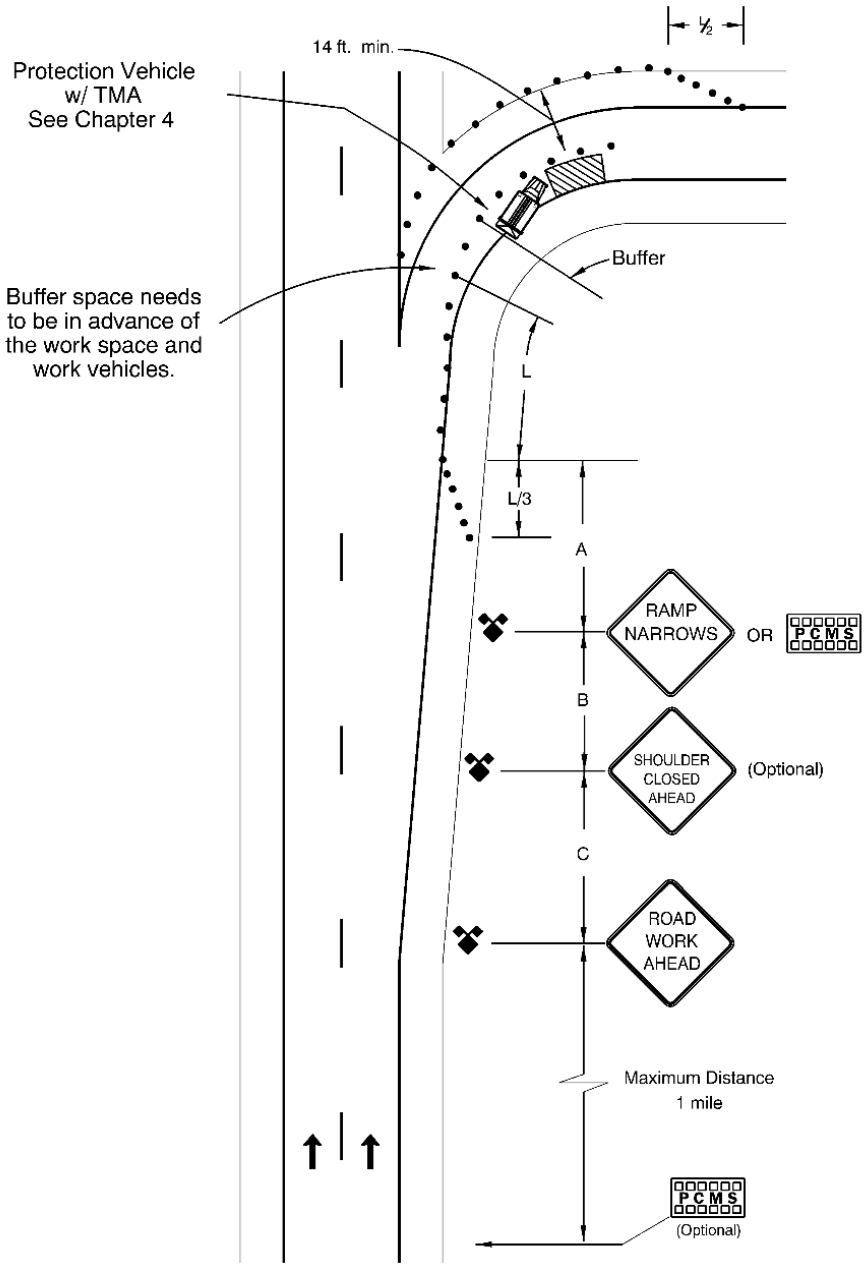
5. For multi-lane exits, merge exiting vehicles into one lane until past the work space.

6. Use Table 2-3 and the posted speed on mainline to determine the appropriate value for “L”.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Work On an Exit Ramp Diagram 740



Exit Ramp Closure Diagram 750

Diagram 750 covers full closure of an exit ramp.

1. Place cones across the exit.

2. Black-on-white EXIT CLOSED (E5-2a) or RAMP CLOSED (OR22-18) roll-up signs **shall** be placed in the closed travel lane on the ramp, as shown.

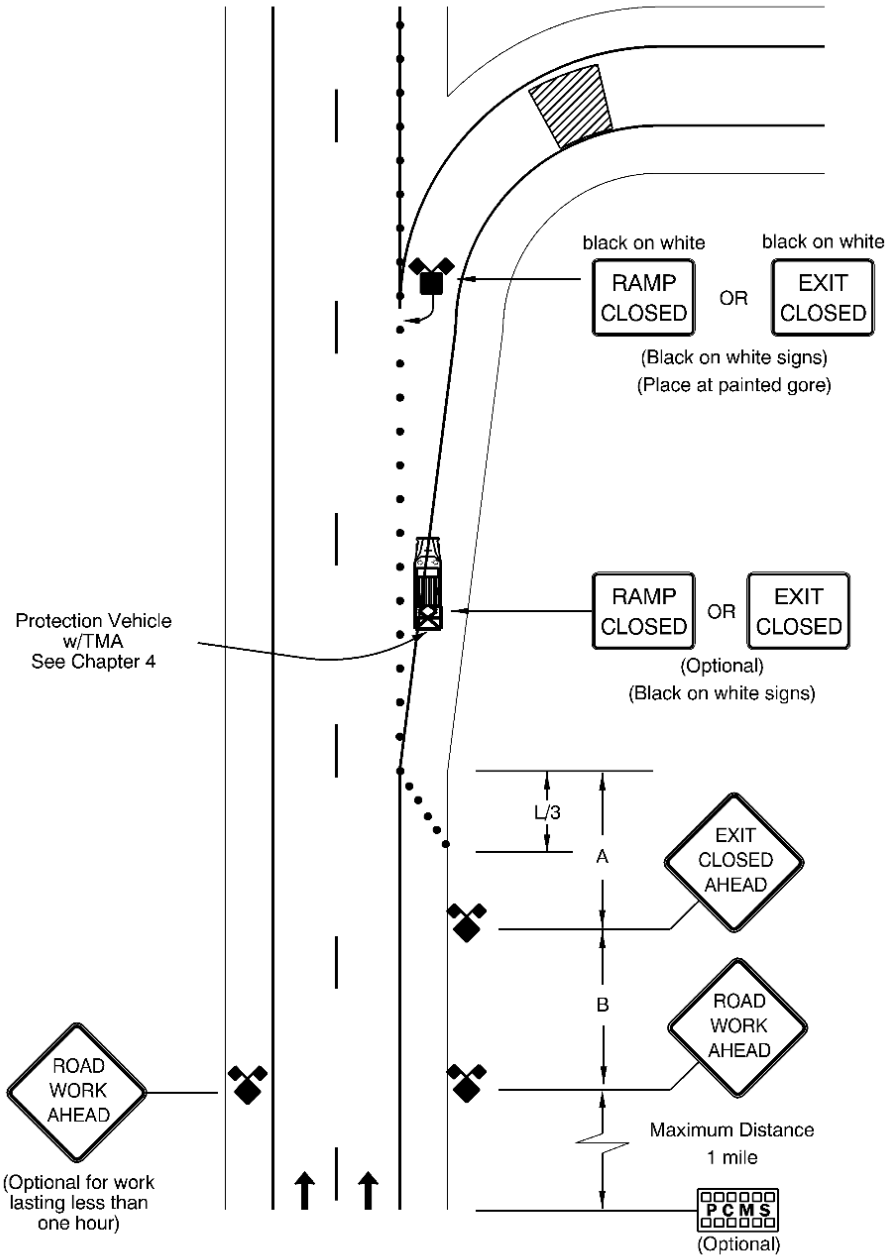
3. Signs **shall** be located on the same side of the roadway where work is occurring. On divided freeways, signs *should* also be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS *should* be installed on the same side of the roadway where work is occurring. Use truck-mounted flashing lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

4. For added visibility, truck-mounted arrow panels or PCMS in the caution mode may be used.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Exit Ramp Closure Diagram 750



Work Near an Entrance Ramp Diagram 760

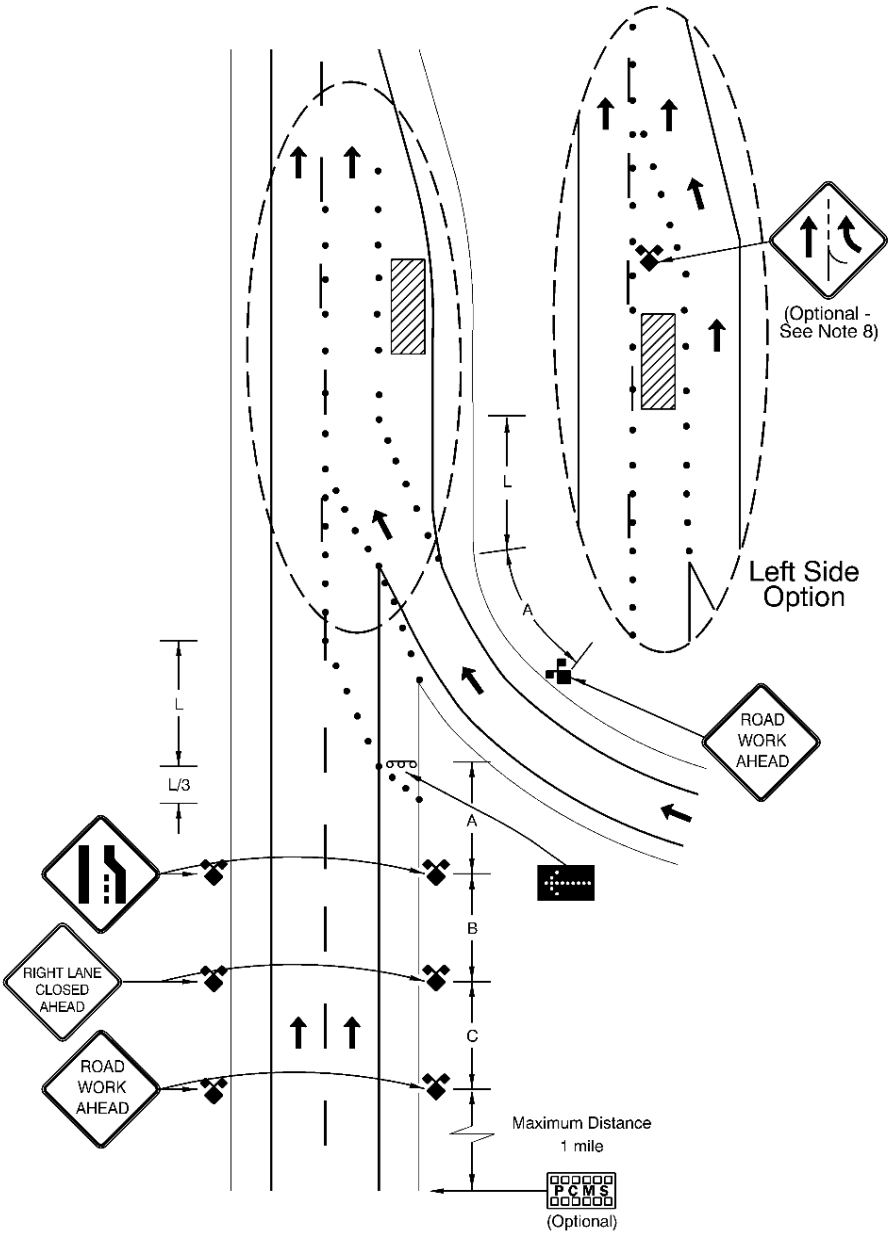
Diagram 760 covers work on or near the right-hand side of a freeway entrance ramp. Traffic on the freeway is moved out of the right lane to create an adequate merge area (refer to Diagram 720 – Freeway Lane Closures). Ramp traffic is carried onto the freeway in the closed lane to merge with freeway traffic beyond the work space.

1. If the freeway merge area cannot be established by merging the freeway through lanes, consider closing the ramp.
2. If an exit ramp is in close proximity, consider closing the ramp. Weaving maneuvers, entering and exiting traffic occupying the same lane, may require a special analysis to determine if they can be accommodated safely.
3. If closing the ramp, advance signing of the closure will be needed on the cross road in all approach directions.
4. The ramp *should* be restricted to one lane. Flagging may be considered when work will sometimes use the entire width of the ramp. If flagging will impact traffic beyond the ramp, Road Work Ahead (CW20-1) and Flagger (W20-7) advance signs **shall** be placed on the appropriate approaches.
5. The mainline merging taper with the arrow panel at its starting point *should* be located sufficiently in advance so that the arrow panel is not confusing to drivers on the entrance ramp. The mainline traffic merging from the lane closure *should* have the opportunity to stabilize before encountering the merging ramp traffic.
6. Signs **shall** be located on the same side of the roadway where work is occurring. On divided freeways, signs *should* also be located on the opposite side of the roadway when the median or shoulder is at least 8 feet wide. When signs are not able to be placed on opposite side of road, additional warning signs or a PCMS *should* be installed on the same side of the roadway where work is occurring.
7. A PCMS located at least ½ mile before the initial advance warning sign is recommended. The PCMS *should* give the closed lane information (RIGHT, LANE or 2 LANES) and the distance ahead of the closure.
8. If the Added Lane (W4-3 or W4-6) sign is not used, cones on the skip stripe **shall** extend a minimum of 300 feet past the gore point.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
55	1000	1500	2640	250
60				285
65				325
70				365

Work Near an Entrance Ramp Diagram 760



CHAPTER 6 – INCIDENT TRAFFIC CONTROL

A traffic incident can be any emergency, natural disaster, or other unplanned event that affects or impedes the normal flow of traffic. Incident traffic control takes priority over planned activities.

6.1 Incident Traffic Control

Traffic incidents can be emergencies that are road-related, such as a traffic crash or fuel spill, or non-road-related, such as a wildfire or flood.

Responders may use any available devices or equipment to guide traffic through the incident area until proper equipment is available, as long as the devices themselves do not create additional hazards. As soon as practical, *Manual on Uniform Traffic Control Devices* (MUTCD) compliant devices and equipment *should* be used.

Incident response temporary signing may be made using retroreflective fluorescent coral (pink) sign sheeting.

Goal: The goal of incident traffic control is the safe and effective control of traffic through the incident management area.

Objectives:

- Protect responders, victims and other personnel at the site.
- Provide reasonably safe traffic flow.
- Prevent secondary traffic crashes.
- Manage the impact to the surrounding local road system.

Incident Management Area: The section of highway where temporary traffic control devices are placed to delineate the incident area and keep traffic away from workers and equipment. The management area extends from the initial warning device (i.e. a sign or cone) to the last temporary traffic control device or to where vehicles return to their normal travel path beyond the incident.

Staging Area: A staging area may be included for the arrival and placement of emergency response vehicles. The staging area may be inside, in advance of, or beyond the incident management area. It may also include space for emergency vehicles, incident command, and enforcement vehicles (see Figure 6-1).

Incident Traffic Control Plan: The incident traffic control plan *should* use the diagrams in Chapter 5 that are appropriate for the incident.

6.2 Incident Response Needs

Incident traffic control needs are classified into three categories based on their duration. The duration includes clean-up and any road or utility repairs that may continue the impact to traffic. The assessment of the incident duration *should* be made as soon as possible.

The duration categories *should* be used as a guideline for setting up traffic control for an incident. Other factors such as traffic volumes, speeds, road geometry or complexity of the response activities can also affect the traffic control needed.

The incident response duration categories are:

- **Major Incident** – more than two hours
- **Intermediate Incident** – 30 minutes to two hours
- **Minor Incident** – under 30 minutes

If the incident is anticipated to last more than 24 hours, a site specific traffic control layout plan *should* be implemented by the road jurisdiction.

Major Incidents: Involve closing all or part of a road facility for *more than two hours*.

Contact road jurisdictions whose systems are affected by the incident or may carry diverted traffic.

Temporary traffic control measures for major incidents may include:

- Advance warning signs.
- Additional advance warning signs for extended traffic queues.
- Signed detour route(s).
- Shoulder and/or lane closure devices and signing.
- Channelization devices for the incident area.
- Media contacts and frequent bulletins.
- Flaggers and/or uniformed police officers, as needed.

Intermediate Incidents: Affect travel lane operation from *30 minutes to two hours*. Full road closures may be needed for short periods during clearance or clean-up operations.

Temporary traffic control measures for Intermediate Incidents may include:

- Advance warning signs.
- Additional advance warning signs for extended traffic queues.

- Shoulder and/or lane closure devices and signing.
- Channelization devices for the incident area.
- Flaggers and/or uniformed police officers, as needed.

Minor Incidents: Disrupts traffic operations typically for *less than 30 minutes*. On-scene responders typically include law enforcement, emergency medical services (EMS), road and transit authorities, and towing companies. Diversion of traffic into other lanes and lane closures are often not needed or are needed only briefly. Traffic control is usually conducted by on-scene responders.

6.3 Detours

Before establishing any detour, contact all appropriate road jurisdictions whose systems are affected by the incident or that may carry diverted traffic. Some degree of traffic engineering and enforcement is needed for an effective detour.

The local road jurisdiction and enforcement jurisdiction will:

- Determine the most appropriate detour route(s);
- Install detour route signing;
- Maintain the detour route; and,
- Remove all devices and signing when the detour is no longer needed.

Consideration for large trucks **shall** be made if they are being routed onto a local highway or street network. Large trucks may need to follow a separate detour route.

Local road authorities *should* work together to choose the best detour route and determine if it can support the additional traffic, including large trucks, while the detour is in effect.

6.4 Safety Apparel

It is important that all personnel exposed to traffic be highly visible and easily recognizable as a person.

All personnel within the right-of-way who are exposed to traffic, with the exception of law enforcement, **shall** wear high-visibility safety apparel. Safety apparel **shall** meet the requirements of the ANSI/ISEA 107–2015 publication entitled *American National Standard for High-Visibility Safety Apparel and Headwear*, or equivalent revisions, and labeled as ANSI 107-2015 or later for standard performance for Class 2 or 3 risk exposure.

6.5 Emergency Response Example

Figure 6-1 shows an example of modifying a typical application from this Handbook for temporary traffic control for emergency response activity. Note that the layout and placement of all resources for incident response is determined by the incident command.

The layout has been adapted from the MUTCD typical application for closing one direction of a two-way, multi-lane road. The added elements include an incident command post, staging area, and heavy engine protection vehicle.

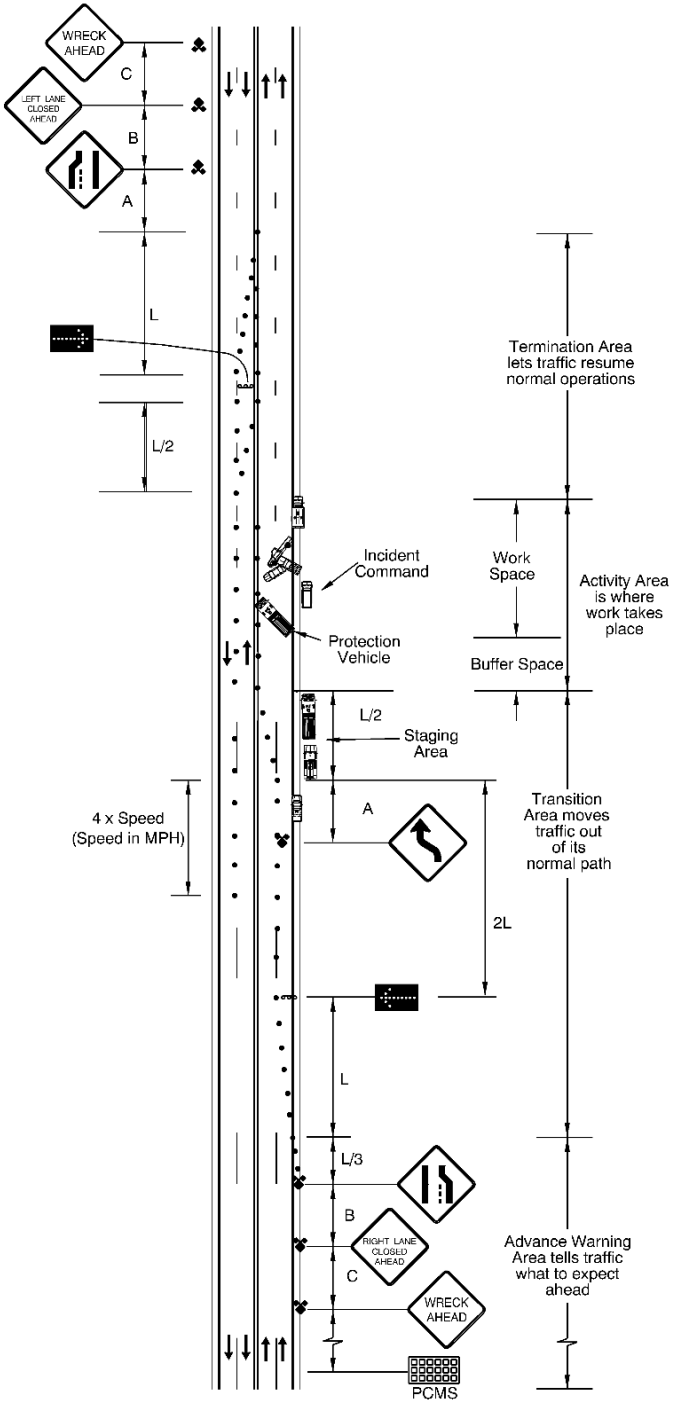
Figure 6-1 is not intended to be interpreted as a standard layout. Not all elements will be present, and there can be additional elements needed. For instance, the incident command post may be set up outside the incident work area, on a side road, ramp or other location that allows for best function. It can be advantageous to have more than one staging area so that incoming vehicles are positioned for easy and safe access where needed.

An additional portable changeable message sign (PCMS), not shown, may be placed in advance of the work area in the opposite travel lanes.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer"
	A	B	C	Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365
Freeways:				
55	1000	1500	2640	250
60				285
65				325
70				365

Figure 6-1: Emergency Response Example



APPENDIX A
GLOSSARY OF TERMS

ACTIVITY AREA – The area within a work zone that contains the buffer space and work space.

ADT – Average daily traffic. The volume or average number of vehicles per day (number shown typically represents both directions of travel combined).

ADVANCE FLAGGER – An additional flagger(s), stationed in advance of the primary flagger, responsible for warning approaching traffic that traffic is slowed or stopped ahead and that they need to slow down themselves. The advance flagger is preceded by additional flagger signing, see Diagram 5-7 – Advance Flagger for Extended Queues. The advance flagger does not stop traffic, and uses the SLOW sign paddle only to get the approaching drivers' attention.

ADVANCE WARNING AREA – An essential portion of all work zones and may vary from a series of signs starting a mile or more in advance of the work space to a single sign or flashing lights on a work vehicle.

ARROW BOARDS – Lighted sign panels conforming to the requirements of the MUTCD with a matrix of lights capable of either flashing or sequential display of directional mode arrows or chevrons or non-directional (caution) mode. These devices are also referred to as (sequential) arrow panels.

AT GRADE CROSSING (MIXED AND CROSS TRAFFIC) – Railway right-of-way (ROW) over which other traffic moving in the same direction or the cross directions may pass.

AT GRADE CROSSING (CROSS TRAFFIC ONLY) – Railway right-of-way (ROW) over which no other traffic may pass, except to cross at grade-level crossings. A median strip right-of-way with grade-level crossing at intersection streets is included.

BEACON (TRUCK-MOUNTED) – A yellow rotating flashing light or strobe light mounted on a vehicle.

BARRICADES – A portable device having one to three horizontal reflective rails with appropriate markings, used to control traffic by closing, restricting, delineating or channelizing all or a portion of the highway.

BLOCKADE VEHICLE – A traffic control vehicle used to control the speed of following traffic in a rolling slowdown. A blockade vehicle is made highly visible with high-intensity rotating, flashing, oscillating, or strobe lights, an arrow board and sign or PCMS.

BUFFER SPACE – A section of clear road between the taper and the work space providing an extra margin of safety for both traffic and workers. The buffer space *should* be kept clear of vehicles, equipment, materials and personnel to provide a clear recovery area.

CATENARY – An overhead wire conductor and support system that supplies the 750-volt direct current (DC) power to the streetcar's current collecting pantograph.

CHASE VEHICLE – The vehicle that enters the road first in a rolling slowdown. The chase vehicle moves forward with traffic in front of the rolling blockade, positioning itself behind the last through vehicle before entering the work space. Seeing the chase vehicle go by, workers can move into the open travel lanes and begin working.

CLEAR ZONE – The unobstructed area provided beyond the edge of the travel lane(s) for the recovery of errant vehicles, including any shoulders or auxiliary lanes.

CONES – A conical-shaped channelization device with a weighted base. Cones are used to temporarily redirect traffic traveling through a work zone or incident response area. Cones can be used in tapers and along tangent areas to separate traffic from a work space and guide traffic along a desired path.

CRASHWORTHY – The ability of a roadside safety hardware device or appurtenance to minimize risks to vehicle occupants by allowing a vehicle impacting the appurtenance to be slowed before stopping, redirecting, or to continue without significant resistance. Crashworthy, as referenced in the manual, means that the device meets standards in the *Manual for Assessing Safety Hardware* (MASH). Existing devices that comply with *National Cooperative Highway Research Program* (NCHRP) 350 requirements may be used through their useful lives, at which point they *should* be replaced with devices that comply with MASH requirements.

DEVICE SPACING – The longitudinal distances between channelization devices (cones, tubular markers, drums) in a taper or along tangent sections of the work and buffer spaces.

DRUMS (BARRELS) – Lightweight, flexible, and deformable barrel-shape channelization devices used to temporarily redirect traffic traveling through a work zone or incident response area. Drums can be used in tapers and along tangent areas to separate traffic from a work space and guide traffic along a desired path.

EDGE OF TRAVELED WAY – The traveled way is the portion of the highway for the movement of vehicles not including shoulders. The edge of traveled way is often delineated by the “fog line” or edge of pavement.

EXTENDED TRAFFIC QUEUE – When the line of vehicles (queue) stopped at the beginning of a work zone extend beyond the initial ROAD WORK AHEAD sign. To prevent rear-end collisions at the end of the queue, additional advance warning signs are installed further in advance of the work zone (see Diagram 5-6 – Extended Traffic Queues).

FLAGGER – A trained and qualified person responsible for controlling the flow of traffic through a work zone. A flagger **shall** be trained as outlined under Flagger Training Requirements in Chapter 3 of this Handbook and **shall** be able to show proof of such training.

FOG LINE – A pavement marking line that delineates the edge of the traveled way. Also referred to as the “edge line.”

FREEWAY – A high-speed, access-controlled roadway where access points to the roadway are facilitated through grade-separated interchanges. Having the highest level of importance in Oregon’s infrastructure, a higher level of traffic control ***should*** be considered when conducting work on freeways.

GRADE CROSSING – A location where a public highway, road, street, or private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade.

HIGH-SPEED – A designated or posted speed of 45 mph or above.

HIGH-VOLUME – While defined by each Agency, typically identified as average daily traffic (ADT) volumes greater than 2,000 vehicles per day.

INTERMEDIATE-TERM WORK – Work that occupies a location for more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.

LOW-SPEED – A designated or posted speed of 40 mph or below.

LOW-VOLUME – An average daily traffic volume (ADT) of 400 vehicles per day or less.

MAY – Indicates an allowed (optional) alternative to a mandatory condition or action.

MOBILE OPERATION – Work activities where work equipment is continuously moving along the road at an average speed of 3 mph or more.

MULTI-LANE ROAD – A road with at least two lanes in at least one direction.

MUTCD – The national *Manual on Uniform Traffic Control Devices* published by the Federal Highway Administration and adopted as the statewide standard for traffic control devices by OAR 734-20-005 under the authority of ORS 810.200.

ONE-LANE, TWO-WAY TAPER – A series of channelization devices (i.e. cones, tubular markers) placed at an angle to the highway at the flagger station to make the flagger station more visible. Taper is 50 – 100 feet and consists of 4 – 6 devices.

PILOT CAR – A four-wheeled vehicle no smaller than a compact pickup, identified by a 36 x 18-inch PILOT CAR FOLLOW ME (G20-4) sign (sign mounted on the rear) and equipped with a beacon and two-way radios or other communication devices. The communication devices **shall** have a range suitable for the length and terrain of the project. A vehicle-mounted PCMS may be used in lieu of the 36 x 18-inch rigid sign.

PORTABLE CHANGEABLE MESSAGE SIGN (PCMS) – Includes a portable message sign panel capable of displaying more than one message. They **shall** conform to all requirements in the MUTCD. For use on state highways, a PCMS **shall** be listed on the ODOT *Qualified Products List*.

PORTABLE TRAFFIC SIGNAL – A portable traffic signal is a self-contained, self-powered, green-yellow-red traffic signal used for controlling traffic through a short-term traffic control section.

PROTECTION VEHICLE – A vehicle strategically placed to protect the workers and work activity. The protection vehicle is used in a stationary work zone. The protection vehicle is placed after the buffer space and sufficiently in advance of the work space protected to allow for run-out if hit but not so far in advance that traffic can enter the space before the work space.

RAILWAY RIGHT-OF-WAY – The horizontal and vertical space occupied by the rail system; includes track, ballast, rail systems, platforms and overhead catenary system. Horizontal area is typically measured from curb to curb or fence line to fence line. This area may be shared by a variety of vehicles or may be an exclusive rail corridor.

ROAD – Every public way, state highway, county road, or city street.

RUN-OUT – The distance in front of a protection vehicle it is likely to move if hit. The length of the space between a protection vehicle and the work activity *should* be at least equal to the run-out. For TMA-equipped protection vehicles, follow the manufacturer's recommendations in determining the proper run-out distance.

SHADOW VEHICLE – A trailing vehicle used as a warning and traffic control vehicle in a mobile work zone. Shadow vehicles provide both the advance warning area and any lane or shoulder closures for a mobile work zone.

SHALL – Indicates a mandatory condition or action.

SHORT-DURATION WORK – Short-duration work that involves short stops of up to one hour, such as litter cleanup or pothole patching.

SHORT-TERM WORK – Daytime work that occupies a location for more than 1 hour within a single daylight period.

SHOULD – A strong recommendation for an action or practice, and is the standard treatment under normal conditions.

SHOULDER – That portion of a road adjoining but outside of the normal travel lanes.

SIGHT DISTANCE – The length of unobstructed roadway ahead that is visible to the driver. Sight distance may be obstructed by the road surface (hills or dips) or some feature beyond the shoulder (trees or vegetation).

SPEED (POSTED SPEED) – The designated (posted) speed as shown on roadside signs or, if no signs, the statutory speed set in Oregon Revised Statutes.

SPOTTER – A worker who takes a position near the work with a clear view of the work space and the road whose primary duty is to warn the other worker(s) of approaching traffic. A spotter is not a flagger and does not control traffic.

TAPER – A series of channelization devices (i.e. cones, tubular markers, drums) placed at an angle to the traffic flow to slowly guide traffic out of its normal path. Commonly used to close a travel lane or shoulder, or to shift traffic from one portion of the roadway to another.

TEMPORARY PEDESTRIAN ACCESSIBLE ROUTE (TPAR) – Area within a work zone, marked by signing, delineation and TCD, for the use of pedestrians to navigate through or around the work area.

TERMINATION AREA – A short distance after the work space that allows traffic to clear the work space and return to normal operation.

TRAFFIC CONTROL DEVICE (TCD) – All signs, signals, markings, and other devices use to regulate, warn, or guide traffic.

TRANSITION AREA – Where traffic is moved out of normal traffic paths and into a temporary path around the work space. It commonly contains channelization tapers used to shift or close the travel lane(s) or to close the shoulder.

TRUCK-MOUNTED ATTENUATORS (TMA) – Truck-mounted attenuators (TMA) are energy absorbing devices attached to the rear of a heavy vehicle. They are used on equipment located in advance of workers or work equipment to reduce the severity of rear-end crashes from errant vehicles. A TMA may be used on a work vehicle, protection vehicle or shadow vehicle.

TUBULAR MARKERS – Tubular markers are channelization devices that are cylindrical in shape with a weighted base.

WORK COMMENCEMENT – The start of work activity in or along the road.

WORK SPACE – That portion of the work zone which contains the work activity, equipment, materials and workers.

WORK VEHICLE – Any vehicle in the work area or work zone (mobile operations) conducting work. Examples include sweepers, rollers, paver, striping truck, one-ton utility truck, and supervisor's pickup truck.

WORK ZONE – An area identified by advance warning where road construction, repair, utility or maintenance work is being done by workers on or adjacent to a highway, regardless of whether or not workers are present. The work zone begins with the initial advance warning sign (e.g. ROAD WORK AHEAD) and ends at the END ROAD WORK sign, the last TCD, or where traffic resumes normal operations.

APPENDIX B

SHORT-TERM TRAFFIC CONTROL PLAN FORM

This ODOT form is provided as an example of short-term traffic control planning.

Oregon Department of Transportation

Short Term Traffic Control Plan Form

Task Information

Task Description:	Date(s):	Time Start: Finish:
	Authorized Signature:	Hwy #: MP: to:

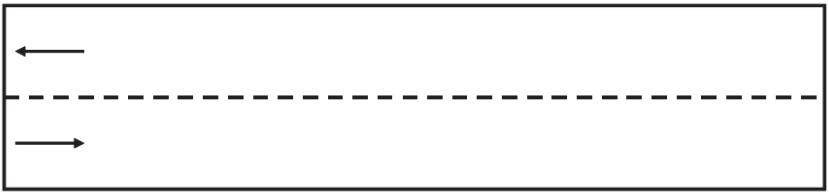
Equipment/Safety Considerations/Personnel Required

Equipment	No.	Safety & Roadway Considerations		Personnel (Names)
Loaders		ADT		
Sweepers		Site Distance		
Graders		Posted Speed		
10 Yd Trucks		Communication Plan		
5 Yd Trucks				
Belly Dumps		Evacuation Route		
Water Trucks				
Grinders		Emergency Vehicles		
Backhoes		PPE		
Mobile Crane		Media Notified		
Flatbed Trucks		Equipment Parking		
Other:		Other:		

Use the Tables and Diagrams below to design your temporary traffic control plan. These plans should be maintained for a minimum of 1 year from the date of the maintenance operation.

Two Lane, 2-way Road Diagram – Page # from Temporary Traffic Control Handbook (_____)

Type of Signs Required	No.	Type of Signs Required	No.	Other Traffic Control	No.
Flagger Ahead		Transition		Cones	
Be Prepared to Stop		Road Narrows		Signs	
Road Work Ahead		Right Lane Ends		Shadow Vehicles	
End Road Work		Left Lane Ends		Flaggers	
Shoulder Work		Pilot Car Follow Me		Arrow Boards	
Survey Crew Ahead		One Lane Ahead		Variable Message Signs	
Road Closed		Road Machinery Ahead		Barricades	
Right Lane Closed		Bridge Work Ahead		Portable Lighting	
Left Lane Closed		Other:		Pilot Vehicle	
Comments or revisions:					



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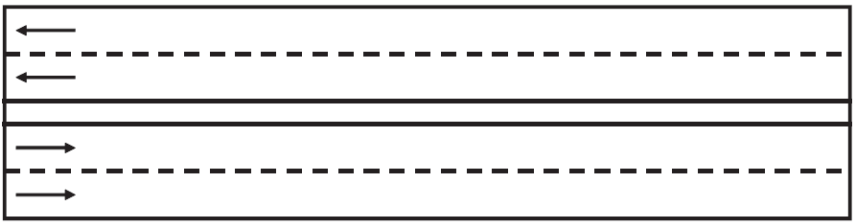
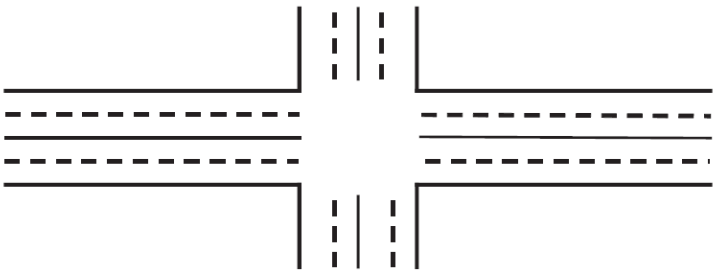
Freeway/Multi-Lane, Road Diagram – Pg. # from Temporary Traffic Control Handbook (_____)

Type of Signs Required	No.	Type of Signs Required	No.	Other Traffic Control	No.
Flagger Ahead		Transition		Cones	
Be Prepared to Stop		Road Narrows		Signs	
Road Work Ahead		Right Lane Ends		Shadow Vehicles	
End Road Work		Left Lane Ends		Flaggers	
Shoulder Work		Pilot Car Follow Me		Arrow Boards	
Survey Crew Ahead		One Lane Ahead		Variable Message Signs	
Road Closed		Road Machinery Ahead		Barricades	
Right Lane Closed		Other:		Portable Lighting	
Left Lane Closed		Other:		Other:	
Comments or revisions:					



Intersection Road Diagram – Page # from Temporary Traffic Control Handbook (_____)

Type of Signs Required	No.	Type of Signs Required	No.	Other Traffic Control	No.
Flagger Ahead		Transition		Cones	
Be Prepared to Stop		Road Narrows		Signs	
Road Work Ahead		Right Lane Ends		Shadow Vehicles	
End Road Work		Left Lane Ends		Flaggers	
Shoulder Work		Pilot Car Follow Me		Arrow Boards	
Survey Crew Ahead		One Lane Ahead		Variable Message Signs	
Road Closed		Road Machinery Ahead		Barricades	
Right Lane Closed		Other:		Portable Lighting	
Left Lane Closed		Other:		Other:	
Comments or revisions:					



APPENDIX C

CHECK LIST FOR WORK ZONE LAYOUT & OPERATION

Use the following check list for good practices in work zone layout and operations:

☐ **Each operation requires a work zone traffic control plan.**

- ✓ Determine and note the relevant diagram(s) in the Handbook.
- ✓ Note any special or unique traffic control needs and revisions to a diagram to accommodate the work and site conditions.
- ✓ Consult with a qualified person in your agency and/or the permitting agency for any changes not discussed in this Handbook.
- ✓ All changes **shall** meet the standards and guidelines of this Handbook and the MUTCD.

☐ **Stay out of the travel lanes as much as possible.**

- ✓ Maintain normal travel paths as much as possible while allowing for work space safety.
- ✓ The traffic control *should* be designed to move traffic past the area smoothly.

☐ **Do not tell drivers to break the law.**

- ✓ This means being aware of regulatory signs, pavement markings and traffic signals that will conflict with your traffic control.
- ✓ Be sure you have road jurisdiction permission to override and cover any regulatory traffic movement signs and signals.
- ✓ For work that is in place less than an hour, emphasize your work activity by using a combination of highly visible signs, flashing/rotating beacons or light bar, arrow board or truck-mounted PCMS.

☐ **Do not let traffic stop on or across the tracks or between the crossing markings and the tracks at a railroad crossing.**

- ✓ Extend the work space if it is close to the tracks to include the railroad crossing inside your work zone.
- ✓ If the work site is away from the crossing but traffic queues may reach across the tracks, provide flaggers at the railroad crossing to prevent vehicles from stopping on or too near the tracks.

☐ **Always give advance warning.**

- ✓ Use advance warning shown in this Handbook for the type of work.
- ✓ Be sure that approaching drivers can see the work space in plenty of time to be able to pass by safely. Adjust the spacing of signs and tapers as necessary.
- ✓ Maintain a consistent distance between warning signs. If one distance needs to be adjusted, adjust all the distances similarly.

☐ **Delineate the work space and travel paths clearly with cones, tubes, drums or barricades. Driver confusion may result in crashes.**

- ✓ Chevrons, arrows, or flashers on cones may be added if needed.
- ✓ Too many devices could make the travel path difficult to navigate.
- ✓ Drive through the work zone and then adjust if necessary.

☐ **Place signs where they will do their job properly.**

- ✓ Keep at least the minimum spacing between signs from the sign spacing table.
- ✓ Keep sign spacing consistent for each approach to the work site.
- ✓ Maintain good sight distances:
  - o for each sign;
  - o for lane shifts and changes; and,
  - o for equipment and workers in the road or on the immediate shoulder. Use at least three cones placed near the work if the work is not visible from the nearest advance warning sign.
- ✓ Make sure the signs are placed in the driver's line of sight and within the headlight beams if headlights are needed.
- ✓ Make sure signs are not blocked by parked vehicles, trees, utility poles or other roadside features. Adjust the sign spacing if necessary.

☐ **Remove signs, cones and drums as soon as they are no longer appropriate.**

- ✓ Keep in place only what is needed.
- ✓ Inappropriate signs and devices can confuse drivers or lead them into your work space.

☐ **Ensure that all workers are wearing high-visibility clothing appropriate for the work.**

- ✓ Safety apparel **shall** be clean and in good condition.
- ✓ Safety apparel **shall** be worn and function properly so that the reflective area has 360° visibility.
- ✓ The type of clothing **shall** meet the minimum requirements for the work as determined by the employer and/or permit or contract.

☐ **Leave a safety clearance area or buffer.**

- ✓ Maintain the buffer area clear of work vehicles, equipment, materials and activity.
- ✓ Leave as close to 5 feet or more, as practical, of clearance between your work space and the line of cones used to mark the edge of the travel lane.
- ✓ Allow for a leading buffer on the near traffic approach to the work space if possible. Consider closing off parking spaces if there is on-street parking.

☐ **For worker protection, you may position a work vehicle in an area closed to traffic and in front of the work.**

- ✓ Leave enough buffer space to the work activity to allow for run-out if the vehicle is hit.
- ✓ Turn the vehicle wheels so that if it's hit, the vehicle will move away from both traffic and the work activity.

☐ **Accommodate safe and convenient access for pedestrians and bicyclists including pedestrians with disabilities.**

- ✓ Consider any pedestrian and cyclist needs including accessibility when setting up the traffic control for a work space.

APPENDIX D
ACKNOWLEDGEMENTS

OTTCH Review Subcommittee

A stakeholder subcommittee of a broad range of individuals was convened to provide their professional expertise and direction during the update process. Comprised of 15 members, the subcommittee was selected to represent public and private viewpoints and provide consultant, utility, county, city and state representation.

Individual	Group	Title
Fahad Alhajri	ODOT – ETSB	Work Zone Standards Engineer
Steve Anderson	ODOT – District 11	Transportation Maintenance Manager
Brendan Baggett	ODOT – ETSB	Work Zone Traffic Analyst
Laurel Byer	Benton County	County Engineer
Jeremy Finkle	City of Portland	Senior Engineering Associate
Mo Gabr	ODOT – Region 1	Traffic Work Zone Engineer
Kevin Haas	ODOT – ESTB	State Traffic Standards Engineer
Deanna Kanashiro	Portland General Electric	Municipal Program Manager
Justin King	ODOT – ETSB	State Work Zone Engineer / OTTCH Subcommittee Chair
Christina LaFluer	ODOT – Region 2	Traffic Design Engineer
Richard Lani	ODOT – District 12	District Manager
Shawn Martin	ODOT – Region 2	Transportation Operations & Maintenance Manager
Alex Pelayo	City of Bend	Traffic Control Engineer
Jon Preis	ODOT – Region 1	Region Safety Specialist
Jeff Whitman	PBS Engineering and Environmental	Senior Transportation Engineer

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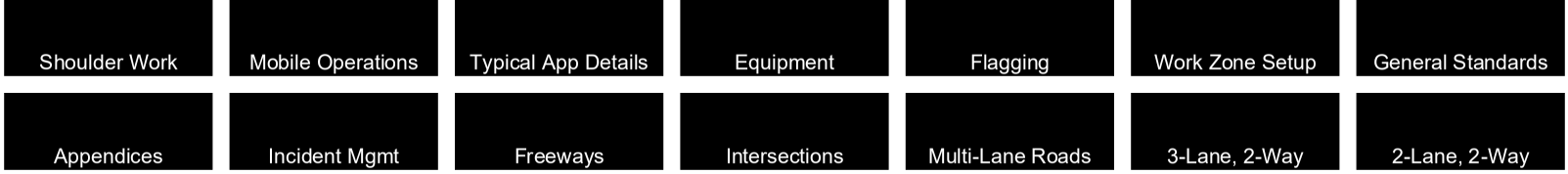
Shoulder Work
Mobile Operations
Typical App Details
Equipment
Flagging
Work Zone Setup
General Standards
Appendices
Incident Mgmt
Freeways
Intersections
Multi-Lane Roads
3-Lane, 2-Way
2-Lane, 2-Way